A Computer Simulation Model of Municipal Resource Allocation

John P. Crecine

Follow this and additional works at: http://repository.cmu.edu/dissertations

Recommended Citation
Carnegie Institute of Technology

Committee on Graduate Degrees

In the Social Sciences and Industrial Administration

Dissertation

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Industrial Administration.

A Computer Simulation Model of Municipal Resource Allocation

by

John P. Crecine

Approved by the Dissertation Committee

(Signed) Herbert A. Simon May 31, 1966
Professor Herbert A. Simon, Chairman

Date

Approved by the Committee on Graduate Degrees in the Social Sciences and Industrial Administration

(Signed) R. M. Cyert May 3, 1966
Chairman

Date
This report contains a description of a particular kind of governmental decision making -- the decisional behavior connected with municipal operating budgets. The theory is stated in the language of a computer program. The model of governmental problem solving is applied to the cities of Cleveland, Detroit, and Pittsburgh. The model, with appropriate parameter estimates, is used to reproduce operating budget decisions in the three cities. In addition various naive models are tested and then compared with our decision model (Section 6). Analysis of model residuals (Section 7) and a sensitivity analysis of some model parameters (Section 10) is used to study "unprogrammed" aspects of budgetary behavior. The formal model (presented in Section 4) is also related to various theories of individual and organizational behavior in Section 9. The behavioral antecedents of the model are discussed in Section 5. Implications of the study for political research are touched on in Section 11 and our positive model forms the basis for a normative discussion of municipal resource allocation in Section 12.

Acknowledgements

I am deeply indebted to the members of my dissertation committee. Professor Herbert A. Simon, the chairman, provided me with a great number of insightful and provocative ideas, not only in
reference to the dissertation, but for the entire range of the social sciences, Professor Otto A. Davis, in addition to the invaluable, general encouragement, has made great efforts to get me to sharpen my thinking on a number of issues. Timothy Keane has exerted a similar influence with respect to the statistical issues involved. The final, official member of the committee Professor Richard T. Cyert, has provided the kind of general support and encouragement over a long period of time, that has been much more important than he probably realizes. Having access to the University of Pittsburgh computation center when the alternatives were unproductive, is one example of this. I would be especially remiss if I did not acknowledge the influence and encouragement of the man who introduced me to the "non-casual" study of political phenomena, Professor James C. March, the initial member of my committee. I feel extremely fortunate to have had the advise and counsel of this group.

In a study of this nature, success (or the opportunity for it) is largely dependent on those individuals studied. Individually and collectively, the governmental decision makers encountered in this study merit a great deal of thanks. In Detroit city government, Al Teague of the Budget Bureau spent many productive (from my standpoint) hours with me and readily supplied necessary data. Alfred H. Pelham, former Controller of Detroit and of Wayne County, graciously shared his experience with me. Also very helpful in
Detroit were Richard Strickhartz, Controller, and Bob Gueller of the Citizen's Research Council.

In Cleveland, James A. Lorton, Pres. of Greater Cleveland Associated Foundations kindly provided access to the necessary information. Edward Knuth (Director) and Ralph T. Huntz in the Department of Finance were very cooperative.

In Pittsburgh, I was exceedingly fortunate in being able to speak freely with the Mayor, Hon. Joseph C. Barr. The Mayor's Secretary, Aldo Colautti, provided me with several hours of productive conversation and generously allowed me to browse through the department request files. David Craig, then City Solicitor and presently Director of Public Safety also provided me with a great many favors and valuable information. Calvin R. Hamilton, former City Planning Director (now with Los Angeles), has, during the period I have known him, provided me with a great deal of insight into the workings of government, as has Richard K. Guenther (formerly with Pittsburgh's City Planning Department). Without the willingness of these men (and a large number of their colleagues) to provide necessary background and information, this report would not have been possible.

The computer work for the dissertation has been carried out at the Carnegie Institute of Technology (G-20 and 7040), the University of Pittsburgh (IB 7094), and the University of Michigan (7090). The experiences at these four installations have taught me to
deeply appreciate the conditions found at the University of Pittsburgh (and acknowledge the assistance of Ted Van Horner) and at the IBM 7040 installation at Carnegie Tech.

Any research effort of the nature presented here is dependent on the generous financial assistance of various parties. I gratefully acknowledge the support, at various times, of the Ford Foundation, the Richard D. Irwin Foundation, Carnegie Institute of Technology, and more recently, The Institute of Public Administration at the University of Michigan (Ferrel Ready, Director).

The physical task of preparing and reproducing a document of this length is enormous. Without my very able and dedicated typist, Miss Judy Brunclik, deadlines would not have been met and my work would have been increased substantially. Miss Brunclik was invaluable. Miss Rosemary Conte also deserves special thanks for helping ease the load. To Mrs. Betty Henry, who unsuspectingly volunteered to reproduce and assemble the final copy, goes my deepest thanks.

John Patrick Crecine
## CONTENTS

### Section

1. **INTRODUCTION**  
   - Importance of Municipal Finance  
   - Scope of Study  
   - Existing Theories  
   - Organization of Report  

2. **CONCEPTS OF BUDGET**  
   - Budgeting as an Externally-Determined Event  
   - Budgeting as an Internal, Bureaucratic Process  
   - Overview of Theories of Budgetary Behavior  

3. **RESEARCH STRATEGY**  
   - Theory Formalization  
   - Computer Programs and Problem Solving Process  
   - Computer Simulation and Municipal Budgeting  
   - Hypothesis Construction  
   - Data Collection  
   - Budget Categories  

4. **FORMAL MODEL**  
   - Overview  
   - Scope of Model  
   - DEPT. Submodel  
   - MAYORS Submodel  
     - Revenue Decisions  
   - COUNCIL Submodel  
   - Submodel Interdependence and Feedback  

5. **BEHAVIORAL ANTECEDENTS OF THE MODEL**  
   - Problem Perception  
   - Problem Partitioning  
   - Governing by Precedent  
   - DEPT. Submodel  
   - MAYORS Budget Recommendation Model  
     - Wage and Tax Policy  
   - COUNCIL Submodel  

vii
Section

6  EMPIRICAL TESTS -- CLEVELAND, DETROIT, AND PITTSBURGH  

A. Parameter Estimation  
1. Revenue Estimates  
2. Submodel Parameter Estimates  
   a. DEPT. Relationships  
   b. MAYORS Relationships and Parameters  
   c. COUNCIL Relationships  

B. Model Tests  
1. Model Runs  
2. Measures of Goodness-of-Fit  
   a. Alternative Models  
   b. Choosing between Alternative Models  
   c. Goodness-of-Fit Tests  
   d. Pittsburgh GOF Tests  
   e. Cleveland GOF Tests  
   f. Detroit GOF Tests  

Overall Goodness-of-Fit  

7  UNPROGRAMMED BUDGETARY CHANGE AND POLICY SHIFTS  

A. Invisible Organizational Change  
1. Increases in "Effective Budget Ceiling"  
   a. Increases in Available Revenue  
   b. Increases in Agency Efficiency  

Detroit's Budget Bureau  

B. Visible Organizational Changes  
1. Incremental Change-Cumulative Nature  
2. Non-incremental Change-Unprogrammed Decisions  
   a. Model Deviations to be Examined  
   b. Rationale for Model Deviations  
3. Analysis of Residuals  
   a. Detroit  
   b. Cleveland  
   c. Pittsburgh  

General Patterns of "Policy Shifts"  

viii
### Section

#### C. Long-Run Characteristics of Budget Process
1. Model Drift
2. Causes of Model Drift
3. Observed Environmental Corrections in Drift

#### 8 REPRESENTATIVENESS OF SAMPLE

A. Applicability to Central Cities
1. Political Characteristics
2. Economic Characteristics
3. Population Characteristics

B. Applicability to Other Levels of Government
1. Smaller Municipalities and Local Governments
2. State and Federal Governments
3. Other Non-market Organizations

#### 9 BUDGETING FROM DIFFERENT VIEWPOINTS

1. Budgeting as an Externally Determined Event
   Parameters and "Influence" or "Demands"
   Informational Inputs as External "Influence"
   Literature
   Summary

2. Budgeting as Internal, Bureaucratic Process
   Literature
   1. "Conflict" Models
      a. "Raw" Conflict
      b. "Log-Rolling"
   2. Budget Formation as Problem-Solving and as a Decision Process
      a. Organizational Behavior
      b. Computer Simulation of Human Thinking and Problem Solving
   "Profitable" Vantage Points
Section

10 SENSITIVITY ANALYSIS 358

A. Model Test — Administrative Constraints and Guidelines 360
   1. Results 366
   2. Conclusions — Role of Internal Constraints 369

B. Model Test — Revenue Constraint 369
   1. Results 371
   2. Conclusions — Role of Revenue Constraint 377

C. Summary 378

11 SUMMARY AND CONCLUSIONS 379

12 NORMATIVE CONSIDERATIONS 383

APPENDIX

I. Parameter Estimation Procedures A-1

II. Administrative Units A-5

III. Model Parameters A-8
   A. Cleveland A-8
   B. Detroit A-10
   C. Pittsburgh A-20

IV. Sample of Computer Program: Detroit — Fortran II A-30

V. Sample Model Output A-49

VI. Data Sources A-53
SECTION 1

INTRODUCTION

This is a study of the decision process surrounding municipal operating budgets for city governments in large metropolitan areas (cities with populations of over 500,000 located in metropolitan areas of over 1,000,000 population - roughly 21 areas in the United States). It will be shown that existing propositions or theories dealing with how municipal budgetary decisions are made (vs. how they ought to be made) are ambiguous and conflicting. They are ambiguous largely because empirical testing has not been undertaken for the few theories that are well-enough formulated to be so tested. The model that is central to the thesis is expressed as a computer program that describes the municipal budgetary decision process. The model, constructed on the basis of observations taken in three large metropolitan governments (Pittsburgh, Detroit, and Cleveland) consists of three sub-models - the first replicating the formulation of departmental requests for the mayor's office, the second "formulating" the executive (mayor's) budget request, and the third duplicating the adjustment in the executive budget by the city council or legislative body which approves final appropriations. The model, while consistent with many observations of federal and state budgetary procedures, is applied only to municipal budgets.

The principal conclusions of this study of municipal operating budget formations are as follows:

1. The structure of decision rules for formulating the municipal operating budget are basically the same, over time, in large cities, with only the parameters varying

---

1 Theories of the expenditure side of municipal resource allocation are few. While the fields of public finance, municipal decision making, and political science are far from empty, there is a tremendous preoccupation with the revenue side of municipal resource allocation with a corresponding neglect of municipal expenditures. As Thompson points out in A PREFACE TO URBAN ECONOMICS, "Literally, public expenditures and public services are typically cast as exogenous variables - even as constants - that are extraneous to the proper study of local public finance." Thompson, W. R., A PREFACE TO URBAN ECONOMICS, Baltimore: Johns Hopkins Press, 1965, p. 256.
between cities. (The model functions are of the same mathematical form, contain the same variables, and differ only in the constant terms or parameters.)

2. Three institutional rules or norms appear to be dominant in all municipalities tested:
   a. Balanced budget requirement in city charter (revenue constraint).
   b. Physical form of budget preparation sheets for departmental budget requests (forces historical comparisons).
   c. Uniform wage policy (one group of employees does not receive a wage increase unless all municipal employees are granted one — wages account for 65-80 percent of a city’s total operating expenses); occasionally, uniformed police and fire ranks are treated separately from the other city employees.

3. The decision rules used by members of the municipal governments appear to be internalized and to a large extent insulated from external pressures.

4. The decision system appears to be responsive only to long-run, cumulative "political" pressures or to reasonably "catastrophic" events in the short-run.

5. Municipal operating budgets exhibit a great deal of organizational inertia.

6. The decision process can best be described as one in which the problem solver is faced with a great deal of uncertainty about future events and must satisfy a large number of fairly restrictive constraints, rather than as a process having a great deal of "political" content.

7. The general hypothesis that "the more 'complex'" the

---

2Where "complexity" is indicated by a large number of interdependent, real variables, by a high degree of uncertainty attached to "key" variables, and by non-linear relationships between real variables.
problem, the 'simpler' the decision rules used to solve it is supported by the findings of this study.

8. "Last year's" budget represents a sort of equilibrium solution to the municipal resource allocation problem for city officials. "This year's budget" represents marginal adjustments to "last year's" solution to obtain "this year's" solution.

9. The perceived lack of comparable performance data by city officials (budgets and expenditures in one city "not the same" as "our situation") leaves the budget maker with little alternative but to use historical decisions as the sole reference point for current decisions.

This Section will briefly discuss the importance of municipal finances, the scope of the decision process involved in the study, and the nature of existing theories of budget making and government decision processes. Also included is a description of the organization of the remainder of this report.

Importance of Municipal Finance

Urban centers are important. With roughly seventy percent of the population of the United States found in urban areas\(^3\) the affairs of urban governments should hold a great deal of interest and be of some importance for most people. Local government expenditures account for over one quarter of total government expenditures. When expenditures for national defense and international relations are excluded, over half of the remaining expenditures are those of local governments.\(^4\) And, the trends for both level and percent of total government expenditures by local governments is upward. These expenditures help provide for such

---


every-day items as hospitals, police and fire protection, streets, sewers, parks, schools, libraries, water, welfare, airports, public housing, and the like. In addition, the resources utilized in these ventures represent diversions of resources from other potential activities on the part of individuals, corporations, other governments, etc. The point is not a controversial one -- local government is important, as is local government finance. The importance is primarily because of the day-to-day effects it has on the behavior of individuals and groups.

To say that local government is significant is, perhaps, too general a statement. We first stated that urban centers were important because of the number of people found in them and then went on to say that local government and local government finances are important. Just what does "local government" mean with respect to an urban center? For example, within the Chicago, Illinois standard metropolitan statistical area (SMSA) there are 1,0605 "local governments."6

Most of these "governments" have some powers of taxation and represent such diverse (politically, legally, and geographically) and overlapping units as school districts, townships, counties, municipalities, utility districts (water, power, sewage, etc.), urban renewal authorities, and the like. Usually, when we speak of "government in Chicago," we are referring to the City of Chicago, not the other 1059 local governments in the area. This is not because the City government represents the most people or the largest area (Cook County does). It is because, in most urban or area-wide affairs, the City of Chicago is the dominant force -- either "officially" or through the unofficial political mechanisms


6"A government is an organized entity which, in addition to having governmental character, has sufficient discretion in the management of its own affairs to distinguish it as separate from the administrative structure of any other governmental units." CENSUS OF GOVERNMENTS 1962, op. cit., p. 15.
operating in the Chicago metropolitan area. The central city or core city in any urban area tends to be the focal point of that area's governmental activities in practice and for that reason constitutes the "most important" governmental unit. Again, this point is not particularly controversial (which is not to say that the central city should be the dominant force -- merely that it is. It follows, then, that the "most important" local government finances are those of the central city. It is the largest portion of the "central city" finances that will be studied -- operating or general fund expenditures.

Why Study the Budget?

Because budgets represent planned or expected expenditures and reflect commitments on the part of the organizations involved, they tend to be self-confirming. Thus, it is contended that the primary determinant of expenditures in a particular period is "planned" expenditures. Inasmuch as the municipal budget is also a control device (no expenditure may be made unless authorized in the city's annual appropriation bill or in some municipal ordinance), all actual expenditures must be made within the confines of the budget. The budget specifies an upper bound on municipal expenditures as well as a target.

Given the above characteristics of budgets, it is clear that one important way to study the process of allocating municipal government resources is to study the municipal budgetary process or the process of "planning" resource allocation. This is precisely what we intend to do.

It is planned to study, in detail, only the operating budget or the general fund budget (including both revenue and expenditure plans) of city governments. There are two primary justifications for this limitation. First, the evidence indicates that the decision procedures surrounding the operating or general fund budget are largely independent

---

7See Banfield, Edward C., POLITICAL INFLUENCE, Glencoe, Free Press, 1961, for examples of the City of Chicago's dominance in area affairs.

of the capital budget and "fixed" expenditure items (pensions, etc.)? The other principal reason for eliminating the capital budget is the lack of available data and the infrequency of "significant" capital budgeting decisions. Capital budgeting decisions provide for independent but "automatic" changes in operating appropriations. Hence, the effects of capital decisions should show up as deviations in our model and provide a measure of the appropriateness of treating the decisions as independent.

Characteristics of Municipal Budgets: Existing Theories

The pattern of (metropolitan) expenditures, in general, and the makeup of a (metropolitan) budget, in particular, has been conceptualized in many ways.

Organizational theorists have described the budget as "... an explicit elaboration of previous (organizational) commitments," plans for organizational behavior "... in the form of an intended allocation of (municipal) resources among the alternative activities available..." to the organization (city government), a precedent which "... defines the decisions of one year and thereby establishes a prima facie case for continuing existing decisions," the result of a negotiated internal (to the governmental organization) environment which permits each governmental unit to avoid uncertainty about other units in making decisions.

As is pointed out in later discussions, (see p.102), although operating considerations may have constituted a significant consideration in the original capital decision, for purposes of "current" operating budgets, the capital decision is taken as given and results in automatic adjustments (usually several years after the original decision). For purposes of analyzing the change in the operating budget from time $t$ to $t + 1$, previous capital decisions appear to be largely "independent" decisions.

10Cyert and March, op. cit., p. 33.
11Cyert and March, op. cit., p. 104.
12Cyert and March, op. cit., p. 112.
13Cyert and March, op. cit., p. 120.
and the solution to the problem of efficient utilization of an organization's resources.\textsuperscript{14} It has been characterized as providing estimates of problem magnitudes for the various departments (number of fires during the period for the fire department to extinguish), estimates of service levels adequate to fill the needs of the community in terms of the resources available to the community,\textsuperscript{15} as an indication of the relative merits of competing claims on public funds,\textsuperscript{16} the outcome of conflict among organizational subunits for resources,\textsuperscript{17} as the means used to apply pressure to parts of the organization,\textsuperscript{18} an indication of the distribution of resources to departments so that they may carry out their assignments,\textsuperscript{19} and as means of coordinating departmental activities.\textsuperscript{20}

Political scientists speak of the municipal budget as the result of the interaction of political interests,\textsuperscript{21} a possible focal point of

\textsuperscript{14}Cyert and March, \textit{op. cit.}, p. 120.


\textsuperscript{16}Simon, \textit{op. cit.}, p. 214.


\textsuperscript{20}Parsons, \textit{op. cit.}, p. 47.

the community power structure, a reflection of community values, a political act requiring the employment of "political" techniques and strategies on the part of the participants, the product of the resultant force of various group pressures, an expression of institutional inertia, and as an administrative decision process.

Students of public administration have tended to take a more utilitarian approach. For them, the budget is likely to be a plan of expenditures designed to meet public needs, a contest balancing tax rates, public needs, and inflation, a decision-making process involving the allocation of scarce resources among alternative uses, a device which acts to enforce "efficiency" in the public sector, and an expression of government policy. Budgeting has been described by Simon as a

"... complex process in which change, bargaining skill, actual and anticipated political pressures, and the prejudices of particular budget estimators all play an important role. The resulting (budget) estimates are

---


'consistent' only in the sense that they add up, more or less, to a predetermined total ..."31

Economists, Political Economists, and people in Public Finance and Welfare Economics traditionally have taken a more utopian and "rational" approach to the question of governmental resource allocation. Generally governmental expenditures should be made so as to maximize something known as the community's welfare. This is done by maximizing a theoretical construct referred to as a community welfare function or preference ordering. Briefly, a welfare function (analogous to an individual's utility function) is a device which will evaluate alternative courses of action and will indicate which alternative(s) is to be preferred over all others considered -- i.e., which alternative (set of policies) will maximize net community welfare. As Pigou points out, two "decisions" are necessary to determine the optimal governmental budget: 1) overall level of government expenditures. 2) distribution of government expenditures among various possible functions.

"Expenditure should be distributed between battleships and Poor Relief in such wise that the last shilling devoted to each of them yields the same return of satisfaction .... This method of approach suggests an analogous test for determining how large government expenditure in the aggregate ought to be. If a community were literally a unitary being, with the government as its brain, expenditure should be pushed in all directions up to the point at which the satisfaction obtained from the last shilling expended is equal to the satisfaction lost in respect of the last shilling called up on public service."32

More briefly, maximum community welfare is found at a point where the marginal benefit of one more dollar's expenditure equals the marginal


cost. The vast majority of economics literature pertaining to government resource allocation is merely a variation on this basic theme — some works emphasize the concept of a welfare function,33 while others are concerned with procedures or rules for realizing the maximization of the community welfare goal.34 While few argue that governmental expenditure decisions are made in this rational, economic manner, there is a good deal of debate over whether the "rational" model ought to be an aim of governmental decision-makers.35

Another branch of the political-economic literature brings features of the "rational" model of economic decision making to bear on the problems of political and government decision-making. Buchanan and Tullock in CALCULUS OF CONSENT, assuming the individual to be a utility maximizer, evaluate various sets of ground rules, institutional arrangements, and norms roughly comparable to those found in a political constitution. The central question analyzed is "which decisions should be subjected to collective choice (given a majority-rule norm) and which decisions should be left in the private sphere?" Some measure of total community well-being, utility, or benefit is used for evaluation. Anthony Downs' ECONOMIC THEORY OF DEMOCRACY takes a similar, economic approach to the analysis of political affairs but assumes the political party to be the rational, utility-maximizing actor in the market of political policies and ideals rather than the individual. The goal assured the maximization of political support (votes) for a particular party. (Both Downs and Buchanan and Tullock attempt to include some "reasonable" assumptions about human behavior in their analyses — this will be commented on later.)


35For the flavor of this debate see National Bureau of Economic (Continued on next page)
Organizational theorists tend to emphasize internal factors as the most relevant whereas political scientists, public administrators, and economists emphasize external factors and pressures. Obviously both internal and external variables have relevant effects on budgetary behavior. This study should shed light on the empirical question of where internal factors are dominant in the decision process and where external factors are dominant? What form does this "influence" take, and under what conditions will it be found?

Methodology

It should be clear that governmental budget-making in general and municipal budget-making in particular can be approached in a variety of ways. It should also be clear from the brief list of "theories" and propositions concerning municipal budget-making that an attempt to construct a general and consistent theory or set of propositions about how municipal budgets are formulated from the above concepts is likely to be fruitless. One can think of specific situations, however, where it would be useful to view the budget as exhibiting each of the abstract characteristics cited above. Another of the central questions of this thesis is "When and under what circumstances does a budget fulfill the functions listed above?"

A brief review of the literature indicates that no "general" theory of municipal budget making can be deduced from the abstract characteristics or propositions found. The primary reason is that many theories in the social sciences fail to specify when propositions hold and when they do not -- in other words the theories are incomplete. (When a theory is subjected to a quantitative test, quantification can lead to a precise, unambiguous specification of conditions under which the theory or proposition does apply and when it does not, and the empirical data can help draw attention to cases where the theory must be extended.

or modified. This is one reason it was decided to construct a quantitative model and subject it to empirical tests.) A detailed study of the actual decision process, if properly made, will specify the decision mechanisms operating at each point in the process and will help specify conditions under which a particular behavioral proposition holds.

Organization of Report

Section 2 contains a review of theories, empirical findings, etc. that have some bearing on the actual budget decision processes found in large municipalities. This is designed to acquaint the reader with the problem area and some existing approaches. In addition, it should help place this study in its proper perspective as well as to suggest relevant areas of inquiry. Section 3 argues for a process-oriented investigation of municipal budgeting rather than an attempt to test models deduced from theories in Section 2. A discussion of the "advantages" of, and rationale for, a simulation model as opposed to a system of equations or statistical model will be found in Section 3 also.

Section 4 contains a detailed description and flow chart of the model and the methods of model construction (personal interviews, analysis of documents, regression analysis for parameter estimates, etc.). The computer model "produces" budget estimates for each of the several departments and administrative units in a municipality, for each of several account categories. Estimates were made for the three decision stages:

1. departmental request
2. mayor's budget request
3. final council appropriations

An analysis of the model in terms of its behavioral antecedents is found in Section 5. In particular, the "meaning" of the structural form (variables and functional form) of the decision rules is examined in detail. In addition, the decision-rule parameters are discussed in terms of the "real" variables they might reflect.

Sections 6 and 7 will deal with the model applied to the operating
budget decision process in the cities of Cleveland, Detroit, and Pittsburgh.

Modifications of the basic decision model to fit the environmental context of the particular city are analyzed. Effects of the cohesiveness of political party organizations, concentration of business interests, degree of dependence on a particular industry, revenue and taxation constraints, growth patterns in both population and area, etc. are discussed in terms of model parameters and structure in Section 8. Comparisons of the results obtained from the computer model with actual decisions made in the respective cities are made (Section 6) and an analysis of budget items the model fails to "explain" is undertaken (Section 7). (Data consists of: Detroit - 7 years, Pittsburgh - 6 years, Cleveland - 10 years.) Section 8 is devoted to discussion of the model's likely applicability to other municipalities. This applicability is, of course, a function of the degree to which Detroit, Cleveland, and Pittsburgh are representative of areas with over 1,000,000 in population. Applicability of the model at other levels of government and in other non-profit institutions is also examined.

The model serves as a common language to tie together various other theories and propositions related to municipal budget making in Section 9. In general the model and portions of it will permit concrete illustrations of some of the theoretical constructs discussed in Section 2, challenge the relevance of some, and provide meaningful extensions and modifications of others. Specifically, Section 9 will discuss the municipal budgetary process in terms of a complex problem-solving situation in an organizational environment. With the budget as a problem in resource allocation, in prediction, electioneering, and in finding solutions feasible with respect to a series of constraints, the works of Braybrooke and Lindblom, Lindblom, Wildavsky, Braybrooke and Lindblom, op. cit.


Wildavsky, op. cit.
Simon,40 March and Simon,41 Cyert and March,42 and Popper 43 seem espe-
cially relevant. In general, the model makes the most "sense" when
conceived of as a problem-solving sequence.

Also in Section 9, the model is evaluated with respect to the budget
as a "response-to-pressure" process. The "pressure" model of govern-
mental decision making is common to most political science literature.
Our computer model has a great deal to say about the kinds of "pressure"
to which the system is subjected, where the pressure is applied and how
it is responded to. Four general conclusions seem warranted at this
point:

1. While "political" pressure or citizen demands may determine
the pattern of expenditures within certain accounts for
certain departments, there is virtually no direct connection
between "political" pressure and departmental budget or
account totals.

2. Negligible pressure is exerted by the business and industrial
community to influence expenditure distributions or levels,
directly. The only observable pressure is to keep property
tax rates constant.

3. The nature of public demands on the council is usually such
that "in order to satisfy one you would have to satisfy them
all." If "all" demands were yielded to, it would mean re-
vision of the entire mayor's budget -- including revenues --
which the council is not equipped to do. Consequently,
council also "ignores" specific or direct pressures.

40Simon, op. cit.
41March and Simon, op. cit.
42Cyert and March, op. cit.
43Popper, Karl R., THE POVERTY OF HISTORICISM, Boston: Beacon
Press, 1957.
4. Relevant "pressure" for the system appears to be of a cumulative long-run nature which results in a very gradual adjustment of parameters, or related to "dramatic" external events.

The model will also be considered as a reflection of the community's power structure or distribution of values. The New Haven studies, Hunter's Atlanta study, Banfield's observations in Chicago, and the study of DECISIONS IN SYRACUSE will be compared and contrasted with our model of resource allocation for operating expenses in a community.

Finally, the implications of this behavioral model of governmental resource allocation for traditional economic approaches to the same problem is discussed. The general conclusion that the problem is too "complicated" for the rigorous, rational treatment specified in traditional welfare economics seems the most reasonable, given present technology. Lindblom's arguments "that a strategy of 'disjointed incrementalism' is the only feasible one for the complex problems of public policy making" are certainly consistent with our model of municipal resource allocation.

A sensitivity analysis of the model is found in Section 10. The decision model of municipal resource allocation in this study is largely independent of external influences -- at least in the short run. Short

---


45Hunter, F. W., op. cit.

46Banfield, op. cit.

47Although most economic theories are normative theories (how the budget problem ought to be solved), there have been numerous attempts to "adapt" the theories into positive plans of behavior. See, for instance, Lewis, V. B., "Toward a Theory of Budgeting," PUBLIC ADMINISTRATION REVIEW (Winter, 1952).

48Braybrooke and Lindblom, op. cit.
and long-term effects of external variables such as population changes and changes in assessed valuation are likely to have their effects through increased revenues. The sensitivity of the computer model to revenue constraints will be explored. The effects of changes in assessed valuation and community wealth are likely to change model parameters in rather systematic ways. Although the revenue constraint is embedded in all our empirically-estimated parameters, the effect of reasonable parameter changes on budget levels and shares is also examined.

Section 11 suggests some substantive and methodological implications of this study for political research.

Finally, in Section 12, some normative implications of the decision model will be covered.

In the Appendix will be found a listing of the FORTRAN computer programs of the model, a specification of parameter estimation procedures, parameter values, and a listing of administrative units included in the study.

---

49See Sacks and Hellmuth, FINANCING GOVERNMENT IN A METROPOLITAN AREA for an example of a study of the relationship between "external" variables and governmental expenditures.
Attempts at reviewing the literature with the purpose of "discovering" a positive theory or description of the municipal budgeting process in the United States quickly lead to several conclusions. Little directly applicable to the problem is available. Most studies of municipal budgeting are attempts at specifying conditions under which it should be decided to allocate X dollars to Activity A instead of Activity B\(^1\) (attempts at an "economic-normative" theory), or are attempts to link budget expenditure items to demand-for-services variables or ability-to-pay variables in particular municipalities.\(^2\) The Political Science literature (with the exception of Wildavsky's works) has surprisingly little to say on the subject. Works in the Public Administration field are generally case studies of a particular budget or a specification of the legal requirements of the budget and the formal procedures it must undergo. The Organization Theory literature contains many specific references to budgeting as a control device (referring, generally, to business firms however), but few references to the budget formulation procedure. Primary emphasis is placed on the effects of the budget -- control


on expenditures, pressures on workers, etc. The implicit assumption in most of the literature seems to be that the budget formation process for any organization is unique to that organization and so dependent on the particular programs, goals, technology, and accounting procedures of the particular organization as to defy generalization. Hopefully, this report will cast some doubt on that assumption.

Concepts of the Budgetary Process

Budgeting in general has received somewhat different treatments from different disciplines. Basically, these treatments can be grouped under three conceptual frameworks. These frameworks are based on the decision processes implied in the formulations: budgeting as an internal bureaucratic process, as an externally determined event, and as an optimizing process. In most of the works cited, both positive (how budgets are made) and normative (how budgets ought to be made) notions appear.

Budgeting as an Optimizing Process

The normative theories of public resource allocation found in Public Finance and Welfare Economics are concerned, generally, with maximizing net social welfare, a community utility function, and the like. Another central concern is that of "calculating" community utility functions by aggregating individual utility functions. The assumptions underlying these theories are primarily two: 1) governments (should) attempt to maximize community utility
and 2) governments (should) have the information to do so. These notions will be of little use to us in a search for a descriptive theory of how municipal budgets are formulated. From the outset, it is clear that neither of the assumptions (borrowed from traditional economic theory) is satisfied. Governments (and their officials) do not possess information about individual utility functions, let alone the information (about relationships between variables in the community) necessary to maximize some aggregate of these. Even a casual conversation with governmental decision makers indicates that maximizing community welfare is neither a real nor operative goal for them.

---

3 The public finance literature applicable to public resource allocation, while not constituting even a reasonable positive or descriptive theory of budgeting because of the informational and cognitive limits on individual decision makers, should at least be mentioned in passing. Dahl, R. A., and Lindblom, C. E., POLITICS, ECONOMICS, AND WELFARE, New York: Harper, 1953, and Musgrave and Peacock, CLASSICS IN THE THEORY OF PUBLIC FINANCE, op. cit., give a good cross section of works in the field which concentrate on maximizing net social welfare, community utility functions and the like and is concerned with such "computational" problems as defining individual utility functions and then aggregating them in some manner to obtain community utility functions. "Utility functions" are dealt with by Arrow, K. J., in SOCIAL CHOICE AND INDIVIDUAL VALUES, op. cit. A growing number of people in the Public Finance and Welfare Economics fields are challenging the usefulness of the above approach. For a view of this controversy, see the National Bureau of Economic Research publication, PUBLIC FINANCING, NEEDS, SOURCES, AND UTILIZATION: A CONFERENCE, op. cit. Samuelson argues that it is impossible to obtain the information necessary to maximize "social welfare" in a system having "public goods" --- "A Pure Theory of Public Expenditures," REVIEW OF ECONOMICS AND STATISTICS, (November, 1954), pp. 387-9.

For two reasons, then, Welfare Economics and Public Finance approaches are likely to be of little help in the search for a positive theory of budgeting. First, the assumptions underlying these theories seem to require abilities no decision maker possesses. Secondly, the theories were constructed for different purposes and designed to explain different phenomena than those we are concerned with. The economic branch of the literature is largely concerned either with the way decisions ought to be made or with how they are made at a more global level than that of a department or bureau in a municipality.

Lewis, a former budget officer in the Atomic Energy Commission, attempts to merge the notions of marginal utility and relative values in proposing a budgeting procedure that forces comparisons of programs and services at the margin. Pigou's objective "... that resources should be so distributed among different uses that the marginal return of satisfaction is the same for all of them," is "realized" in Lewis' plan through the concept of alternative budgets where

"... each administrative official who prepares a budget estimate, either as a basis for an appropriation request or an allotment request after the appropriation is made, would be required to prepare a basic budget estimate supplemented by skeleton plans for alternative amounts. If the amount of the basic estimate equals 100, the alternatives

---

5Lewis bases his work on the theories of Pigou (A STUDY IN PUBLIC FINANCE, op. cit.).

6Lewis, Verne B., op. cit.

might represent, respectively, 80, 90, 110, and 120 percent of that amount.\(^8\)

These alternative budgets would then provide the basis for comparison by the "Superior" of the budgets of the various administrative units under his control by considering the marginal returns and marginal costs. By comparing the "marginal programs" of his subordinates and accepting a portion of these programs on the basis of their relative merits, the "superior" reduces his problem (or, so Lewis claims) of choosing an expenditure distribution, which maximizes community satisfaction, to a manageable one.

Lewis' attempt to apply normative, economic theories of public resource allocation is one of many in the literature. While not intended to be a description of actual behavior it at least represents a potential positive theory of budgeting.

Another departure from the traditional economic approach is found in Lindblom's work. He argues that, given the complexity of the real world, the multiplicity of values and goals to be considered, the difficulty in generating policy alternatives to "achieve" multiple goals, the lack of theory to predict consequences of policy alternatives, the lack of available information on relevant values, and the limited computational ability of the administrator, in practice, the policy maker must settle for much less than rational, optimizing decision procedures.\(^9\) Because of these difficulties with the ideal, analytic

---

\(^8\)Lewis, Verne B., *op. cit.*, p. 49.

decision model, the policy maker concentrates on one or two of the many possible policy goals, limits the alternatives considered to "those relatively few" that occur to him ("most of them familiar from past controversies") and will "rely heavily on the record of past experience with small policy steps to predict the consequences of similar steps extended into the future." The choice of policies would involve, first, a choice among values, and then a choice among policy instruments for achieving those values.\(^\text{10}\) Briefly, Lindblom's administrator is a man with limited knowledge, limited information, and limited cognitive ability, making a policy choice in an uncertain world by "drastically" simplifying the problem and making marginal adjustments in past, "successful" policies to formulate current policies.\(^\text{11}\) Lindblom goes on to argue that, in the face of uncertainty, limited information (and the "cost" of information), and limited computational ability (and the "cost" of expanding it), that incremental change -- marginal adjustments of "proven" policies -- is probably a very rational way to reach policy decisions.

(continued from preceding page)


When applied to the budget problem, Lindblom's model is similar, in some respects, to Lewis'. Departmental budget estimates, for Lindblom, would be marginal adjustments of previous appropriations (last year's budget with a small change), with the lion's share of the estimate never being reconsidered from year to year. This would correspond quite closely to Lewis' alternative budget concept where there are only marginal differences between budgets.

**Budgeting as an Externally Determined Event**

A sizeable portion of the studies of governmental budgeting represent attempts to link expenditures with community demands for services or the availability of revenue (ability of the community to pay). This linkage implies some way of translating demands into specific expenditures — i.e., some form of service standard. For example, Sacks and Hellmuth, in *FINANCING GOVERNMENT IN A METROPOLITAN AREA*, attempt to link government expenditures in the Cleveland area to variables such as population, representing a demand for services, and a measure of community wealth (based on both personal income and real property), representing an ability to pay. Although these variables explain a portion of the differences (from about 10% to 80% of the variance) in per capita expenditures for various functions between governmental subdivisions in the Cleveland area, a good deal of the short run variation remains unexplained. The model of the

---

budgetary process implied by this type of public expenditure study is a simple one. In the long run, the budget is merely a computational mechanism whereby demands for services (population) are multiplied by some standard of service (measured in dollars per capita) determined by community wealth per capita (wealthier communities demand higher service levels than poorer communities) to arrive at total dollars to be expended on a given community function. Thus, the municipal budgetary process, according to this long-run view is a passive instrument for translating demands into expenditures (supplies of services), where the environment (again, in the long run) provides some sort of cues and correctional mechanisms for policy makers.

In a cross-sectional study of differences for similar service functions between per capita expenditure levels (differences in service levels or standards) in 462 cities in the United States, Brazer\(^\text{13}\) found a great deal of variance in per capita expenditure levels between cities, some of which could be attributed to population density and the ratio of central city population to that of the entire metropolitan area. The hypotheses tested by Brazer would imply, as did those of Sacks and Hellmuth, that budgets, \textit{in the long run}, are determined by demands for services and ability to pay. The findings of both works suggest that in the short run, either the concept of "service standards" is not used in the budget formation process (assuming, of course, that expenditures are roughly equivalent

\footnote{\textit{Brazer, Harvey E., \textit{op. cit.}}}
to appropriations), different cities use different service standards (an historically generated standard, perhaps), or that standards include such a wide range of behaviors as to be unimportant in the short run. In any case, a budget-making mechanism that has a set of service standards is not likely to give adequate representation of actual budgetary process in the short run.

Much of the Public Administration literature deals at length with so-called performance and program budgeting. A budget formulated according to these procedures starts with a desired level of activity (x miles of street, y applications processed, etc.) or a program elaborated into the necessary personnel and materials and, by applying a set of unit costs ($/mile of street, etc.), ends with a dollar level of estimated expenditures. The antithesis, of course, is the budget that begins with the dollar amount and then is

---

14 The one exception to this "lack of standards" seems to be in the field of education. Here, dollars per student per year seems to be a meaningful operating standard. In addition, public school revenues received from the State are many times tied to number of pupils. One would expect, therefore, that budgetary processes associated with education would be somewhat different than those associated with other municipal purposes.


translated into activities or programs. Admittedly, a good deal of the discussion of performance or program budgeting is aimed at converting administrators to the "cause" and its adherents do not claim its widespread usage. In spite of this, performance and program budgeting represent a theory of the budgetary process.

The "service standard" -- "unit cost" approach to budgeting represents a force model of decision making where the budget merely translates the sum of the forces into dollar amounts -- the forces being public demand for service levels (amount of service) and service quality (cost of service). An alternative force "model" of public decision making can also be found in the literature.

Both Key and Truman imply that governmental budgets are the product of pressures on the chief administrative budget officer (mayor, in our case) exerted by a coalition of the agency making the request and interested pressure groups, combined with his ability to resist these pressures.\(^\text{17}\) Much of the organizations literature takes a similar view.\(^\text{18}\)

The community decision literature, while preoccupied with the

\(^{17}\text{Key, V. O., Jr., op. cit., p. 744, and Truman, David B., op. cit., pp. 428-430.}\)

\(^{18}\text{For example, "There will be more conflict between units adjacent to one another in a flow-chart sense than between other units, and the conflict will center on the resource (budget is an internal allocation of resources) ..., represented in the flow (Whyte, 1947). Conflict among subunits in an organization will be particularly acute with respect to budgeting and the allocation of money ...," March, J. G., and Simon, H. A., op. cit., p. 123. See also, Argyris, Chris, THE IMPACT OF BUDGETS ON PEOPLE, New York, 1952 , p. 23.}\)
question of who "really" makes decisions in a community, uses a rather simple model of community decision making which can easily be applied to budgetary decisions. It, too, is a force model. The vector addition of the component forces produces a resultant force which, in turn, determines policy. Dahl and his followers contend that while few individuals or groups are active and exert force (power) in any given decision, different sets of people operate in different decision areas and that community decision making viewed in its entirety is dispersed. On any given issue, however, it was the sum of the exerted forces that determined the decision. Hunter presents an almost identical model of choice. The actors in his system are different however. He contends that only a few in the community possess enough force (power) to have any influence on the outcome and that the same, small set of people (ruling elite) exerts its power in practically every area of community decision. Applied to the municipal budgetary process, the community decision literature would imply a major role for individuals and groups outside of government in a theory of budgeting. While many social scientists view the municipal budget as the outcome of a contest conducted


20Hunter, Floyd, op. cit.

21For example, Sayre and Kaufman in GOVERNING NEW YORK CITY, New York: Russell Sage Foundation, 1960, describe the political decision process as a contest involving seven categories of participants: 1) Public officials of a city, 2) members of the government bureaucracy, 3) hierarchies of political party functionaries, 4) non-governmental groups (interest groups), 5) the press and other mass media, 6) electorates, 7) officials of other governments. Their study suggests that these (continued on following page)
outside the formal administrative organization of city government, others conceive of the process as primarily a bureaucratic, administrative phenomena subject to some external constraints. It is to this class of "theories" that we now turn.

**Budgeting as an Internal, Bureaucratic Process**

Cyert and March have sketched a theory of internal resource allocation for business firms\(^{22}\) which, with only slight modification, they claim, is applicable to other non-business organizations.\(^{23}\) This theory of internal resource allocation is presented within the framework of the four major relational concepts found in Cyert and March's theory of business decision making:

1. **Quasi-resolution of conflict** where goal conflicts are not "resolved" by reducing all goals to a common dimension or making them internally consistent, but by viewing goals as a set of independent constraints which an acceptable policy must satisfy; by subdividing problems and delegating them to subunits thereby insuring that subunits deal with a "limited set of problems and a limited set of goals," and reducing the potential for goal conflict between subunits; by using acceptable-

(continued from preceding page) participants enter the allocation process at different points. Precisely what these points are is an empirical question and a legitimate inquiry.


level decision rules rather than optimization as a decision criterion (reducing potential for goal conflict); and by sequential attention to goals rather than simultaneous consideration of all goals.

2. **Uncertainty avoidance** where uncertainty is circumvented rather than faced by resorting to feed-back react decision procedures to solve problems when they arise instead of anticipating problems and planning for their solution ahead of time; and by negotiating with the environment to insure stability and predictability of the organization's surroundings through standard practices in an industry, or budgets within a firm.

3. **Problematic search** where the search for alternatives or solutions is activated by the presence of a perceived problem and depressed by a perceived solution; where the search for solutions "proceeds on the basis of a simple model of causality" based on the characteristics of the problem until failure to discover a solution forces use of a more complex model; and where search is biased and aimed in the direction of previous, successful problem solutions, existing organizational information, experience, and training.

4. **Organizational learning** where learning is conceived of as the adaptation, with experience, of goals, attention rules, and search rules. Goals are changed on the basis of past experience, past goals, and the performance of comparable organizations. Attention rules are reasonably fixed in the
short run but shift in the long run towards those that generally indicate satisfactory performance for the subunit involved.

Search rules change slowly in the direction of success.

"When an organization discovers a solution to a problem by searching in a particular way, it will be more likely to search that way in future problems of the same type ..." and conversely.24

Cyert and March then apply these notions to the problem of internal (to the organization) resource allocation.

"Consider the quasi-resolution of organizational conflict. In budgeting, ... we expect to find that goals tend to enter as more or less independent constraints .... Where an allocation plan apparently meets the constraints, we expect rather loose evaluations of the accuracy of the estimates and other assumptions on which it is based. Where resource rationing is necessary, we expect two general kinds of reactions: first, a tendency to use arbitrary allocation rules that maintain the relative positions of the members of the coalition; second, a tendency to re-evaluate those estimates that are relatively difficult to defend in terms of traditional organizational practice, standard accounting procedure, or immediacy of tangible return."25

Applied to municipal budgeting, this seems to imply that if revenue estimates are less than departmental requests (always the case), the mayor's office will scale down requests so that each department retains the same portion of the municipal-expenditure's pie. Furthermore, maintenance and equipment items are the most likely items to be cut, because they can easily be deferred, and would not lower current levels of operations.


25Cyert and March, op. cit., p. 270.
Discussing search behavior, Cyert and March predict "problem-oriented" search -- request-cutting procedures are evoked by the mayor's office or council only when total department requests exceed estimated revenues, when a department's request exceeds last period's appropriations by more than a fixed percentage, etc. They also predict search "... directed by learned rules for associating search behavior with particular problems"2^ -- there exists a set of fixed procedures, policies, etc., in city government for deciding which requests are granted, cut, etc.

While dealing with "uncertainty avoidance" as applied to budgeting, Cyert and March contend that we will find "... extensive dependency of budgeting on standard industry and firm rules .... Widely shared operative criteria ... both standardize decisions by permitting cross-form comparisons."2^ Translated to the case of municipal operating budgets, this implies rather uniform budgeting procedures (decision sequences, budget forms, etc.), perhaps through "model legislation" drafted by various national organizations or reform groups, and a set of service or operating standards (x dollars/capita to be spent on police protection, etc.).

Finally, Cyert and March theorize that "organizational learning" with respect to budgeting will take the form of "... changes in goals over time, changes in the search and decision rules, and changes in

2^Cyert and March, op. cit., p. 271.

2^Cyert and March, op. cit., p. 271.
the learning rules." "In general, ... (they) expect a behavioral model of (internal) resource allocation to be heavily history-dependent in the same way, and for the same reasons, as ... (their) suggested model of pricing." 28

What Cyert and March seem to be suggesting is that there exists a set of widely shared heuristics for solving complex problems within an organization, with "only" parameters changing from organization to organization or from problem to problem within an organization. With internal resource allocation being a complex problem for any organization, the broad outlines of the Cyert-March behavioral theory of organizational decision making will be relevant to our problem.

The Cyert-March theory of organizational decision making is generally consistent with the works in organization theory that take the decision and associated decision process as the focal point in the study of organizations. 29 For this reason, it will not be necessary

28Cyert and March, op. cit., p. 271.

29Simon first advocated the "decision" as the unifying concept in the administrative process in ADMINISTRATIVE BEHAVIOR (pp. 8-9). This viewpoint was significantly expanded and elaborated in March and Simon's ORGANIZATIONS. Cyert and March's work in many respects is a continuation, expansion, and elaboration of many of the notions found in ORGANIZATIONS and applied to organizational decision processes, just as Clarkson's (G. P. E.) book on PORTFOLIO SELECTION: A SIMULATION OF TRUST INVESTMENT, Englewood Cliffs: Prentice Hall, 1962, represents a similar extension into the realm of individual decision making.
to consider explicitly such important (and relevant) works as Simon's ADMINISTRATIVE BEHAVIOR and PUBLIC ADMINISTRATION (with Smithburg and Thompson), and March and Simon's ORGANIZATIONS.

In easily the most important theoretical work to date on a positive theory of governmental budgeting, Wildavsky's findings are strikingly similar to the theories of Simon, March and Simon, and Cyert and March relative to the organizational decision processes. A similar congruence exists between those notions relating to problem complexity and its influence on decision strategies put forth by Braybrooke and Lindblom in A STRATEGY OF DECISION. Wildavsky has constructed a theory of the formation of the Federal Budget based on a detailed description of the decision process. Wildavsky obtained the material for his theory through a series of detailed interviews with agency heads, Bureau of the Budget personnel, and Congressmen. Perhaps the most important feature of Wildavsky's theories, however, is the empirical verification of many of them in work directed by Otto A. Davis, an economist, using linear regression models of Congressional decision processes.

While emphasizing the complexity of the budget maker's problem, Wildavsky describes a series of "aids to calculation" to help the decision maker simplify his problem and reach a decision. Some of


these are:

1. Experiential budgeting — "One way of dealing with a problem of huge magnitude is to make only the roughest guesses while letting experience accumulate."

2. Simplification — ignore complicated aspects of the problem and concentrate on those items with which decision maker is familiar.

3. "Satisfice" — rather than maximize, budget officials "satisfy and suffice."32

4. Incrementalism — "The largest determining factor of the size and content of this year's budget is last year's budget. Most of the budget is a product of previous decisions." (Parallels Cyert and March's contention that internal resource allocation is "heavily history dependent" and that the budget can usefully be thought of as an elaboration of goals and policy commitments. Also similar to Lindblom's notions of "incrementalism" as a method of dealing with complex problems.) "(I)t is based on last year's budget with special attention given to a narrow range of increases or decreases."33

Wildavsky also describes two notions widely held by participants in the federal budgetary process — "fair share" and "base." "The base is the general expectation among participants that programs will be carried on at close to the going level of expenditures but it does not necessarily include all activities."34 In other words, appropriations for a department in year t - 1 are "never" less than a fixed percentage of appropriations for year t. "'Fair share' means not only the base

---

32 Term originated by Herbert A. Simon, MODELS OF MAN, (New York: Wiley), 1957. Similar to "aspiration level" of March and Simon and "acceptable-level decision criteria" of Cyert and March.

33 Wildavsky, A., op. cit., pp. 11-16.

34 Wildavsky, A., op. cit., p. 17.
agency has established but also the expectation that it will receive some proportion of funds, if any, which are to be increased over or decreased below the base of the various governmental agencies.1

Increases and decreases are to be distributed "democratically" among the agencies.36

The roles of the participants cited by Wildavsky are generally those assumed by more casual observers of a bureaucracy in general and the Federal government in particular: department heads ask for more than they expect, budget officials and the chief executive tend to scale down agency requests, and Congress tends to cut the executive budget.

The extension of Wildavsky's theory to municipal budgeting is fairly straightforward. If police and fire department functions are substituted for the defense functions of the Federal government and if foreign policy is ignored, large municipal governments perform functions very similar to those of the Federal government on the expenditure side of the ledger. The roles of participants in the sequence or flow of decisions is, as a first approximation, roughly similar: with city department heads corresponding to agency or bureau chiefs, the mayor's office or budget department similar to the Bureau of the Budget, the mayor's function paralleling that of the Chief Executive, and that of the council corresponding to Congress.

35Wildavsky, A., op. cit., p. 17.

36Neither Davis' work or ours confirms the existence of this "concept" in the behavioral sense. See goodness-of-fit for model A3 in Section 6.
How well Wildavsky's "model" fits municipal budgets is, of course, an empirical question that this study will attempt to answer.

Other approaches to the study of organizations and bureaucracies that might be considered focus on role perceptions of the participants (sociological approach), motivations, "compliance systems," informal social network, etc. All of these approaches are represented in one form or another in either Cyert and March's formulation of budgetary processes or in Wildavsky's.

Before moving on to the methodological question one other general conception of political decision processes should be discussed. Banfield, in his studies of political processes in the Chicago area, conceives of the area as being governed by "... hundreds, perhaps thousands of bodies, each of which has a measure of legal authority .... Altogether, these many bodies are like a great governing committee each member of which has, in matters affecting it, an absolute veto." Banfield contends there is "no communication" between members of the committee and each body "acts independently without knowledge of the others," with the result that proposed action must satisfy a series of independent constraints imposed by the bodies or committee members.40 Applying this decision model to the municipal


38Argyris, C., op. cit.


budgetary process means identifying the relevant members of the "committee" (individuals or groups) and specifying the constraints imposed by each "member" for budget approval. Banfield's model bears some similarity to the Cyert-March concept of goals of the participants entering the decision process as a series of "more or less independent constraints (each of which must normally be satisfied)". 41 and to the Dahl influence model where the influencers must be identified for each problem area.

Overview of Theories of Budgetary Behavior

The above represents the general "state of the art" relative to positive theories of municipal resource allocation. As can be seen, many of the theories are somewhat ambiguous (and perhaps open to interpretations different from the ones given). This ambiguity is not a characteristic of a particularly good theory, however. A second problem arises in the set of theories offered above. Many are inconsistent with each other, so that it is not merely the case of many blind men observing different portions of the same elephant and coming up with different descriptions—all of which are true, but only partially so. For instance, the differences between the Wildavsky, Davis, Cyert-March, and Lindblom views of the world and those implied in the works of Pigou, Lewis, and Cyert and March, op. cit., p. 270.
Sacks and Hellmuth, Brazer and Hunter are more than differences of degree or emphasis, they are differences in kind. Assuming that the participants in the budget making process are passive instruments who will come up with a predetermined solution to the problem of municipal resource allocation either by following economic dictates and service demands or by following the dictates of community power figures vs. assuming that budget makers are organizational decision makers and problem solvers who structure complex problems, generate alternatives, and make choices on the basis of some criteria, is a real difference.

If "external" (to the formal government) participants and environmental information constitute important elements in the process, then:

1. References to these extra-governmental information sources should emerge in interviews of the formal participants, or
2. Models that consider only those "internal" mechanisms "uncovered" in interviews with the formal (governmental) participants should produce systematic errors when model predictions are compared with observed budgetary behavior.

Most of the economics and public finance literature is aimed at discovering long-run forces that shape the overall distributions of municipal resources -- with the hope of constructing an "operational" normative theory. The two "expectations" listed above would apply if these external forces were important in the short-run decision process.
Another possibility exists. Suppose that the decision system monitors these external forces only occasionally (or vice versa). It might be that the decision system (or their "decisions") is "allowed" to operate within a relatively loose set of constraints imposed by the external environment. The decision system would be "allowed" to "wander" within this system of external, changing constraints. If the government wandered outside these constraints, the external environment would then "step in" and correct the situation. If this were the case:

3. "External" decision corrections would be observed occasionally, and any model based solely on internal, bureaucratic processes would experience a sizeable error when the environment intervened to make corrections.

Thus, a model based on interviews with the formal participants in the decision process that did not have the "external" environment as a key variable would either not "explain" (statistically) very well or would generate significant errors whenever the external environment intervened. The relationships between short-run, internal bureaucratic models and long-run, external-environment models can be investigated through measures of overall model goodness-of-fit and an analysis of residuals. (These analyses are found in Sections 6 and 7). Both are empirical issues involving theory validity. We now turn to the problem of constructing theories that can be subjected to empirical test.
SECTION 3
RESEARCH STRATEGY

The choice of a research methodology is really a two-stage process. Before one can decide on a particular methodology, one must first decide on the scope of the problem to be examined and the general research strategy to be employed.

Research Strategy

The scope of the problem has already been discussed in a very general sense in Section 1. The expenditure side of the municipal operating budget is our problem area. The decision to separate the study of the municipal operating budget from the capital budget and revenue or tax decisions was based partially on rough empirical knowledge, and partially on the availability of data. Preliminary interviews with budget officials indicated that:

1. In the short run, only a loose connection seems to exist between the capital and operating budgets in municipal government. These connections appear to be computational in nature and to consist of the elaboration of the implications of particular capital expenditures. For example, moving several city departments from rented quarters to a new, city-owned building involves a "legitimate" (i.e., automatic) increase in custodial costs, maintenance charges, furniture, and the like. Equally automatic decreases in rental charges are also made in the operating budget.¹

¹In the long run, elaborations of the capital decision process could prove to be one of the prime determinants of resource allocation. For instance, the construction of a Civic Center in Detroit involved more than just a facility to be maintained (the impact on the operating budget). It represented elements of a long-run urban renewal commitment as well as the desire for convention trade. These "shocks" to the operating budget in the form of capital budget elaborations can be cumulative in many cases.

By nature, capital decisions are infrequent decisions, thereby limiting the opportunity for observation. Also, access to relevant decision variables and decision makers is largely a chance phenomena. If the success of a research project is a function of the number of relevant variables and relationships investigated, then research on capital decisions has a low probability of success. Both the frequency (number) of observations and the probability of making a successful observation are low.
2. Revenue estimates made by the city administration appear "unbiased" and as accurate as possible, with the estimates being corraborated by outside, "independent" organizations. The primary connection between revenue estimates and budgeted expenditure estimates occurs when anticipated expenditures force an increase in tax rates (i.e., a change in tax policy). No changes in tax yield estimates to "make the budget balance" were observed.

In a sense, the decision to limit the scope of the problem to operating expenditures leaves the study open to a charge that methodology (commitment to an empirically-based study) has limited the choice and scope of the problem.2 This is true. This limitation appears to be a reasonable one, however, in so far as the operating budget represents a set of relationships reasonably independent from the capital and revenue decisions for the municipality.

Given the scope of the study, there are many possible ways that we can proceed. One possible research strategy would be to take some or all of the theories outlined in Section 2, gather information on the relevant variables, use the theories (elaborated or restated in a testable form) to make predictions, then compare predictions with real, observed behavior to arrive at a choice among theories or a specification of the conditions for a theory's applicability.

2 "The more substantively oriented social scientists decry the tendency to study what they visualize as trivial problems with impeccable methodology, and argue that despite inadequate techniques, social scientists have more to contribute by exploring bigger and more significant problems. The new school of empiricists and methodologists responds that all scientific activity moves slowly; systemization, they say, is required if we are ever to be in a position to make an intelligent attack on many problems of great importance." Mechanic, David, "Some Considerations in the Methodology of Organizational Studies," in Levitt, H.J. (ed.), THE SOCIAL SCIENCE OF ORGANIZATIONS: FOUR PERSPECTIVES, Englewood Cliffs: Prentice Hall, 1963, p. 142.
A second possible research strategy is to construct a descriptive model of the budgetary decision process based on empirical evidence and use the validated model as a theory in its own right and/or use the model as a focal point, comparing existing theories and postulates to it in a sort of consistency test. This comparison would then serve the same function as the first strategy outlined above.

Our basic research strategy, then, is to examine the municipal budgetary process in detail, forming a positive theory of municipal budgeting, rather than examining the various theories cited in Section 2 in the context of municipal budgeting. On the basis of preliminary empirical evidence, it was decided to construct one theory or abstraction of municipal budgeting, rather than a separate one for each municipality examined, thus gaining some of the advantages of a more general theory.

In this report, "theory" and "model" are used interchangeably. Generally speaking, a theory should contain statements of the relations between important variables in the system being studied -- statements of the interdependencies between variables, the functional form of those interdependencies, and the structural characteristics of the system of behavior. A "model" or "theory" is "... essentially a set of assumptions from which a conclusion or a set of conclusions is logically deduced.... (T)he assumptions need not be exact representations of reality, but they may instead be reasonable abstractions of reality." (Cohen, K. J., and Cyert, R.M., "The Methodology of Model Building," unpublished mimeographed paper, Carnegie Institute of Technology, 1961.) In our case, this means that the abstraction of decision rules used in the model or theory must be a "reasonable abstraction" of the decision rules actually employed as well as being capable of generating the same kinds of decisions found in reality.
Methodology

In our discussion of existing theories of governmental resource allocation and decision making we alluded to two problems in existing theory:

1. ambiguity or the use of non-operational concepts, and
2. the presence of "conflicting" theories with no way to choose among them because they were not stated in empirically verifiable form.

If we are not to be guilty of the same sins of omission, our theory must be such that it is precise and unambiguous with respect to the kinds of behavior it implies and must be stated in an empirically testable form. These two considerations are definite, self-imposed constraints on this study.

Theory Formalization

The desire to state a theory in an unambiguous form leads directly to the question of the language to be used. The language of mathematics is clearly unambiguous and is a ready solution to our own problem of precision. In addition, properly constructed, a mathematical formulation of relationships and processes involved in the budgetary decisions should permit one to unambiguously trace out the implications of these relationships. The "implications" of our theory (budget figures generated by the mathematical statement of our theory) will be in a form that permits ready comparison with observed behavior (actual budgetary decisions).
The advantages of formulating a problem mathematically are many --

"a) Knowing more precisely what mechanisms or structural relationships are being postulated, and sometimes calling attention to the need for further clarification of the operational meaning of definitions and statements;

"b) Discovering whether certain postulates can be derived from others, and hence can be eliminated as independent assumptions; whether additional postulates need to be added to make the system complete and the deductions rigorous; and whether there are inconsistencies among postulates;

c) Assisting in the discovery of inconsistencies between the empirical data and the theories used to explain them;

d) Laying the basis for the further elaboration of theory, and to deductions from the postulates that suggest further empirical studies for verification;

e) Aiding in handling complicated, simultaneous interrelations among a relatively large number of variables, with some reductions of the obscuring circumlocutions entailed by non-mathematical language.4

Having chosen a language (mathematics) it is necessary to pick a dialect. Many types of mathematical models exist -- systems of equations (linear and differential, to name two), statistical models (stochastic, Markovian, etc.), and computer programs are a few of the many dialects in the language of mathematics.

**Computer Programs and Problem Solving Processes**

Our model is stated in the form of a computer program. The nature of the budgetary decision process suggests such an approach. Even a

---

superficial examination of the municipal resource allocation procedure indicates that it is the result of a sequence of decisions — departmental requests, mayor's executive budget, and final council appropriations. A computer program is really a collection of instructions executed in a specific sequence.

A logical question to be raised at this point is "Are the individual budgetary decision procedures repetitive?," and "If so, are these 'stable' decision rules applied in a regular, systematic sequence?" The answers to both questions ought to be affirmative if the computer-program description of budgeting is to be valid. Fortunately, there are some compelling reasons why this should be so. The obvious reason why "programmed" decisions tend to be repetitive, and vice versa, is that "if a particular problem recurs often enough, a routine procedure will usually be worked out for solving it." Certainly the municipal budget is a recurrent problem (yearly). Evidence that recurrent, complex problems are solved by individuals by breaking the global problem into a series of less complex ones, and then solving the simplified problems sequentially, is growing.

In particular, the problem-solving behavior of individuals has been described by a computer program for a trust investment officer by Clarkson, a department store buyer by Cyert and March, and laboratory

---

5 Clarkson, G. P. E., op. cit.

subjects solving simple problems as well as chess players by Newell and Simon.

**Computer Simulation of Municipal Budgeting**

Our proposed computer program will attempt to describe or simulate the behavior of many individuals — department budget officers, budget officials in the mayor's office, and the council — simultaneously. But there is no reason to think that the hundred or so actors involved in the formal budgetary decision system will be any more difficult to "program" or simulate than such individuals as, say, the trust investment officer. The difficulty, if any, will arise from the number of decisions and decision makers in our model, and the quantity of data to be analyzed.

---


9 The implications of the "magnitude of the problem" are many. First, it should be fairly obvious that each actor in our simulation model will be described in a simpler manner than the individual problem solvers in most of the works cited above. Secondly, assumptions will have to be made which will detract from the overall accuracy (i.e., completeness) of the model. For example, it will be necessary to assume that each department head in the system behaves according to the same decisional model, with only parameters changing. It is obviously not practical or reasonable to interview all department heads and all parties involved in the budgetary process. Behavioral rules attributed by others to our decision makers will have to be incorporated in the model without individual preliminary checks. The reasonableness and "accuracy" of these necessary "short cuts" will, of course, be measured empirically when the model is tested.
Simulation as a Research Tool

"Simulation is a technique for building theories that reproduce part or all of the output of a behaving system." In addition, some simulation models have the goal of reproducing not only the final output but also the procedures, processes, decision rules between the informational inputs and outputs (budgetary decisions). This is our task. The attempt to reproduce output and procedures will be in the form of a computer program representing the structural form of the decision process (sequence of decisions), the functional form of the individual decision rules (individual equations representing actual decision rules), and the decision parameters (values of "constants" or empirically determined variables embedded in the structure and functional relations of the model).

The entire computer program will then represent a formalization of our positive theory of municipal resource allocation.

In addition to the advantages of theory formulation cited above, the particular kind of formulation -- computer simulation -- offers other advantages:

1. "Since most mathematical models are intended for analytic solution, their complexity and realism must be severely limited. Computer models, however, can be made as complex and realistic as our theories permit, for analytical solutions to these models are unnecessary."

10 Clarkson, G.P.E., op. cit., p. 16.

<table>
<thead>
<tr>
<th><strong>Terminology</strong></th>
<th><strong>Translation</strong></th>
<th><strong>Examples</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model Structure</td>
<td>Sequence of Decisions and application of decision rules.</td>
<td>1. Departmental Estimates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Mayor's Budget</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Final Council Appropriations</td>
</tr>
<tr>
<td>Functional form of decision</td>
<td>Mathematical relationship representing decision rules.</td>
<td>A. Budget request</td>
</tr>
<tr>
<td>rules</td>
<td>Rules: A. Budget request is based on last year's appropriation plus an increment.</td>
<td>= (1 + a) x Last Year's Appropriation</td>
</tr>
<tr>
<td></td>
<td>B. Budget increase no greater than a certain percent of last year's appropriation.</td>
<td>B. If [(Budget request) (1 + d) x Last Year's Appropriation], then</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Budget request = (1 + d) x (Last Year's Appropriation)</td>
</tr>
<tr>
<td>Decision Parameters</td>
<td>Empirically determined parameters in decision rules</td>
<td>A. Value of &quot;a&quot;</td>
</tr>
<tr>
<td></td>
<td>A. Size of increment</td>
<td>B. Value of &quot;d&quot;</td>
</tr>
<tr>
<td></td>
<td>B. Maximum increase</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1 Model Terminology
2. The assumptions inherent in a computer program can be easily modified, and once the model (program) is set up, it is relatively easy to test alternative assumptions by changing one or two relationships in the program or by varying values of parameters and noting the effects of such changes on the system.

Cohen and Cyert identify four categories of simulations of organizational behavior:

1. "(D)escriptive simulation studies of existing organizations .... to formulate theories which explain why existing organizations have behaved in particular ways, to test these theories by comparing the observed past behavior with the simulated behavior generated by the model, and to predict how these organizations will behave in the future.

2. "Illustrative simulations" that explore the implications of a set of reasonable assumptions about organizational behavior.

3. "Normative simulations" exploring several types of organizational structure and design in terms of certain desired characteristics.

4. "Man-machine" simulations to train "people to function better in organizational settings."

---

12 The "relevant" organization here includes those people involved in formulating the municipal operating budget -- specifically, department heads and their chief accountants or budget officers, the budget and controller's office in some cities, those people in the mayor's office concerned with budgetary decisions, and the council. The possibility of "outside" forces being involved in a systematic way (See Dahl and Hunter) is not denied: it simply was not observed.

Quite obviously, our study is a "descriptive simulation" of the governmental decision process for forming the operating budget.

Hypothesis Construction

Up to this point it was implied that a set of hypotheses or assumptions existed and that the problem was merely one of finding a language, in which to state the assumptions, that was the desired characteristics of precision and empirical testability. This is clearly not the case. The reason for examining the theory-language and methodological-technique questions first is simple. The methods of collecting data and formulating hypotheses about municipal budgeting depend somewhat, at least, on what is to be done with the data and hypotheses found. The decision to use computer simulation as a research tool means that relationships uncovered through interviews, etc. must ultimately be stated in a quantifiable form and that "key variables" for purposes of the model must have some means of being measured or calculated.

The basic research strategy was covered briefly in Section I:

1. Preliminary unstructured interviews.

2. Construction of preliminary model -- uncovering inconsistencies in interview data and highlighting missing sets of relationships not discovered in preliminary interviews.

3. Re-interviews (structured and unstructured) to cover model deficiencies found in step 2.

4. Construction and modification of computer model on basis of 3.
5. Examination of model's output. If "satisfied", move on to step 6; if not, recycle through 3 and 4.

6. Examine cases where model fails to explain for regularity.

A first, reasonable step in finding out how a municipality allocates its resources and operating funds is to ask the decision makers (those charged with official responsibility for the decisions) how they arrive at their decisions or budget estimates. This is clearly a reasonable way to proceed unless one believes that a widespread conspiracy exists within a city government and that the formal decision makers ("puppets") will conceal or be unaware of the presence of the "real" decision maker or "power behind the throne." It is the researcher's task to ask questions in such a way that a realistic and "complete" theory can be formulated. Failure of the researcher to construct a realistic description (model) of the decision process will ultimately show up when the hypotheses derived from the interviews are subjected to empirical tests, so that one need not worry about the methodology being inherently misleading.

Data Collection

We are attempting to reproduce the budgetary decision processes. This means that the majority of our decisions data will be part of the public record. Specifically, the mayor's budget recommendations to the council and the final appropriations of council are available in public
Unfortunately, departmental request data are sometimes not kept or must be assembled by the researcher. Some cities, however, publish departmental request figures as well (in our study, Detroit publishes departmental request data, Cleveland keeps it in files for four or five years, and Pittsburgh keeps it for one year only and in an unassembled form).

What other data are relevant will of course depend on the kind of model we construct and the relevant variables in the model. We will defer discussion of this portion of the data until the model itself has been presented.

**Budget Categories**

One other item remains to be covered in this section -- the choice of budget categories. This involves two questions:

1. The method of dividing the budget into administrative units -- Should the Department of Public Safety be considered as one or should it be broken down into its component bureaus -- Police, Fire, Building Inspection, etc.?; and

2. How finely should one divide the account categories within administrative units? Should salaries and wages be treated as one category or should there be a separate category for administrative salaries?

They are both answered rather pragmatically. Because the model is a behavioral one the answers rest in the assumptions that administrative units are treated differently and expenditure items are treated differently ("Salaries and wages" are treated differently than "equipment."). The appropriateness of the assumptions depends on the
models ability to "explain" and predict decisions. Prima facie evidence of the "real" cognitive differentiation of administrative units and account categories can be found in the accounting systems of the government involved. For example, where the budget for the "Bureau of Streets and Highways" appears separately from that of the "Bureau of Sewers and Sanitation" in the final appropriations bill, even though both are in the Department of Public Works, it is probably a safe bet that the two bureaus' budget estimates were processed differently by the various decision makers. Similarly the fact that "Expenses" and "Equipment" are separate, summary-line items in the final appropriations bill more than likely reflects a real, cognitive differentiation on the part of decision makers. It was on this basis that the component budget decisions were defined. More will be discussed on this matter in Section 5.

Summary

In the quest for a positive (behavioral) model of municipal resource allocation we have:

1. Decided to concentrate on a semi-independent portion of the problem -- general fund or operating expenditures,
2. Chosen mathematics as the language to describe the allocation process,
3. Proposed a computer program as the particular kind of mathematical description to be employed,
4. Designated the computer abstraction of the decision process to be the focal point and organizing device for our discussion of alternative and related theories of bureaucratic and political decision making, and

5. Assumed that empirical verification was the objective to be strived for in model construction.

We now turn to the formal model of municipal resource allocation.
Overview of Decision Process

Figure 4-1 illustrates the information flow in the municipal budgetary decision process in the three cities examined (Cleveland, Detroit, and Pittsburgh). This general sequence of decisions is common to Mayor-Council municipal governments.

Strictly speaking, the decisions flow through the network with surprisingly little feedback. Estimates of revenue and surplus are "unbiased." There was no evidence in any of three cities of any "doctoring" of the anticipated funds estimate because of expenditure decisions. The only "adjustments" of the funds estimate occur as the result of policy decisions on new taxes or tax rates by the Mayor's Office or as the result of a "better" estimate of yield being available.

Although much information is exchanged, most of it represents attempts by the Mayor's Office to keep other parts of the decisional system informed on developments. In the sense that this information will lead to changes in behavior, there is surprisingly little feedback.

Overview of Decision Procedures

Figure 4-1

Cash Surplus (deficit) anticipated at end of current fiscal year

Tax Revenue Estimates (with existing tax rates) for Budget Period

Estimated Total Funds Available for Budget Period

Previous Budget Figures, Trends

Mayor's Tax Policy (See Figure 5-1)

Previous Expenditure Figures

Mayor's Budget Letter

Department Head

A

Dept. Budget Request

Department Head

Dept. Budget Request

Department Head

Dept. Budget Request

Department Head

Dept. Budget Request

Mayor's Office

B

Mayor's Budget

City Council

C

Final Appropriations for Budget Period
The estimate of the expected yield from a tax is not "tampered" with. The revenue estimate is taken as a "given" by the Mayor's Office and by our model.4

On the basis of estimated revenues for the coming budget period and anticipated cash surpluses at the end of the current budget period, an estimate of funds available for expenditure in the coming budget period is calculated. By comparing the current year's budget totals plus "known" expenditure changes (for example, increases in Social Security payments, increased maintenance and custodial personnel for a new public building about to be completed, etc.) with the available-funds estimate, the mayor's office forms a general impression of the budget -- whether it will be "tight" or "loose," whether new revenues are needed, etc. The Mayor then sends a letter to department heads with instructions for filling in their department budget request forms. The instructions or budget "guidelines" sent to department heads are reasonably explicit and reflect the revenue-expenditure picture for the city quite accurately.5

4In all three cities investigated, the Mayor's Office attempts to corroborate the city's revenue estimates with like estimates from outside, independent sources. In all cases great attempts are made to get accurate revenue estimates.

5The following are excerpts from executive budget letters in each of the three cities:

Cleveland -- "... your requests for salaries and wages for the year should be computed at the present rates of pay."

Detroit -- "We find that in the past comparatively few changes in the Personal Services section were requested by the departments. It is assumed that a similar situation will prevail in the 1964-65 budget .... (continued on following page)
Using guidelines specified in the Mayor's budget letter, previous budget figures, and (to a lesser extent) past expenditure data as explicit inputs, the department head formulates his regular departmental request. In some cities, any request for an increase of a "noticeable" (+2-5%) amount over current appropriation must be submitted via a "supplemental budget request." 7

Departmental requests (together with supplemental requests -- "unusual" increases) are then transmitted to the mayor's office where a preliminary estimate of the total operating budget is made (excluding supplemental requests). The estimate of total expenditures is then compared with estimated available funds for the budget period. If a surplus is indicated, a general salary increase is considered for inclusion in the budget along with increases in various departmental appropriations or "special" programs of the Mayor. If the preliminary expenditure estimate and anticipated funds figures are close, a slight

(continued from preceding page)
the figures appearing in the '1963-64 Budget Allowance' column have been duplicated in the "Departmental Request' column."

Pittsburgh -- "In arriving at your departmental estimates, the following ground rules must be followed:
1. Your 1965 total requests should be lower than your 1964 appropriations, and in no instance, higher than 1964 appropriations."

6Pittsburgh and Detroit in our sample.

7There is evidence that even though Cleveland does not require a "supplemental request" as such, the portion of a request that exceeds current appropriations is processed by the Mayor's Office in much the same way that "supplemental requests" are processed in Detroit and Pittsburgh.
tax increase (either a rate or "coverage" increase of a new tax) may be considered, small cuts may be proposed to bring revenues and appropriations into line, or portions of some supplemental requests may be granted. On the basis of the Mayor's tax policy and wage policy, a "final" budget is prepared (with revenues always greater than expenditures as specified by law for the municipalities investigated) -- after conferences with department heads where they are allowed to argue for their supplemental requests or to protest minor cuts. This budget is then transmitted to the Council with the Mayor's budget message outlining, in detail:

1. General economic picture for the area.
2. Revenue estimates and reasons for changes from the previous year.
3. Changes in expenditures from the previous year.
4. A list of deserving programs or projects that could not be included because of lack of revenue.

The Council, in virtually every case, approves the Mayor's budget exactly as submitted after a series of public hearings where interested parties plead their cases (always for increased expenditures for some purpose, or a decrease or elimination of a tax).

Scope of Model

The formal, computer model will consider explicitly three decision processes -- departmental requests as formulated by the various department heads in city government, mayor's budget for council consideration, and final appropriations as approved by the council.
These three processes are indicated by areas A, B, and C in Figure 4-1. The outputs of the departmental-request submodel are inputs to the mayor's-budget submodel and outputs of the mayor's submodel are inputs to the council appropriations submodel. (For convenience, these submodels will be referred to as the DEPT. model, MAYORS model, and COUNCIL model).

The outputs of each submodel correspond quite closely, in number and level of detail, with the outputs (or decisions) found in the municipal budgetary process. In the model, each department included in the general fund or operating budget has requests for appropriations for each of 2 to 5 standard account categories -- depending on the city involved. For example, the model will produce -- at each stage of the decision process (3 stages) -- the following dollar estimates for the City Planning Department:

<table>
<thead>
<tr>
<th>Cleveland</th>
<th>Detroit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Services</td>
<td>Administrative Salaries</td>
</tr>
<tr>
<td></td>
<td>$X</td>
</tr>
<tr>
<td></td>
<td>Non-Adm. Salaries</td>
</tr>
<tr>
<td>Materials</td>
<td>Materials,</td>
</tr>
<tr>
<td>Supplies</td>
<td>Supplies and</td>
</tr>
<tr>
<td>Expenses</td>
<td>Expenses</td>
</tr>
<tr>
<td>Equipment</td>
<td>Equipment and</td>
</tr>
<tr>
<td>Repairs and Improvement</td>
<td>Repairs</td>
</tr>
<tr>
<td></td>
<td>Special</td>
</tr>
<tr>
<td></td>
<td>Special</td>
</tr>
</tbody>
</table>

Roughly, 44 to 64 departments and administrative units are involved in each of the cities examined, with units having estimates for 2 to 5 accounts. About 128 to 220 decisions are produced at each of the three stages of the model, for each year tested, in each of the three cities.
At this point, one might legitimately ask two important questions:

1. Why are accounts categorized in the manner indicated?
2. Why is "dollars" the unit of resources allocation rather than men, number of street lights, etc.?

Both questions are "crucial" ones for a normative theory of budgeting. In a positive theory, however, the answers are the same and rather straightforward. People interviewed in all three cities think and talk in terms of "dollars"; they differentiate (at least in interviews) expenditures in terms of the same categories that the city's accounting system uses. Apparently, dollar amounts provide the relevant reference points for dealing with the conceptual framework provided by the city's accounting system.  

Submodels

Before describing in detail the three submodels, it might be wise to present a list of the variables used. Variables, without exception, represent either past budget decisions (appropriations), experience (expenditures), or decisions (departmental requests, mayor's budget) previously made for the current budget period. A general rule has been used in naming variables. Variables dealing with the current budget period have the number "1" (one) in the variable name.

---

8A legitimate question would be, "Why was a city's accounting system designed around a particular set of account categories?" This, however interesting, is beyond the scope of this study.
Variable names referring to the previous budget period include the number "0" (zero), and those referring to the next budget period (for which decisions must be made), have the number "2" (two). For example, if the 1965 budget is under consideration, the current year will be 1964, and previous year 1963.

Decision Period (1965 in example):  \( t + 1 \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final council appropriations</td>
<td>APPR2_i,j</td>
</tr>
<tr>
<td>Mayor's budget request</td>
<td>RMAY2_i,j</td>
</tr>
<tr>
<td>(&quot;Regular&quot;) Departmental budget request</td>
<td>DEPR2_i,j</td>
</tr>
<tr>
<td>Department Supplemental budget request</td>
<td>DSUPR2_i,j</td>
</tr>
<tr>
<td>Total Department request</td>
<td>TDEP2_i,j</td>
</tr>
<tr>
<td>Estimated Available Funds</td>
<td>REVEST</td>
</tr>
<tr>
<td>&quot;Allowable&quot; Increase as indicated by Mayor in</td>
<td>TML</td>
</tr>
<tr>
<td>his budget letter</td>
<td></td>
</tr>
</tbody>
</table>

where \( i \) = department or administrative unit
\( j \) = account category

Analysis (current) Period (1964 in example):  \( t \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Appropriation</td>
<td>APPR1_i,j</td>
</tr>
<tr>
<td>Mayor's Request</td>
<td>RMAY1_i,j</td>
</tr>
<tr>
<td>Departmental Request (total)</td>
<td>DEPR1_i,j</td>
</tr>
<tr>
<td>Total Departmental Appropriation</td>
<td>TAPR1_i</td>
</tr>
</tbody>
</table>

Previous Period (1963 in example):  \( t - 1 \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Appropriation</td>
<td>APPR0_i,j</td>
</tr>
<tr>
<td>Actual Expenditures</td>
<td>EXPND_i,j</td>
</tr>
</tbody>
</table>

In addition, the following variables are calculated by decision units as part of the decision process:
<table>
<thead>
<tr>
<th>Variable</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget Total, all depts., all accounts</td>
<td>TBUD</td>
</tr>
<tr>
<td>City-wide salary totals</td>
<td>TSAL</td>
</tr>
<tr>
<td>Preliminary Surplus or Deficit</td>
<td>RESID</td>
</tr>
<tr>
<td>(= REVEST - TBUD)</td>
<td></td>
</tr>
<tr>
<td>Reduction ratio to &quot;cut&quot; non-salary budgets</td>
<td>SCALE</td>
</tr>
</tbody>
</table>

**DEPT. Request Submodel**

Armed with the Mayor's budget letter providing rather specific guidelines with respect to limits on total requests and general wage and personnel policies, the department head with standard budget preparation forms, has a reasonably well-structured problem in front of him. In all three cities investigated, the budget preparation forms consisted of three columns: 1) Actual Expenditures, year \( t - 1 \), 2) Appropriations, year \( t \), and 3) (Regular) Departmental requests, year \( t + 1 \). In all cases, the "Actual Expenditures" (EXPND) and "Appropriations" (APPR1) columns were filled in for the department head, for each of the account categories appearing in the previous budgets. The department head's task is to fill in the blank "Departmental Request" column. The physical makeup of the budget forms probably has as much influence as anything in determining the department head's response to the request for budget estimates. By structuring the department head's problem, the forms "bias" the outcome or decision in two ways:

1. They provide a great deal of incentive for the department head to formulate his requests within the confines of the existing set of accounts.

2. They provide for an automatic comparison between "next year's" request and "this year's" appropriation -- which automatically determines that "this year's" appropriation provides one criterion and reference point for "next year's" request.
1. Budget letter and Budget Forms received from mayor containing: a. current appropriations for all account categories in the department; b. current total appropriation; c. previous year's expenditures in various account categories; d. estimate of allowable increase over current appropriations implied from the "tone" of the mayor's letter.

2. Trend of departmental appropriations -- direction and magnitude of recent changes in amounts of appropriations in departmental account categories.

3. Department, using information from 1. and 2., formulates a "reasonable request" for funds in its existing account categories, using current appropriations as a "base" or reference point and adjusting this estimate according to whether there was an increase in appropriations last year (for some accounts, an increase for the current year means a decrease for next year -- equipment, for others, an increase for the current year indicates another increase next year), and the difference between last year's expenditures and appropriations.

4. Using "reasonable requests" calculated in 3., a preliminary department total request is calculated.

5. Is the total department request outside the guidelines set by the mayor's office (implied from the "tone" of the mayor's budget letter?
   no
   yes

6. Check to see if there are any increases in salary accounts over current appropriations
   no increase
   increase

7. All department requests in all categories are adjusted so that any increase (proposed) over current appropriations is submitted as a supplemental request. Go to 6. to check for salary increases.
6. no increase
7. increase

8. Make regular request equal current appropriations and put increase in as supplemental request.

9. Calculate total of regular departmental request.

10. Send regular requests and departmental total to mayor's office along with supplemental requests.
Variables in Figure 4-A1

Inputs*: APPR₁ᵢⱼ, APPROᵢⱼ, TAPR₁ᵢ  
EXPNDᵢⱼ  
TML  

Outputs*: DEPR₂ᵢⱼ, DSUPRᵢⱼ  
TDEP₂ᵢ  

Empirically-determined parameters* and relative weights:  

\[ Aᵢⱼ, Bᵢⱼ, Cᵢⱼ, Dᵢⱼ \]  

*i equals department subscript and j refers to the standard-account subscript.

*See Section 6 and item 3 in Figure 4-A1.
Figure 4-A1

Formalized DEPT. Request Decision Process

1. Budget letter and budget forms:
   \[ \text{APPR}_{ij}, \text{TAPR}_{ij}, \text{EXPND}_{ij}, \text{TML} \]

2. "Memory" of dept. treatment in past
   \[ (\text{APPR}_{ij} - \text{APPRO}_{ij}) \]

\[ j = 0 \]

\[ j \leftarrow j + 1 \]

Is \[ j > \text{NACCT}_i \]?

- no
- yes

3. Preliminary Calculation of department request:
   \[ \text{DEPR}_{ij} \leftarrow A_{ij}(\text{APPR}_{ij}) + B_{ij}(\text{APPR}_{ij} - \text{APPRO}_{ij}) + C_{ij}(\text{EXPND}_{ij}) + D_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) \]
   
   \[ \alpha \]

4. \[ \text{TDEP}_i = \sum_j \text{DEPR}_{ij} \]

5. \[ \text{TDEP}_i > (1.0 + \text{TML})(\text{TAPR}_i) \]?

- no
- yes

Preliminary Total of dept. requests

Is request outside mayor's guidelines?
Formalized DEPT. Request Decision Process (cont.)
The Mayor's budget letter always contains instructions which reinforce the structuring of the problem provided by budget forms -- to provide a "... written explanation for any change in individual code accounts," "(e)xperience for the years 1962 and 1963 is shown ... to assist you in estimating your needs for 1965," "(u)nder the heading 'Explanation of Increases and Decreases' must be explained the factors ... which make up the increase or decrease over or under the current budget allowance as shown above on this form."

With the above in mind, we now turn to the formal model.

Several features of the DEPT. model deserve mention. First, the contention of the model is that all department heads in all cities use substantially the same structure of decision process and that differences in behavior are "caused" by different decision parameters. While this may be a surprisingly good hypothesis for regular departmental requests, it is probably inadequate for predicting the behavior of innovative departments in formulating supplemental requests (although the parameters $A_{ij}$ and $B_{ij}$ should capture some of this effect). Unfortunately, "innovative" behavior has not been a central concern of our model (although factors constraining innovation will be commented on in Sections 7 and 12.

Secondly, it should be noted in passing that department heads (in our model) follow Mayor's Office directives very closely. Perhaps this is a characteristic (or definition) of the so-called "Strong Mayor" form of municipal government. One important instance of this is the presence of a uniform wage policy in all three cities -- all
raises are uniform and originate in the Mayor's Office. All salary adjustments are approved by the Mayor's Office.  

MAYORS Budget Request Submodel

The single, dominant feature of the decision process in the Mayor's Office is the goal (and legal requirement) of a balanced budget. The "directives" issued by the Mayor's Office in the budget letter to department heads may be viewed as devices for guaranteeing that the budget will be "nearly" balanced. All alterations in regular departmental requests are aimed at balancing the budget. "Balancing techniques" are:

1. Raise tax rates or add a new tax to eliminate anticipated deficit.
2. Cut "lower priority" account categories (maintenance, equipment) to bring expenditures into line with revenues.
3. Grant some supplemental requests to reduce anticipated surplus.
4. Eliminate an "undesirable" tax or reduce tax rates to reduce anticipated surplus.

In general, strategies 1 and 4 are used when the anticipated discrepancy between revenues and expenditures is high while techniques 2 and 3 are used if revenues and expenditures are reasonably close. The general tendency is to move toward a balance between revenues and expenditures by changing either revenue or expenditures, but not both. There is one exception to this. The exception involves general wage and salary increases for city employees. A minimum payroll increase (in all three

9The "uniform wage policy" is part of a city-wide civil service (continued on following page)
cities investigated) appears to be an across-the-board 5% increase. Although not enough data points are available to specify the complete decision process for the mayor's wage and salary policy, a general set of "necessary" conditions for an across-the-board increase can be identified:

1. Very small anticipated deficit or an anticipated surplus (without payroll increase).
2. At least 2 years since last general salary increase.
3. Availability of an "acceptable" revenue source.
4. Generally rising economic conditions (low unemployment in the area and high "yield" from city income taxes).

Revenue Decisions

Although revenue estimates are taken as given by our model and although tax decisions [whether to raise (or lower) taxes or add (or subtract) a new tax] are generally made before the mayor's budget letter goes out (see Section 5, pp. 113-115.) for additional discussion), they are sufficiently important to warrant discussion. Additional revenues can be obtained in any of three ways.10

(continued from preceding page)
classification system. Thus, one important way in which individuals receive pay increases is through a change in classification (promotion). Our model does not deal explicitly with these kinds of changes in wage accounts. Our model does not distinguish between increments due to reclassification and those attributable to new personnel.

10Other revenue "sources" do exist such as transfers of funds from other government authorities, transfer of functions to other governmental units, removal of exemption status from classes of taxpayers, etc., but these sources cannot usually provide funds in any substantial amounts.
1. Increase in rate of existing taxes.

2. Expand base of an existing tax (increase assessed valuation, etc.).

3. Addition of a new tax.

There seem to be three or four requirements that any new revenue source must satisfy:

1. It must be within the limits on tax rates specified by the state government. If the alternative involves a new tax, it must be allowable under state laws.\textsuperscript{11}

2. The additional revenue must come from those who "can afford to pay," not the unemployed, retired, etc.

3. The additional revenue, if at all possible, should come from all who use the city's facilities, not just residents or property owners (i.e., increased property taxes are avoided in an attempt to get area residents to pay "their share" of city expenses).

4. Increased property or business operation taxes are to be avoided to keep business firms from moving out of the city.

If the anticipated deficit is large enough or pressures for a general wage increase are strong enough, a new revenue source must be found that will provide additional revenues in quantities at least as great as those required by the deficit or wage increase.\textsuperscript{12} The decision

\textsuperscript{11}State taxation limits are not unimportant. The City of Pittsburgh has reached the point where it can no longer add new general taxes -- it has exhausted those allowed by the state legislature -- without special state legislation. In addition, rates for all taxes except the property tax are at their legal limits. The only new tax sources available are those affecting business operations inside the city limits. The mayor's belief that increased taxes on businesses would cause firms to leave Pittsburgh limits this tax source.

\textsuperscript{12}The minimum salary increase considered in all three cities appears to be about 5%. All officials in the mayors' offices appear to be aware of the total cost of an across-the-board increase also. (In Pittsburgh the cost is approximately $2,500,000.)
to change the revenue sources or rates results in a minimum revenue increase of about $1,000,000. Any lower "deficit" will be eliminated by reducing expenditures. Any substantial tax increase is usually decided upon before the mayor's budget letter is sent and has the effect of loosening restrictions on all expenditures. (All departments are likely to get a portion of any new tax revenue.)

Below is an outline of the decision process (generally) used by the Mayor's Office in formulating the municipal operating budget for the approaching fiscal year.
General MAYORS Budget Recommendation Model

1. Department regular and supplemental budget requests received

2. Latest Revenue Estimate

3. Historical Data -- Current appropriations, last year's expenditures, and appropriation trends

4. Preliminary check of all departmental requests -- if departmental request is less than current appropriations, it is tentatively accepted; otherwise a tentative "calculation" of the mayor's recommendation is made based on the department's regular and supplemental requests together with the change in appropriation from last year to the current year and the last available expenditure data.

5. Preliminary calculation of total budget -- sum of preliminary calculation

6. Check of preliminary total against revenue estimate to determine if a surplus or a deficit is anticipated. If "surplus," a set of "surplus reduction" routines is evoked. If "deficit," "deficit elimination" routines are evoked.

surplus reduction procedures

7. Calculate magnitude of anticipated surplus or residual.

8. Find total salaries and wages for the city (preliminary estimates).

9. Is the anticipated surplus large enough to finance a minimum salary increase?

yes

no

deficit elimination procedures (Go to 15.)
10. If so, increase salary levels for all departments and reduce calculated surplus.

11. Is there enough anticipated surplus left to distribute among departments?

   yes
   
   no

   yes
   
   no

12. Consider the highest priority, non-salary account category (that has not yet been considered) starting with general expense accounts and ending with equipment and maintenance accounts.

13. Increase the budget recommendation for the account category under consideration for all departments (until the surplus is exhausted) by granting a portion of each department's supplemental request. When (and if) money runs out, prepare final budget recommendations.

14. Move to next highest priority account category and Go to 12. If all categories have been considered, prepare final budget recommendations (Go to 26.).

Deficit Elimination Procedures

6. surplus reduction procedures

15. Consider accounts in reverse order of their priority (consider equipment and maintenance first, salaries last.)

16. Check, department by department, to see if the preliminary budget estimate (mayor's) for the account category under consideration is within the limits (% of current appropriations) implied in the mayor's budget letter to departments.

   within limits
   
   outside limits
17. If within limits, no change in preliminary budget estimate.

18. Decrease preliminary estimate of budget so that it falls within mayor's limits.

19. Repeat 16.-18. until deficit is eliminated or departments have all been considered.

20. Consider next lowest priority account (Go to 16.), unless all account categories have been examined.

21. For non-standard account categories (not found in all departments), check -- for all departments -- to see if the preliminary budget request exceeds current appropriations.

22. Adjust preliminary budget recommendation so that it equals current appropriations.

23. No change in preliminary figure.

24. After all departments have been considered (by 21., 22., 23.), calculate a new preliminary budget total based on adjusted recommendations.

25. If "deficit" still exists, consider standard account categories in order of decreasing priority, department by department, until deficit is eliminated (repeat steps 21., 22., 23., 24.), or list of account categories has been exhausted.
26. Calculate total budget based on existing preliminary totals, making sure that no mayor's budget recommendation exceeds the total of department's regular plus supplemental request.

27. Check to see if there is a deficit.

no deficit

29. Final Budget to 28. Eliminate deficit by scaling all non-salary accounts to make budget balance -- proportional allocation of deficit. (Go to 26.)
<table>
<thead>
<tr>
<th>Inputs*:</th>
<th>DEPR2_{ij}, DSUPR_{ij}, TDEP2_{i}</th>
<th>Department request data — regular, supplemental, and total (for each department) — outputs from DEPT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPR_{ij}</td>
<td></td>
<td>Current appropriations data</td>
</tr>
<tr>
<td>EXPND_{ij}</td>
<td></td>
<td>Most recent available expenditure data</td>
</tr>
<tr>
<td>REVEST</td>
<td></td>
<td>Total revenue estimate for budget period</td>
</tr>
<tr>
<td>Outputs*:</td>
<td>RMAY2_{ij}</td>
<td>Mayor's budget recommendations</td>
</tr>
<tr>
<td></td>
<td>TBUD</td>
<td>Total Mayor's budget estimate</td>
</tr>
</tbody>
</table>

Empirically-determined parameters* and relative weights:12a

D_{ij}, E_{ij}, F_{ij}, G_{ij}, X, XLMT, GG_{ij}, XL

*i is the department subscript, j reflects the account category.

12aSee Figure 4-B1, items 4, 9, 11, 13, 16, 18 and Section 6 for estimation procedures.
Figure 4-B1

Formalized MAYORS Budget Recommendation Model

1. Inputs: DEPR2\textsubscript{ij}, DSUPR\textsubscript{ij} from dept. heads

2. Revenue Estimate: REVEST

3. Historical Data: APPR\textsubscript{ij}, EXPN\textsubscript{ij}, (APPR\textsubscript{ij} - APPRO\textsubscript{ij})

```
1. i = 0

2. i ≠ i + 1, j = 0

3. Is i > N?
   - yes (B) j = j + 1
   - no (d)

4. Is j > NACCT\textsubscript{i}?
   - yes (a) Is DEPR2\textsubscript{ij} < APPR\textsubscript{ij}?
   - no

Have all departments (N) in city been considered?

Have all accounts for the department been considered?
```

Is the department request less than current appropriations?
Formalized MAYORS Budget Recommendation Model (cont.)

4. \( \text{RMAY}_{2ij} \leftarrow \text{DEPR}_{2ij} \)

Calculation of preliminary recommendation using dept. request as reference point

\[
\text{RMAY}_{2ij} \leftarrow D_{ij}(\text{DEPR}_{2ij}) + E_{ij}(\text{DSUPR}_{1ij}) + E_{ij}(\text{APPR}_{1ij} - \text{APPRO}_{ij}) + G_{ij}(\text{EXPND}_{1ij} - \text{APPRO}_{ij})
\]

5. \( \text{TBUD} = \sum \sum \text{RMAY}_{2ij} \)

Initial calculation of budget total

6. If anticipated "deficit," evoke "deficit elimination" routines, if "surplus," evoke "surplus reduction routines."

\[
\sum \text{RESID} = \text{REVEST} - \text{TBUD}
\]

Magnitude of anticipated surplus

7. Total salary and wages in city

\[
\text{TSAL} = \frac{1}{\sum} \sum \text{RMAY}_{ij}
\]

8. Is the surplus sufficient for a minimum (XX) across-the-board salary increase?

\[
\sum \text{RESID} > \lambda(\text{TSAL})
\]

9. Yes

\[
\sum \text{RESID} > \lambda(\text{TSAL})
\]

No
Formalized MAYORS Budget Recommendation Model (cont.)

10. (Salary accounts only)

\[ R_{MAY2ij} \leftarrow (1.0 + XK)(R_{MAY2ij}) \]

\[ \text{RESID} \leftarrow \text{RESID} - (XK)(TSAL) \]

\[ TSAL \leftarrow (1.0 + XK)(TSAL) \]

10. Is adjusted "anticipated surplus" enough to distribute among departments?

<table>
<thead>
<tr>
<th>m = k</th>
<th>expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>m = n</td>
<td>maintenance</td>
</tr>
<tr>
<td>m = n</td>
<td>materials</td>
</tr>
</tbody>
</table>

Priority list of account categories

is adjusted "anticipated surplus" enough to distribute among departments?

\[ i > N \]

Is

\[ i = 0 \]

\[ i \leftarrow i + 1 \]

\[ \text{Is} \]

\[ i > N \]

Have all departments been considered?
Formalized MAYORS Budget Recommendation Model (cont.)

13. Grant portion of department's supplemental request to reduce surplus

Has the surplus been eliminated

Is

ADDED > RESID

yes

no

RMAY2im ← RMAY2im + GGim(DSUPRim)

ADDED ← ADDED + GGim(DSUPRim)

m = n

12. Through searching account list?

Is

m > n

Search list from lowest to highest priority account to highest m=n maintenance equipment:

m=1 salaries

15.

search list

m = n

i = 0

i ≤ i + 1

Is

i > N ?

no

yes
16. Is the preliminary mayor's recommendation within limits of current appropriations? (XL = 1.0)

18. Bring recommendation within limits

19. Have all account categories been considered?

19. Has deficit been eliminated?

20. Consider (reduce) non-standard accounts first

\[
\text{RESID} = \text{REVEST} - \text{TBUD}
\]

\[
\text{ZCNT} = 0.0
\]
24. Consider standard account categories, lowest priority first

22. \[ \text{RMAY2} \_ \text{im} > \text{APPRI} \_ \text{im} \]

Consider "non-standard" account categories

Is \( i > N \) ?

Does \( m = 10 \) ?

All possible "non-standard" accounts considered?
25. Is $\text{RMAY2}_{im} > \text{APPR1}_{im}$ ?

yes

no

23. Has deficit been eliminated?

yes

no

RESID = RESID + ($\text{RMAY2}_{im} - \text{APPR1}_{im}$)

$\text{RMAY2}_{im} \leftarrow \text{APPR1}_{im}$

RESID > 0.0 ?

yes

no

Does $m = \nu + 1$ ?

yes

no

Have all non-salary "standard" accounts been considered? ($\nu =$ highest numbered salary account)

all depts. checked?

no

yes

i = 0

\[ i = i + 1 \]

Is $i > N$ ?

no

\[ j = 0 \]

\[ j \leftarrow j + 1 \]

Is $j > \text{NACCT}_i$ ?

yes

\[ j \leftarrow j + 1 \]

no
Is \( R\text{MAY}_{1j} < 0.0 \) ?

\[ \text{RMAY}_{1j} \leq 0.0 \]

Is \( R\text{MAY}_{1j} > (D\text{EPR}_{1j} + D\text{SUPR}_{1j}) \) ?

\[ R\text{MAY}_{1j} \leftarrow D\text{EPR}_{1j} + D\text{SUPR}_{1j} \]

TBUD = \( \sum \sum \text{RMAY}_{1j} \)

Is \( \text{TBUD} > \text{REVEST} \) ?

Balanced Budget

Outputs:

\( \text{RMAY}_{1j}, \text{TBUD} \)

Final Mayor's Budget Recommendation to COUNCIL Model

Is there still a deficit?

sum of salary accts.

Sum of non-salary accts.
28. SCALE = (REVEST - SUMW)/SUM

\[ i = 0 \]

\[ i \leftarrow i + 1 \]

all depts. checked?

\[ i > N ? \]

no yes

\[ j = 1 \]

\[ j \leftarrow j + 1 \]

all accts. considered?

\[ j > \text{NACCT}_1 ? \]

no yes

28. \[ \text{RMAY}_{2i} \leftarrow \text{SCALE}(\text{RMAY}_{2i}) \]
The mayor's decision process can be described as a series of searches for a feasible solution to the budgetary problem (search for a balanced budget). The sequence of search really represents a measure of the desirability of proposed solution methods.

COUNCIL Submodel

The mayor's budget is then submitted to city council for their approval and/or alteration. The council traditionally holds a series of public hearings on various portions of the budget, but rarely makes alterations of any significance.\(^\text{13}\) The reasons for a lack of "initiative" on the part of council is largely explained in terms of the nature of demands on the council, and party control in Pittsburgh (and to a lesser extent in Cleveland). A review of public hearings records indicates that nearly all demands are for employee salary increases, increased services, or for a reduction or elimination of a tax. The mayor's budget really represents a broad policy where the various parts are not independent of one another (the "balanced-budget" requirement insures this). To change one portion of the budget means to change at least one other portion to compensate for the change. In addition, commitment to a uniform wage and salary

\(^{13}\)In the past 20 years, the Pittsburgh council has made but one significant alteration in the mayor's budget. In 1958, a proposed tax increase was doubled and a general wage and salary increase granted. In Detroit, the only major alteration in the last 10 years has been to reject (in 1963) a proposed Meat Inspection tax "yielding" $500,000/year.
policy means that any change in any salary account (approximately 70% of the budget) involving wage rates also means a major revision in the tax policy of the city. The council has neither the staff nor inclination to undertake such drastic revisions.
Figure 4-C

General COUNCIL Appropriations Model

1. Historical Budget data:
   a. current appropriations
   b. latest expenditure data available with associated appropriations

2. Mayor's budget recommendations, revenue estimate

3. Departmental requests to Mayor's office

4. Calculation of residual ("surplus") implied by mayor's recommendations: revenue estimate minus mayor's total budget.

5. Preliminary calculation of council appropriations -- equal to mayor's recommendation.

6. Check of all account and department categories to see if mayor gave the department as much as it asked for.

   mayor cut department request

8. Is surplus in mayor's budget large enough to bother with?
   yes no

9. Preliminary calculation of revised appropriations based on mayor's recommendation, the amount the mayor cut the department request, and the amount the last expenditure figures exceeded appropriations for that period.

10. Is the "new calculation" (in 9.) greater than the mayor's recommendation?
   yes no

11.  

12.  

13. Is there a deficit?
   no yes

14. Is the preliminary calculation greater than current appropriations?
   greater less

15.  

16.  

17. Council Appropriations equal to mayor's recommendation.

Go to 18.
<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>greater</th>
<th>less</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Revised appropriation</td>
<td>equal to that calculated in 9.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Council appropriation</td>
<td>equal to mayor's recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Reduce &quot;surplus&quot; by difference between 9. and 5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Make appropriation equal to current recommendation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Reduce deficit by amount indicated in 16.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. If all accounts and departments have been considered, compile Final Appropriations, otherwise, go to 5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Variables in Figure 4-C1

Inputs*: RMAY_{i,j}, REVEST, TBUD
- Mayor's budget recommendations, revenue estimate and total budget
- Current appropriations
- Departmental request figures
- Most recent available expenditure data

Outputs*: APPR_{i,j}, REVEST, TBUD
- Final council appropriations, revenue estimate, and total budget

Empirically-determined parameters* and relative weights. 13a
- Q_{i,j}, P_{i,j}, S_{i,j}, XLMT

*i corresponds to department, j to account category

13a See Section 6 for estimation procedures, and Figure 4-C1, items 8 and 9.
Figure 4-C1

Formalized COUNCIL Appropriations Model

1. Historical Data: APPR1_ij, EXPND_ij, APPRO_ij

2. Mayor's Budget Recommendations: RMAY2_ij, TBUD, REVEST

3. Budget hearings: DEPR2_ij, DSUPR_ij

4. RESID = REVEST - TBUD

i = 0

α → i ← i + 1

Is i > N?

no yes

j = 0

j ← j + 1

β

Is j > NAACFT_i?

α

yes no

5. APPR2_ij ← RMAY2_ij

6.
6. If Mayor gave dept. as much as it asked for, "go along" with mayor - no controversy

7. no

If surplus is sufficient, add to mayor's total, based on expenditure experience and size of mayor's cut

8. yes

STOR = APPR2ij

9.

APPR2ij \leftarrow qij(\text{DEPR2ij} + \text{DSUPRij} - \text{RMAY2ij}) + \text{PPij}(\text{RMAY2ij}) + sij(\text{EXPNDij} - \text{APPRij})

10. Don't cut mayor's total

11., 13.

APPR2ij \leftarrow \text{STOR}

RESID \leftarrow \text{RESID} - (\text{APPR2ij} - \text{STOR})

12. Is

14. Is there a surplus?

15. Increase over current appropriations?
\[ \Pi \text{ yes} \]

\[ \text{STOR} = \text{APPR2}_{ij} \]

\[ \text{APPR2}_{ij} \leftarrow \text{APPR1}_{ij} \]

\[ \text{RESID} = \text{RESID} + (\text{STOR} - \text{APPR2}_{ij}) \]

\[ \sum \]

\[ \text{TBUD} = \sum \sum \text{APPR2}_{ij} \]

\[ \text{Output: APPR2}_{ij}, \text{TBUD} \]

Final Appropriations Bill
Submodel Interdependence and Feedback

Referring back to the diagram of general information flow for the process in Figure 4-1, the only feedback provided occurs through past budgetary decisions and the mayor's budget letter. This obviously is not literally true. Informal communications certainly do exist between areas A, B, and C in the diagram.

Communications between department heads and the mayor's office (A and B) tend to center around feeling out which supplemental requests are likely to be approved, etc. The mayor's office generally just reinforces the impressions and guidelines set down in the budget letter to department heads. If a tax increase is in the offing, this is communicated to department heads (having the result of slightly increasing requests). A series of executive budget hearings or review sessions are held before the mayor's budget is submitted to the council. In reality, these sessions are concerned with the departments' supplemental requests -- an extremely small portion of the total. By the time the mayor's budget reaches this stage, most of the major decisions have been made and there is very little, if any, left to allocate. Often times, these sessions are used to explain to department heads just why there are no more funds available to grant their particular request.

---

14 Aldo Colautti, Mayor's Executive Secretary, City of Pittsburgh, October 30, 1964 interview.

15 Two chief budget officers describe these hearings as follows: "The department hearings (with the mayor's office), give (continued on following page)
The council is briefed informally by the mayor (B and C) prior to the formal presentation of the budget, but this is primarily a communication of information, not a "bargaining" session.\textsuperscript{16} "Council really changes very little in the mayor's budget. There has been only one substantial change in the last twenty years. That was in 1958 when council doubled a proposed 2 mill (property tax) increase and raised wages."\textsuperscript{17} Most significant council changes in the mayor's budget, when observed, seem to deal with his tax policy.\textsuperscript{18}

Usually, little or no informal communication relative to budget requests exists between council and department heads outside of the council's budget hearings.\textsuperscript{19} "Politically" going over the mayor's

(continued from preceding page)
the department a chance to argue for its programs, but by that time, most of the decisions have been made."

"It resulted in a feeling of greater satisfaction on their part that they had been fairly dealt with. They knew what the situation was in terms of fund availability, they recognized the multiple demands that were being placed on these limited resources ...." (Name withheld on request.)

\textsuperscript{16}"He's (the mayor) the boss and what he says goes."
(Name withheld on request.)

\textsuperscript{17}Aldo Colautti, Mayor's Executive Secretary, City of Pittsburgh, October 30, 1964 interview.

\textsuperscript{18}The Detroit Common Council rejected a proposed meat inspection tax in 1964 ($500,000+) and in 1965 the Cleveland Council rejected a proposed general income tax.

\textsuperscript{19}"We (department heads) never go over the mayor's head to council. It just wouldn't pay to undermine a relationship with the mayor and his staff for the sake of one 'break' in our budget for one year." (Department head's name withheld on request.)

"If you want to get more money for the department, there are better ways than to try and go around the mayor's office. There are many sources of funds outside of the city government if you're just willing to search them out." (Department head's name withheld on request.)
head is not perceived as a wise strategy. As we will see again in Section 5, the council is not in a position to change the budget much anyway.

In summary, the municipal budget is the mayor's budget in which the mayor's policies dominate the department totals and city-wide wage and tax policies. The council and department heads have surprisingly little to say about municipal resource allocation on a macro level.

Research Methodology

Briefly, the research procedure consisted of:

1. A series of unstructured interviews discussing budget preparations, relevant considerations, reference points, etc.

2. Construction of model structure on the basis of (1) - identification of variables and functional forms.

3. Structured interviews designed to clear up deficiencies in 2.

4. Analysis of past budget documents in great detail: 
   a. mayor's budget letter
   b. departmental budget requests
   c. mayor's budget
   d. mayor's budget messages
   e. final appropriations bills and the following documents in lesser detail:
      f. council budget hearing minutes
      g. newspaper accounts

5. Parameter estimation using:
   a. regression analysis to determine functional parameters

6. Preliminary computer runs to identify major deviations (estimated versus actual decisions) of the model and model deficiencies.

7. A repetition of steps 2 - 6 in light of deviations found in 6.
SECTION 5

BEHAVIORAL ANTECEDENTS OF THE MODEL

The model of the municipal budgetary decision process presented in Section 4 can be described in many ways. We will attempt to shed some light on two aspects of the model: its structure and its parameters. By structure, we mean the functional form of the decision rules and the way the individual rules are related. Referring back to the DEPT. submodel in Figure 4A1, the "structure" of the DEPT. model is represented by the flow chart illustrating the sequencing of decision rules in the process and the functional form of the component decision rules. Also included in "structure" for the DEPT. model would be the account categories used by the department (the "j's" for department, i). By "parameters," we mean those items in the model that must be empirically estimated. The "parameters" for the DEPT. model as shown in the flow chart are $A_{ij}$, $B_{ij}$, $C_{ij}$, and $D_{ij}$ -- all other features of Figure 4-A1 relate to model structure.

A discussion of the "meaning" of the overall model structure will be found in this section, along with a discussion of the meaning of model parameters.

$^1$Rather than footnote most ideas in this Section, let it suffice to note that the behavioral notions presented are, in general, very similar to and consistent with those found in Cyert and March, A BEHAVIORAL THEORY OF THE FIRM, and Braybrooke and Lindblom, A STRATEGY FOR DECISION.

$^2$For instance, the particular decision rule in Figure 4-A1, no. 3:

$$\text{DEPR}^2_{ij} = A_{ij}(\text{APPR}^1_{ij}) + B_{ij}(\text{APPR}^1_{ij} - \text{APPRO}_{ij}) + C_{ij}(\text{EXPND}_{ij}) + D_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij})$$

specifies a particular functional relationship (linear) between a particular set of variables. This is the structure of the decision rule. The parameters in this component of the DEPT. submodel are the values: $A_{ij}$, $B_{ij}$, $C_{ij}$, and $D_{ij}$. These parameters must be empirically determined for each account category, for each department, in each city.
Overview of Decision Process

The entire process can usefully be thought of as an organized means for the decision maker to deal with the potential complexity of the budgetary problem. The most prominent feature of the "original" problem in terms of its contribution to complexity is the externally imposed constraint of a balanced budget -- and by requiring that, at some level of generality, all budget items be considered simultaneously.

Problem Perception

Before proceeding, we should note that the "problem" we are referring to is the budgetary problem as seen by the actual decision makers (department officials, mayor and mayor's staff, and council members). It is quite clear (from interviews) that the decision makers do not see the problem as one of optimally balancing community resources, allocating funds among functions to achieve overall community goals, and the like. The problem is generally "seen" by department heads as coming up with a budget request that 1) assures the department of funds to carry on existing programs as part of a continuing attack on existing problems, 2) is acceptable to the mayor's office, 3) and provides for a reasonable share of any overall budget increases for the city to enable the department to attack new problems (if any). The mayor's problem is largely one of recommending a budget that 1) is balanced, 2) at least maintains existing service levels, 3) provides for increases in city employee wages if at all possible, and 4) avoids tax increases (especially property tax increases in the belief that increased property taxes cause business and industry to move from the city, reducing its tax base). If, after achieving some of the above objectives, the mayor has "extra" funds, they will be used to sponsor programs or projects the mayor has on the "agenda." The "problem" for the council is to

3The presence of an "agenda" of projects by the mayor is easily seen in the mayor's annual budget messages to council. The list is reasonably stable from year to year. For example:
1) 1964 Pittsburgh Budget Message -- (continued on next page)
review the mayor's budget recommendations and check for "obvious" errors and omissions. Because of the complexity and detail in the mayor's budget and lack of council staff, council's options are limited largely to approving the mayor's budget. The requirement of a balanced budget means that a change in one expenditure category, for instance, implies a change in other categories and for other administrative units or a change on the revenue side of the bill — i.e., one change in the budget (by council) implies many changes which the council has neither time nor staff to consider.

Partitioning the Problem into Manageable Subproblems

Part of the way municipal decision makers deal with the potential complexity of the municipal resource allocation problem is through their necessarily simplified perception of the problem as discussed above. Notice, also, that:

1. The operating budget is treated separately from the capital budget — as generally independent problems. The only behavioral connection between the operating and capital budgets is the "logical" elaboration of capital budgeting

(continued from previous page)

a. "We have reached the point, it seems to me, beyond which it would be unfair to ask the municipal employee to go. I therefore propose the following wage adjustment .... (5% general increment).

b. "... I was hoping to recommend the elimination of the one mill mercantile tax imposed (on) ... wholesalers."

c. "... attempt to have the cost of area-wide functions ... shared on a County-wide level."

2) 1965 Pittsburgh Budget Message —

a. "A wage increase for municipal employees would be wholly justified .... Our executive and supervisory salaries, in my judgment, particularly need revision ...."

b. "I am recommending the abolition of this levy (wholesale mercantile tax) ...."

c. "We would hope that Allegheny County ... will give high priority to securing proper reassignment of public functions, particularly those that are area-wide in scope ...."

d. "Council should be alerted to the possibility that City cash may be needed ... to take full advantage of this program (Federal Poverty Program)."
decisions in the operating budget.4

2. The budget is formulated within a system of administrative units (departments and bureaus) and account categories (salaries, supplies and expenses, equipment, etc.) that is extremely stable from year to year. This partial structuring of the problem "allows" most of the decision makers to treat the appropriation question for one account category in one administrative unit as a (sub-) problem, separate from the overall resource allocation problem. Thus, the overall problem is transformed into a series of smaller problems of determining appropriations for individual departments.

3. As noted earlier, the revenue estimates are generally separate from expenditure estimates. That is, estimates of yields from a given tax are treated independently from expenditures. While, on occasion, tax rates may be adjusted somewhat on the basis of preliminary calculations of total expenditure estimates, in order to balance the budget, tax yield estimates are never manipulated to achieve a balance.

4. The fact that the decision process itself represents a division of labor between department heads, the mayor's office, and council, reflects not only the administrative hierarchy, but a set of simplifying heuristics for making a complex problem manageable.

4The "legitimate" claim on operating funds by the capital budget is reflected in the following, found in the Mayor's Message accompanying the 1965 Pittsburgh budget:

"A big item in the Lands and Buildings request pertains to the opening and operation of the new Public Safety Center next spring.... There is a non-recurring expenditure of $150,000 for new furniture ... and $91,000 is sought for maintenance personnel." Our model does not formally include this one-way interaction with the capital budget, but as will be seen in Section 7, this particular kind of behavior will explain many of the model's deviations from actual behavior.
5. Finally, an additional simplifying policy is found in all cities investigated. The presence of a uniform wage policy\(^5\) which maintains relative positions of employees within a city-wide civil service pay scale, eliminates the potentially complex problem of deciding wage rates on an individual basis while attempting to maintain some kind of "similar-pay-for-similar jobs" standards.

**Governing by Precedent**

Perhaps the overriding feature of the mayor's budgetary "problem" is the balanced budget requirement. If the mayor took even the majority of items in the budget under serious consideration, his task would be enormous. The requirement of a balanced budget could mean that not only would the mayor have to consider every budget item, but he would have to consider each item relative to all other items. Somehow the entire level of police expenditures would have to be justified in light of the implied pre-emption of health department services, public works, fire department expenditures, etc. Obviously the mayor does not have either the staff, cognitive ability, or time to undertake such a study -- even if the necessary knowledge and information existed.

Instead, the mayor perceives the budgetary problem as a continuing one that must be dealt with periodically (yearly). He perceives this year's budget problem to be basically similar to last year's with a slight change in resources available (new revenue estimates) to deal with a continuing set of municipal problems (police and fire protection, urban renewal, public works, transportation) augmented by a small number of partial solutions to old problems. In this context, a "logical" way to proceed in solving this complex problem of budgeting is to take "last year's solution" (current appropriations) to the problem and modify it in light of the change in available resources and the change

\(^5\)On some occasions we note that police and fire personnel are dealt with as a unit, separate from other personnel.
in municipal problems and their available solutions, to obtain "this year's solution." This, of course, means that the budget is a slowly changing thing, consisting of a series of "marginal changes" from previous budgets. Very small portions of the budget are reconsidered from year to year and consequently, once an item is in the budget, its mere existence becomes its "reason for being" in succeeding budgets.

"Government by precedent" is an integral part of virtually all the positive models of decision making in existence today. Cyert and March's *A Behavioral Theory of the Firm* describes the usage of previous solutions and solution procedures to solve new problems and is largely a model of incremental adaptations of economic organizations to their internal and external environment. Braybrooke and Lindblom argue that "precedent" is justified and defensible as a "rational" decision strategy. Wildavsky emphasizes the role of "precedent" as an "aid to calculation" in the Federal budgetary process.

**Openness of Public Decisions**

A basic property of decision making in the public sector (vs. the private) is the realization that both ultimate decisions and decision procedures are always subject (at least potentially) to public scrutiny. This means that decisions in the public sector would tend to be ones that can be defended and that each particular decision (budget item) in a decision system (entire budget) "ought" to be able to stand on its own "merits." In addition, decision procedures are also subject to public question. We would argue that the openness of public decisions reinforces the use of rather straightforward methods of partitioning the budget decision problem, the usage of precedent as a defensible decision strategy.

---

6These notions are very similar to those of "disjointed incrementalism" expressed in Braybrooke and Lindblom, *op. cit.* and Lindblom, "The Science of Muddling Through," *op. cit.*

7We would also argue that, in general, the need for "defensible" decisions leads to more conservative decisions in the public sector than in the private.
decision strategy, and encourages the use of simpler, easier-to-understand decision procedures than might otherwise be found.

In the context of the problem complexity and devices used to deal with that complexity, we now turn to an analysis of the model's behavioral characteristics. Inasmuch as the model can be broken down into three reasonably independent submodels (the existence of these submodels illustrates the use of partitioning and division of labor in dealing with complexity), we will discuss each submodel separately.\(^8\)

**DEPT. Submodel**

**Role** -- The role of the department head is similar to that of the agency or bureau chief in the Federal government as described in the Wildavsky study. His objective is to obtain the largest possible amount of funds for his department and his purposes. Just as "'Washington is filled' ... 'with dedicated men and women who feel that government funds should be spent for one purpose or another,'"\(^9\) so are municipal governments. In general, department heads, through experience and the process of socialization into their positions, and by "learning" that their request is likely to be cut by the mayor's office or council, tend to ask for more than they "expect" to get. This "padding" of the budget is one part of a system of mutual expectations and roles. Department heads are expected to ask for more than they really need; the mayor's office is expected to cut these requests in order to balance the budget.

**Context** -- Another set of behavior norms for department heads was found in the study and is "incorporated" in the model. While these norms deal with things that aren't done rather than with things that are, they deserve mention. Unlike some agency and bureau heads in the

\(^8\)In submodel discussions, we will refer back to the model flow charts in Section 4. For example, (4-A-4.) will refer to Figure 4-A, item 4. -- "Using 'reasonable requests' calculated in 3., a preliminary request is calculated." (4-B1-7.) refers to [RESID - REVEST - TBUD].

federal government, municipal departments do not go "over the mayor's head" to council to try and get more funds for their programs or to get cuts made in the mayor's office restored. No widespread system of stable relationships seems to exist between particular council members or committees and departments. Whether this is a characteristic of strong-mayor systems of government,\(^\text{10}\) a result of the lack of a council staff to enable the council to alter the mayor's budget, or something else, is not clear. Another kind of phenomena that is not found is the existence of competition (in a behavioral sense) between department heads for funds as expected in the theory of internal resource allocation outlined by Cyert and March.\(^\text{11}\) Not only are department requests treated independently (as independent constraints)\(^\text{12}\) by the mayor's office -- especially if the total revenue constraint is not particularly binding -- but, the departments do not perceive themselves as competing with one another for funds. Instead the "competition" is perceived to be with the mayor's office\(^\text{13}\) over the granting of funds. Much of this lack of a competitive viewpoint between departments can probably be attributed to the great differences in functions, etc., making the sorts

\(^{10}\)Research is currently under way, testing the notions in this study in the city-manager, non-industrially based municipality of Kansas City that should shed some light on this question.


\(^{12}\)As predicted by Cyert and March.

\(^{13}\)For instance, in the City of Pittsburgh, the firefighters union has picketed the mayor off and on for several years in the attempt to get higher pay. Their demands and suggestions do not include notions of "competing departments" depriving them of needed funds. Their wrath is focused entirely on the mayor's office.

"'Conflict' among departments for funds is not a very useful way to describe the (budgetary) process." Aldo Colautti, Executive Secretary to the Mayor, City of Pittsburgh (interview), October 30, 1964.
of comparisons necessary for a competitive outlook meaningless. Widely-held municipal policies also contribute to this lack of interdepartmental squabbling. For instance, police and fire, being semi-military organizations, are either given identical pay scales and/or are grouped together into a department of public safety. By treating these two subunits identically, the opportunity for conflict is reduced.

This is not to say, however, that conflict does not exist on an intra-department level, only that it has not been observed on an inter-department plane. Actually, the decisions we are talking about are ones setting a limit on spending for the coming fiscal year. They are limits on manpower, supplies, material, and equipment. They are not program budgets in the sense that exact activity mixes are included in the municipal budget. In a sense, what we are talking about is an intermediate decision. This decision provides the constraints under which decisions about particular activities that a department will undertake must be made. The setting of levels of expenditures is just one part of the department head's continuing problems. Within a given expenditure ceiling, many different activity mixes can be utilized. "Low ceilings, in short, can still permit several rooms."14

DEPT. Model Characteristics

The role of the mayor's budget letter and the budget forms sent to the department head is a clear one. Together with the time schedule for submission of the completed budget forms, these items have the effect of structuring the department head's problem for him. Budget forms are typically sent to department heads less than two months in advance of the presentation of the completed budget to council. The department head usually has about one month before his completed request forms are due in the mayor's office.

The function of the time deadline should not be underestimated.

14Sorensen, T. C., referring to the federal budgeting process in KENNEDY, p. 414.
In that there is no moratorium on the department head's problems, budget compilation represents an additional workload. In the context of a myriad of non-budgetary problems and duties, the vast majority of department heads are more than willing to accept the way the problem is structured for them by the budget forms. To do otherwise would not only involve the task of creating an alternative structure, but would place the "burden of proof" on the department head as far as justifying the alternative to the mayor's office is concerned.

Just how is the problem presented to the department head so as to pre-structure it for him?

**Budget forms** -- Budget forms (4-A-1 and 4-A1-1) seem to be nearly one of the physical constants of the universe. They are laid out as follows:

<table>
<thead>
<tr>
<th>Standard Account 1</th>
<th>Expenditures</th>
<th>Appropriations</th>
<th>Next Year's Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itemization of 1</td>
<td>$54,321.00</td>
<td>$57,400.00</td>
<td>?</td>
</tr>
<tr>
<td>Standard Account 2</td>
<td>$43,219.00</td>
<td>$45,600.00</td>
<td>?</td>
</tr>
<tr>
<td>Itemization of 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Account N</th>
<th>Expenditures</th>
<th>Appropriations</th>
<th>Next Year's Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itemization of N</td>
<td>$100.00</td>
<td>$120.00</td>
<td>?</td>
</tr>
</tbody>
</table>

The problem is structured in two ways: 1) Use of standard account categories (line items) which "coerces" (i.e., makes it much simpler) the department head into using the same set of categories (for to do otherwise involves the establishment of a new city account -- added work for the accounting department, etc. -- and the need to "show cause") year after year. 2) Presence of historical guidelines -- last year's expenditures and current appropriations -- guarantees that the request submitted will have for one of its primary tests a comparison with previous appropriations for the particular account category.

In addition to the "standard" account categories (those categories common to most departments in the city -- e.g., salaries and wages,
materials and expenses, equipment), each line item's historical data are listed. The level of detail in line items has its influence on the department head's decision process also. (In one city studied, one of the line items listed a $3.00 current appropriation for "Mothballs.") In general, each item broken out in the budget (each line item) "forces" one historical comparison and, hence, represents one more constraint the department request must satisfy. In the face of an increasing number of constraints (increasing as budget detail increases), it seems only reasonable that the department head will resort to simpler decision rules to handle this difficult problem. In addition, we would predict that the more detailed the budget (in terms of line items), because of the structure of the budget forms, the less change in requests (and appropriations) from year to year.

The need for effective budgetary control in the mayor's office, made more difficult by the presence of a small staff15 (small in relation to a similar organization in the private sector), is met by a large number of simple, historical comparisons and has, in many instances, resulted in a burdensome amount of detail -- responded to by busy department heads with little change in budget behavior from year to year.

The "tone" of the letter accompanying the budget forms has the effect of providing an arbitrary ceiling on the department's request (4-A-5 and 4-Al-5). If the department total exceeds the "ceiling," the overage is generally submitted as a "supplemental" request (4-A-7, 8 and 4-Al-7, 8). In addition, changes in salary rates through raises or promotions are submitted as a supplemental request (or not at all). Supplemental requests are accompanied with a detailed explanation and are treated separately by the mayor's office -- and are always on the agenda when the department head meets with the mayor's office to discuss his requests.

So far, we have discussed only the constraints a department head must satisfy and the procedures he must follow. There is, obviously,

15For instance, in the City of Pittsburgh, no more than four people examine the budget in any detail. Of these four (maximum), at least one is faced with the purely physical problem of putting the budget together, checking and compiling city totals.
some room for maneuvering. Much of the department head's "calculations" involve figuring "what will go" with the mayor's office. This calculation involves using current appropriations as a base and adjusting this amount for recent appropriations trends discrepancies between appropriations and corresponding expenditures and the like (4-A-3 and 4-A1-3). The results of this "calculation" are then tested to see if they satisfy the constraints discussed above. Preliminary decisions are then adjusted until constraints are satisfied and the final request is entered on the standard budget forms and sent to the mayor's office for consideration.

Behavior Not Included in Formal DEPT. Model

A quick look at the DEPT. model would indicate that (at least according to our theory) department budgetary behavior varies from department to department only by the relative weights assigned to previous appropriations, trends, and expenditures by the various department heads (4-A1-3). Furthermore, it is contended (by the model) that these relative weights are stable over time. Missing from the formal model are notions of non-regular innovation (or change) by department administrators and notions of the department as a mechanism for responding to particular kinds of complaints from the citizenry -- in short, the department is conceived of as explicitly responding to only the mayor's pressures. Also missing are changes in the budget requests as logical elaborations of other policy commitments -- implied increases in operating budget because of capital budgeting considerations, changes in intergovernmental support for services (the classic problem in this category involves the highly volatile state-local split of welfare payments), transfer of activities to (and from) other governing units (transfer of hospital system to state or county, etc.), and changes in activity level and scope because of funds obtained from outside sources (Urban Renewal planning and demonstration

16 Similar to Wildavsky's observations about department heads at the large end of the funnel (POLITICS OF THE BUDGETARY PROCESS, pp. 25-31) and Sorensen's at the small end of the federal budgetary funnel (KENNEDY, p. 414).
grants, the Federal Anti-Poverty Program, etc.) other than the general fund.

At first glance, the model might be said to preclude innovative behavior on the part of department heads. Inasmuch as innovation is a relative concept, operationally this allegation refers to the models assumption that department heads vary only by the relative weights attached to previous appropriations, trends and expenditures when calculating what the department can expect to get, reasonable requests, etc.:

$$DEPR_{ij} = A_{ij}(APPRI_{ij}) + B_{ij}(APPRI_{ij} - APPRO_{ij}) + C_{ij}(EXPND_{ij}) + D_{ij}(EXPND_{ij} - APPRO_{ij})$$

In other words the parameters $A_{ij}, B_{ij}, C_{ij},$ and $D_{ij}$ are different from department to department and these differences are enough to explain differences in behavior from department to department which, in turn, reflect stable relationships between department personnel and the mayor's office. This assumption of the model does not preclude innovative behavior. It merely states that innovation (if any) takes place within a regularly changing budget ceiling. It could be argued that parameter values in the above relationship that lead to relatively large, regular request increases ($DEPR_{ij} - APPRI_{ij}$) represent a greater potential for innovation than do those leading to smaller increases (or decreases) -- providing, of course, that a portion of the request is granted. On the other hand, it could be argued that the presence of a budget ceiling in the face of changing citizenry needs and pressures (precipitating a change in department goals and program needs) forces a department head to "innovate" to survive. Cyert and March, citing the work of Mansfield\(^\text{17}\) side with the former concept of innovation rather than the latter. They argue that the presence of "organizational slack" (evidenced by budgetary increases) "... provides a source of funds for innovations that would not be approved in the face of scarcity but that have strong subunit support." Major technological innovations, it is argued, are not

problem-oriented innovations.\textsuperscript{18} At any rate, our model does not restrict innovation producing behavior. The model is, however, unable to predict or recognize the acceptance of innovations (major changes in expenditure and appropriations).

The other "charge" that the model is open to is that it fails to deal with "outside" influences at all. This is particularly true if by departmental responses to pressure one assumes that total (for the department) external pressure and influence is a thing that varies a good deal from year to year and that mechanisms for responding to that pressure would lead to irregular budget decisions reflecting this variation. If, however, one assumes that each department has, over the years, not only "made its peace" with the mayor's office, but with the extra-governmental environment, then, the pressure response mechanisms (i.e., constant responses to constant pressures) would also be reflected in the parameters $A_{ij}$, $B_{ij}$, $C_{ij}$, and $D_{ij}$. The pressure-response characteristics of this model will be discussed more fully later in the report. Again, the model does not exclude a pressure-response kind of budgetary behavior, but has a good deal to say about the nature and context of the response (and pressure).

\textbf{MAYORS Budget Recommendation Model}

\textbf{Role} -- The function of the mayor's office relative to the budget is to fulfill the legal obligation of submitting a balanced budget to the city council for its consideration. The key word, of course, is "balanced." Most of the problem solving activity and behavior in the mayor's office revolves around attempts to eliminate a deficit or reduce a surplus. Like any other organization, subunit requests (stated needs) almost always exceed available resources. So, vis-a-vis the departments, the mayor's office's role is that of an economizer, cutting departmental requests to the "bare minimum" in lean years and keeping the cost of government "under control" when revenues are more plentiful.

\textsuperscript{18}Cyert and March, \textit{op. cit.}, p. 279.
Characteristics of the MAYORS Model

The decision process in the mayor's office can usefully be thought of as a search for a solution to the balanced-budget problem. In a sense, the mayor has guaranteed the existence of a solution through use of budget guidelines set up in his letter of instruction to department heads. Approximately four months before the final budget is due council passage, the mayor obtains preliminary revenue estimates from people in city government and from an outside source. Armed with a rough estimate of money available for expenditures in the next budget period, current appropriations, and a knowledge of "required" and predetermined budgetary changes for the coming year, the mayor is able to make a rough guess of the total allowable increase or decrease over current appropriations. From this figure, an estimate of the "allowable" percent increase (or decrease) is made and transmitted to department heads via the budget letter. (Only the output from this part of the process is explicitly included in our model, TML - "tone of mayor's letter.") In most instances, then, the "sum" of the budget requests reaching the mayor's office represents a "nearly" (within 10%) balanced budget.

The conversion of departmental requests to a balanced budget recommendation to council is the task of the mayor's office. As was pointed out before, the revenue estimate enters into the process as an independent constraint to be satisfied. On a few occasions, revenue or tax rates are changed to bring the budget into balance, but, in the municipalities investigated, there was no evidence of any altering of tax yields to balance the budget. One exception to the general rule that there is no alteration of the revenue yield estimates (revenue side) to achieve balance with expenditures, was found. For a couple of years in Detroit, part of the cost of governmental operations was financed through "overly optimistic" revenue estimates which ultimately resulted in operating deficits. Those deficits (technically illegal) were then refinanced, with debt service charges for this refinancing showing up in subsequent operating (Continued on next page)
Preliminary Budget Estimate by Mayor (current appropriations and known changes and desired programs)

Is Wage Increase Desired?

- yes
- no

Increase Budget Estimate

Magnitude of difference large enough to necessitate change in tax rates or addition of new tax?

- yes
- no

Change in revenues = f (magnitude of preliminary difference)

Revenue Estimate

Outside of formal model

Mayor's letter

DEPT. submodels

MAYORS

Formal Model

COUNCIL

Mayor’s Tax Decision Process

Figure 5-1
part of the decision process evoked when the revenue constraint becomes so restrictive (or loose) as to necessitate a change in tax rates. Tax rate decisions are made prior to the sending of the budget letter to department heads and are considered as given from that point on.

Just as the budget forms and account categories structure the problem for the department head, they also structure it for the mayor's office (4-B1-1 and 4-B1-3). The legal requirement of a balanced budget also structures the problem for the mayor's office -- as well as partially determining its role behavior. The system of accounts and administrative units in the city together with the balanced budget requirement combine to specify the cognitive map for the decision situation for participants in the mayor's office.

**Preliminary Screening of Requests**

As budget requests are received from departments by the mayor's office they are screened individually (4-B1-4). This preliminary screening of requests reflects particular biases and relationships the mayor's office has with individual department heads (and departments).

"Competent evaluation in the Budget Division will rather quickly discern over a period of time who the ones are that you can depend upon as requesting their basic and fundamental needs without 'fat,' shall we say. You get to know the ones who generally will ask for a heckuva lot more than they expect to get on the theory that they are going to be cut down anyway and, of course, in most big organizations ... you'll have some that don't pay the appropriate amount of attention or place the proper importance upon the preparation of budget requests and they are then sometimes not too carefully prepared or too carefully documented."\(^{20}\)

(continued from previous page) budgets as deductions from revenue available for general fund expenditures. This brief "operating practice" was quickly discontinued by a new city administration. The magnitude of the effect of this operating practice on the planning process (budgetary decision process) is unclear and is not incorporated in the formal model. The effects should show up in larger deviations of model estimates from actual decisions during particular years in the City of Detroit.

\(^{20}\) Alfred M. Pelham, former Controller, Wayne County, Michigan, former Controller, City of Detroit (interview), October 7, 1964.
Different perceptions of different departments show up (in the model) in both model structure and model parameters (4-B1-4). The interaction of the mayor's role in the budgetary process (to cut requests) and perceptions describes the preliminary screening process.

Basically, if the department request for a given account category is less than current appropriations an automatic, preliminary acceptance of the request is made. If the request is larger than current appropriations a request evaluation procedure is evoked that "calculates" or subjectively determines preliminary appropriations figures. This subjective evaluation problem is represented in our model as a problem of choosing between four basic evaluation models (i.e., a particular department can evoke one of four basic evaluation models, the particular model evoked representing the cognitive map used by the mayor's office).

The four basic models consist of two which arrive at a preliminary appropriations figure by making marginal adjustments to the departments request (DEPR2ij) figures -- representing departments that submit "honest" or "realistic" budget estimates -- and two which make adjustments in current appropriations (APPR1ij) to arrive at preliminary recommendation figures (RMAY2ij) -- representing less "realistic" or "honest" departments.

Two of the four models estimate the change (difference) from the reference point [(RMAY2ij - DEPR2ij) and (RMAY2ij - APPR1ij)] and two estimate the preliminary recommendation (RMAY2ij) directly.

1) \[ RMAY2_{ij} = a_{ij} \text{DEPR}_2_{ij} + b_{ij} \text{SUPR}_{ij} + c_{ij} (\text{APPR}_1_{ij} - \text{APPO}_1_{ij}) \]
department head's request respected and adjusted by his supplemental request and current trends.

ii) \[ RMAY2_{ij} = a_{ij} \text{APPR}_1_{ij} + b_{ij} (\text{APPR}_1_{ij} - \text{APPO}_1_{ij}) + c_{ij} (\text{EXPND}_{ij} - \text{APPO}_1_{ij}) \]
department head's request ignored, and current appropriations adjusted to reflect recent trends and over or under spending in the past.
iii) \((R\text{m}AY_{2ij} - \text{DEPR}_{2ij}) = a_{ij}(\text{DEPR}_{2ij} - \text{APPR}_{1ij}) + b_{ij}\text{SUPR}_{ij} + c_{ij}(\text{APPR}_{1ij} - \text{APPRO}_{ij})\)

department head's request used as a basis for calculation and changes in it are based on the magnitude of the requested change in appropriations, supplemental requests, and past changes in appropriations.

iv) \((R\text{m}AY_{2ij} - \text{APPR}_{1ij}) = a_{ij}(\text{APPR}_{1ij} - \text{APPRO}_{ij}) + b_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij})\)

department request ignored and change from current appropriations based on previous changes and magnitude of underspending or overspending in the past.

The values of the parameters \((a_{ij}, b_{ij}, \text{etc.})\) represent the relative weights given to variables in the particular model by decision makers in the mayor's office. While these weights may reflect real variables in the external environment (the effects of rising costs or inflation, interest groups, etc.), there was no indication that these kinds of variables ever were a conscious (or significant) part of the decision process. The search for possible unconscious relationships between parameter values and other external variables is beyond the scope of this study.

The two "trust" models are i) and iii) and the two "no-confidence" models are ii) and iv). i) and ii) represent "levels" calculations and iii) and iv) are "change" models.

The table (Figure 5-2) on the following page gives a broad overview of a portion of budgetary behavior in the three cities.

On the basis of Figure 5-2 one should not conclude that the mayor's office trusts few of its departments in Cleveland. While there is a substantial theoretical difference between models i) and ii) in many

21According to our theory, we would expect the values of the parameters to shift with a change in participants (new department head or new city administration). Unfortunately, not enough data exists to identify these shift points.
Figure 5-2

Models Used (frequency)\(^{22}\) -- (4-B1-4)

<table>
<thead>
<tr>
<th></th>
<th>trust-level</th>
<th>no-confidence-level</th>
<th>trust-change</th>
<th>no-confidence-change</th>
</tr>
</thead>
<tbody>
<tr>
<td>trust-i)</td>
<td>21</td>
<td>60</td>
<td>30</td>
<td>17</td>
</tr>
<tr>
<td>no-confidence-ii)</td>
<td>30</td>
<td>120</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>change-iii)</td>
<td></td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>no-change-iv)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cleveland
Detroit
Pittsburgh

cases both models fit the data equally well. The reason for similar fits of cognitively different models to the same data is easily seen by noting that when:

a) Department requests are highly correlated with current appropriations, and

b) The department-request and current-appropriations terms represent much greater quantities than the other terms in models i) and ii),

model i) is nearly equivalent (mathematically) to model ii).\(^{23}\)

From the preliminary screening of requests outlined above (4-B1-4), a preliminary budget total is compiled (4-B1-5). On the basis of the

\(^{22}\)Models were chosen for particular account categories and departments by choosing that model with the lowest standard-error-of-the-estimate.

\(^{23}\)i) \(RMA\_2i\_j = a_i\_jDEPR\_2i\_j + b_i\_jDSUP\_R\_i\_j + c_{i\_j}(APPR\_1i\_j - APPRO\_i\_j)\)

If \(DEPR\_2i\_j = a'\_i\_jAPPR\_1i\_j\), then

\(i') RMA\_2i\_j = a'\_i\_jAPPR\_1i\_j + b_i\_jDSUP\_R\_i\_j + c_{i\_j}(APPR\_1i\_j - APPRO\_i\_j)\)

which is equivalent to model ii) if both supplemental requests and overspending are relatively small amounts.
preliminary total, it is noted whether there is an anticipated deficit or anticipated surplus (4-B1-6). If a surplus is indicated, surplus-reduction routines are evoked; if not, deficit elimination procedures are evoked. Note, either one set of procedures or another is used, not both.

**Surplus Elimination Procedures**

If a surplus is anticipated, several standard spending alternatives are considered in order of their priority:

1. General salary increase (4-B1-8 to 10)
2. Grant portion of supplemental requests (4-B1-11 to 14)
   a. general expense accounts (4-B1-12) first, then
   b. equipment accounts
   c. maintenance accounts

Although the formal model includes only the above alternatives, others are clearly available to the mayor. It can be said with reasonable assurance, though, that the first alternative considered is a general salary increase whenever a surplus is anticipated.

The model is also incomplete in the sense that some departmental priority list obviously exists for the granting of supplemental requests. Thus, the sequence in which departments are considered (the order of the i's in 4-B1-11 and 4-B1-13) is important under a revenue constraint. The model's assumption that departments are considered in the order of their account numbers is unrealistic, but not enough department request data existed to establish any other reasonable priority list.²⁴ A priority list of account categories does exist though and is shared by both departments and the mayor's offices. The salience of wage and salary accounts is readily discernible through interviews.²⁵

²⁴It should be noted that a substantial portion of this department priority phenomena is accounted for in the preliminary screening of requests (4-B1-4).

²⁵As well as satisfying Harrison White's "principle of least astonishment" and the 'intuitively obvious" arguments of mathematicians. (Continued on next page)
If, after preliminary screening of requests, a potential deficit appears (the usual case), some routines are evoked to eliminate this deficit. One routine not evoked in the formal model, but part of the behavioral alternatives evoked in practice is the routine that says "raise taxes." The conditions under which this alternative is likely were specified in Section 4 (see p. 72).

The alternatives are evoked in the following order.

a) Check preliminary recommendations (checking lower priority accounts first) to see if they are within certain limits on increases — alter recommendations accordingly.

b) Eliminate all recommended increases in non-salary appropriations, considering low priority accounts first.

c) Uniform reduction of all non-salary accounts to eliminate deficit, if all else fails.

The order in which the alternatives are considered represents a priority list for the alternatives (in the order of their decreasing desirability). The anticipated deficit stimulus (4-B1-15) first evokes a check of all preliminary mayor's recommendations to see if they represent an increase over current appropriations of more than a specified percent (an increase roughly equivalent to the limit indicated in the mayor's budget letter to department heads). If the particular recommendation represents an increase over the limit (i.e., doesn't satisfy the constraint), the increase is set back to the limit and a new preliminary recommendation is arrived at. Obviously, the order in which the screened requests are considered can be of crucial importance. A priority list of departments probably exists that partially determines which departments are cut and which ones are not, but here again, it is not part of the formal model. Instead it is assumed that departments are considered in

(continued from previous page)

"Priority list" suggested and confirmed by the following participants in the budgetary process: Alfred M. Pelham, former Detroit controller; Aldo Colautti, Mayor's Executive Secretary, Pittsburgh; Calvin H. Hamilton and David W. Craig, former department heads, Pittsburgh.
the order in which they are numbered in the accounting system. A priority of account types is explicitly a part of our model, however.

The order of account sanctity for the mayor's office is identical to that of the department. This shared preference ordering is as follows:

1. administrative salaries,
2. non-administrative salaries and wages,
3. operating expenses, supplies, materials, etc.,
4. equipment,
5. maintenance.

The order corresponds to the postponability of expenditures with maintenance and equipment being the first to be cut (and the last to be considered for an increase in the surplus elimination routines) and salaries the last. The deficit elimination procedure is executed only as long as a "deficit" exists. The first acceptable alternative (balanced budget) found is adopted and search activity is halted.

If, however, the budget is examined and altered so as to keep all recommended appropriations within a fixed percentage of current appropriations, and a "deficit" still exists, another set of constraints is evoked and the search for a solution continues. A check is then made of the preliminary mayor's recommendations to see if there is any planned increase over current appropriations. If there is, the preliminary recommendation is altered to satisfy the constraint (4-B1-22, 23). The application of the "no-increase-over-current-appropriations" constraint is, again, sequential. The constraint is first applied to non-standard account categories (4-B1-2 and 4-B1-24), then to lower priority accounts (4-B1-25), and finally, if the deficit is not yet eliminated, to salaries and wages for the departments.

---

26 Again, the hard, departmental request data do not exist in sufficient quantities to reconstruct the departmental priority list and the soft data are unavailable. Interviewees are perfectly willing to talk about relative importances of account categories, but not of departments and department heads.

27 Shared also with the council.
If the budget is not yet balanced, the remaining deficit is eliminated by spreading a uniform cut over all non-salary and wage account categories and over all departments. One item that is never reduced from current appropriations in the usual sense is salaries and wages. The salary and wage accounts are different from other accounts in that they represent commitments to individuals currently employed. There are no mass layoffs of government employees or firings to eliminate potential budget deficits. If things get "tight" in city hall, a freeze is placed on the filling of positions vacated by retirement, resignation, and death and on scheduled step-raises and salary increments, in order to reduce costs.

Finally, either by reducing the surplus or eliminating a deficit, the mayor's office arrives at a balanced budget.

Behavior Not Included in the Formal MAYORS Model

As we have noted previously, the mayor's tax decision (and, hence revenue) is taken by the model as given. Our assumption has been that revenue decisions are substantially independent of expenditure decisions. This is not completely true, of course. While the revenue decisions could legitimately provide the subject matter for an entire study, there are some things we can say about its relationship to the allocation decisions. A look at some crude data and interviews with people corresponding to the MAYORS Submodel indicates that the primary systematic relationship between allocation and total-budget (revenue) decisions is related to general salary levels, rather than activity levels. "The 'only' time we raise taxes is to finance a pay increase for municipal employees. No tax increase -- no wage increase. Of course, when we (the mayor) do decide to raise taxes, the word gets around and we find departments coming in (with their budget requests) a little higher, trying to take advantage of any leftovers."28 A brief look at the data (see Figure 5-3) indicates that there is a high correlation between

28Aldo Colautti, Mayor's Executive Secretary, City of Pittsburgh, October 30, 1964, interview.
<table>
<thead>
<tr>
<th>Year</th>
<th>Tax changes</th>
<th>Wage-level increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleveland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td>.60 mill property tax increase defeated at polls</td>
<td>5% for uniformed police and fire, 3% general</td>
</tr>
<tr>
<td>1956</td>
<td>1.20 mill increase defeated at polls</td>
<td>none</td>
</tr>
<tr>
<td>1957</td>
<td>County Auditor increased property valuation: increased yield</td>
<td>10% for uniformed police and fire, 8% all others</td>
</tr>
<tr>
<td>1958</td>
<td>1.30 mill reduction (increased valuation)</td>
<td>5% for uniformed police and fire, 3% general</td>
</tr>
<tr>
<td>1959</td>
<td>.90 mill increase</td>
<td>5.3% for uniformed police and fire, 3% general</td>
</tr>
<tr>
<td>1960</td>
<td>.70 mill reduction</td>
<td>none</td>
</tr>
<tr>
<td>1961</td>
<td>.70 mill increase</td>
<td>5.2% for uniformed police and fire, 3% for all others</td>
</tr>
<tr>
<td>1962-63</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>1964</td>
<td>1.20 mill increase</td>
<td>10% for all</td>
</tr>
<tr>
<td>1965</td>
<td>.40 mill increase</td>
<td>none</td>
</tr>
<tr>
<td>Detroit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1958-59</td>
<td>slight property tax increase to offset declining yields</td>
<td>none</td>
</tr>
<tr>
<td>1959-60</td>
<td>&quot; &quot; &quot; &quot; &quot; &quot; &quot; &quot;</td>
<td>4% general cost-of-living</td>
</tr>
<tr>
<td>1960-61</td>
<td>none</td>
<td>2% increase</td>
</tr>
<tr>
<td>1961-62</td>
<td>small property tax increase to offset decreases in assessments</td>
<td>$.04/hour cost-of-living</td>
</tr>
</tbody>
</table>

(continued on next page)
Figure 5-3 (continued)

Relationship Between Wages and Taxes

<table>
<thead>
<tr>
<th>Year</th>
<th>Tax change</th>
<th>Wage-level increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detroit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1962-63</td>
<td>reduced property tax and new income tax</td>
<td>2% increase plus $100/year for uniformed police and fire</td>
</tr>
<tr>
<td>1963-64</td>
<td>none</td>
<td>$.03/hour cost-of-living</td>
</tr>
<tr>
<td>1964-65</td>
<td>small property tax reduction</td>
<td>2 1/2% increase plus $140/year for uniformed police and fire</td>
</tr>
<tr>
<td></td>
<td>more income tax available as previous years' deficits are eliminated</td>
<td></td>
</tr>
<tr>
<td>Pittsburgh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>1961</td>
<td>earned income tax up from 1/2% to 1%</td>
<td>$2.2 M increase associated with major job reclassification plan</td>
</tr>
<tr>
<td>1962-63</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>1964</td>
<td>$10 occupational privilege tax</td>
<td>5% increment</td>
</tr>
<tr>
<td>1965</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>
general wage increases and new or increased taxes. We can say little about cause and effect, however. Another thing that the data indicate is the ability of uniformed police and fire to secure differential wage increases (not possible in our model). This could reflect the availability of comparable salary data between cities.

Another prominent omission of problem-solving behavior concerns the lack of a priority list for departments. The model assumes that the departmental priority list is ordered the same way as department account numbers. The overall importance of this faulty assumption is, of course, an empirical question. If we assume that high-priority departments are distributed randomly among all departments on the list and that deficit elimination procedures are evoked much more frequently than surplus elimination figures, then we should expect that our model would, in general, underestimate appropriations for lower-numbered departments (always the first ones to be cut regardless of actual department priority) and overestimate them for higher numbered departments. In fact, we did not observe this, indicating that the priority-effect might be reflected in the preliminary screening coefficients (4-Bl-4).

The entire budgetary process model we have constructed hypothesizes a stable decision structure between and within cities, reflecting stable sets of relationships between positions and roles within the city established through some process of learning, reinforcement, and socialization. This assumption of stability and uniform socialization is predicated on an assumption that relatively few participants in the budgetary process change in a given period of time. One obvious exception is found when an administration is defeated at the polls. This results in a complete reordering of position occupants and relationships. The gradual socialization and learning process will no longer hold. So, we expect that the first years at the start of a new administration will produce a shift in model parameter values and a change in model fit.29

---

29Davis, et. al., op. cit., noted a shift in models and parameters while studying the Federal budgetary process, representing the Truman-Eisenhower switch. Although our lack of data prevented us from calculating parameter shift points, we were able to detect a shift in model fit for a new administration (see Section 6).
Another kind of behavior not included in the model is a response to external (to the government) pressure and constraints by the mayor. Again, as in the department models, the MAYORS model does not preclude a response to requests for services from "powerful" interest groups or individuals. It only postulates that the response is within the budget level for the department involved. The model, as constructed implies that either the response to "pressure" is systematic and regular over the years (implying a stable system of "pressure" or "influence" in the community) and is reflected in the model parameters or it does not enter the part of the budgetary process represented by our model at all. The only case where external "influence" could be conceived of as imposing a decisional constraint is in the revenue estimate. Most systematic "pressure" from the business community concentrates on keeping tax rates constant, and not on particular expenditure items.30

The importance of these conscious omissions will be reflected in the empirical tests of the model.

Characteristics of the COUNCIL Model

The role of the city council is a limited one. A primary reason for this limitation is more one of cognitive and informational constraints than lack of interest. The city budget is a complex document when it reaches the council. The level of detail makes it virtually impossible to consider all or even a majority of the items. For example, in the Pittsburgh Department of Public Works, the Division of Incineration Miscellaneous Services account is presented to the council as shown in Figure 5-4.

The council is asked to deal with the budget at this level of detail. When it is realized that, in Pittsburgh, for example, there are five or more account categories like "Miscellaneous Services" in each administrative unit and that there are about 45 such units in the

30Suggested by Hon. Joseph H. Barr, Mayor of Pittsburgh (November 19, 1964 interview), Aldo Colautti, Mayor's Executive Secretary, Pittsburgh (October 30, 1964 interview), Alfred M. Pelham, former Controller, Detroit (October 7, 1964 interview), and Richard Strichartz, Controller, Detroit (October 6, 1964 interview).
### Figure 5-4

**Budget Complexity**

**Department of Public Works**

<table>
<thead>
<tr>
<th>Code Acct. No.</th>
<th>Title of Account</th>
<th>Departmental Estimates 1964</th>
<th>Appropriation Year 1963</th>
<th>Expenditures Year 1962</th>
<th>Increase '64 Over '63</th>
</tr>
</thead>
<tbody>
<tr>
<td>1687</td>
<td>Division of Incineration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-5</td>
<td>Recharge Fire Extinguishers</td>
<td>$ 50.00</td>
<td>$--------------</td>
<td>$ 89.26</td>
<td>$----------</td>
</tr>
<tr>
<td>B-5</td>
<td>Extermination Service</td>
<td>200.00</td>
<td>---------------</td>
<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>B-8</td>
<td>Towel Rental</td>
<td>25.00</td>
<td>---------------</td>
<td>.26</td>
<td>--------</td>
</tr>
<tr>
<td>B-9</td>
<td>Supper Money</td>
<td>100.00</td>
<td>---------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>B-13</td>
<td>Freight and Express Charges</td>
<td>89.00</td>
<td>---------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>B-17</td>
<td>Public Property and Property Damage Insurance</td>
<td>125.00</td>
<td>---------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>B-18</td>
<td>Water Cooler Rental</td>
<td>390.00</td>
<td>---------------</td>
<td>390.00</td>
<td>---------</td>
</tr>
<tr>
<td>B-18</td>
<td>Power Shovel Rental</td>
<td>12,960.00</td>
<td>-- --------------</td>
<td>14,880.00</td>
<td>---------</td>
</tr>
<tr>
<td>B-18</td>
<td>Truck Rental for Incinerator and Bell Farm</td>
<td>3,765.00</td>
<td>---------------</td>
<td>2,295.00</td>
<td>---------</td>
</tr>
<tr>
<td>B-20</td>
<td>Waste Disposal Permits</td>
<td>50.00</td>
<td>---------------</td>
<td>50.00</td>
<td>---------</td>
</tr>
<tr>
<td>B-20</td>
<td>Demurrage on Oxygen and Acetylene Tanks</td>
<td>170.00</td>
<td>---------------</td>
<td>200.40</td>
<td>---------</td>
</tr>
<tr>
<td>B-20</td>
<td>Services, N.O.C.</td>
<td>275.00</td>
<td>---------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>B-21</td>
<td>Test Boring, Survey and Report, for Landfills</td>
<td>1,000.00</td>
<td>---------------</td>
<td>390.00</td>
<td>---------</td>
</tr>
</tbody>
</table>

**TOTALS**

$19,199.00 $18,199.00 $17,904.92 $1,000
city, it is easy to see why the council cannot seriously consider each line item (like the $25.00 reference to "Towel Rental," Figure 5-4). The sheer volume of information to be processed limits the ability of a council, without its own budget staff, to consider the budget in a sophisticated or complex manner.

Another, perhaps more important, consideration is the balanced budget requirement. If there is no slack in the budget the mayor presents to the council (4-C1-8), any increase the council makes in any account category must be balanced by a corresponding decrease in another account (or by an increase in revenue). So, in the presence of a revenue constraint, council cannot consider elements of the budget independently as is done in Congress. Davis, et al., found that Congressional budgetary behavior could be described extremely well using a series of linear decision rules.\textsuperscript{31} Behavior of this nature would not be possible if it were required that the sum of the changes in budgets made by Congress add to zero -- i.e., the budget must add up to an amount pre-determined by the President. Congressman and Congressional committees also have staffs, councilmen do not.

Of course, there are other behavioral options open to councilmen which allow changes while maintaining a balanced budget:

\begin{figure}
\centering
\caption{Council Strategies}
\begin{tabular}{|l|l|l|l|l|}
\hline
 & Decrease other item(s) & Raise taxes & Lower taxes & Increase other budget item(s) & No other changes \\
\hline
Item Budget Cuts & - & - & C & D & E \\
Item Budget Increases & A & B & - & - & F \\
\hline
\end{tabular}
\end{figure}

(only feasible or probable strategies are identified)

\textsuperscript{31}Davis, O.A., et. al., \textit{op. cit.}
When one considers the nature of the external pressures on council members, strategies A and B appear most likely. All interest groups, neighborhood organizations, department heads, etc. feel that some department's budget should be increased. The pressures transmitted to council concerning the operating budget are of one kind -- those advocating increases in the mayor's recommendations. The other side of the argument -- curtailment of government activities -- is seldom, if ever, presented to council. This countervailing influence enters the decision process not at the council level, but generally through the mayor's office and in particular, through the mayor's revenue estimate. It is at this stage in the decision process that the business community or so-called economic elite attempt to influence municipal resource allocation by either implicitly or explicitly arguing for stable (non-rising) tax rates (not yields) and hence limiting the resources available for allocation. Little interest is exhibited by the business community in the exact allocation of resources (the operating budget), however. The lack of pressure for budget cuts at the council level makes strategies C, D, and E less likely. The use of strategy F assumes that the mayor leaves enough slack (surplus) in his budget to allow council the luxury of selectively increasing portions of the budget. This, of course, the mayor seldom does.

It is seen from the above that the role of council is a limited one due both to the nature of pressures impinging on them and their lack of informational and computational capabilities (budget staff). Where the

32 Suggested by Aldo Colautti, Executive Secretary to the Mayor, City of Pittsburgh (October 30, 1964 interview).

33 The nature of "pressures" on tax policy may partially explain the commitment of a large portion of the city's capital budget to those projects which tend to increase the city's tax base.

34 In Detroit, until Mayor Cavanaugh took office, it was customary, when city employees received a general pay raise, for the mayor to grant a general increase and then leave enough of a surplus in the budget so that the council could add to the pay raise and take some "credit" for it, too.
mayor and council are of the same party the party also acts as a control mechanism. The mayor as party leader acts to reduce the council's role also. The council is then forced to use the mayor's decisions as reference points for their decisions. The constraints -- "pressure," informational, and computational -- coupled with a recommended budget with no slack to allocate makes it extremely difficult for the council to change any portion of the mayor's budget.

Formal Model Characteristics

The problem is perceived by the council as one of compromising the department requests (including supplementals) with the mayor's recommendations (4-C1-6 and 9) if there are enough resources available to allow this (4-C1-4 and 8). The preliminary decision in all cases is to accept the mayor's recommendation (decisional reference point) -- (4-C1-5). If the mayor gave the department all it asked for (4-C1-6), -- including supplemental requests -- then the mayor's recommendation is accepted automatically. If not, and if the anticipated surplus (revenue estimate minus preliminary budget total) is large enough, the department is granted an amount based on the mayor's recommendation, the magnitude of the mayor's cut in the departmental request, and past, actual expenditure amounts (4-C1-9).

If, by chance or through the elimination of a revenue source by council, there is an anticipated deficit, it is eliminated by successively reducing proposed appropriations to current appropriations levels (4-C1-14 and 15).

Behavior Not Included in Formal COUNCIL Model

As we have indicated above, constraints and the nature of the pressure on the council are such that it really has few behavioral alternatives. Those alternatives not open to the council were not included in the model. Really, only one kind of councilmanic behavior observed in

35Occasionally the council will "veto" a proposed new tax -- income tax in Cleveland, tax for meat inspectors in Detroit, but hardly ever "vetoes" an expenditure recommendation.
the last ten years in our three cities will not be found in the formal model. The behavior occurs in those rare instances when council decides to change the tax rates (either by "vetoing" a tax proposal of the mayor's or by increasing a tax to provide additional revenue for a particular purpose). These omissions will show up in an analysis of the model's residuals.

Overview

Generalizing, the entire model is one of a systematic, administrative decision process. The stability of the decision system is portrayed as evolving from the restrictive revenue environment, an assumed continuity in the actors manning the system, and an implied stable or non-existent "community power network." The interaction of problem complexity and need for decision combined with the lack of extragovernmental reference points or standards fosters:

1) a decision system which uses historical experience and precedent as its operating standards,

2) a system which handles interest conflicts (high service rates, low taxes) by largely ignoring divergent viewpoints and using feasibility as the prime decision criterion,

3) a system which handles complexity by fragmenting and simplifying the problem by assuming (implicitly) that "this year's problem" is nearly identical to "last year's" and therefore "this year's solution" will be nearly identical to "last year's;"

4) a system that structures a complex problem, formulates alternatives and makes choices using simple decision rules.

The fitting of this set of relatively simple decision procedures to the real worlds of Cleveland, Detroit, and Pittsburgh is the problem to which we now turn.
A. Parameter Estimation

A.1. Modification of Model Structure — In fitting the model to our three data points, several structural modifications must be made. These "structural specifications" consist of fitting the particular city's accounting system to the model, and in one case (Cleveland), reflect the fact that more data are available to decision makers at the time of decision than in other cities. Referring back to the formal model presented in Section 4, the administrative units (the i's specified in the submodel flow charts) for each city must be defined. In general, the administrative units for which a separate budget was recorded in the city's annual budget were defined to be the administrative units in the model. It was assumed that the city's accounting system as presented in the municipal budget provided the cognitive map and problem structure for the decision makers involved. (See Appendix for a listing of the administrative units in the various cities.)

The standard account categories used vary somewhat from city to city. Again, the categorization scheme used in the final appropriations bill was assumed to provide the cognitive map of the process for the decision makers. Inasmuch as the form of the appropriations provides an upper limit on expenditures
of a particular kind, the system of standard account categories found constitutes a real variable and not merely a decisional aid.

The standard accounts (j's) used in the model were:

<table>
<thead>
<tr>
<th>Account Category</th>
<th>01 Salaries and wages</th>
<th>02 Other</th>
<th>01 Salaries and wages</th>
<th>02 Supplies, materials</th>
<th>03 Equipment</th>
<th>01 Administrative salaries</th>
<th>02 Non-administrative salaries</th>
<th>03 Supplies, materials and expenses</th>
<th>04 Equipment</th>
<th>05 Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleveland</td>
<td>NSTD = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detroit</td>
<td>NSTD = 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>NSTD = 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Account Categories**

**Figure 6-1**

In Cleveland and Detroit, the summary categories in Figure 6-1 are found in the appropriations bills. The Pittsburgh categorization is a summarization of a larger number of "standard" account categories.

The fact\(^1\) that different kinds of expenses are dealt with

---

\(^1\)Based on interviews and the observed uniform wage policy in all three cities (indicating that at least personnel accounts are handled differently than others).
differently led to the inclusion of additional complexity into our model. Otherwise, our task would have been simplified by dealing with total department appropriations, rather than breakdowns by standard account categories within departments.

One other structural consideration should be mentioned. In Cleveland, there is a January 1 to December 31 fiscal year, but the budget for a particular year is not formulated until the end of February — well into the budget period. This means, for example, that decision makers putting the 1966 budget together would have access to preliminary totals of actual expenditures in 1965 — information not available to their counterparts in Pittsburgh and Detroit. Except for Cleveland, budgets for a period are formulated prior to the budget period, not during it. Not all departments in Cleveland use these additional data, however, because the department must gather the expenditure data themselves, through the Finance Department. Nevertheless, in the Cleveland model, expenditure data (EXPNi_j) for the period immediately preceding the budget period is used as a data input\(^2\) to the model (whether it is used by the department is reflected in our parameter values — see below).

\(^2\)Include EXPNi_j in 4-A1-1, 4-B1-3, and 4-C1-1 for the Cleveland models, in place of \(\text{EXPND}_{i_j}\) and \((\text{EXPNi}_{i_j} - \text{APPRl}_{i_j})\) in place of \((\text{EXPND}_{i_j} - \text{APPRO}_{i_j})\).
A.1.a. **Revenue Estimates** — Each city investigated has a rather complex system of revenues, of which general fund revenues are only part. Generally, a city's revenues consist of contributions from several sources — property taxes, city income tax, licenses and fees, treasurer's sales, amusement taxes, mercantile taxes, interest, utility charges, rental income, assessments, etc. Funds from some of these revenue sources are earmarked for specific expenditures even though still in the "general" fund. Adding to the complexity of accounts is the practice of including many outside revenue sources (including those outside of the general fund, such as intergovernmental transfers, fees, etc.) in the operating budget. In the departments affected, some appropriations are charged to the general fund, others to the special funds (revenue sources). This means the revenue estimate is really a number of separate estimates. To add to difficulties, many of these separate estimates are not kept (in their original form) by the city in any systematic way. To avoid confusion and the painstaking task of separating department appropriations by funds, while still retaining the essence of the revenue constraint and balanced budget requirement, the revenue estimates used in the model consist of the total of actual appropriations for those accounts included in the model plus any surplus indicated in the council appropriations bill. The difference between this method of determining the overall revenue estimate (REVEST) for a year and the theoretically preferable way of using individual estimates and the total general fund revenue
estimate, is more one of convenience than substance. The dollar difference is relatively small and represents a large number of small, automatic, accounting adjustments that are unimportant for our purposes.

The revenue estimates used were:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cleveland</th>
<th>Detroit (with welfare)</th>
<th>Detroit (without welfare)</th>
<th>Pittsburgh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>43100000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1957</td>
<td>45780000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1958(-59)</td>
<td>43400000</td>
<td>164000000</td>
<td>147100000</td>
<td>-</td>
</tr>
<tr>
<td>1959(-60)</td>
<td>46470000</td>
<td>166700000</td>
<td>153000000</td>
<td>-</td>
</tr>
<tr>
<td>1960(-61)</td>
<td>48870000</td>
<td>163800000</td>
<td>149400000</td>
<td>38300000</td>
</tr>
<tr>
<td>1961(-62)</td>
<td>51440000</td>
<td>163100000</td>
<td>156100000</td>
<td>40350000</td>
</tr>
<tr>
<td>1962(-63)</td>
<td>51630000</td>
<td>187000000</td>
<td>153900000</td>
<td>39870000</td>
</tr>
<tr>
<td>1963(-64)</td>
<td>51260000</td>
<td>174200000</td>
<td>148800000</td>
<td>39660000</td>
</tr>
<tr>
<td>1964(-65)</td>
<td>56370000</td>
<td>171000000</td>
<td>153000000</td>
<td>42950000</td>
</tr>
<tr>
<td>1965</td>
<td>57020000</td>
<td>-</td>
<td>-</td>
<td>44540000</td>
</tr>
</tbody>
</table>

Model Revenue Estimates

Figure 6-2

A.2. Parameter Estimates

By first committing ourselves to the problem of municipal resource allocation and then committing ourselves to the methodology of computer simulation as the best language to describe the process of decision in
municipal resource allocation, we have somewhat limited our choice of parameter estimation procedures. The lack of data forces us to use less-than-optimal estimation procedures. Records of the following subunit decisions were available:

<table>
<thead>
<tr>
<th>DEPT. requests</th>
<th>MAYORS recommended budget</th>
<th>COUNCIL final appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleveland</td>
<td>5 years</td>
<td>10 years</td>
</tr>
<tr>
<td>Detroit</td>
<td>7 years</td>
<td>7 years</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>1 year</td>
<td>6 years</td>
</tr>
</tbody>
</table>

**Data Used in Model**

**Figure 6-3**

The *ideal* research methodology would have been to have had access to all the decision makers (department heads and all employees dealing with the budget, employees in the mayor's office, and members of the council) involved in the formal budgetary decision process for a long enough period of time (since World War II, for example) to establish a significant statistical foundation for parameter estimates. Unfortunately, we are not afforded this luxury. Either the data were not kept (department requests in Pittsburgh and Cleveland) or the accounting system changed significantly so as to make analysis of time-series data meaningless or to require infeasible amounts of time and effort to transform
the data into comparable time-series forms. In any case, we are forced to "make do" with the data available.

Note also that the data we have represent a set of concrete decisions -- decisions of the department heads, mayor's office, and council. Because our model parameters deal with intermediate stages in the submodel decision processes, we would like to have data at the intermediate stages to estimate our parameters. Again, this is a luxury we do not enjoy and we are faced with the task of estimating the internal workings of a black box using only input and output data. (For a discussion of the mathematical reasonableness of this procedure, see Appendix, pp. A1-A5.) Fortunately, through interviews and an analysis of budgetary documents, we have some knowledge of the mechanisms inside the black box. Specifically, we have used those mechanisms in Figures 4-A1, 4-B1, and 4-C1 to describe the budgetary decision process found in municipal government.

Mathematically, our submodels consist of a linear function used to make some sort of preliminary calculation (4-A1-3, 4-B1-4, and 4-C1-9) and a series of constraints the problem solution must satisfy. Generally speaking, we shall use multiple regression analysis to estimate the parameters of the linear function, interview "data," and ad hoc techniques to determine appropriate values for the other parameters in the submodels.

Possible Problems in Parameter Estimation

Before discussing some of the statistical problems likely to be encountered with our parameter estimation procedures, it should be
pointed out that we are working with so few observations (see Figure 6-3) that we will be able to say very little substantively about the estimated values. The paucity of data, in most instances, leaves so few degrees of freedom as to make statistical analysis of parameters meaningless. It also lessens the value of including error terms as a formal part of our process model. Multiple regression will be used for the most part as a reasonable mathematical method for estimating parameters rather than as an optimal statistical technique. Our small sample problem, although crucial, is unavoidable. This "handicap" makes it all the more important to avoid other statistical pitfalls, however. A brief description of some of the problems associated with the preliminary calculations of parameters (4-A1-3, 4-B1-4, and 4-C1-9) and how they affect our estimates, follows:

1. Autocorrelation -- one of the assumptions underlying the linear regression model is that of serial independence. For our purpose, this means that there is no correlation between the error in the budget estimate (based on the linear regression model) for a particular year and the error for the previous year. The errors are assumed to

3The error term would refer to unpredictable or random, external events, affecting the budget (civil rights riots, changes in State legislative regulations, availability of Federal monies, etc.).
be independent. A calculation of the Durbin-Watson d statistic for each parameter estimated with time-series data indicated that this is not a significant problem.

2. Heteroscedasticity - the linear model assumes that the magnitude of the error is independent of the magnitude of the dependent variables (and normally distributed). While this was generally not a problem for us where we had complete data for a particular set of subunit decisions (MAYORS and COUNCIL), in Pittsburgh and Cleveland we were forced to group subunits (see below) to get enough data

---

4Johnston, J., ECONOMETRIC METHODS, New York: McGraw-Hill, 1963, p. 177. Johnston also discusses a problem associated with lagged variables. Because all of our preliminary-calculations models dealing with adjustment in levels (models 11, 12, 13, and 14 for the DEPT. Submodel, 21 and 22 for the MAYORS Submodel, and 31 and 32 for the COUNCIL Submodel -- see below) rather than changes (models 21 and 22 in the MAYORS Submodel below) have this problem, it is worth noting. Johnston concludes that "... the least-squares estimates will be biased, though if the disturbance term follows a normal distribution, they will tend to have the desirable asymptotic properties of consistency and efficiency." Op. cit., p. 212.

5Davis, et al., found in their studies of Congressional budgetary behavior (CN THE PROCESS OF BUDGETING: AN EMPIRICAL STUDY OF CONGRESSIONAL APPROPRIATIONS) that the error terms were correlated in some cases and represented a norm-restoring mechanism for correcting previous errors. Durbin-Watson d statistics (see Appendix, item III) indicate that these mechanisms were not present to a great extent in our analysis (probably due to the tighter budget constraints and the inclusion of a "trend" term in most of our relationships).

to estimate parameter values. When a scarcity of data forces us to group subunits with budgets of a different magnitude together (for instance, Police and Building Inspection), we are bound to run into a problem of heteroscedasticity. In the instances where the problem was encountered (estimating the DEPT. parameters in Pittsburgh and Cleveland), we could have avoided it by transforming the data. This was not done, however, because of the computational difficulties.\footnote{Johnston, J., op. cit., pp. 208-211. Johnston indicates a way of transforming the data if the linear relationship contains a constant term. Our relationships do not, however. Hence, not only would the original data have to be transformed, but so would the resulting vector of regression coefficients. This difficulty plus the fact that the data transformation matrix was unknown for each (of several hundred) set of data, discouraged any attempt at systematically dealing with this problem.}

3. **Multicollinearity** - the linear model also assumes that the independent variables are independent of one another. This problem can be avoided in three ways:

a. Allow only one of two correlated independent variables to be in the relationship (a step-wise regression procedure can prevent much of this) at any one time,
b. Group the two correlated variables to form a third variable.

In general, we used technique a to circumvent this problem.

A.2.a DEPT. Relationships

Pittsburgh --

Four preliminary-calculations relationships (4-A1-3) were tested (See Section 4 for variable definitions):

11. \[ \text{DEPR2}_{ij} = A_{ij}(\text{APPR1}_{ij}) + B_{ij}(\text{APPR1}_{ij} - \text{RMAY}_{ij}) + D_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) \]

Regular department request is based on current appropriations adjusted to second-guess mayor-council change and previous expenditure.

12. \[ \text{DEPR2}_{ij} = A_{ij}(\text{APPR1}_{ij}) + B_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + C_{ij}(\text{EXPND}_{ij}) \]

Regular department request based on current appropriations, trends, and expenditure experience.

13. \[ (\text{DEPR2}_{ij} + \text{DSUPR}_{ij}) = A_{ij}(\text{APPR1}_{ij}) + B_{ij}(\text{APPR1}_{ij} - \text{RMAY}_{ij}) + D_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) \]

Total department request -- same as 11.

14. \[ (\text{DEPR2}_{ij} + \text{DSUPR}_{ij}) = A_{ij}(\text{APPR1}_{ij}) + B_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + C_{ij}(\text{EXPND}_{ij}) \]

Total department request -- same as 12.

Relationships 13 and 14 estimate the total department request (regular and supplemental) while relationships 11 and 12 estimate
only the regular request. Clearly, with information from only one year -- 1965 (See Figure 6-3) -- we must use cross-sectional data to estimate the values of $A_{ij}$, $B_{ij}$, $C_{ij}$, and $D_{ij}$ in the above relationships. Having no basis for grouping departments (the $i$'s), we are left with only one reasonable alternative for grouping our data -- by account categories. It is a reasonable way to group the data insofar as different types of expenditures are treated differently by department heads in Pittsburgh (See Section 5, pp. 120-121). The results are found in Figure 6-4.
Pittsburgh DEPT. Submodel Relationships

**Relationship 11**

\[ DEPR_{1j} = A_{i1}(APPR_{1i1}) + B_{i1}(APPR_{1ij} - RMAY_{1ij}) + C_{i1}(EXPND_{1ij} - APPRO_{1ij}) \]

<table>
<thead>
<tr>
<th></th>
<th>A_{i1}</th>
<th>B_{i1}</th>
<th>C_{i1}</th>
<th>r^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Accounts</td>
<td>.998</td>
<td>0</td>
<td>0</td>
<td>.9999</td>
</tr>
<tr>
<td>Account j = 1</td>
<td>.999</td>
<td>-.065</td>
<td>6.777</td>
<td>.999</td>
</tr>
<tr>
<td>Account j = 2</td>
<td>.999</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Account j = 3</td>
<td>1.005</td>
<td>.170</td>
<td>0</td>
<td>.9998</td>
</tr>
<tr>
<td>Account j = 4</td>
<td>1.362</td>
<td>-.503</td>
<td>1.079</td>
<td>.998</td>
</tr>
<tr>
<td>Account j = 5</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Relationship 12**

\[ DEPR_{1j} = A_{i1}(APPR_{1i1}) + B_{i1}(APPR_{1ij} - APPRO_{1ij}) + C_{i1}(EXPND_{1ij}) \]

<table>
<thead>
<tr>
<th></th>
<th>A_{i1}</th>
<th>B_{i1}</th>
<th>C_{i1}</th>
<th>r^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Accounts</td>
<td>.998</td>
<td>0</td>
<td>0</td>
<td>.9999</td>
</tr>
<tr>
<td>Account j = 1</td>
<td>.999</td>
<td>.0067</td>
<td>0</td>
<td>.9998</td>
</tr>
<tr>
<td>Account j = 2</td>
<td>.999</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Account j = 3</td>
<td>1.002</td>
<td>.083</td>
<td>0</td>
<td>.9998</td>
</tr>
<tr>
<td>Account j = 4</td>
<td>.245</td>
<td>.476</td>
<td>1.062</td>
<td>.998</td>
</tr>
<tr>
<td>Account j = 5</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Relationship 13**

\[ (DEPR_{1j} + DSUPR_{1j}) = A_{i1}(APPR_{1i1}) + B_{i1}(APPR_{1ij} - RMAY_{1ij}) + C_{i1}(EXPND_{1ij} - APPRO_{1ij}) \]

<table>
<thead>
<tr>
<th></th>
<th>A_{i1}</th>
<th>B_{i1}</th>
<th>C_{i1}</th>
<th>r^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Accounts</td>
<td>1.057</td>
<td>-.270</td>
<td>-.289</td>
<td>.9990</td>
</tr>
<tr>
<td>Account j = 1</td>
<td>1.015</td>
<td>.158</td>
<td>-137.848</td>
<td>.998</td>
</tr>
<tr>
<td>Account j = 2</td>
<td>1.041</td>
<td>-.825</td>
<td>-.942</td>
<td>.999</td>
</tr>
<tr>
<td>Account j = 3</td>
<td>1.037</td>
<td>-.167</td>
<td>.158</td>
<td>.999</td>
</tr>
<tr>
<td>Account j = 4</td>
<td>2.525</td>
<td>-.596</td>
<td>4.532</td>
<td>.967</td>
</tr>
<tr>
<td>Account j = 5</td>
<td>1.130</td>
<td>0</td>
<td>.210</td>
<td>.989</td>
</tr>
</tbody>
</table>

*Used in process model
Relationship 14

\[ (\text{DEPR}_{ij} + \text{DSUPR}_{ij}) = A_{ij}(\text{APPR}_{ij}) + B_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + C_{ij}(\text{EXPND}_{ij}) \]

<table>
<thead>
<tr>
<th></th>
<th>( A_{ij} )</th>
<th>( B_{ij} )</th>
<th>( C_{ij} )</th>
<th>( r^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Accounts</td>
<td>1.327</td>
<td>-1.189</td>
<td>-0.274</td>
<td>0.9990</td>
</tr>
<tr>
<td>Account ( j = 1 )</td>
<td>1.143</td>
<td>0</td>
<td>0</td>
<td>0.998</td>
</tr>
<tr>
<td>Account ( j = 2 )</td>
<td>1.055</td>
<td>0.207</td>
<td>0</td>
<td>0.999</td>
</tr>
<tr>
<td>Account ( j = 3 )</td>
<td>0.914</td>
<td>0.168</td>
<td>0.112</td>
<td>0.999</td>
</tr>
<tr>
<td>Account ( j = 4 )</td>
<td>-1.993</td>
<td>3.945</td>
<td>4.511</td>
<td>0.967</td>
</tr>
<tr>
<td>Account ( j = 5 )</td>
<td>1.019</td>
<td>1.195</td>
<td>0</td>
<td>0.999</td>
</tr>
</tbody>
</table>

Account 1 -- Administrative Salaries
Account 2 -- Nonadministrative Salaries
Account 3 -- Materials, Supplies, Expense
Account 4 -- Equipment
Account 5 -- Maintenance
Account 6+ -- Miscellaneous, Special

Figure 6-4
As can be seen in Figure 6-4, there is not much basis for choosing among the relationships in terms of goodness-of-fit. One criterion, of course, is the needs of the DEPT. submodel. Because supplemental requests are calculated within the submodel with our "preliminary request calculation" as an input, it seems reasonable to use either relationship 13 or 14 in the Pittsburgh DEPT. submodel.

Ideally, we would like to choose between 13 and 14 on the basis of the cognitive maps of individual department heads. Although our interviews suggested (at least consciously, and for 1965) that department heads did not attempt to "game" the mayor or "blame" him for past dissatisfactions with the budget, statistical considerations dictate that 13 be used in the model. The variables associated with $A_{ij}$ and $C_{ij}$ in relationship 14 are of roughly the same magnitude, presenting the multicollinearity problem (note the effects of this in the coefficients for $j$ equals 3 and 4).

The "tone-of-the-mayor's-letter" variable, TML, in Pittsburgh has the effect of deciding the portion of the request included in "supplemental requests." Anything over a "reasonable increase" must be submitted via supplemental requests. The "reasonable increase" was somewhat arbitrarily chosen to be five percent in all cities. A sensitivity analysis of the model in Section 10 indicates this constraint is not very significant (probably because it is imbedded in the preliminary-calculations parameters). Lack of supplemental request data also forced the assumption of five percent (See footnote 12 in this Section).
Cleveland --

In Cleveland, unlike Pittsburgh, we do have some time-series data on department requests. We do not have enough observations to justify estimating a separate relationship for each account category in each administrative unit, however. Fortunately, administrative units in the budget are (and have been for the ten-year study period) grouped together by "major classifications" (See Appendix, item II), for a listing of units included in these classifications). The two relationships outlined below were tested for each of the major classifications, using the available data (1960-63 and 1965) for department requests.

Relationships tested:

11. \[ DEPR2_{ij} = A_{ij}(APPR1_{ij}) + B_{ij}(\text{EXPN1}_{ij} - \text{APPR1}_{ij}) + C_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) \]

12. \[ DEPR2_{ij} = A_{ij}(\text{APPR1}_{ij}) + C_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + D_{ij}(\text{EXPND}_{ij}) \]

Multiple regression techniques were used to estimate the values of \( A_{ij}, B_{ij}, C_{ij}, \) and \( D_{ij} \), and a choice between Relationships 11 and 12 was made for each major classification of administrative units on the basis of the associated \( r^2 \)-statistic. Preliminary-calculations models chosen appear in Figure 6-5.
Cleveland DEPT. Submodel Relationships

<table>
<thead>
<tr>
<th>Major Classification</th>
<th>Relation-ship No.</th>
<th>Account Category</th>
<th>( A_{ij} )</th>
<th>( B_{ij} )</th>
<th>( C_{ij} )</th>
<th>( D_{ij} )</th>
<th>( r^2 )</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Government</td>
<td>12 Salaries Wages* (j = 1)</td>
<td>0.320</td>
<td>---</td>
<td>0.653</td>
<td>0.745</td>
<td>0.996</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 Other (j = 2)</td>
<td>1.198</td>
<td>0.274</td>
<td>---</td>
<td>0.157</td>
<td>---</td>
<td>0.948</td>
<td>65</td>
</tr>
<tr>
<td>Public Properties</td>
<td>11 Salaries Wages (j = 1)</td>
<td>1.625</td>
<td>0.782</td>
<td>---</td>
<td>-4.424</td>
<td>---</td>
<td>0.473</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>11 Other (j = 2)</td>
<td>1.045</td>
<td>0.864</td>
<td>---</td>
<td>-0.213</td>
<td>---</td>
<td>0.9923</td>
<td>55</td>
</tr>
<tr>
<td>Public Service</td>
<td>11 Salaries Wages (j = 1)</td>
<td>1.045</td>
<td>4.068</td>
<td>---</td>
<td>-0.192</td>
<td>---</td>
<td>0.9666</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>12 Other (j = 2)</td>
<td>0</td>
<td>---</td>
<td>0.737</td>
<td>1.023</td>
<td>0.9917</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Health and Welfare</td>
<td>12 Salaries Wages</td>
<td>0</td>
<td>---</td>
<td>0.487</td>
<td>1.110</td>
<td>0.9992</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 Other</td>
<td>1.108</td>
<td>1.574</td>
<td>0.333</td>
<td>---</td>
<td>0.9990</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Urban Renewal</td>
<td>12 Salaries Wages*</td>
<td>2.044</td>
<td>---</td>
<td>-1.359</td>
<td>-0.845</td>
<td>0.9990</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 Other</td>
<td>1.094</td>
<td>3.586</td>
<td>---</td>
<td>---</td>
<td>0.872</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Public Safety</td>
<td>11 Salaries Wages</td>
<td>1.026</td>
<td>0.890</td>
<td>0.360</td>
<td>---</td>
<td>0.9993</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 Other*</td>
<td>-0.0878</td>
<td>---</td>
<td>0.312</td>
<td>1.140</td>
<td>0.9971</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Finance</td>
<td>11 Salaries Wages</td>
<td>1.039</td>
<td>1.002</td>
<td>-0.080</td>
<td>---</td>
<td>0.9989</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 Other</td>
<td>1.627</td>
<td>-1.773</td>
<td>-2.701</td>
<td>---</td>
<td>0.540</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Port Control</td>
<td>11 Salaries Wages</td>
<td>1.274</td>
<td>0.794</td>
<td>-0.954</td>
<td>---</td>
<td>0.9962</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 Other</td>
<td>1.003</td>
<td>6.421</td>
<td>-0.221</td>
<td>---</td>
<td>0.9968</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>11 Salaries Wages</td>
<td>1.044</td>
<td>1.105</td>
<td>1.792</td>
<td>---</td>
<td>0.9842</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 Other</td>
<td>1.439</td>
<td>0.895</td>
<td>-0.081</td>
<td>---</td>
<td>0.991</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*Biased due to multicollinearity

Figure 6-5
Detroit --

The estimation of DEPT. relationships in Detroit is a more straightforward problem. Department request figures are part of the public record and have been published since 1958. Hence, department request figures were available from the 1958-59 budget to the 1964-65 budget and were used in our study. Enough data were available to calculate separate parameters for each account category in each administrative unit. Again multiple regression was used to estimate the parameters.

Relationships tested were:

11. \[ \text{DEPR}^{2}_{ij} = A_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) + B_{ij}(\text{APPR1}_{ij}) + C_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) \]
12. \[ \text{DEPR}^{2}_{ij} = B_{ij}(\text{APPR1}_{ij}) + C_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + D_{ij}(\text{EXPND}_{ij}) \]
13. \[ (\text{DEPR}^{2}_{ij} + \text{SUPR}_{ij}) = A_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) + B_{ij}(\text{APPR1}_{ij}) + C_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) \]
14. \[ (\text{DEPR}^{2}_{ij} + \text{SUPR}_{ij}) = B_{ij}(\text{APPR1}_{ij}) + C_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + D_{ij}(\text{EXPND}_{ij}) \]

In Detroit, "supplemental requests," defined (by Detroit) as any requested increase over current appropriations, are incorporated in the regular department requests for all items except salary rate changes (caused by filling an open position, change in civil service seniority status, step raises, etc.). This means that Relationships 11 and 13, and 12 and 15 are identical for all accounts except Salary and Wages. On the basis of the \(r^2\)-goodness-of-fit criterion, Relationship 13
was chosen\(^8\) (identical to Relationship 11 in all non-salary accounts) for all accounts and all administrative units in the Detroit DEPT. Submodel. (See Appendix, item III B.1.) for listing of regression coefficients used in Detroit DEPT. Submodel.)

A.2.b. MAYORS Relationships and Parameters

In the MAYORS Submodel, the primary relationship to be empirically determined relates to the preliminary screening of department requests by the mayor's office. (See Figure 4-B1-4.) In addition the following items must be estimated: The minimum salary increase considered for city employees ("XK" in 4-B1-9), the level of "anticipated surplus" the decision makers will tolerate without searching for ways to eliminate it ("XLMT" in 4-B1-11), the portion of department supplemental requests granted by the mayor's office if anything extra is granted at all\(^9\) ("CG\(_{ij}\)" in 4-B1-14), and the limit on departmental increases for the year ("XL" in 4-B1-16). Again, the ideal way to estimate the relationships and constraints in the MAYORS Submodel would be to use observations made of relevant variables at appropriate stages of the actual decision processes, over time. Obviously, these intermediate data were not and are not

\(^8\)Unlike 14, it also has the desirable characteristic of not having multicollinearity problems built in.

\(^9\)Either nothing extra is granted, or a significant portion of the supplemental request is granted. If any increase is granted, it must be "enough to matter."
recorded in any form, let alone the form implied by our formal model. As in the DEPT. Submodel, the only hard data we have are specific, final decisions made at fixed stages in the decision process (i.e., department requests, mayor's recommendations to council, and final council appropriations). (See discussion on estimation of submodel relationships, Appendix, pp. A1-A5.)

MAYORS Relationships: Preliminary Screening

As departmental requests are received in the mayor's office, a preliminary screening is undergone. For each department, in all three cities, four different models of the preliminary-screening estimate (4-B1-4) were tested (See Section 5, pp. 116-117):

21. \[ RMAY2_{ij} = a_{ij}DEPR2_{ij} + b_{ij}DSUPR_{ij} + c_{ij}(APPRl_{ij} - APPRO_{ij}) \]
    department head's request respected and adjusted by his supplemental request and current trends.

22. \[ RMAY2_{ij} = a_{ij}APPRl_{ij} + b_{ij}(APPRl_{ij} - APPRO_{ij}) + c_{ij}(EXPND_{ij} - APPRO_{ij}) \]
    department head's request ignored, and current appropriations adjusted to reflect recent trends and over or under-spending in the past.\(^{10}\)

23. \[ (RMAY2_{ij} - DEPR2_{ij}) = a_{ij}(DEPR2_{ij} - APPRl_{ij}) + b_{ij}DSUPR_{ij} + c_{ij}(APPRl_{ij} - APPRO_{ij}) \]

\(^{10}\)For Cleveland, substitute \((EXPND_{ij} - APPRO_{ij})\) in all four models for \((EXPN_{ij} - APPRO_{ij})\) to reflect the availability of more current expenditure data at the time of decision.
department head's request used as a basis for calculation and changes in it are based on the magnitude of the requested change in appropriations, supplemental requests, and past changes in appropriations.

24. \((RMAY_{ij} - APPR_{ij}) = a_{ij}(APPR_{ij} - APPRO_{ij}) + b_{ij}(EXP_{ij} - APPRO_{ij})\)

department request ignored and change from current appropriations based on previous changes and magnitude of previous underspending or overspending.

Time-series data and linear regression techniques were used to estimate parameters for all departments and account categories in all three cities. Parameters and models used as a result of the regression analyses are found in the Appendix (item III). As mentioned in Section 5, models were chosen for particular account categories and departments on the basis of the standard-error-of-the-estimates. The frequency of choice of the four formulations of the preliminary-screening procedure in the mayor's office is found in Figure 5-2.

**Minimum Salary Increase Parameter, "XK"**

If there is a surplus of any magnitude (4-B1-6), the first surplus-reduction alternative evoked is that of granting an "across-the-board" salary increase (4-B1-9, 10). An increase is granted if the anticipated surplus exceeds a certain percent (XK) of the city-wide salary total. The minimum across-the-board salary increase is
a percent, "XK," of total salaries. The value of "XK," according to interviews in all three cities and recent salary increases appears to be in the neighborhood of 5%. One reason for the five percent figure, of course, is the desire on the part of city administrators to make salary changes visible or significant. At any rate, 5% is the figure explicitly mentioned as a target by budget decision makers, used most often when salaries are increased, and incorporated as the value of "XK" in our model for all three cities.

Criteria for Solution to Budget Balancing Problem, "XLMT"

Quite clearly, the mayor's office, while trying to balance the budget, does not balance it exactly — so that revenues equal expenditures exactly. Specifically, in the "surplus elimination" routines evoked, a limit is reached when it is no longer feasible to search for ways to eliminate the anticipated surplus (4-B1-11). All this says is that part of the budget will be a "planned surplus." This "planned surplus" takes the place of a contingency fund for the administration in some cities. The magnitude of this "test for a feasible solution" is the product of many considerations:

1. The presence of a formal, explicit contingency fund or other sources of a budget cushion (for instance, a "programmed" discrepancy between appropriations and expenditures).\(^\text{11}\)

\(^{11}\)In Pittsburgh, two budgetary rules result in a level of expenditures lower than appropriations:

(continued on next page)
2. The nature of the projects and programs competing for funds. In some respects the magnitude of the limit is really an estimate of that surplus level at which no more desirable programs can be undertaken. The indivisibility of projects enters into this limit. If a program or project has a minimum feasible price tag, the value of "anticipated surplus" is really a kind of measure of this minimum price. For instance, if a data processing installation can be set up for a minimum of $300,000 and the "anticipated surplus" is only $200,000, then it is unlikely that "data processing" will be undertaken in the budget.

3. The total size of the budget. The compilers of a $1 billion budget are likely to stop searching for ways to eliminate an "anticipated surplus" much sooner than their counterparts putting together a $100 million budget.

In light of the considerations above, and the difficulty of

(continued from preceding page)

a. An extremely detailed appropriations bill coupled with the requirement that only expenditures explicitly approved in the appropriations bill can be made. The more specific the approved expenditure items, the more difficult it is to spend to the approved limit. (See pp. 108-109.)

b. The presence of a cash budget for quarterly expenditures with the provision that there is no carryover from quarter to quarter (if a department does not spend the money it has budgeted for an item in the third quarter, it cannot purchase that item in the fourth quarter without a special authorization). Again, this makes it more difficult for departments to spend up to their appropriation limits.
estimating their effect on the value of "XLMT," the observed "planned surpluses" in the budgets of the three cities were used as a guide for determining "XLMT." Because of the limited effect "XLMT" has in the model, no formal estimating procedures were used and a "reasonable value" of $150,000 was used in the MAYORS submodel in all three cities. An analysis of the model's sensitivity to "XLMT" was undertaken in Section 10. It did not prove to be a significant parameter.

Portion of Supplemental Request Granted

If an anticipated surplus is encountered in budget preparation that is "large enough to bother with," one way of eliminating it is to grant a portion \( G_{ij} \) of a department's supplemental request (4-B1-13). The lack of data relating to departmental requests in general and supplemental requests in particular (very few supplemental requests are granted at all), forced us to use a rather simple mechanism to determine the portion granted. It was assumed that there would be a compromise between the department (all) and the mayor's office (nothing granted). It was assumed that if a supplemental was granted, it would equal one-half of the department's original supplemental request \( G_{ij} = 0.5 \).\(^{12}\)

\(^{12}\)One real difficulty in estimating \( G_{ij} \) statistically is that the supplemental requests are usually in the form of a memo to the mayor. These are not codified and included in any single document (except in Detroit) and as a result are in department and mayor's office files — and, hence, "unavailable."
Preliminary Recommendation within Limits?

When an anticipated deficit is encountered (4-B1-6), the first deficit-elimination routine evoked is a check to make sure that the preliminary mayor's recommendation is within limits of current appropriations indicated by the mayor in his budget letter ([equals \((1.0 + T\bar{M}_L)\) in (4-A1-5)]. While it is acknowledged that conditions probably change between issuance of the mayor's budget letter to department heads and the consideration of the budget by the mayor's office, the "tone of the mayor's budget letter" is probably a good estimate of the limits actually applied to appropriations by the mayor's office (4-B1-16). The assumption used in the model was that "\(XL = 1.0 + T\bar{M}_L\)," for all accounts in all cities.

A.2.c. COUNCIL Relationships

Parameters for two relationships were estimated for the COUNCIL Submodel:

1. A test to see if the mayor (output from MAYORS Submodel) had left enough of a budgetary surplus for the council to "bother" with (4-C1-8): Because of the council's lack of staff (and time) and in light of the balanced-budget requirement, the only strategies open to council are to increase appropriations in the face of an "adequate" surplus (4-C1-8) or to decrease appropriations in light of an "anticipated deficit" (4-C1-14, 15). The limit, "XLMT" defining an "adequate surplus" is the parameter to be estimated.
2. If the test above indicates an adequate surplus, the council then increases appropriations for various departments and account categories on the basis of:

   a. Mayor's recommendation \( R_{MAY2_{ij}} \)

   b. Magnitude of the mayor's cut in the total departmental request \( (\text{DEPR}_{ij} + \text{DSUPR}_{ij} - R_{MAY2_{ij}}) \)

   c. Over or underspending by the department in the past\(^{13}\)

      \( (\text{EXPND}_{ij} - \text{APPRO}_{ij}) \), or

   d. Current appropriations trends \( (\text{APPR}_{ij} - \text{APPRO}_{ij}) \).

(See 4-C1-9 in the formal model.)

**Criteria for "Adequate Surplus" -- XLMT**

The criteria council applies to decide whether the mayor's budget recommendation has a surplus adequate to allow additional appropriations is subject to the same sorts of considerations inherent in the mayor's "criterion for solution to budget balancing problem," "XLMT," discussed above. Because council rarely alters the mayor's budget in any significant way and because of the similarity in the two concepts, the limit defining an "adequate surplus," "XLMT," for COUNCIL to increase appropriations was assumed to be identical to the "criterion for solution to the budget balancing problem," "XLMT," in the MAYORS Submodel.\(^{14}\)

\(^{13}\)Because of the availability of more current data in Cleveland, over and underspending is calculated using \( (\text{EXPND}_{ij} - \text{APPR}_{ij}) \).

\(^{14}\)Equal to $150,000. This assumption means that the council alters the budget "only" when the mayor's office has not used up the excess over $150,000. The net effect is for the council to grant a larger portion of supplemental requests than the mayor under these circumstances.
Adjustment of Mayor's Recommendations

Two relationships for describing the COUNCIL adjustment process (if evoked) were tested for each account category in each department.

Relationships tested for Detroit and Pittsburgh:

1. \[ \text{APPR2}_{ij} = \text{PP}_{ij}(\text{RMAY2}_{ij}) + q_{ij}(\text{DEPR2}_{ij} + \text{DSUPR}_{ij} - \text{RMAY2}_{ij}) \]

2. \[ \text{APPR2}_{ij} = \text{PP}_{ij}(\text{RMAY2}_{ij}) + r_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + S_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) \]

The parameters \( \text{PP}_{ij} \), \( q_{ij} \), \( r_{ij} \), and \( S_{ij} \) were estimated using time-series data from Detroit and Pittsburgh and linear regression techniques. A choice between relationships 1 and 2 was made for each account category in each department on the basis of the associated \( r^2 \)-statistics. In most cases, there was no significant difference between the \( r^2 \)-statistics for models 1 and 2, and the choice was somewhat arbitrary. The results of this choice are found in the Appendix.

Relationships tested for Cleveland:

1. \[ \text{APPR2}_{ij} = \text{PP}_{ij}(\text{RMAY2}_{ij}) + q_{ij}(\text{DEPR2}_{ij} - \text{APPR1}_{ij}) + r_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) \]

2. \[ \text{APPR2}_{ij} = \text{PP}_{ij}(\text{RMAY2}_{ij}) + r_{ij}(\text{APPR1}_{ij} - \text{APPRO}_{ij}) + S_{ij}(\text{EXPND}_{ij} - \text{APPRO}_{ij}) \]

In nearly every case, \( \text{PP}_{ij} \) equaled 1.0 and the other parameters were not significant. Because of this, \( \text{PP}_{ij} \) was assumed to be 1.0 in Cleveland for all accounts and administrative units and \( r_{ij} \), \( S_{ij} \), and \( q_{ij} \) were set equal to zero.
B. Model Tests

The formal simulation model as presented in Section 4 represents a series of interdependent hypotheses relative to the municipal budgeting process. After fitting the general model to the specific cases of Cleveland, Detroit, and Pittsburgh as outlined above, the task is now one of testing the model to see if it conforms to the real-world phenomena it is attempting to describe.

There are two kinds of questions to which we should address our decision model to:

1. Does the model yield the same decisions as the real-world phenomena it purports to describe?

2. Does the model reach these decisions, using the same mechanisms as the corresponding real-world decision system?

Operationally, 1) implies a comparison between time-series data (decisions) generated by the model (computer program) and data generated by the real decision system (municipal government).

Question 2) asks for a comparison of decision mechanisms evoked by the model (branches in the computer program) and decision rules or procedures evoked by the decision makers in the real-world system.

Operationally, 2) asks questions like "In 1962, did both the model and the Mayor of Pittsburgh check to see if the anticipated surplus was sufficient for a 5%, across-the-board salary increase for municipal employees (4-B1-9), and did both the model and the mayor find that there was not a sufficient surplus (Did model branch from 4-B1-9 to 4-B1-11 instead of to 4-B1-10?)?"
Testing the Process or Model Mechanisms

As both Newell and Simon and Clarkson have pointed out, an adaptation of Turing's test is an adequate (and potentially strong) way of testing decision-process models.

"Turing's test can be applied in stronger or weaker forms. Comparison of the (decision made by the computer model) with the (decisions made) by human (decision makers) in the same position would be a weak test. The program might have reached its decision by quite a different process from that used by humans....

If data are gathered, however, by the thinking-aloud technique or by other means, that indicate the process used to select the behavior, it may, and usually will be possible to distinguish different ways of arriving at the same result. If the program makes the same analysis as the humans, notices the same traps, then we will infer, and properly, that down to some level of detail, the program provides an explanation of the human processes. The more minute and detailed the comparison between program (model) and behavior, the greater will be the opportunity for detecting differences between the predicted and actual behavior.

---


18 Turing's test was proposed "... to consider the question, 'Can machines think?'". Turing proposes an "imitation game" with three players: a human subject, a machine, and an interrogator. Communication between the interrogator and other players is allowed only under conditions "... which (prevent) the interrogator from seeing or touching the other competitors, or hearing their voices." The object of the interrogator is to discover which player is the human and which the machine. Turing, A. M., "Computing Machinery and Intelligence," in Feigenbaum and Feldman (eds.), op. cit., pp. 11-13.

19 The "weak Turing's test" is equivalent to "Does the decisional model yield the same decisions as the real-world phenomena it purports to describe?"

20 Newell and Simon, op. cit.
The Newell and Simon quotation above has several implications for our goodness-of-fit problem. For the municipal budgetary decision process, the strength of the application of Turing's test varies both with the "minuteness" and "detailedness" of the comparison and the number of comparisons made. Figure 6-6 indicates the relationships between the positions in the decision process at which comparisons with actual data are made, the level of detail of the decisions and the strength of an adapted Turing's test.

**Strength of Turing's Tests**

= \( f \) (level of detail of model comparisons with actual behavior)

<table>
<thead>
<tr>
<th>Strong</th>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual submodel decision rules</td>
<td>Total of Appropriations during a several year period</td>
</tr>
<tr>
<td>Outputs in Submodels*</td>
<td></td>
</tr>
<tr>
<td>Final Appropriation* totals only</td>
<td></td>
</tr>
<tr>
<td>Department Totals only</td>
<td></td>
</tr>
<tr>
<td>Entire budget total</td>
<td></td>
</tr>
<tr>
<td>Total of Budgets over span of several years</td>
<td></td>
</tr>
<tr>
<td>*Standard (summary) account categories</td>
<td></td>
</tr>
<tr>
<td>All Budget line items</td>
<td></td>
</tr>
</tbody>
</table>

*Comparisons used in study

Figure 6-6

(for a one-period change model)
Naturally enough, our position is one of maximizing the strength of a Turing's test subject to data constraints.

It is entirely infeasible for us to "sit in" or obtain "thinking-aloud" data from forty to sixty different department heads in each city, the mayors and their staffs, and the various city councils. The best we can do is compare model generated data at the three submodel stages with observed decisions at these stages — DEPT. Submodel output with department requests, MAYORS Submodel outputs with mayors recommended budgets, and COUNCIL Submodel outputs with final municipal appropriations in our three cities. Comparison of submodel outputs, while not as "strong" a test of our simulations model as Clarkson was able to use or as Newell and Simon have used to test their models of a chess player, is not a particularly weak test. Certainly, our goodness-of-fit test is no less strong (on the level-of-detail continuum) than the ones reported by Cyert and March of the department store buyer — where sales estimation decisions, actual orders, markups, sale prices, and mark-downs generated by the model were compared with decisions made by the department store buyer.21

Before continuing our discussion of model tests, it should be pointed out that our tests will suffer from one major, but unavoidable, deficiency. Due to lack of data (six years' in Pittsburgh, seven

years' in Detroit, and ten years' data in Cleveland), it is impossible to follow the much preferred procedure of estimating parameters using one set of data and testing the model with another set. Unfortunately, the same data will be used for both estimation and testing. The only alternative would be to let the "tail wag the dog" and reduce the scope and complexity of our research task and realism of our decision model.

Specific elaboration of the ideas presented above is called for in two areas:

1. Exact nature of model runs
2. Definition of goodness-of-fit measures.

B.1. Model Runs

Generally speaking, each of the three submodels (DEPT., MAYORS, and COUNCIL) defines a function which transforms input data to output data. The inputs to the "next" submodel can be real-world decision inputs or they can be outputs from the previous submodel. Certainly, the model takes on different meanings depending on the spacing of reconciliations with real-world data. Below is an example of a one-stage change model.

---

One-Stage Change Model:

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Model</th>
<th>Outputs (to be compared with actual data to obtain goodness-of-fit measures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962 Actual Appropriations</td>
<td>DEPT.</td>
<td>1963 Departmental Requests (model)</td>
</tr>
<tr>
<td>1963 Departmental Requests (actual)</td>
<td>MAYORS</td>
<td>1963 Mayors Budget Recommendations (model)</td>
</tr>
<tr>
<td>1963 Mayor's Actual Budget recommendation</td>
<td>COUNCIL</td>
<td>1963 Model Appropriations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965 Departmental Requests (actual)</td>
<td>MAYORS</td>
<td>1965 Mayors Budget Recommendations (model)</td>
</tr>
</tbody>
</table>

Figure 6-7

By piecing together the submodels in a different manner and "letting the submodels run" for a longer period before updating input data with actual data, we can obtain a one-period change model:
**One-Period Change Model:**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Model</th>
<th>Outputs (to be compared with actual data to obtain goodness-of-fit measures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962 Actual Appropriations</td>
<td>DEPT.</td>
<td>1963 Departmental Requests (model)</td>
</tr>
<tr>
<td>1963 Dept. Requests (model)</td>
<td>MAYORS</td>
<td>1963 Mayors Budget Recommendation (model)</td>
</tr>
<tr>
<td>1963 Mayors Budget (model)</td>
<td>COUNCIL</td>
<td>1964 Dept. Requests (model)</td>
</tr>
<tr>
<td>1963 Actual Appropriations</td>
<td>DEPT.</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 6-8*

If instead of intervening after each decisional stage (DEPT., MAYORS, COUNCIL) to obtain a one-stage change model, or after each year to obtain a "one-period change model, we start the model at the beginning of our data and "let it run" without updating until the data are exhausted, we have a "simulation model in the true sense of the word."^23^

We shall space our "real-world interventions so that we have a one-period change model for all three cities and a simulation model where the real decision system parallels the computer model, but never

---

intervenes. Of course, we shall measure goodness-of-fit after each stage in the decision process (after DEPT., after MAYORS, and after COUNCIL).

B.2. Measures of Goodness-of-Fit

The concept of "goodness-of-fit" is a relative one. A given theory or model "explains" (in the statistical sense) a phenomenon well, relative to an alternative hypothesis. Perhaps the most well-known goodness-of-fit measure is the $r^2$-statistic associated with regression analysis. The $r^2$ goodness-of-fit measure, mathematically, is:

$$r^2 = 1.0 - \frac{\sum(\text{observed} - \text{expected})^2}{\sum(\text{observed} - \text{mean of observed})^2}.$$

"Observed" refers to values of the dependent variable in the hypothesis found in the real world. "Expected" refers to the corresponding value predicted or expected by the model or hypothesis being tested. From the above, it is easily seen that the value of $r^2$ is merely a measure of how much better the model or hypothesis does at regenerating the observed data than can be expected from assuming that the data ("observed") come from random draws from a normal population (If this is so, then the "best" estimate of the value of the dependent variable is the "mean of the observed" variables.). So, $r^2$ is a statistic which measures the goodness-of-fit of data generated using a linear hypothesis relative to the hypothesis that "expected" equals the mean.

---

24Also known as the coefficient of determination.

of the observations.

Measures of goodness-of-fit are simply indices which indicate how well a given hypothesis "explains" the data relative to an alternative hypothesis.

For the moment, let us assume that our dependent variable is "level of appropriations in dept. i, account category j" — APPR2i,j. We have a set of observed values for APPR2i,j ("observed") and a set of values generated by our computer budgeting model ("expected"). This immediately suggests a measure of goodness-of-fit analogous to $r^2$.

$$1.0 - \frac{\sum(\text{observed} - \text{expected})^2}{\sum(\text{observed} - \text{mean of observed})^2}$$

Is this an appropriate measure? It depends. It depends upon the class of model decisions we are summing over. If we are summing over all departments and all account categories for a single year, the alternative hypothesis inherent in the above GOF measure is not a reasonable one. Pitting our computer model against the hypothesis that the appropriation for a given account category in a given department is equal to the mean over all departments and accounts is unfair. Almost any model will fare well under these conditions. What is needed, if we are to use an $r^2$-equivalent kind of measure, is a more reasonable alternative hypothesis. Two come to mind:

1. Appropriations for a given account category in a given department equal the mean appropriations for that particular account category in that department during the study period.
2. Appropriations for a given account category in a given department equal the appropriations for the same account category and department for the previous year.

Mathematically, the $r^2$-equivalent measures are:

1. $r^2$ about the department and account mean

\[
r_m^2 = 1.0 - \frac{\sum_{i=1}^{n} \sum_{j=1}^{m_i} (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum_{i=1}^{n} \sum_{j=1}^{m_i} (\text{AAPRO}_{ij} - \bar{\text{AAPRO}}_{ij})^2}
\]

if we are speaking of a measure for a single year, where

- $\text{APPR2}_{ij}$ = model-generated estimate, department $i$, account $j$.
- $\text{AAPRO}_{ij}$ = observed appropriations, department $i$, account $j$.
- $\bar{\text{AAPRO}}_{ij}$ = mean level of appropriations, department $i$, account $j$.

- $n$ = number of departments in a city.
- $m_i$ = number of account categories in department $i$.

For the entire study period, the appropriate measure would be

\[
r_m^2 = 1.0 - \frac{\sum_{t=1}^{\text{yrs.}} \sum_{i=1}^{n} \sum_{j=1}^{m_i} (\text{estimated} - \text{observed})^2}{\sum_{t=1}^{\text{yrs.}} \sum_{i=1}^{n} \sum_{j=1}^{m_i} (\text{observed} - \text{mean of observed})^2}
\]

2. $r^2$ about current appropriations:

\[
r_c^2 = 1.0 - \frac{\sum_{i=1}^{n} \sum_{j=1}^{m_i} (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum_{i=1}^{n} \sum_{j=1}^{m_i} (\text{AAPRO}_{ij} - \text{APPR1}_{ij})^2}
\]

for a single year, where

- $\text{APPR1}_{ij}$ = current appropriations, department $i$, account $j$.
Two characteristics of the above goodness-of-fit measures should be noted:

a. Unlike the $r^2$ statistic (coefficient of determination) found in regression analysis, there is no "guarantee" that $0.0 \leq r_c^2, r_m^2 \leq 1.0$ holds. Bounds on the regression - $r^2$ statistic are inherent in the least-squares estimation procedure used in regression analysis. Our estimation procedure has no such "guarantee."

b. Because of the relatively short period of time in our study periods, the "alternative hypotheses" inherent in the $r_m^2$ and $r_c^2$ statistics are likely to be very good predictors in their own right. In fact, we have argued throughout that stability and organizational inertia are key features of the problem-solving process. Consequently, any positive values for $r_m^2$ and $r_c^2$ might be regarded as a "reasonable" test of the predictive ability of our resource allocation model.

We are suggesting that because of a) and b), the values of $r_c^2$ and $r_m^2$ should be evaluated quite differently than the usual "$r^2" of regression analysis. Values close to zero may merely indicate that both the alternative hypotheses' and the model do an excellent job of predicting appropriations. In the short run, while the assumptions that:

1. $\text{APPR}_{ij}^2 = \text{AAPRO}_{ij} (r_m^2)$ next-year's appropriations equals the average over the study period, or

2. $\text{APPR}_{ij}^2 = \text{APPR}_{ij} (r_c^2)$ next-year's appropriations equals current appropriations.
may provide excellent estimates of the appropriations decisions but not an "excellent" description of the procedures leading to the decision.

Another "undesirable" feature of the measures outlined above ($r_m^2$ and $r_c^2$) concerns the characteristics of these statistics in years where the revenue constraint is very tight and the "line is held" on appropriations. In cases where a small change occurs in the denominator, any random errors occurring in our model (and hence, appearing in the numerator) are amplified unduly. This phenomenon is easily observed by analyzing the "extreme case where every item in the new budget is identical to current appropriations (or "nearly" equal to the average for the period)." This would make the denominator zero and if there were any errors in the model at all, the value of the $r^2$-equivalent statistic would approach a minus infinity. In summary, in those years where the number of budget changes are small, the $r_m^2$ and $r_c^2$ goodness-of-fit measures have the undesirable property of "falsely" amplifying model errors.

Another $r^2$-equivalent measure comes to mind immediately. Perhaps we should base our goodness-of-fit measures on budgetary changes and not on levels. If we take the "alternative hypothesis" that "new appropriations equal current appropriations," it is easily shown that an $r^2$-equivalent goodness-of-fit measure based on change is equivalent to the $r_c^2$-statistic, above, based on level:

Alternative hypothesis:

$$APPR_{ij}^2 = APPR_{ij}^1$$
"Expected" change then equals zero.

\[ E(AAPR_{ij} - APPR_{ij}) = 0 \]

\[
\begin{align*}
\text{r}_c^2 \text{ change} &= 1.0 - \frac{\sum (\text{estimated change} - \text{observed change})^2}{\sum (\text{observed change} - \text{alternative hypothesis of change})^2} \\
\text{r}_c^2 \text{ change} &= 1.0 - \frac{\sum [(AAPR_{ij} - APPR_{ij}) - (AAPR_{ij} - APPR_{ij})]^2}{\sum [(AAPR_{ij} - APPR_{ij}) - E(AAPR_{ij} - APPR_{ij})]^2} \\
&= 1.0 - \frac{\sum [(AAPR_{ij} - AAPR_{ij})]^2}{\sum [(AAPR_{ij} - APPR_{ij}) - 0]^2},
\end{align*}
\]

Briefly, we have outlined two kinds of goodness-of-fit measures to use in evaluating the predictive power of our model. Some problems exist with these measures, however, in that

1. the bounds of the values of the measures are not well defined,
2. the alternative hypotheses cited are not only reasonable but, in most cases, extremely good predictors themselves, and
3. in years where small numbers of budget changes occur, the \( r^2 \)-equivalent statistic provides a relatively severe penalty for random model errors.

In spite of these difficulties, however, the measures \( r_m^2 \) and \( r_c^2 \) are on the whole reasonable and should, properly interpreted, shed a good deal of light on our model's predictive power.

B.2.a. Alternative Models

Two overall measures of goodness-of-fit have been outlined above based on two reasonable, alternative hypotheses or models --
1. \( \text{APPR}_2_{ij} = \text{APPR}_1_{ij} \)
   Next-year's appropriations equal current appropriations.

2. \( \text{APPR}_2_{ij} = \text{AAPRO}_{ij} \)
   Appropriations are random fluctuations about a constant mean level of expenditures.

Other reasonable alternative models come to mind, that might be compared with our resource allocation model:

A1: Constant growth model
   \[ \text{APPR}_2_{ij} = a_{ij} \text{APPR}_1_{ij} + b_{ij} \]
   Where \( a_{ij} \) and \( b_{ij} \) represent growth parameters and are empirically determined using linear regression techniques.

A2: Constant-Share-of-the-Pie Model
   \[ \text{APPR}_2_{ij} = c_{ij} \text{TBUD}_2 \]
   Where \( \text{TBUD}_2 \) is the total budget for the city and \( c_{ij} \) represents the portion of the total going to department \( i \), account \( j \). "\( c_{ij} \)" will be empirically determined using linear regression techniques.

A3: Constant-Share-of-the-Increase Model

---

26 Similar to Wildavsky's concept of agency "base." "The base is the general expectation among the participants that programs will be carried on at close to the going level of expenditures..." Wildavsky, Aaron, THE POLITICS OF THE BUDGETARY PROCESS, p. 17.

27 Similar to Wildavsky's concept of "fair share" of any increases or decreases above or below "... the base of the various governmental agencies." Wildavsky, A., op. cit.
(APPR2_{ij} - APPR1_{ij}) = d_{ij}(TBUD2 - TBUD1)

where (TBUD2 - TBUD1) represents the total increase in the budget, and \( d_{ij} \) is an empirically determined parameter — the share of the increase for department \( i \), account \( j \).

As an additional test of the "predictive" power of our model of municipal resource allocation, the parameters \( a_{ij}, b_{ij}, c_{ij}, \) and \( d_{ij} \) were calculated for all "i" and "j," and estimates of appropriations were generated on the basis of these three, alternative models. These estimates were generated in a manner similar to the one-period change models discussed above.

The task of evaluating the relative goodness-of-fits for the three alternative models and our process model is not a particularly easy one.

B.2.b. Choosing Between Alternative Models

One basis for selecting one model over another as a description of a situation is the ability of the model to "predict" or regenerate data relevant to the situation. Many statistical tests exist for describing the ability of a model to predict. One such device is known as the \( \chi^2 \)-goodness-of-fit test.

Consider the "... case in sampling with replacement from a population of individuals which could be classified into \( k \) classes, a common problem is that of testing whether the probabilities have specified numerical values."\(^28\) If we assume our resource allocation

model generates probabilities that one dollar will be distributed to each of several department and account categories, we may be able to make some use of the $\chi^2$ goodness-of-fit technique.\(^{29}\)

Pearson's $\chi^2$ test statistic is

$$\chi^2 = \sum \frac{(n_i - np_{oi})^2}{np_{oi}}$$

where $p_i$ = estimated probability of $i^{th}$ event

$nn$ = total observations (events)

$n_i$ = observed frequency of $i^{th}$ event

$p_{oi}$ = theoretical probability of $i^{th}$ event.

Translating to the budgetary problem, let:

$p_{ij} =$ probability $1.00 will be found in department $i$, account $j$

$n_{ij} =$ observed "frequency of dollars" in department $i$, account $j$

$p_{ij} =$ "expected" probability $1.00 will be found in department $i$, account $j$

$n =$ total dollars "drawn" from the "population" -- i.e., total budget

Model appropriations estimate $ij = np_{ij}$,

so, $p_{ij} = \frac{\text{Model appropriations estimate } ij}{n}$

or, $p_{ij} = \frac{\text{APPR2}_{ij}}{\text{TBUD2}}$

The Pearsonian $\chi^2$ statistic:\(^{30}\)

\(^{29}\)We are also assuming that the total budget is large enough so that the distribution of $1.00 to an account and department without replacement is roughly equivalent to sampling with replacement.

\(^{30}\)Mood, op. cit., p. 271.
\[
\sum_{i,j} \frac{(n_{ij} - np_{ij})^2}{np_{ij}}
\] (Pearsonian \( \chi^2 \))

can now be redefined using our standard variables,

\[
\sum_{i,j} \frac{n_{ij} (AAPRO_{ij} - APPR2_{ij})^2}{AAPR2_{ij}}
\]

More simply put,

\[
\sum \frac{(observed - expected)^2}{expected}
\]

If it is valid to view our model(s) as generating probabilities of dollars finding their way into a particular account in a particular department, we can draw on the work of Hunt for guidelines in choosing between our model and the alternative models.

Hunt contends that two meaningful statistics can be used to distinguish between models. He cites the \( \chi^2 \)-quantity as a value to be minimized when choosing between models for a fixed set of data:\(^{31}\)

\[
\text{Min} \sum \frac{(observed - expected)^2}{expected}
\]

By applying Bayes' theorem to model evaluation, Hunt also uses a Bayesian induction criterion to select the correct model. The criterion is:\(^{32}\)


\(^{32}\)Hunt, op. cit., p. 41.
Restated, the two criteria become:

A. Chi-squared:

$$
\text{Min } \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{(\text{AAPRO}_{ij} - \text{APPR2}_{ij})^2}{\text{APPR2}_{ij}}
$$

B. Bayesian Induction:

$$
\text{Min } \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{(\text{APPRO}_{ij} - \text{APPR2}_{ij})^2}{\text{APPRO}_{ij}}
$$

It should be further noted that in order to make effective use of these criteria, we must recognize that they represent approximations of other statistical functions. These approximations break down for "rare events."\(^{33}\) "Rare events" refers to the magnitude of the denomination in A and B above. We can operationalize the above criteria by excluding rare events from our calculations, where "rare event" is defined as accounts whose expected (for the \(\chi^2\) criteria) or observed (for the Bayesian Induction criteria) appropriations are less than twenty dollars. Elimination of rare events introduces another problem -- depending on the model results, we can have different numbers of departments and accounts (categories) for different models. Summing over different events makes the models incomparable again. To circumvent this problem, we are introducing another modification in the criteria. To make the criteria comparable

\(^{33}\)Hunt, _op. cit._, p. 42.
once again, the statistics totals will be divided by the number of observations (departments and accounts) contributing to the sum. This "average" $\chi^2$ or Bayesian Induction total will be used as the relevant criteria:

$$A'. \text{ Chi-squared:}$$

$$\text{Min} \frac{n \sum m_i (\text{AAPRO}_{ij} - \text{APPR2}_{ij})^2}{\sum \text{AAPRO}_{ij}}$$

$$\text{for } \text{APPR2}_{ij} \geq 20$$

$$B'. \text{ Bayesian Induction:}$$

$$\text{Min} \frac{n \sum m_i (\text{AAPRO}_{ij} - \text{APPR2}_{ij})^2}{\sum \text{AAPRO}_{ij}}$$

$$\text{for } \text{AAPRO}_{ij} \geq 20$$

B.2.c. Goodness-of-Fit Tests

In analyzing the relative "predictive" powers of our models, we will rely on two $r^2$-equivalent measures based on the alternative hypotheses that:

a. next-year's appropriations equals mean of appropriations throughout the study period.

b. next-year's appropriation equals current appropriations.

In addition, three alternative models will be used to generate

33a The underlying statistical distributions for the statistics in A' and B' are unknown. By referring to "Chi-squared" we wish only to maintain the continuity in this report, not to suggest a relationship between our statistic and the Chi-squared distribution.
predictions to be compared with our process model:

A1. Constant growth model
A2. Constant-share-of-the-pie model
A3. Constant-share-of-the-increase model

Choice between our model and the alternative models (considering only predictive power) will be based on Chi-squared and Bayesian Induction statistics, as well as on the $r^2_c$ and $r^2_m$ statistics.

The naive, alternative models will be run as one-period change models.

There are many ways of compiling the goodness-of-fit measures we have discussed -- by city, by department, by submodel, by standard account type, by year, for the entire study period, etc. The following were computed for final appropriations predictions generated by the one-period change and simulation models and for A1, A2, and A3:

1. $r^2_m$ - appropriations equals study period mean - computed over entire study period, by city,
2. Bayesian Induction Statistic - by city, by year,
3. Chi-squared Statistic - by city, by year.

Computed for the one-period change, simulation, and A3 models was $r^2_c$, by city, by year. In addition, $r^2_c$, Bayesian Induction Statistics, and Chi-squared Statistics were computed for DEPT. and MAYORS submodels for the one-period change and simulation models. These submodel measures of fit were consistent with the measures for final appropriations and will not be found in this section.
Another, rather incidental, goodness-of-fit measure was calculated, having as an alternative hypothesis: appropriations for a particular department and account equals the average over all departments and accounts in the city for that year. The inclusion of this statistic \( r^2_o \) may make it easier for the reader to relate \( r^2_c \) and \( r^2_m \) to the more familiar regression \( r^2 \).

By calculating separate goodness-of-fit measures for each year, rather than obtaining one summary measure for the study period, it is hoped some "causes" can be established for model success or failure. Some possible "causes" that are monitored are changes in administration and changing total revenue patterns.

**B.2.d. Pittsburgh Goodness-of-Fit**
Pittsburgh Goodness-of-Fit Measures

Bayesian Induction Statistic

\[
\frac{n \sum \sum (\text{APPR}^2_{ij} - \text{AAPRO}_{ij})^2}{\sum \sum \text{AAPRO}_{ij}}
\]

\[
\frac{n}{\sum m_i}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chnc.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>4.095x10^3</td>
<td>9.430x10^4</td>
<td>1.671x10^3</td>
<td>2.503x10^4</td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>2.207x10^3</td>
<td>2.466x10^4</td>
<td>1.601x10^3</td>
<td>2.175x10^4</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>2.254x10^3</td>
<td>2.254x10^3</td>
<td>1.134x10^4</td>
<td>1.366x10^3</td>
<td>-1.252x10^5</td>
</tr>
<tr>
<td>1963</td>
<td>6.498x10^3</td>
<td>8.755x10^3</td>
<td>4.514x10^5</td>
<td>3.164x10^3</td>
<td>3.117x10^6</td>
</tr>
<tr>
<td>1964</td>
<td>2.177x10^3</td>
<td>4.939x10^3</td>
<td>1.274x10^5</td>
<td>1.130x10^3</td>
<td>1.456x10^4</td>
</tr>
<tr>
<td>1965</td>
<td>1.749x10^3</td>
<td>1.498x10^4</td>
<td>8.415x10^3</td>
<td>4.877x10^3</td>
<td>4.89x10^4</td>
</tr>
</tbody>
</table>

**APPR^2_{ij}** = model estimate, department i, account j.

**AAPRO_{ij}** = observed appropriations, department i, account j.

**m_i** = number of accounts, department i.

**n** = total number of departments.

**APPR1_{ij}** = "Last-year's" appropriation.

*denominator is: (AAPRO_{ij} - APPR1_{ij})

Figure 6-9
Pittsburgh Goodness-of-Fit Measures

Chi-Squared Statistics

\[
\frac{n \sum_{i=1}^{m_i} \frac{(\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\text{APPR2}_{ij}}}{\sum_{i=1}^{n} m_i}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>2.137x10^3</td>
<td>6.588x10^4</td>
<td>2.064x10^3</td>
<td>-1.995x10^5</td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>2.373x10^3</td>
<td>6.578x10^5</td>
<td>1.985x10^3</td>
<td>5.914x10^3</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>3.824x10^3</td>
<td>3.824x10^3</td>
<td>6.387x10^5</td>
<td>1.96x10^3</td>
<td>2.085x10^3</td>
</tr>
<tr>
<td>1963</td>
<td>8.000x10^3</td>
<td>7.520x10^3</td>
<td>7.885x10^4</td>
<td>5.459x10^3</td>
<td>-1.747x10^2</td>
</tr>
<tr>
<td>1964</td>
<td>1.975x10^3</td>
<td>5.342x10^3</td>
<td>1.239x10^4</td>
<td>8.603x10^2</td>
<td>-3.036x10^4</td>
</tr>
<tr>
<td>1965</td>
<td>8.951x10^2</td>
<td>8.24x10^3</td>
<td>4.152x10^3</td>
<td>1.970x10^3</td>
<td>-6.867x10^4</td>
</tr>
</tbody>
</table>

\text{APPR2}_{ij} = \text{model estimate, department } i, \text{ account } j. \\
\text{AAPRO}_{ij} = \text{observed appropriations, department } i, \text{ account } j. \\
\text{m}_i = \text{number of accounts, department } i. \\
\text{n} = \text{total number of departments.}

*denominator is: \((\text{APPR2}_{ij} - \text{APPR1}_{ij})\)
Pittsburgh Goodness-of-Fit Measures

\[ r_c^2 = 1.0 - \frac{\sum\sum_{i,j} m_i (APPR2_{ij} - AAPRO_{ij})^2}{\sum\sum_{i,j} m_i (AAPRO_{ij} - APPR1_{ij})^2} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>.0305</td>
<td></td>
<td>-.0872</td>
</tr>
<tr>
<td>1961</td>
<td>.7392</td>
<td></td>
<td>-.1961</td>
</tr>
<tr>
<td>1962</td>
<td>-.1079</td>
<td>-.1079</td>
<td>-57.17</td>
</tr>
<tr>
<td>1963</td>
<td>-.1210</td>
<td>-.0613</td>
<td>-393.7</td>
</tr>
<tr>
<td>1964</td>
<td>.8415</td>
<td>.5001</td>
<td>.8977</td>
</tr>
<tr>
<td>1965</td>
<td>.0178</td>
<td>.0117</td>
<td>-.4619</td>
</tr>
</tbody>
</table>

APPR2_{ij} = model estimate, department i, account j.

AAPRO_{ij} = observed appropriations, department i, account j.

m_i = number of accounts, department i.

n = total number of departments.

APPR1_{ij} = "Last-year's" appropriations.

Figure 6-11
Pittsburgh Goodness-of-Fit Measure

\[ r_0^2 = 1.0 - \frac{\sum_{i}^{n} \sum_{j}^{m_i} (\text{APPR}_{ij} - \text{AAPRO}_{ij})^2}{\sum_{i}^{n} \sum_{j}^{m_i} (\text{AAPRO}_{ij} - \text{AAPRO})^2} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>.9989</td>
<td>.6269</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>.9988</td>
<td>.7544</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>.9948</td>
<td>.9948</td>
<td>.7321</td>
<td>.9974</td>
</tr>
<tr>
<td>1963</td>
<td>.9951</td>
<td>.9950</td>
<td>.6969</td>
<td>.9981</td>
</tr>
<tr>
<td>1964</td>
<td>.9996</td>
<td>.9979</td>
<td>.6231</td>
<td>.9997</td>
</tr>
<tr>
<td>1965</td>
<td>.9980</td>
<td>.9943</td>
<td>.7554</td>
<td>.9984</td>
</tr>
</tbody>
</table>

\text{APPR}_{ij} = \text{model estimate, department } i, \text{ account } j.

\text{AAPRO}_{ij} = \text{observed appropriations, department } i, \text{ account } j.

m_i = \text{number of accounts, department } i.

n = \text{total number of departments.}

\text{AAPRO} = \text{average of all observed appropriations.}

Figure 6-12
Figure 6-13

PITTSBURGH GOODNESS-OF-FIT MEASURES

Appropriations
(+ increase (0) (++) (-) (0) (++) (+)
PITTSBURGH GOODNESS-OF-FIT MEASURES

Portion of Variance "Explained" by "model vs. assumption "This Year's equals Last Year's"

1960 (0) Appropriations
1961 (+) Increase
1962 (-) Decrease
1963 (0)
1964 (+)
1965 (-)

Figure 6-1

Ship fuel, same demand

+1/2% general salary increase financed by +1/2% income tax

Large consternation on salary increments, tight budget, no supplemental requests granted.

"Hard times" all requests for or below current appropriations - many were dropped, packing up, other stringent revenue tactics

Economic outlook better - "back to normal"

Revenue problems ease due to economic climate - merit raises, tax dropped.
The Pittsburgh results are of more interest for what they do not show than for what they show.

First, the one-period change model did not appear to "shift" or experience any "difficulty" in processing a new mayor. None of the measures associated with the 1960 budget (new mayor) appear to reflect this change in the decision system. This should not be too surprising, however. The previous mayor in Pittsburgh resigned to become Governor of Pennsylvania. The outgoing mayor "chose" (with his party's approval) his replacement. The transition was smooth and the new mayor retained the retiring mayor's personal staff and administration. In our system of stable relationships and mutual expectations, we would expect the system characteristics to change only if there were a substantial change in the actors. With a change of only one actor (mayor), it is far more likely that the single actor will, through a process of socialization or "learning" merge with the existing system, than change the system.

Our process models (one-period change and simulation) did not do quite as well at allocating under conditions of declining revenues (appropriations) as it did at allocating budgetary increases (see Figure 6-13). Referring to the fit of naive model A3 ("constant-share-of-decrease") to the 1962 and 1963 budgets, it is apparent that budget cuts are not across-the-board cuts. By examining Figures 6-14 and 6-11, it is apparent that the deficit-elimination procedures contained in our process model account for budget reduction procedures "better" than A3. On the other hand, A2's (constant-share-of-total-
budget) naive predictions are nearly as accurate as those of our process models.

As was expected, (see discussion on p. 6-35 and 6-36), the values of $r_c^2$ in years where appropriations (revenues) were nearly constant (1960 and 1963) or declining (1962) are near zero. The corresponding values of the Bayesian Induction and Chi-squared Statistics did not rise, however, indicating the problem is with the goodness-of-fit measure and not necessarily with the model(s).

In summary, our one-period change and simulation models perform reasonably well on all goodness-of-fit measures. Given the short study period (6 years) and the fluctuating revenue picture, the total change in the budget during the period was not great. Consequently, the naive models emphasizing stability -- A2: constant-share-of-the-total -- proved to be a slightly better predictor. Naive models emphasizing change -- A1 (constant growth) and A3 (constant share of the increase) -- did not fare as well.

B.2.e. Cleveland Goodness-of-Fit
Cleveland Goodness-of-Fit Measures

Bayesian Induction Statistic

\[ n \sum_{i} \sum_{j} \left( \frac{\text{APPR}_{ij} - \text{AAPRO}_{ij}}{\text{AAPRO}_{ij}} \right)^2 \]

\[ \sum_{i} \sum m_{i} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>8.330x10^3</td>
<td>2.051x10^4</td>
<td>2.507x10^5</td>
<td>2.475x10^5</td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>3.825x10^3</td>
<td>3.256x10^4</td>
<td>2.803x10^5</td>
<td>1.055x10^5</td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>1.618x10^4</td>
<td>5.895x10^4</td>
<td>2.385x10^4</td>
<td>-1.468x10^6</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>4.742x10^4</td>
<td>6.395x10^3</td>
<td>1.421x10^4</td>
<td>1.514x10^6</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>1.881x10^3</td>
<td>1.881x10^3</td>
<td>2.817x10^3</td>
<td>1.401x10^4</td>
<td>1.619x10^5</td>
</tr>
<tr>
<td>1961</td>
<td>2.160x10^3</td>
<td>4.070x10^3</td>
<td>5.092x10^3</td>
<td>1.485x10^4</td>
<td>8.044x10^4</td>
</tr>
<tr>
<td>1962</td>
<td>1.515x10^3</td>
<td>6.650x10^3</td>
<td>5.912x10^3</td>
<td>1.481x10^4</td>
<td>6.381x10^4</td>
</tr>
<tr>
<td>1963</td>
<td>9.840x10^2</td>
<td>6.920x10^3</td>
<td>1.077x10^4</td>
<td>1.702x10^4</td>
<td>5.738x10^6</td>
</tr>
<tr>
<td>1964</td>
<td>4.380x10^3</td>
<td>2.096x10^4</td>
<td>1.203x10^4</td>
<td>2.005x10^4</td>
<td>6.734x10^4</td>
</tr>
<tr>
<td>1965</td>
<td>3.170x10^3</td>
<td>2.135x10^4</td>
<td>3.565x10^4</td>
<td>6.763x10^4</td>
<td>-1.335x10^5</td>
</tr>
</tbody>
</table>

\[ \text{APPR}_{ij} = \text{model estimate, department } i, \text{ account } j. \]

\[ \text{AAPRO}_{ij} = \text{observed appropriations, department } i, \text{ account } j. \]

\[ m_{i} = \text{number of accounts, department } i. \]

\[ n = \text{total number of departments.} \]

*denominator = (AAPRO_{ij} - APPR_{ij})
Cleveland Goodness-of-Fit Measures

Chi-Squared Statistic

$$\frac{n \sum_{i=1}^{n} m_i (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum_{i=1}^{n} m_i \text{APPR2}_{ij}}$$

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>2.920x10^3</td>
<td>1.799x10^4</td>
<td>6.487x10^4</td>
<td>1.136x10^5</td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>6.690x10^4</td>
<td>1.349x10^4</td>
<td>5.974x10^3</td>
<td>3.22x10^5</td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>7.940x10^4</td>
<td>2.750x10^4</td>
<td>2.168x10^3</td>
<td>5.111x10^4</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>3.440x10^4</td>
<td>1.414x10^4</td>
<td>5.033x10^3</td>
<td>9.335x10^4</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>1.430x10^3</td>
<td>1.430x10^3</td>
<td>3.486x10^3</td>
<td>5.119x10^3</td>
<td>4.037x10^4</td>
</tr>
<tr>
<td>1961</td>
<td>4.975x10^3</td>
<td>4.910x10^3</td>
<td>3.500x10^3</td>
<td>3.390x10^3</td>
<td>2.928x10^4</td>
</tr>
<tr>
<td>1962</td>
<td>6.001x10^2</td>
<td>7.210x10^3</td>
<td>4.20x10^3</td>
<td>3.40x10^3</td>
<td>-2.788x10^3</td>
</tr>
<tr>
<td>1963</td>
<td>8.540x10^3</td>
<td>1.622x10^4</td>
<td>4.095x10^3</td>
<td>2.922x10^3</td>
<td>-3.748x10^3</td>
</tr>
<tr>
<td>1964</td>
<td>5.299x10^3</td>
<td>3.221x10^4</td>
<td>8.903x10^3</td>
<td>4.745x10^3</td>
<td>5.282x10^4</td>
</tr>
<tr>
<td>1965</td>
<td>6.170x10^3</td>
<td>3.530x10^4</td>
<td>2.336x10^5</td>
<td>3.569x10^5</td>
<td>4.039x10^5</td>
</tr>
</tbody>
</table>

APPR2_{ij} = model estimate, department i, account j.

AAPRO_{ij} = observed appropriations, department i, account j.

m_i = number of accounts, department i.

n = total number of departments.

*denominator = (APPR2_{ij} - APPR1_{ij})

Figure 6-16
Cleveland Goodness-of-Fit Measures

\[
r_c^2 = 1.0 - \frac{\sum_{i}^{n} \sum_{j}^{m_i} (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum_{i}^{n} \sum_{j}^{m_i} (\text{AAPRO}_{ij} - \text{AAPRO})^2}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd.Chng.</th>
<th>Simulation</th>
<th>A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>-.9469</td>
<td>---</td>
<td>.188</td>
</tr>
<tr>
<td>1957</td>
<td>.7507</td>
<td>---</td>
<td>.4793</td>
</tr>
<tr>
<td>1958</td>
<td>.0378</td>
<td>---</td>
<td>-16.8</td>
</tr>
<tr>
<td>1959</td>
<td>-.4422</td>
<td>---</td>
<td>.011</td>
</tr>
<tr>
<td>1960</td>
<td>.9302</td>
<td>.9302</td>
<td>.2179</td>
</tr>
<tr>
<td>1961</td>
<td>.8631</td>
<td>.1730</td>
<td>.2999</td>
</tr>
<tr>
<td>1962</td>
<td>-.2527</td>
<td>-5.254</td>
<td>-3.74</td>
</tr>
<tr>
<td>1963</td>
<td>-.0048</td>
<td>-.2537</td>
<td>-14.4</td>
</tr>
<tr>
<td>1964</td>
<td>.3510</td>
<td>-.0301</td>
<td>.4129</td>
</tr>
<tr>
<td>1965</td>
<td>-.2707</td>
<td>.0021</td>
<td>-1.12</td>
</tr>
</tbody>
</table>

\[\text{APPR2}_{ij} = \text{model estimate, department } i, \text{ account } j.\]

\[\text{AAPRO}_{ij} = \text{observed appropriations, department } i, \text{ account } j.\]

\[m_i = \text{number of accounts, department } i.\]

\[n = \text{total number of departments.}\]

Figure 6-17
Cleveland Goodness-of-Fit Measures

\[
r^2 = 1.0 - \frac{\sum_{i} \sum_{j} (\text{APPR}_{2ij} - \text{AAPRO}_{ij})^2}{\sum_{i} \sum_{j} (\text{AAPRO}_{ij} - \text{AAPRO})^2}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>.9971</td>
<td>---</td>
<td>.9730</td>
<td>.9191</td>
</tr>
<tr>
<td>1957</td>
<td>.9993</td>
<td>---</td>
<td>.9792</td>
<td>.9150</td>
</tr>
<tr>
<td>1958</td>
<td>.8953</td>
<td>---</td>
<td>.9515</td>
<td>.9927</td>
</tr>
<tr>
<td>1959</td>
<td>.9926</td>
<td>---</td>
<td>.9987</td>
<td>.9952</td>
</tr>
<tr>
<td>1960</td>
<td>.9998</td>
<td>.9998</td>
<td>.9981</td>
<td>.9953</td>
</tr>
<tr>
<td>1961</td>
<td>.9996</td>
<td>.9968</td>
<td>.9941</td>
<td>.9950</td>
</tr>
<tr>
<td>1962</td>
<td>.9999</td>
<td>.9966</td>
<td>.9929</td>
<td>.9954</td>
</tr>
<tr>
<td>1963</td>
<td>.9985</td>
<td>.9944</td>
<td>.9918</td>
<td>.9947</td>
</tr>
<tr>
<td>1964</td>
<td>.9939</td>
<td>.9778</td>
<td>.9797</td>
<td>.9931</td>
</tr>
<tr>
<td>1965</td>
<td>.9992</td>
<td>.9770</td>
<td>.9464</td>
<td>.8729</td>
</tr>
</tbody>
</table>

\(\text{APPR}_{2ij}\) = model estimate, department \(i\), account \(j\).

\(\text{AAPRO}_{ij}\) = observed appropriations, department \(i\), account \(j\).

\(m_i\) = number of accounts, department \(i\).

\(n\) = total number of departments.

\(\text{AAPRO}\) = average of all observed appropriations.

Figure 6-18
CLEVELAND GOODNESS-OF-FIT MEASURES

Appropriations
(+ increase) (+) (+) (-) (+) (+) (+) (0) (0) (+) (+)
CLEVELAND GOODNESS-OF-FIT MEASURES

Appropriations
Figure 6-21


1956 (+) 1957 (+) 1958 (-) 1959 (+) 1960 (+) 1961 (+) 1962 (+) 1963 (+) 1964 (+) 1965 (+)

A2

Simulation

I-Pd, Cave

General salary increase
New Traffic Engineering Dept.

City hospital to County
Police & Fire only pay increase

New mayor
Some admin. - Sewer Maint.
Out of general fund

10% general salary increase
Additional police inc.
The Cleveland models performed in much the same manner as their Pittsburgh counterparts. No "shift" in model fit with a change in city administration was noted. Again this would be expected. The man who had been mayor in Cleveland for a number of years, resigned his position to accept a Cabinet post. The vacancy was filled from within the incumbent political party and, similar to the case in Pittsburgh, did not result in a change in the administration, only in the change of one member.

The Cleveland one-period change and simulation models appear to work equally well for revenue increases and declines (see Figures 6-18, 6-19, and 6-20), unlike the Pittsburgh models.

A major organization change in Cleveland city government in the study period shows up as a "poor year" in four measures (Bayesian, Chi-squared, $r_o^2$, and $r_c^2$). More will be said about this policy shift in Section 7 when model residuals are analyzed.

On the basis of predictability only, the one-period change model would be chosen over the naive models in nine of ten years using the Bayesian Induction criteria, half of the time using the Chi-squared statistics, in eight of ten years using $r_c^2$, and in seven of ten years using $r_o^2$.

The Cleveland data, unlike Pittsburgh's, represent a much wider range of activities. While the study period in Pittsburgh exhibited a fluctuating revenue pattern, there was no substantial change in the budget total over the six years. During the ten-year study period in Cleveland, however, the total budget increased
substantially. Consequently, Cleveland parameters and, hence, the
Cleveland process models probably represent a better test of our
theory than does Pittsburgh.

B.2.f. Detroit Goodness-of-Fit Measures

Before examining the model applications to Detroit in detail,
there are some "operating irregularities" that will strongly influence
the model fit that should be discussed.

1. Welfare payments — In Detroit, both the State and City
"cooperate" on welfare payments, with each paying its
share. The first portion of the seven year study period
in Detroit was dominated by the difficulties surrounding
the State's share of the total. In 1957, the State,
unilaterally cut its share of payments from 50% to 30%.
This caused a deficit of $6.8 million for the 1957-58
fiscal year,\textsuperscript{36} plus provided for a corresponding increase in

\textsuperscript{36}The City administration appeared committed to the existing
schedule of welfare payments. Otherwise another response to the
State-share reduction could have been to reduce total welfare
payments proportional to the State's reduction — i.e., lower payments
and blame the State government, not the City Welfare department. The
reduction in the State share from 50% to 30% was the product of an
outstate, Republican legislature against the wishes of the State
Executive branch, controlled by more "urban-minded" Democrats. The
reluctance to reduce welfare payments could have been to avoid
embarrassing the State administration (both the State Executive and
City officials draw their political and elective support from the
same groups -- Detroit labor -- who would be affected by the welfare
reduction) or could have represented a commitment to the existing
payment schedule.
the 1957-58 budget. Perhaps the most important outcome of this was that the 1957-58 deficit was refinanced, thus providing a precedent for deficit spending.

2. Large Operating Deficits -- Partly due to the Welfare problems above, and partly due to the economic downturn in the late 1950's resulting in inflated revenue estimates and faulty expenditure estimates (particularly on Welfare needs), Detroit accumulated a general fund deficit of over $19,200,000. In addition, operating deficits in previous years had been partially financed through deferred payments to the tax-supported employees pension systems. Funds had been transferred from the pension funds to the General Fund -- illegally, according to a 1962 Circuit Court decision. At any rate, when a new administration took office in 1963, it was faced with a $35,000,000-plus, deficit. "It was therefore necessary in the 1962-63 budget to add approximately $18,500,000 to previously underfinanced appropriations just to maintain the existing level of operations and further eliminate over-estimation of revenue in the sum of approximately $2,000,000."35 In addition, old deficits had to be financed. The response was an income tax for the City.

---

An accounting irregularity also existed until 1962-63:

3. **Capital Items Included in Operating Budget** -- Until 1962-63, the Detroit "operating" or General Fund budget included a series of large improvements or capital items. Subsequently, items of this nature were included in the capital budget. As a result of this accounting irregularity, many "errors" are built into the model. Departments whose expenditures include a major capital item before 1962-63 will not only contribute greatly to the total model error for that year, but the department parameters, being biased, will generate faulty model estimates for other years.

The ideal way to handle the third problem would have been to eliminate large, capital items from the raw, Detroit budget data. Unfortunately, detailed appropriations records were not available for the earlier years in Detroit.

Insofar as the operating-deficit problem affects the planning or budgeting process indirectly most of the time, it does not constitute a problem of the magnitude presented by the capital items. Again, the effect enters through the revenue constraint and represents a kind of "pad" on the revenues during the years the deficit is incurred, or alternatively, represents an external source of funds. In the years the accumulated deficit must be eliminated (1962-63 and 1963-64) it represents a pressure to increase total revenues, and an "automatic" or "accounting deduction" from the revenue estimate. The direct effects of the problem of deficit financing were largely
"eliminated" by our choice of revenue estimating procedures (see, above, item A.1.a, Section 6).

The Welfare problem with the State can be partially eliminated by subtracting Welfare appropriations from the revenue estimate and by not considering the Welfare department in the budget. This will eliminate the "direct" effect of the Welfare department, but will not remove the effects this externally-caused event had on the other department appropriations as mediated by the revenue constraint.

Because this change did not require any recalculation of parameters, the Detroit one-period change and simulation models were run two ways:

1. with the Welfare Department —  W
2. without the Welfare Department —  NW

In examining overall goodness-of-fit for Detroit, it appears, especially in the $r_c^2$ and $r_0^2$ statistics, that by removing the welfare estimates, we removed proportionately more variance from the actual appropriations than we did from the model errors. This causes the $r_c^2$ (alternative hypothesis: new budget amount equals current appropriations) (see Figures 6-31, 6-23, and 6-27) and $r_0^2$ (see Figures 6-30, 6-24, and 6-28) to be higher with Welfare included than without. A glance at the Chi-squared (see Figures 6-29, 6-22, and 6-26) and Bayesian Induction Statistics (see Figures 6-29, 6-21, and 6-27) reveals a significant overall improvement, however.

All of the goodness-of-fit measures seem to improve considerably at the end of the study period (1962-63 and after). Two events would seem to account for this. First, 1962-63 signals the start of the
Detroit* Goodness-of-Fit Measure

Bayesian Induction Statistic

\[ \frac{n}{\sum \frac{m_i (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum \text{AAPRO}_{ij}}} \]

\[ \frac{n}{\sum m_i} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3**</th>
</tr>
</thead>
</table>
| 1958-59  | 8.45x10^8   | 1.856x10^5 | 2.206x10^5 | -----
| 1959-60  | 4.033x10^5  | 3.099x10^5 | 3.324x10^5 | 8.33x10^5 |
| 1960-61  | 2.319x10^4  | 2.319x10^4 | 1.470x10^5 | 1.204x10^5 | -6.34x10^6 |
| 1961-62  | 1.725x10^5  | 1.763x10^5 | 1.036x10^6 | 6.675x10^5 | -1.301x10^6 |
| 1962-63  | 4.371x10^5  | 6.267x10^5 | 2.458x10^5 | 1.872x10^5 | 1.763x10^4 |
| 1963-64  | 3.572x10^5  | 1.504x10^6 | 6.630x10^5 | 2.837x10^5 | 7.186x10^5 |
| 1964-65  | 4.040x10^4  | 2.303x10^6 | 1.262x10^5 | 3.482x10^5 | -5.96x10^6 |

APPR2_{ij} = model estimate, department i, account j.

AAPRO_{ij} = observed appropriations, department i, account j.

m_i = number of accounts, department i.

n = total number of departments

*including Welfare Department

**denominator = (AAPRO_{ij} - APPR1_{ij})

Figure 6-21
Detroit Goodness-of-Fit Measures

Chi-Squared Statistics

\[
\frac{n \sum_{i} \sum_{j} \frac{(\text{APPR}2_{ij} - \text{AAPRO}_{ij})^2}{\text{APPR}2_{ij}}}{m} = \frac{\sum_{i} \sum_{j} m_i}{m}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chang.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>5.826x10^5</td>
<td>5.711x10^5</td>
<td>5.635x10^5</td>
<td>3.045x10^5</td>
<td></td>
</tr>
<tr>
<td>1959-60</td>
<td>6.988x10^4</td>
<td>5.536x10^5</td>
<td>9.868x10^5</td>
<td>1.945x10^5</td>
<td></td>
</tr>
<tr>
<td>1960-61</td>
<td>7.664x10^4</td>
<td>7.644x10^4</td>
<td>7.357x10^5</td>
<td>9.631x10^5</td>
<td></td>
</tr>
<tr>
<td>1961-62</td>
<td>1.172x10^6</td>
<td>1.614x10^6</td>
<td>3.136x10^5</td>
<td>4.459x10^5</td>
<td></td>
</tr>
<tr>
<td>1962-63</td>
<td>1.492x10^5</td>
<td>1.383x10^6</td>
<td>4.112x10^6</td>
<td>9.932x10^6</td>
<td></td>
</tr>
<tr>
<td>1963-64</td>
<td>7.400x10^4</td>
<td>1.595x10^6</td>
<td>2.749x10^6</td>
<td>3.854x10^6</td>
<td></td>
</tr>
<tr>
<td>1964-65</td>
<td>6.085x10^4</td>
<td>9.350x10^5</td>
<td>9.453x10^5</td>
<td>2.909x10^6</td>
<td></td>
</tr>
</tbody>
</table>

APPR2_{ij} = model estimate, department \(i\), account \(j\).

AAPRO_{ij} = observed appropriations, department \(i\), account \(j\).

\(m_i\) = number of accounts, department \(i\).

\(n\) = total number of departments.

*including Welfare Department

**denominator = (AAPR2_{ij} - APPR1_{ij})

Figure 6-22
Detroit* Goodness-of-Fit Measure

\[
    r_c^2 = 1.0 - \frac{\sum_{i} m_i \left( \sum_{j} (\text{APPR}2_{ij} - \text{AAPRO}_{ij})^2 \right)}{\sum_{i} m_i \left( \sum_{j} (\text{AAPRO}_{ij} - \text{APPR}1_{ij})^2 \right)}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chnn.</th>
<th>Simulation</th>
<th>A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>.8755</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>1959-60</td>
<td>-.4764</td>
<td></td>
<td>-11.1</td>
</tr>
<tr>
<td>1960-61</td>
<td>.9631</td>
<td>.9631</td>
<td>-24.0</td>
</tr>
<tr>
<td>1961-62</td>
<td>-.2731</td>
<td>.0525</td>
<td>-4.6</td>
</tr>
<tr>
<td>1962-63</td>
<td>.7389</td>
<td>.3136</td>
<td>-2.94</td>
</tr>
<tr>
<td>1963-64</td>
<td>.6949</td>
<td>.045</td>
<td>-4.39</td>
</tr>
<tr>
<td>1964-65</td>
<td>.1035</td>
<td>-.0194</td>
<td>-31.36</td>
</tr>
</tbody>
</table>

\( \text{APPR}2_{ij} \) = model estimate, department \( i \), account \( j \).
\( \text{AAPRO}_{ij} \) = observed appropriations, department \( i \), account \( j \).
\( m_i \) = number of accounts, department \( i \).
\( n \) = total number of departments
\( \text{APPR}1_{ij} \) = "Last-year's" appropriation.

*Including Welfare Department.
Detroit Goodness-of-Fit Measures

\[
r_0^2 = 1.0 - \frac{\sum_{i}^{n} \sum_{j}^{m_i} (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum_{i}^{n} \sum_{j}^{m_i} (\text{AAPRO}_{ij} - \text{AAPRO})^2}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>l-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>.8863</td>
<td></td>
<td>.9761</td>
<td>.9541</td>
</tr>
<tr>
<td>1959-60</td>
<td>.9621</td>
<td></td>
<td>.9429</td>
<td>.9257</td>
</tr>
<tr>
<td>1960-61</td>
<td>.9980</td>
<td>.9980</td>
<td>.9765</td>
<td>.9601</td>
</tr>
<tr>
<td>1961-62</td>
<td>.9439</td>
<td>.9560</td>
<td>.8851</td>
<td>.8698</td>
</tr>
<tr>
<td>1962-63</td>
<td>.9401</td>
<td>.9126</td>
<td>.8668</td>
<td>.8919</td>
</tr>
<tr>
<td>1963-64</td>
<td>.9880</td>
<td>.9200</td>
<td>.8467</td>
<td>.9057</td>
</tr>
<tr>
<td>1964-65</td>
<td>.9761</td>
<td>.9331</td>
<td>.8345</td>
<td>.8925</td>
</tr>
</tbody>
</table>

\[\text{APPR2}_{ij} = \text{model estimate, department } i, \text{ account } j.\]

\[\text{AAPRO}_{ij} = \text{observed appropriations, department } i, \text{ account } j.\]

\[m_i = \text{number of accounts, department } i.\]

\[n = \text{total number of departments.}\]

\[\text{AAPRO} = \text{average of all observed appropriations.}\]

*including Welfare Department

Figure 6-24
Detroit* Goodness-of-Fit Measures

Bayesian Induction Statistic

\[ \frac{n \sum m_i (\text{APPR}2_{ij} - \text{AAPRO}0_{ij})^2}{\sum \text{AAPRO}1_{ij}} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>3.715x10^5</td>
<td>1.856x10^5</td>
<td>2.206x10^5</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>1959-60</td>
<td>3.981x10^5</td>
<td>3.099x10^5</td>
<td>3.324x10^5</td>
<td>8.33x10^5</td>
<td></td>
</tr>
<tr>
<td>1960-61</td>
<td>2.098x10^4</td>
<td>2.098x10^4</td>
<td>1.470x10^5</td>
<td>1.204x10^5</td>
<td>-6.34x10^6</td>
</tr>
<tr>
<td>1961-62</td>
<td>3.648x10^5</td>
<td>1.171x10^5</td>
<td>1.036x10^6</td>
<td>6.675x10^5</td>
<td>-1.301x10^6</td>
</tr>
<tr>
<td>1962-63</td>
<td>1.861x10^5</td>
<td>9.470x10^4</td>
<td>2.458x10^5</td>
<td>1.972x10^5</td>
<td>1.763x10^4</td>
</tr>
<tr>
<td>1963-64</td>
<td>4.395x10^5</td>
<td>5.956x10^5</td>
<td>6.630x10^5</td>
<td>2.837x10^5</td>
<td>7.186x10^5</td>
</tr>
<tr>
<td>1964-65</td>
<td>1.906x10^4</td>
<td>1.157x10^6</td>
<td>1.262x10^5</td>
<td>3.483x10^5</td>
<td>-5.96x10^6</td>
</tr>
</tbody>
</table>

**APPR2_{ij} =** model estimate, department \(i\), account \(j\).

**AAPRO0_{ij} =** observed appropriations, department \(i\), account \(j\).

\(m_i =\) number of accounts, department \(i\).

\(n =\) total number of departments.

*not including Welfare Department

**denominator = (AAPRO0_{ij} - APPR1_{ij})

Figure 6-25
Detroit* Goodness-of-Fit Measures

Chi-Squared Statistic

\[
\frac{n \sum m_i (\text{APPR2}_{ij} - \text{AAPRO}_{ij})^2}{\sum \text{APPR2}_{ij}}
\]

\[
\sum m_i
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
<th>A3**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>7.449x10^4</td>
<td>5.711x10^5</td>
<td>5.635x10^5</td>
<td>3.045x10^5</td>
<td></td>
</tr>
<tr>
<td>1959-60</td>
<td>6.199x10^4</td>
<td>5.536x10^5</td>
<td>9.866x10^5</td>
<td>1.945x10^5</td>
<td></td>
</tr>
<tr>
<td>1960-61</td>
<td>4.928x10^4</td>
<td>7.357x10^5</td>
<td>9.631x10^5</td>
<td>2.810x10^5</td>
<td></td>
</tr>
<tr>
<td>1961-62</td>
<td>1.634x10^6</td>
<td>3.136x10^5</td>
<td>4.459x10^5</td>
<td>-4.654x10^5</td>
<td></td>
</tr>
<tr>
<td>1962-63</td>
<td>4.584x10^4</td>
<td>4.112x10^6</td>
<td>9.932x10^6</td>
<td>2.410x10^7</td>
<td></td>
</tr>
<tr>
<td>1963-64</td>
<td>6.886x10^4</td>
<td>2.749x10^6</td>
<td>3.845x10^6</td>
<td>7.836x10^4</td>
<td></td>
</tr>
<tr>
<td>1964-65</td>
<td>4.406x10^4</td>
<td>9.453x10^5</td>
<td>2.909x10^6</td>
<td>9.610x10^4</td>
<td></td>
</tr>
</tbody>
</table>

\[\text{APPR2}_{ij} = \text{model estimate, department } i, \text{ account } j.\]

\[\text{AAPRO}_{ij} = \text{observed appropriations, department } i, \text{ account } j.\]

\[m_i = \text{number of accounts, department } i.\]

\[n = \text{total number of departments.}\]

*not including Welfare Department

**denominator = (APPR2\textsubscript{ij} - APPR1\textsubscript{ij})

Figure 6-26
Detroit* Goodness-of-Fit Measure

\[
r_c^2 = 1.0 - \frac{n \sum_{i} m_i \sum_{j} (\text{APPR}_{2ij} - \text{AAPRO}_{ij})^2}{n \sum_{i} m_i \sum_{j} (\text{AAPRO}_{ij} - \text{APPR}_{1ij})^2}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.*</th>
<th>Simulation</th>
<th>A3**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>.9120</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>1959-60</td>
<td>-.0787</td>
<td></td>
<td>-11.1</td>
</tr>
<tr>
<td>1960-61</td>
<td>.9649</td>
<td>0.9649</td>
<td>-24.0</td>
</tr>
<tr>
<td>1961-62</td>
<td>-.0569</td>
<td>0.0856</td>
<td>-4.6</td>
</tr>
<tr>
<td>1962-63</td>
<td>.7906</td>
<td>0.0594</td>
<td>-2.94</td>
</tr>
<tr>
<td>1963-64</td>
<td>.4822</td>
<td>.2959</td>
<td>-4.39</td>
</tr>
<tr>
<td>1964-65</td>
<td>.3902</td>
<td>-.2785</td>
<td>-31.36</td>
</tr>
</tbody>
</table>

\*not including Welfare Department
\**including Welfare Department

**APPR_{2ij} = model estimate, department i, account i.**

**AAPRO_{ij} = observed appropriations, department i, account i.**

**m_i = number of accounts, department i.**

**n = total number of departments.**

**APPR_{1ij} = "Last-year's" appropriation.**

Figure 6-27
Detroit: Goodness-of-Fit Measures

\[ r_0^2 = 1.0 - \frac{\sum_{i=1}^{n} m_i}{\sum_{i=1}^{n} m_i} \left( \sum_{j=1}^{m_i} \frac{(AAPR_{2ij} - AAPR_{ij})^2}{AAPR_{ij} - AAPRO_{ij}} \right)^2 \]

<table>
<thead>
<tr>
<th>Year</th>
<th>1-Pd. Chng.</th>
<th>Simulation</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>.9128</td>
<td></td>
<td>.9761</td>
<td>.9541</td>
</tr>
<tr>
<td>1959-60</td>
<td>.9770</td>
<td></td>
<td>.9427</td>
<td>.9257</td>
</tr>
<tr>
<td>1960-61</td>
<td>.9979</td>
<td>.9979</td>
<td>.9765</td>
<td>.9601</td>
</tr>
<tr>
<td>1961-62</td>
<td>.9738</td>
<td>.9757</td>
<td>.8851</td>
<td>.8698</td>
</tr>
<tr>
<td>1962-63</td>
<td>.9963</td>
<td>.9898</td>
<td>.8668</td>
<td>.9818</td>
</tr>
<tr>
<td>1963-64</td>
<td>.9893</td>
<td>.9719</td>
<td>.8467</td>
<td>.9057</td>
</tr>
<tr>
<td>1964-65</td>
<td>.9970</td>
<td>.9574</td>
<td>.8345</td>
<td>.8925</td>
</tr>
</tbody>
</table>

AAPR_{2ij} = model estimate, department \(i\), account \(j\).

AAPR_{ij} = observed appropriations, department \(i\), account \(j\).

\( m_i \) = number of accounts, department \(i\).

\( n \) = total number of departments.

AAPRO = average of all observed appropriations.

*not including Welfare Department

Figure 6.28
Figure 6-29

Detroit Model-Selection Statistics

Appropriations
- decrease) (+) (+) (-) (0) (+) (++) (-) (-) Appr.-W

Welfare Dept.

*W includes Welfare Dept.

- W excludes Welfare Dept.

Appr.-W

1-Pd.Chng.-17
1-Pd.Chng.-11
A2-W
A1-1
Simulation-W
Simulation-1

Note: includes Welfare Dept.
Note: excludes Welfare Dept.
Appr.-W
Figure 6-30

Detroit Goodness-of-Fit Measures

- Includes welfare debt.
- Excludes welfare debt.

1959-60
+ Increase
1958-59
- Increase
1960-61
+ Increase
1961-62
- Increase
1962-63
+ Increase
1963-64
- Increase
1964-65
+ Increase

1958-59
- Increase
- Welfare debt from 50% to 30% - positions eliminated (not filled)
- Economic conditions poor

1959-60
- Increase

1960-61
+ Increase

1961-62
- Increase

1962-63
+ Increase

1963-64
- Increase

1964-65
+ Increase

State reduced welfare debt from 50% to 30% - positions eliminated (not filled)
Economic conditions poor

Economy drive continued
Recent positions eliminated
- Financial general fund increase (+4%)

Cumulative effects of operating deficits, capital operating expenses intermingled

New mayor - more general income for passive yielding new revenues, accumulated operating deficits funded in budget, general wage increase, assumed 25% state will contribute more to welfare

The financing of pension funds - city deferred contributions to finance operation. Deficit must be made up
Federal AID - welfare helps
State failure to adopt welfare returns offset economic prosperity
### Portion of Variance "Explained" by Model vs. Assumption "This Year's Equals Last Year's"

<table>
<thead>
<tr>
<th>Year</th>
<th>Model vs. Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>(+)</td>
</tr>
<tr>
<td>1959-60</td>
<td>(+)</td>
</tr>
<tr>
<td>1960-61</td>
<td>(+)</td>
</tr>
<tr>
<td>1961-62</td>
<td>(+)</td>
</tr>
<tr>
<td>1962-63</td>
<td>(+)</td>
</tr>
<tr>
<td>1963-64</td>
<td>(-)</td>
</tr>
<tr>
<td>1964-65</td>
<td>(+)</td>
</tr>
</tbody>
</table>

- **1-Pd. Chn.** includes Welfare Dept.
- **1-Pd. Conc.** excludes Welfare Dept.
- **1-Pd. Conc.** includes Police & Fire

---

*Figure 6-31:*
- **Steep reduced welfare contribution from 50% to 30% - recent positions eliminated.**
- **Economy drive:**+ cost + housing
- **Cumulative operating deficit, capital items in operating budget etc.**
  - New mayor - general income tax adopted and general salary increase
  - Pension limit (unpaid & uncollected) and previous operating deficits to financed
  - Economic prosperity - fewer revenue constraints - cost of living increase plus increase for Police & Fire
administration of a new mayor of Detroit. Contrary to the Pittsburgh and Cleveland administration "changes" described above, this change was a significant one. Not only the occupant of the mayor's office changed in this decisional coalition, but all of the "key" department heads and financial officers as well. Davis, et al., found a similar break in model fit while examining the Federal budgetary process in the change from the Eisenhower to the Kennedy Administrations. A change in all the "key actors" in the decision system is bound to cause a significant shift in the system of interrelationships and mutual expectations characterizing the budgetary process. This "shift" really signals the existence of a "new" set of model parameters reflecting the cognitive maps and perceptions of the new participants. Unfortunately, we did not have enough data points to estimate two sets of parameters for Detroit, so this shift in "real" parameter values is compromised by the estimated parameters and reflected in a shift in goodness-of-fit. The other "changes" which improved goodness-of-fit measures after 1961-62 were also related to the new administration. They "removed" capital items from the operating budget and eliminated the deficit-spending practice.

There does not appear to be any difference between goodness-of-fit in years of budget increase (surplus elimination routines evoked) and budget decline (deficit elimination procedures evoked).

36 Davis, et al., op. cit.
Considering the problems presented by deficit spending, capital items in the operating budget, and State shares of the welfare load, the Detroit models fit reasonably well. Although in many years, an alternative, naive model predicts as well or better, on the whole, the process models (one-period change and simulation) rate much higher (see Figures 6-29, 6-30, 6-23, and 6-27).
Process Model vs. Constant-Share Model

As we have seen, above, the constant-share, naive model (A2) "predicted" nearly as well as our process model.

<table>
<thead>
<tr>
<th>No. of Years</th>
<th>Model Chosen (2-statistic)</th>
<th>No. of Years</th>
<th>Model Chosen (Bayesian-Induction Statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2 Process</td>
<td>A2 Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleveland</td>
<td>6 4</td>
<td>1 9</td>
<td></td>
</tr>
<tr>
<td>Detroit -- W</td>
<td>3 4</td>
<td>5 2</td>
<td></td>
</tr>
<tr>
<td>Detroit -- NW</td>
<td>1 6</td>
<td>3 4</td>
<td></td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>4 2</td>
<td>5 1</td>
<td></td>
</tr>
</tbody>
</table>

Choice\textsuperscript{37} Between One-Period Change, Process Model and A2

Figure 6-32

Although both predict well, it may prove informative to investigate those cases where the predictions of the two models do not agree. The constant-share model is illustrated in Figure 6-33.

\textsuperscript{37}See Figures 6-9, 6-10, 6-15, 6-16, 6-21, 6-22, 6-25, and 6-26.

\textsuperscript{38}A2: \text{APPR2}_{ij} = c_{ij}(TBUD2) (See p. 172.)
Process Model vs. Constant-Share Model

As we have seen, above, the constant-share, naive model (A2) "predicted" nearly as well as our process model.

<table>
<thead>
<tr>
<th>No. of Years</th>
<th>Model Chosen ((\chi^2)-statistic)</th>
<th>No. of Years</th>
<th>Model Chosen (Bayesian-Induction Statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A2</td>
<td>Process</td>
<td>A2</td>
</tr>
<tr>
<td>Cleveland</td>
<td>6</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Detroit — W</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Detroit — NW</td>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Choice\(^{37}\) Between One-Period Change, Process Model and A2

Figure 6-32

Although both predict well, it may prove informative to investigate those cases where the predictions of the two models do not agree.

The constant-share model is illustrated in Figure 6-33.

---

\(^{37}\)See Figures 6-9, 6-10, 6-15, 6-16, 6-21, 6-22, 6-25, and 6-26.

\(^{38}\)A2: APPR\(_{ij}\) = \(c_{ij}(TBUD)\) (See p. 172.)
A question of interest to us concerns the reasons for deviations from the constant-share-of-total-budget line (slope, \( c_{ij} \)) as the revenue constraint shifts. We shall use the Detroit\(^{39}\) process and A2 models (including the Welfare Department) in a rough analysis of differences in the models' predictions. What causes the process model to drift off the "constant-share" line? Does the process model describe a random walk about this line, or are there "explainable" and systematic deviations? The characteristics of budget-share-changes over time, for a given account category in particular departments, is covered in detail in Section 10. At present we shall limit our discussion to major differences in model predictions. The five largest (absolute) differences were identified for each year in the study period.

Of the thirty-five model differences so identified, fifteen are attributable to the Equipment accounts in Detroit. The A2 model yields an average share-of-the-budget figure. As we noted above, the Equipment account included capital items until 1962-63. This, of course, would lead to low estimates for A2 in the early years of the study and unusually high estimates for Equipment after capital items had been dropped from the operating budget. The historically-

\(^{39}\)Detroit was chosen partly because the fit of its process model, in general, is not as good as in the other cities, partly because it has complete department request data, partly because of its shift in administrations, and partly because of its fluctuating revenue experience during the study period.
dependent process model, on the other hand, would pick up this shift in accounting practice after one year (see 4-A1-3, 4-B1-4, and 4-C1-9). This leads to the more general observation that A2 should do poorly in account categories where, due to "external" factors, there are large shifts in budget amounts. Most of the remaining differences (e.g., Equipment) between A2 and process-model predictions relate to unprogrammed budget decisions and policy shifts (to be examined in detail in Section 7).

Differences Between
A2 and Process
Model Predictions

<table>
<thead>
<tr>
<th>Department</th>
<th>Affected Account</th>
<th>(A2 Prediction)</th>
<th>Model Nearest to Observed Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civic Center</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recorders Court --Criminal</td>
<td>Equipment</td>
<td>-$7332000</td>
<td>A2</td>
</tr>
<tr>
<td>Police</td>
<td>Salaries</td>
<td>-$1098000</td>
<td>A2</td>
</tr>
<tr>
<td>Public Works --Streets</td>
<td>Salaries</td>
<td>+$4642000</td>
<td>Process</td>
</tr>
<tr>
<td>Welfare</td>
<td>Expenses</td>
<td>+$12180000</td>
<td>A2</td>
</tr>
<tr>
<td>1959-60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare</td>
<td>Expenses</td>
<td>+$8232000</td>
<td>Both</td>
</tr>
<tr>
<td>Civic Center</td>
<td>Equipment</td>
<td>-$5985000</td>
<td>Process</td>
</tr>
<tr>
<td>Health Department</td>
<td>Salaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--Kiefer Hospital</td>
<td>and Expenses</td>
<td>-$1029000</td>
<td>Process</td>
</tr>
<tr>
<td>Parks and Recreation</td>
<td>Equipment</td>
<td>+$1455000</td>
<td>A2</td>
</tr>
<tr>
<td>Public Works --Sewers</td>
<td>Equipment</td>
<td>+$951700</td>
<td>Process</td>
</tr>
</tbody>
</table>

Figure 6-34 (continued on following page)
Figure 6-34 (continued) Differences Between A2 and Process Model Predictions

<table>
<thead>
<tr>
<th>Department</th>
<th>Affected Account</th>
<th>(A2 Prediction) -- (Process Model Prediction)</th>
<th>Model Nearest to Observed Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1960-61</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Police</td>
<td>Salaries</td>
<td>-$2224000</td>
<td>Process</td>
</tr>
<tr>
<td>Public Works ---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitation</td>
<td>Salaries</td>
<td>-$1539000</td>
<td>Process</td>
</tr>
<tr>
<td>Welfare</td>
<td>Expenses</td>
<td>+$1922000</td>
<td>Process</td>
</tr>
<tr>
<td>Civic Center</td>
<td>Equipment</td>
<td>+$2698000</td>
<td>Both</td>
</tr>
<tr>
<td>Public Works ---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streets</td>
<td>Salaries</td>
<td>+$5235000</td>
<td>Process</td>
</tr>
<tr>
<td><strong>1961-62</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Works ---</td>
<td>Salaries</td>
<td>+$6072000</td>
<td>Process</td>
</tr>
<tr>
<td>Streets</td>
<td>Equipment</td>
<td>+$1530000</td>
<td>Process</td>
</tr>
<tr>
<td>Civic Center</td>
<td>Equipment</td>
<td>+$1453000</td>
<td>Process</td>
</tr>
<tr>
<td>Welfare</td>
<td>Expenses</td>
<td>+$1150000</td>
<td>Process</td>
</tr>
<tr>
<td>Lighting</td>
<td>Equipment</td>
<td>+$1025000</td>
<td>Process</td>
</tr>
<tr>
<td>Public Works ---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewers</td>
<td>Equipment</td>
<td>+$1230000</td>
<td>Process</td>
</tr>
<tr>
<td><strong>1962-63</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Works ---</td>
<td>Salaries and</td>
<td>+$9330000</td>
<td>Process</td>
</tr>
<tr>
<td>Streets</td>
<td>Expenses</td>
<td>+$1637000</td>
<td>Process</td>
</tr>
<tr>
<td>Civic Center</td>
<td>Equipment</td>
<td>+$1505000</td>
<td>Process</td>
</tr>
<tr>
<td>Lighting</td>
<td>Equipment</td>
<td>+$1058000</td>
<td>Process</td>
</tr>
<tr>
<td>Public Works ---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewers</td>
<td>Equipment</td>
<td>+$12895000</td>
<td>Process</td>
</tr>
<tr>
<td>Parks and Recreation</td>
<td>Equipment</td>
<td>+$1058000</td>
<td>Process</td>
</tr>
<tr>
<td><strong>1963-64</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Works ---</td>
<td>Salaries</td>
<td>+$12170000</td>
<td>Process</td>
</tr>
<tr>
<td>Streets</td>
<td>Expenses</td>
<td>-$7946000</td>
<td>Process</td>
</tr>
<tr>
<td>Welfare</td>
<td>Salaries</td>
<td>+$3093000</td>
<td>Process</td>
</tr>
<tr>
<td>Police</td>
<td>Equipment, Others</td>
<td>+$2895000</td>
<td>Process</td>
</tr>
<tr>
<td>Lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Works ---</td>
<td>Sanitation</td>
<td>+$2599000</td>
<td>Process</td>
</tr>
</tbody>
</table>

Figure 6-34 (continued on following page)
Several items are suggested by the data in Figure 6-34 concerning the relationships of the naive models and our process model. For instance, in those cases where the differences in prediction are large (i.e., included in 6-34), the process model is almost always the better predictor. Why? As was indicated previously, the process model is able to pick up policy shifts one year after they occur, at the latest. "A2" responds to changes in the total budget only.

A second line of reasoning is also suggested. "A2" obviously performs very well for most departments and accounts, most of the time (see Figure 6-32). When it "misses," however, it appears to "miss" by a large amount (see Figure 6-34). Perhaps the better performance of our process model for these cases indicates the presence of constraints on appropriations decisions. If this is true,
the above analysis indicates that our process model has succeeded in specifying at least some of these constraints.

A third and related "suggestion" emerges from Figure 6-34. We will see that, in most instances, the large differences in model predictions correspond very closely to the large deviations when our process-model is compared with observed budgetary decisions. (See Section 7, "Detroit Model Residuals," pp. 245-253). This suggests that certain irregularities are found in the budgetary process that neither the process model or the naive models can predict. Figure 6-34 indicates that the process model does a much better job of handling these irregularities, however. Perhaps one "key" reason for this is that through "granting" supplemental requests and through the trend terms in the process model, departments can experience very different rates of growth over time, taking advantage of revenue opportunities. An analysis of model residuals in Section 7 indicates that the budgetary process is opportunistic. To the extent that the process model captures some of this, it will behave differently from the naive models.

No relationship was observed between the relative predictive powers of the A2 and process models and the magnitude or direction of revenue change or changes in administration.

We are now in a position to discuss the overall goodness-of-fit of our process model.
Overall Goodness-of-Fit

We will examine the overall goodness-of-fit of the models to Cleveland, Detroit, and Pittsburgh in three ways:

1. Summary goodness-of-fit measure — $r_m^2$ (null hypothesis: individual account total in a particular year equals the mean for the study period).

2. Test of model bias — regression equation relating the process model estimates to observed appropriations plus a constant.


Before interpreting the $r_m^2$ goodness-of-fit measure in Figure 6-35, we would do well to recall our previous discussion (see pp. 169-171). For a "short" study period or one in which revenues do not experience substantial changes, an $r_m^2$ near zero may indicate a reasonably-good fit.
Figure 6-35

Overall Goodness-of-Fit Measure

\[
x_m^2 = 1.0 - \frac{\sum_{t=1}^{n_n} \sum_{i=1}^{n_n} \sum_{j=1}^{m_i} (APPR_{i,j}^{2} - AAPRO_{i,j})^2}{\sum_{t=1}^{n_n} \sum_{i=1}^{n_n} \sum_{j=1}^{m_i} (AAPRO_{i,j} - AAPRO_{i,j})^2}
\]

Detroit (with Welfare Department)
One-Period Change 1958-59 to 1964-65 .1045
Simulation 1960-61 to 1964-65 -.3483
A1 - constant growth .2622
A2 - constant share of total .1069
A3* - constant share of increase -.0267

Detroit (without Welfare Department)
One-Period Change 1958-59 to 1964-65 .0663
Simulation 1960-61 to 1964-65 -.6113

Cleveland
One-Period Change 1956-65 .9207
Simulation 1960-65 -1.527
A1 - constant growth .5311
A2 - constant share of total .2672
A3* - constant share of increase .2570

Pittsburgh
One-Period Change 1960-65 .4322
Simulation 1962-65 -.0256
A1 - constant growth .0000
A2 - constant share of total .6875
A3* - constant share of increase .1955

*statistic based on difference between actual and average increases, not totals.

Denominator is then:

\[
\frac{\sum_{t=1}^{n_n} \sum_{i=1}^{n_n} \sum_{j=1}^{m_i} [(AAPRO_{i,j} - APPR1_{i,j})^2 - t=1 \frac{\sum_{t=1}^{n_n} (APPR_{i,j}^{2} - AAPRO_{i,j})^2}{n_n} ]}{n_n}
\]

(continued on following page)
221

Figure 6-35 (continued)

APPR2\textsuperscript{ij} = model estimate, department i, account j

AAPRO\textsuperscript{ij} = observed appropriations, department i, account j

AAPRO\textsubscript{ij} = average appropriation during study period, department i, account j

n\textsubscript{n} = number of years in study period

m\textsubscript{i} = number of accounts, department i

n = number of departments in city

On the basis of Figure 6-35 and the numerous other goodness-of-fit measures, it appears our model "predicts" reasonably well.

Model Bias

We now turn to the question of overall model bias. Cyert and March suggest one way

"... in which the validation problem for process models can be approached .... Simple regressions of the generated series as functions of the actual (time-) series can be computed, and then we can test whether the resulting regression equations have intercepts that are not significantly different from zero and slopes that are not significantly different from unity."\textsuperscript{40}

Figure 6-36 contains this analysis.

\textsuperscript{40}Cyert, R. M., and March, J. G., \textit{op. cit.}, pp. 319-320.
Test for Model Bias

Relationship tested:

\[
\text{Model Estimate of Appropriations} = a \text{ Observed Appropriations} + b
\]

For an unbiased model, that predicts perfectly, the expected value of "a" is 1.0, and "b" is 0.0.

<table>
<thead>
<tr>
<th>Case</th>
<th></th>
<th>Std. Error of &quot;a&quot;</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>b</td>
<td>r^2</td>
</tr>
<tr>
<td>Cleveland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Period Change</td>
<td>.977</td>
<td>.001</td>
<td>-$5282</td>
<td>.9980</td>
</tr>
<tr>
<td>Simulation</td>
<td>.930</td>
<td>.003</td>
<td>$3526</td>
<td>.9933</td>
</tr>
<tr>
<td>Detroit (with welfare)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Period Change</td>
<td>.963</td>
<td>.007</td>
<td>$31247</td>
<td>.9527</td>
</tr>
<tr>
<td>Simulation</td>
<td>.912</td>
<td>.009</td>
<td>$106402</td>
<td>.9329</td>
</tr>
<tr>
<td>Detroit (without welfare)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Period Change</td>
<td>.984</td>
<td>.005</td>
<td>$7281</td>
<td>.9772</td>
</tr>
<tr>
<td>Simulation</td>
<td>.971</td>
<td>.006</td>
<td>$29181</td>
<td>.9754</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Period Change</td>
<td>.991</td>
<td>.002</td>
<td>-$28</td>
<td>.9975</td>
</tr>
<tr>
<td>Simulation</td>
<td>1.011</td>
<td>.003</td>
<td>-$4918</td>
<td>.9955</td>
</tr>
</tbody>
</table>

Figure 6-36
The one-period-change and simulation models appear reasonably unbiased except in Detroit. The peculiarities in Detroit which probably produce the bias have already been discussed in detail (deficit spending, capital items in the operating budget, etc.).

There does appear to be a slight tendency for the model to underestimate budget appropriations, however. There are several reasons why this would be so. One is that the model deals only with existing administrative units and account categories. When a new unit is created, the model will not recognize it (until the next period, for one-period-change models), leading to a built-in, negative bias (see analysis of model residuals in Section 7). Another bias is inherent in the model. The MAYORS model consists of deficit-elimination and surplus-elimination routines. The deficit-elimination routine is such that any deficit is always eliminated (ultimately, by a proportional adjustment of all non-salary accounts). The surplus-elimination routines are different, however. If the surplus is large enough, it can go undistributed. Only a small number of the many surplus elimination routines available to the mayor are included in our formal model. The absence of a complete set of surplus routines biases the total budget estimate downward.

Identification Problem

One important topic remains to be covered in this section. While we have shown our model to be a reasonably good predictor of budgetary behavior, this may be due to the large number of parameters we have
estimated. The order conditions for identifiability "... means that the number of predetermined variables excluded from the relation must be at least as great as the number of endogenous variables included, less one."\(^{41}\) For a single-equation regression model, the above indicates that one must have more data points than unknowns (regression coefficients). Little is known about parameter estimation for simulation models and other non-linear model structures. We can, however, look at some crude statistics to get an idea of the magnitude of any identification problem we might have. Our crude measure consists of the difference between total observations (decisions) and the number of parameters estimated from these.

### Observations*

<table>
<thead>
<tr>
<th></th>
<th>Cleveland</th>
<th>Detroit (with welfare)</th>
<th>Pittsburgh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Department Requests</td>
<td>620</td>
<td>1204</td>
<td>231</td>
</tr>
<tr>
<td>2. Mayor's Budget Recommendations</td>
<td>1240</td>
<td>1204</td>
<td>1386</td>
</tr>
<tr>
<td>3. Final Appropriations</td>
<td>1240</td>
<td>1204</td>
<td>1386</td>
</tr>
<tr>
<td>Total Observations</td>
<td>3100</td>
<td>3612</td>
<td>2997</td>
</tr>
</tbody>
</table>

**Less: Parameters Estimated**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DEPT. Submodel</td>
<td>120</td>
<td>516</td>
<td>18</td>
</tr>
<tr>
<td>2. MAYORS Submodel</td>
<td>346</td>
<td>344</td>
<td>687</td>
</tr>
<tr>
<td>3. COUNCIL Submodel</td>
<td>--</td>
<td>513</td>
<td>693</td>
</tr>
<tr>
<td>Total &quot;degrees of freedom&quot;:</td>
<td>466</td>
<td>913</td>
<td>1398</td>
</tr>
</tbody>
</table>

(If we include expenditure data used, as well -->)

**Plus: Expenditure observations**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Detroit (with welfare)</td>
<td>1240</td>
<td>1204</td>
<td>1386</td>
</tr>
<tr>
<td>Total &quot;degrees of freedom&quot; including Expenditures data</td>
<td>3874</td>
<td>3903</td>
<td>2985</td>
</tr>
</tbody>
</table>

*Equal to: (Administrative units) x (Account Categories) x (Years of data)
As Figure 6-37 indicates, while the system is not "underidentified," the actual parameter values calculated suffer from a lack of data. Drawing an analogy, Pittsburgh parameter calculations are similar to calculating an average from two observations, in Detroit, from about three observations, and in Cleveland, from five. Clearly, viewed in this light, and analyzing individual parameters in detail would appear to be of little value.

Summary

"The central problem inherent in all simulation processes, and in all model building as well, is that of an adequate reproduction of the real system."42

We have seen that our model generates the same kinds of data that the real system generates. In order to "adequately" reproduce the real system, the model must also arrive at its appropriations decisions in the same manner as the system. The real test of our model is not how well it "predicts" (although this is important), but how well it describes. Referring back to Figure 6-6, we can ask how well the DEPT. and MAYORS Submodels performed in generating their decisions. The same goodness-of-fit measures were calculated for the DEPT. and MAYORS Submodel outputs as were for the COUNCIL model.

---

In general, the MAYORS Submodel's outputs fit the observed mayor's budget recommendations as well or better than the COUNCIL outputs discussed previously. This was not the case with the DEPT. Submodels, however. The measures of fit were significantly worse than with MAYOR or COUNCIL outputs. For the most part a lack of time-series data for the DEPT. model dictated this.

General Model Behavior Characteristics

Another indication of how well the model describes, concerns the roles of the submodels discussed in Section 5. The DEPT. model, with the department head as an advocate, should, if it corresponds to our role description, result in a sum-of-department requests higher than the mayor's budget. In all three cities for all years in the study period (twenty-three observations), the model-estimated DEPT. budget exceeds the mayor's budget by a substantial amount (as did observed requests). In addition the total DEPT. budget was close to the observed totals. The MAYORS Submodel in all cases produced the budget-trimming behavior "expected" by the DEPT. Submodel and observed in practice. Also as expected, final appropriations produced by the COUNCIL Submodel were not substantially different from the outputs of the MAYORS model. Briefly, all submodels in all cities exhibited the "proper" role behavior.
Although some naive models also predicted well, few would argue that they "adequately reproduce" the decision system. An analysis of differences between one naive model and a process model suggests the two are not functional equivalents. Although there are some unavoidable statistical "problems," all goodness-of-fit measures used indicate that our process model is at least consistent with the intermediate and final outputs of the real decision system.

"We do not believe a radically different model can be built that captures the actual decision process and predicts as well. Because our objective is to understand the actual process, we have not attempted to minimize the number of assumptions, the number of variables, or the number of inputs to the model."43

If our model actually describes the decision process, we would expect that those decisions the process model "identifies" as "different" or "special" (i.e., those it cannot predict well) will correspond closely to those the real system perceives as different or special. Hence we would expect explanations of "unusual decisions" to appear in official budget documents. We now turn to an analysis of model residuals in an attempt to:

1. Further investigate the descriptive power of the model (Are certain decisions "unusual" for both the model and the real system?).

2. Discover model limitations and suggest modifications or extensions.

UNPROGRA-MED DECISIONS AND POLICY SHIFTS

In general, there are two kinds of "budgetary" change.¹

1. Those changes resulting from the continuation and elaboration of existing policies, and
2. Those changes resulting from shifts in municipal policies.

Our model is clearly one describing changes of the first kind. It is a model of the standard procedures which result in particular forms of marginal adjustments in resource allocation from year to year. The model, as it stands, assumes the "cognitive maps" of the relevant decision makers are stable over time (the same standard accounts and administrative units exist from year to year). It assumes that perceptions² of departments and administrative units by the participants are relatively stable over time (the model parameters are constants).

The model does not describe changes of the second kind -- significant shifts in municipal policies. The model, however, by filtering out (i.e., "predicting" or "explaining," in the statistical

¹By "change", we mean change in appropriations levels from one year to the next: (APPR₂ᵢⱼ - APPR₁ᵢⱼ).

²Including "expectations."
sense) incremental changes, draws attention to those items ("unexplained") in the budget that are not marginal adjustments or elaborations of previous policies. As we have seen, the model "explains" most resource-allocation decisions made by municipal government -- but not all.

This section will focus on the "unexplained" changes in resource allocation. "Unexplained" significant changes can be characterized in, roughly, three ways:

1. Incremental changes whose cumulative effect results in a "non-incremental" change.
2. Non-incremental policy shifts.\(^3\)
3. Significant changes in policy, not reflected in the budget.

A little reflection on the above indicates that not all large changes are "changes resulting from shifts in municipal policies," and not all small changes are "changes resulting from the continuation and elaboration of existing policies." For example, a significant policy shift may result from the decision to handle the city's welfare load through the welfare department, rather than have the program administered

---

\(^3\)The use of the term "innovation" has been consciously avoided in this section because lack of a generally-agreed-upon operational definition of the concept. Rather, "policy shift" will be our theoretical construct. An allocation decision represents a "policy shift" when either through cumulative effects of small changes or immediate effects, it brings about a "significant" reallocation of resources between account categories.
by the county or the state for a fee. The total budget cost may be nearly the same, so this significant change may never be reflected in the operating budget. On the other hand, suppose the city decides to build an office building of their own to house a number of departments, rather than rent office space. Once the building has been completed, several years after the initial decision, a large change is noted in the budget -- a change our formal model is not equipped to handle. This change, representing an increase in personnel and building maintenance expenses and large decreases in rental expenses for the departments affected does not represent a significant shift in policy. It is merely an elaboration of a long-existing policy (resulting from the decision to build rather than rent). The original decision to build represents a significant "policy shift," however, and anticipated operating budget changes may or may not have been an important part of this capital decision. Our point is that for purposes of analyzing the 1966 operating budgetary process, the items resulting from previous capital decisions represent "automatic" changes in appropriations.

A. Invisible Organizational Changes

Before analyzing model residuals, we should examine the third major class of significant changes: Significant changes in policy, not reflected in the budget. Naturally, because of the lack of "hard" data, we have less to say about this class of significant change than the others. That is not to say that this class of change is either small or unimportant, however. Those policy
shifts not reflected in the budget might be the most significant in terms of activities actually engaged in by municipal agencies and departments. Two important types of significant "policy shifts" that do not appear in the budget will be discussed: (1) Non-general-fund expenditures administered by a municipal department that increase the department's "effective budget ceiling" and (2) Policies that alter efficiencies within an administrative unit, enabling the unit to engage in more (or less) activities and provide more services within the same budget ceiling.

A.1. Increases in "Effective Budget Ceiling"

Within the existing budget framework in our three cities, the revenue or balanced-budget constraint practically guarantees no dramatic increases in general fund appropriations for any department or agency. If municipal revenues were, in fact, the only source of funds for a municipality, the outlook for urban areas would be a dismal one, to say the least. However, there are other methods of funding. For instance, City Planning and Urban Renewal functions have access to many kinds of Federal monies as well as private foundation grants. In their 1965 budget estimate, the Pittsburgh City Planning Department's total budget (general fund appropriations plus outside sources) contained the following sources of funds:

1. Tax-based on General Funds.

2. Municipal Bonds.
3. Private Foundations and Public Corporations
4. Federal Community Renewal Program Funds
5. Federal "701 Program" Funds

An idea of the relative magnitudes of these items can be obtained by looking at the Department's 1964 Estimated Expenses:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tax Funds</td>
<td>$379,674</td>
</tr>
<tr>
<td>2</td>
<td>Bonds</td>
<td>95,378</td>
</tr>
<tr>
<td>3</td>
<td>CRP Funds</td>
<td>318,223</td>
</tr>
<tr>
<td>4</td>
<td>Other</td>
<td>7,247</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>$800,522</strong></td>
</tr>
</tbody>
</table>

Less than half of Pittsburgh's City Planning Department operations were financed through the General Fund. It is quite clear that the municipal operating budget (and our model) is a very misleading document for some municipal activities. This situation is rare in municipal government, however, and can probably be attributed to a very "enterprising" and "imaginative" department head. The situation illustrates a point. City operating budgets do not always reflect either the level or kind of activity carried on in a municipal agency.

---

4Homewood-Brushton Fund, and Regional Industrial Development Corporation -- both of which are financed primarily with private foundation and industrial support such as T. Mellon and Sons and The Ford Foundation.

5Calvin H. Hamilton, now Director of City Planning in Los Angeles, California.
With the influx of Federal Anti-Poverty Programs, etc., outside funding of municipal agencies should become increasingly important. The mere presence of outside sources of funds should (and does, as we shall see) encourage highly-motivated agency heads to expand their search routine to include variables and funds outside the control of the municipal government.

To the extent that outside resources become available to agency heads, our DEPT. model should be modified to include this, and "outside funds" should be included in our MAYORS model (probably as a simple addition to total agency appropriations, unless the increase in outside funds is used to free "regular department funds" for reallocation to other agencies).

A.1.a. Increases in Available Revenue

Another common way of securing funds from outside sources is for a municipality to persuade another governmental unit to share in the cost of some of the city's activities or to take them over completely.

Cleveland persuaded the county to take over the City Hospital, Cleveland Boys School, and the Cleveland Girls School in 1958. This, of course, meant that some of the funds previously appropriated to the hospital and detention homes, were made available for other general fund expenditures.

Much of the "unexplained" portion of Detroit budgets revolves around Detroit's long feud with the State of Michigan over the proper share of expenses to be borne by the State in certain kinds of welfare cases. In recent years, State contributions have fluctuated from 20%
to 50% of the total. As a result of the City's lobbying, the current contribution is 50% -- freeing several million dollars for other uses.

The City of Pittsburgh is engaged in a somewhat similar attempt to obtain additional revenues. Both the City and the Board of Education tax the property within the City. The mayor and his administration wants to keep property taxes constant to keep business firms within the City. Under these conditions, if Pittsburgh is to raise its real estate tax rate, the Board of Education would have to lower its rate. The City has been trying (with the knowledge and cooperation of the Board of Education) to persuade the State to increase appropriations to the Pittsburgh School District. Presumably, if the increase is large enough, this will permit the Board of Education to lower its real estate taxes. The City would then pick up the Board of Education reduction so that the millage total would remain unchanged. (One mill would yield approximately $700,000 additional revenue for the City). So far, they have not succeeded.

Still another class of significant "policy shifts" that is not visible in the budget, exists.

A.1.b. Increases in Agency "Efficiency"

One way for an agency head to gain more resources from the system is to increase agency efficiency. The increase in "efficiency" would enable him to take on new programs and activities while still operating within his "budget ceiling." One of the three cities, Detroit, has in effect institutionalized this particular kind of municipal change to a degree that warrants special attention.
Detroit's Budget Bureau -- Efficiency Experts

The budget Bureau in the City of Detroit is a major operating function. Using a system of budget examiners, "permanently" assigned to a fixed set of departments, the budgeting operation literally becomes a year-round process at all levels of city government.

"The budget examiners are continually in contact with the operating departments. They attend commission and other department meetings. All departmental purchase requisitions have to be approved as to necessity by the budget examiner...

"Between budget periods, the budget examiner makes studies of departmental operating efficiency, organization, and activity.

"...During November and December, the departments prepare their budget requests and fill in the request columns on these forms. The budget examiner is in constant consultation with departments during this period.

"Since he is in constant contact with the department during the year, the examiner is well acquainted with departmental problems. Usually he knows well in advance about major requests, and therefore has a portion of his analysis completed before the requests come to the Budget Bureau.

"After completing his analysis, the examiner prepares for the Budget Director a summary of the requests, his recommendations, and a list of items upon which he could not reach an agreement with the department."6

If, in fact, budget examiners perform these functions in the City of Detroit, the budget examiner for a department is nearly equivalent to having a full-time efficiency expert or operations analyst on the department's staff.

6Budget Bureau, City of Detroit, BUDGET, ORGANIZATION, AND OPERATION IN DETROIT, mimeo, p. 2-3.
Assuming the budget examiner exerts a reasonable amount of
influence in departmental affairs, his presence must help to increase
departmental efficiency.\footnote{Others have dealt with the measurement of "efficiency" in public
categories with little observed success (See Ridley, C.E., and Simon,
H.A., MEASURING MUNICIPAL ACTIVITIES, op. cit., for example), so we
shall ignore the question of whether budget examiners actually in-
crease efficiency. Our contention is that search for more efficient
methods of operation is at least partially successful.}
This being so, the cumulative effects of
repeated and continuous attacks on "efficiency problems", by a somewhat
more detached observer than department personnel, should be considerable.
Most observers familiar with municipal government in all three cities
would agree that Detroit, overall, is considerably advanced in most
areas. The degree to which this is due to "institutionalized
efficiency" or the considerably-higher wage rates for civil servants
in Detroit, is not clear. At any rate, we shall have more to say
about normative considerations in Section 12.

One additional comment on the Detroit budget examiner system
should be made. Note that most of the budget examiner's activity,
influence, etc., is carried on before the department's budget re-
quest is submitted. The reader familiar with Detroit municipal
government will most certainly wonder why there has been little
mention of the Budget Bureau in regard to Detroit when it plays such
a "key" role in the process. The reason should be apparent. The
Budget Bureau functions primarily through its system of budget examiners.
They in turn function primarily in conjunction with the department head. The battles between the Budget Bureau and the department head have usually been fought and settled before the department's budget request is submitted. The major role of the Budget Bureau is, then, embedded in the DEPT. Submodel.  

8

We now turn to those "policy shifts," significant changes, etc., that are reflected in the municipal operating budget.

B. Visible Organizational Changes

As we have pointed out above, two kinds of budgeting change can be observed.

1. Changes resulting from the continuation and elaboration of existing policies, and

2. Changes resulting from shifts in municipal policies.

One way to explore the dynamics of the budgetary process as described in our formal model and see how model dynamics correspond

---

8 The DEPT. Submodel for the City of Detroit is surely open to criticism because of this. Ideally, two submodels should take the place of DEPT.:

The primary reason this was not done was that the Budget Examiner-Department Head Coalition could be perceived of as one decision system, which in turn yielded reasonable statistical fits for DEPT. Submodel in Detroit.
to the 'real world,' is to analyze the deviations of model predictions or expectations from the observed budgetary decisions.

The model is clearly one of incremental changes where current trends, perceptions, needs, policies, etc., are elaborated so as to arrive at future allocation decisions. Model deviations, therefore, ought to represent the unusual or unprogrammed part of decisions and those items with large deviations should highlight major, unprogrammed decisions -- hopefully those decisions representing policy shifts.

B.1. Incremental Change -- Cumulative Nature

We are also aware of the fact that incremental changes, over time, can turn out to be major policy shifts. One example of this concerns the war-time decision of the City of Detroit to attempt to keep municipal salaries as competitive as possible with industrial salaries -- the so-called "prevailing wage" rate policy.

In 1942-43, this policy represented an incremental change (needed to keep municipal positions filled in the face of war-time demands for labor), as the following account indicates:

"July 1, 1941 -- Prevailing rate employees generally were granted an increase of 10 cents per hour.

"July 1, 1942 -- Salary employees were granted an increase of 10% with a maximum of $300. This was later supplemented by an additional 4.54% with a maximum of $150 as of March 8, 1943 to bring the total increase up to 15% or the so-called 'Little Steel Formula.' Prevailing rates were increased on a sliding scale of from 5 cents to 7 cents per hour."^9

^9Budget Bureau, City of Detroit, OFFICIAL COMPENSATION SCHEDULE, (1964-65), p. ii.
In the early 1940's, this was clearly an incremental change (in terms of the immediate impact on salaries for Detroit employees). An indication of the cumulative effect of this policy can be seen in a comparison of salaries for comparable administrative positions in the three cities, twenty-five years later.

**Comparative Salaries, 1965**

<table>
<thead>
<tr>
<th>Position</th>
<th>Detroit</th>
<th>Cleveland</th>
<th>Pittsburgh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Police Commissioner</td>
<td>$23000</td>
<td>$15042-$18072**</td>
<td>$12226-$14909*</td>
</tr>
<tr>
<td>Deputy Superintendent</td>
<td>$15812-$17383</td>
<td>$9500-$10000</td>
<td>$9153</td>
</tr>
<tr>
<td>Director of City Planning</td>
<td>$19245</td>
<td>$14394</td>
<td>$14909</td>
</tr>
<tr>
<td>Commissioner of Public Works</td>
<td>$23000</td>
<td>$18594</td>
<td>$14909</td>
</tr>
<tr>
<td>Superintendent of Motor Transportation</td>
<td>$14175</td>
<td>$13458</td>
<td>$11125</td>
</tr>
<tr>
<td>Superintendent of Street Construction and Maintenance</td>
<td>$14724</td>
<td>$13485</td>
<td>$10596</td>
</tr>
<tr>
<td>Draftsman</td>
<td>$6245</td>
<td>$5000-$5500</td>
<td>$4623</td>
</tr>
<tr>
<td>Clerk</td>
<td>$4981</td>
<td>$4000</td>
<td>$3400-$4400</td>
</tr>
<tr>
<td>Junior Clerk</td>
<td>$4116</td>
<td>$3500</td>
<td>$3400</td>
</tr>
</tbody>
</table>

* $14909 is salary for Director of Public Safety, supervising Bureaus of Police, Fire, 11 others.

** $18072 for Director of Public Safety -- Police, Fire, 5 others.

Figure 7-1

We have already discussed in some detail in Section 6, how well the model performs in describing incremental decision processes. A more detailed investigation of the ways the model responded to systematic changes in parameters and revenue trends will be found in Section 10. Particular attention will be placed there on the cumulative effects of these parameter and revenue shifts.
B.2. Non-Incremental Change -- "Unprogrammed" Decisions

If we assume, for the moment, that our model adequately describes the programmed part of the municipal budgetary process, we can now direct our attention to the unprogrammed decisions or decisions representing "policy shifts." Using model deviations (predicted appropriations minus actual appropriations) as our guide, unprogrammed decisions for each city will be identified. Based on a set of assumed rationales for deviations, we will then attempt to discover systematic deviations. If, in fact, the model "misses" on certain kinds of decisions, it may be possible to suggest model modifications that would lead to an increased predictive power for the model.

Perhaps some of our unprogrammed decisions are really programmed?

B.2.a. Model Deviations to be Examined

Deviations analyzed will be those associated with the one-period change models or those models that, for each year, generate appropriations estimates (based on the three submodels where actual input data is used once -- inputs to DEPT. -- per budget period) using up-dated information, rather than deviations from the "simulation" models (where one set of input data is used to generate appropriations data for a series of years, rather than just one.) The reason for using the one-period change models rather than the simulation models is a simple one. A simulation-model run naturally will generate some errors. To the extent some of these "errors" prove to be cumulative,
an inaccurate picture of unprogrammed decisions would result.

Of the total set of model deviations for each year in each city, we have picked a subset to examine in detail. The subset of deviations considered includes:

1. The five largest, absolute deviations in dollar amounts, and
2. The five largest, absolute deviations in percentage amounts.

The deviations are for department totals, not individual account categories.

**B.2.b. Rationale for Model Deviations**

In general, deviations can be classified by their perceived "cause":

Four types of "causes" appear reasonable:

10. For example, in one year in Detroit, $18,000,000 deviation is observed in the welfare account -- this deviation was the direct result of a change in policy by the State of Michigan. If the next-year's run for the budget model did not reflect this "new information," in effect, we would be requiring that the model also predict actions of the State of Michigan -- an unreasonable burden.

11. Five largest: $\left( \frac{\text{Total estimated appropriations}_i - \text{Total observed appropriations}_i}{\text{Total observed appropriations}_i} \right)$

2. Five largest:

\[
\frac{\left( \text{Total estimated appropriations}_i - \text{Total observed appropriations}_i \right)}{\text{Total observed appropriations}_i}
\]

where $i = \text{department}$. 
1. Change in External Environment
   a. Intergovernmental Transactions
      i. State and Federal subsidies and regulations
      ii. Transfer of functions involving other governments
   b. Catastrophic event, emergency, crises, etc. -- reaction
to focus of public attention
2. Changes in Internal Environment
   a. New Administration (new actors in system of
      interrelationships)
   b. Change in Departments of Functions
      i. Transfers of activities -- change in organizational
         structure.
      ii. Changes in programs, functions
3. Lack of Information (by Model)
   a. Implications of Capital Budgeting decisions
   b. Additional Revenue sources discovered
   c. Change in system of accounts
   d. Other
4. Unexplained, Miscellaneous, and Other
   a. Model Coding errors and missing data
   b. "Improper" accounting procedures (Detroit only --
capital items included in Operating budget 1958-59
to 1961-62)
   c. Increased work load (or decreased)
   d. Other, unexplained
The outline above, will provide the numbering scheme for cataloging model errors. For instance, "2.a." might refer to the first budget after an election which resulted in a new administration (mayor). "1.a.i." might be used to explain a model error which coincided with increased personnel financed with federal funds or funded through an urban renewal grant.

Those "causes" that represent policy shifts would be:

1.a.ii. Transfers of functions involving other governments.
1.b. Catastrophic event, emergency, etc.
2.a. New administration.
2.b.i. Transfers of activities -- organizational change
2.b.ii. New programs, functions.
3.b. Additional revenue sources discovered.

Policy elaborations would correspond to:

1.a.i. State and Federal subsidies and regulations.
3.a. Implications of capital decisions.
3.c. Change in system of accounts.
3.d. Other information not part of allocation process (timing of elections, for example).
4.c. Increased workload.

The remaining items in the outline represent things the model, ideally, should have accounted for.
## B.3.a. Detroit Model Residuals

**Detroit** (one-period change model)

### 1958-59 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error*</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayors Industrial Development Committee</td>
<td>-$21,810</td>
<td>-100%</td>
<td>New &quot;department -- declining revenues&quot;</td>
<td>2.b.ii</td>
</tr>
<tr>
<td>Welfare</td>
<td>-$12,040,000</td>
<td>-71.2%</td>
<td>State reduced share from 50-50 to 30-70. Bad economic situation</td>
<td>1.a.i</td>
</tr>
<tr>
<td>Election</td>
<td>-$823,000</td>
<td>-67.7%</td>
<td>Spring elections</td>
<td>3.d.</td>
</tr>
<tr>
<td>Recorders Court Criminal Division</td>
<td>+$6,384,000</td>
<td>+1519%</td>
<td>Capital expenses included in budget in previous periods</td>
<td>4.b.</td>
</tr>
<tr>
<td>Civic Center</td>
<td>+$5,032,000</td>
<td>+92%</td>
<td>Capital items -- new building</td>
<td>4.b.</td>
</tr>
<tr>
<td>Police</td>
<td>+$1,473,000</td>
<td>+5.0%</td>
<td>Missing data in trend term</td>
<td>4.a.</td>
</tr>
<tr>
<td>Public Works</td>
<td>-$1,041,000</td>
<td>-8.4%</td>
<td>Capital items included in budget</td>
<td>4.b.</td>
</tr>
</tbody>
</table>

* (Model Predictions - Observed)
### 1959-60 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayors Committee on Reports and Information</td>
<td>-$173,700</td>
<td>-100%</td>
<td>New &quot;department&quot; formed</td>
<td>2.b.ii</td>
</tr>
<tr>
<td>Public Works -- Streets</td>
<td>+$6,820,000</td>
<td>+69.1%</td>
<td>Carryover from Capital item in last year's budget</td>
<td>4.b.</td>
</tr>
<tr>
<td>Community Relations</td>
<td>-$38,250</td>
<td>-47.7%</td>
<td>New accounts established</td>
<td>3.c.</td>
</tr>
<tr>
<td>Welfare</td>
<td>-$4,564,000</td>
<td>-33.4%</td>
<td>State reduced share -- continued &quot;bad times&quot;</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Parks and Recreation</td>
<td>-$1,143,000</td>
<td>-11.8%</td>
<td>Capital item included in budget</td>
<td>4.b.</td>
</tr>
<tr>
<td>Civic Center</td>
<td>-$1,056,000</td>
<td>-10.3%</td>
<td>Capital items included in budget</td>
<td>4.b.</td>
</tr>
<tr>
<td>Public Works -- Sanitation</td>
<td>-$1,167,000</td>
<td>- 6.5%</td>
<td>4% Wage increase plus capital items in budget</td>
<td>4.b.</td>
</tr>
</tbody>
</table>
## 1960-61 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayor's Committee on Rehabilitation of Narcotics Addicts</td>
<td>-$2,000</td>
<td>-100.0%</td>
<td>New &quot;department&quot; formed</td>
<td>2.b.ii</td>
</tr>
<tr>
<td>Civic Center</td>
<td>-$1,355,000</td>
<td>-73.9%</td>
<td>Civic Center building opened -- result of capital decision</td>
<td>3.a.</td>
</tr>
<tr>
<td>Elections</td>
<td>-$741,500</td>
<td>-63.0%</td>
<td>Election year</td>
<td>3.d.</td>
</tr>
<tr>
<td>Loyalty Investigation Committees</td>
<td>-$4,808</td>
<td>-19.7%</td>
<td>One new clerk</td>
<td>4.d.</td>
</tr>
<tr>
<td>Civil Defense</td>
<td>$115,600</td>
<td>+53.0%</td>
<td>Curtailment and federal reimbursement for past expenses</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Police</td>
<td>$890,000</td>
<td>+2.9%</td>
<td>Because of Budget deficits, city not filling empty positions</td>
<td>1.b.</td>
</tr>
<tr>
<td>Welfare</td>
<td>$771,300</td>
<td>+5.4%</td>
<td>Aftermath of buildup due to reduction in State share</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Public Works --Sanitation</td>
<td>$569,300</td>
<td>+3.1%</td>
<td>Capital items model error</td>
<td>4.b.</td>
</tr>
<tr>
<td>Department</td>
<td>Error</td>
<td>% Error</td>
<td>&quot;Cause&quot;</td>
<td>Type</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>----------</td>
<td>----------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Welfare</td>
<td>+$9,617,000</td>
<td>+137.3%</td>
<td>State increased share to 50-50</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Public Works</td>
<td>+$ 422,300</td>
<td>+ 4.0%</td>
<td>Part of Mayor's $3M cut in capital improvements</td>
<td>3.a.</td>
</tr>
<tr>
<td>--Streets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Relations</td>
<td>-$ 43,450</td>
<td>- 34.4%</td>
<td>Conscious program expansion</td>
<td>2.b.ii.</td>
</tr>
<tr>
<td>Parks and recreation</td>
<td>-$4,620,000</td>
<td>- 29.5%</td>
<td>Capital item to finance new parks</td>
<td>4.b.</td>
</tr>
<tr>
<td>Civic Center</td>
<td>-$ 666,700</td>
<td>- 26.7%</td>
<td>Capital expenditures item</td>
<td>4.b.</td>
</tr>
<tr>
<td>Elections</td>
<td>-$ 177,000</td>
<td>- 23.3%</td>
<td>Election year</td>
<td>3.d.</td>
</tr>
</tbody>
</table>
### 1962-63 Budget (new mayor)

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare</td>
<td>-$14,190,000</td>
<td>-42.7%</td>
<td>Appropriation to pay off $8.5M deficit for 61-62 and additional $8.3M for current needs</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Mayors Committee for Industrial development</td>
<td>-$14,540</td>
<td>-36.2%</td>
<td>Opening of Washington lobby office</td>
<td>2.a.</td>
</tr>
<tr>
<td>Loyalty Investigating Committee</td>
<td>-$7,531</td>
<td>-31.2%</td>
<td>Carryover from capital item fluctuations</td>
<td>4.a.d.</td>
</tr>
<tr>
<td>Planning</td>
<td>-$196,500</td>
<td>-25.4%</td>
<td>2% wage increase + $100 per uniformed employee, also full staffing + 25 new positions</td>
<td>4.a.b.</td>
</tr>
<tr>
<td>Fire</td>
<td>-$799,700</td>
<td>-5.8%</td>
<td>Refunding of capital items</td>
<td>2.a.</td>
</tr>
<tr>
<td>Zoo</td>
<td>+$379,700</td>
<td>+25.0%</td>
<td>Refunding of capital items</td>
<td>4.b.</td>
</tr>
<tr>
<td>Public Works -- Sanitation</td>
<td>+$984,800</td>
<td>+15.2%</td>
<td>Refunding of capital items</td>
<td>2.a.</td>
</tr>
<tr>
<td>Health Department -- Kiefer Hospital</td>
<td>+$828,900</td>
<td>+15.2%</td>
<td>Refunding of capital items, also decline in TB Cases</td>
<td>4.b.c.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 1963-64 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Renewal</td>
<td>-$25,500</td>
<td>-100%</td>
<td>New department</td>
<td>2.a.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Police</td>
<td>-$1,363,000</td>
<td>-3.9%</td>
<td>Wage increases as result of Public Administration Service survey and 125 new positions for EDP, patrolmen, school guards - Civil Rights?</td>
<td>1.b.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.b.ii.</td>
</tr>
<tr>
<td>Health Receiving Hospital</td>
<td>-$978,800</td>
<td>-9.0%</td>
<td>Patient revenue increase plus City increase because of heavier case loads</td>
<td>3.b.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.c.</td>
</tr>
<tr>
<td>Controller's Office</td>
<td>-$965,300</td>
<td>-35.6%</td>
<td>People to collect New city income tax, etc.</td>
<td>3.d.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.b.ii.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.c.</td>
</tr>
<tr>
<td>Mayor's Industrial</td>
<td>-$21,780</td>
<td>-35.5%</td>
<td>New mayor</td>
<td>2.a.</td>
</tr>
<tr>
<td>Elections Commission</td>
<td>+$245,600</td>
<td>+61.1%</td>
<td>(no election)</td>
<td>3.d.</td>
</tr>
<tr>
<td>Public Works -- Streets</td>
<td>+$3,033,000</td>
<td>+71.1%</td>
<td>Refunding of capital items</td>
<td>2.a.</td>
</tr>
<tr>
<td>Welfare</td>
<td>+$3,241,000</td>
<td>+12.8%</td>
<td>Federal Aid covers part of Aid to Dependent Children with unemployed fathers</td>
<td>1.a.i.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.b.</td>
</tr>
<tr>
<td>Department</td>
<td>Error</td>
<td>% Error</td>
<td>&quot;Cause&quot;</td>
<td>Type</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------</td>
<td>---------</td>
<td>---------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Election Committee</td>
<td>-$666,500</td>
<td>-62.6%</td>
<td>Election year</td>
<td>3.d.</td>
</tr>
<tr>
<td>Public Works -- Streets</td>
<td>-$1,600,000</td>
<td>-35.2%</td>
<td>Includes payments to general fund under state and federal agreements</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Police</td>
<td>-$2,145,000</td>
<td>-5.8%</td>
<td>$1 % wage increase and implementation of public administration survey recommendations</td>
<td>4.d.</td>
</tr>
<tr>
<td>Assessors</td>
<td>-$204,200</td>
<td>-13.8%</td>
<td>Property reassessment required by new State Constitution</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Fire</td>
<td>-$794,600</td>
<td>-5.2%</td>
<td>$1 % wage increase and implementation of public administration survey recommendations</td>
<td>4.a.</td>
</tr>
<tr>
<td>Mayors Committee on Industrial Development</td>
<td>+$13,610</td>
<td>+28.9%</td>
<td>Rapid department growth tapers off</td>
<td>4.d.</td>
</tr>
<tr>
<td>Welfare</td>
<td>+$7,070,000</td>
<td>+39.4%</td>
<td>Aid to dependent children with unemployed fathers legislations</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Public Works -- Sewers</td>
<td>+$1,953,000</td>
<td>-</td>
<td>Transferred to Water Dept. - no longer in general fund</td>
<td>2.b.i.</td>
</tr>
</tbody>
</table>
Summary of Type of "Causes" for Detroit:

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.a.i.</td>
<td>11</td>
</tr>
<tr>
<td>1.a.ii.</td>
<td>1</td>
</tr>
<tr>
<td>1.b.</td>
<td>5</td>
</tr>
<tr>
<td>2.a.</td>
<td>9</td>
</tr>
<tr>
<td>2.b.i.</td>
<td>1</td>
</tr>
<tr>
<td>2.b.ii.</td>
<td>6</td>
</tr>
<tr>
<td>3.a.</td>
<td>2</td>
</tr>
<tr>
<td>3.b.</td>
<td>2</td>
</tr>
<tr>
<td>3.c.</td>
<td>1</td>
</tr>
<tr>
<td>3.d.</td>
<td>6</td>
</tr>
<tr>
<td>4.a.</td>
<td>3</td>
</tr>
<tr>
<td>4.b.</td>
<td>14</td>
</tr>
<tr>
<td>4.c.</td>
<td>4</td>
</tr>
<tr>
<td>4.d.</td>
<td>8</td>
</tr>
</tbody>
</table>

The two highest error frequencies in Detroit were those caused by changes in the State and Federal shares of programs administered by the city (primarily welfare), and the changing accounting practices of the city with respect to capital items. It obviously is "not fair" to require that our model predict the outcome of the long-standing feud between the State and City of Detroit over relative shares of the Welfare bill or to predict Federal-Aid-to-Dependent-Children-of-Unemployed-Fathers legislation.

The effects of the Welfare problem on the model's goodness-of-fit have already been noted in Section 6. By filtering out Welfare items in the budget and only dealing with the remainder, we were able to improve the model's performance in Detroit. It would obviously pay to filter out the Capital Items from the "Equipment and Improvements" account
in Detroit in the years before the capital budget was a completely separate document. Unfortunately detailed, item breakdowns for Mayors Recommendations and department requests are not in existence. If they were, we could expect improvement in model fit for the 1958-59 to 1962-63 period.

The distribution of the "causes" of model errors is certainly reasonable after the Welfare and capital complications are removed. In general, we see a pattern of systematic change in the areas of planning, urban renewal, industrial growth, and the like. Also noted are changes in civil-rights related fields: increased police after the summer of 1963 (riots, boycotts, demonstrations, "March on Washington"), expanded "Community Relations" functions. We would probably note the effect of the federal poverty program if an additional measurement were taken in 1966.

Most changes, it will be observed, are routine changes, resulting from more detailed information than our model has (knowing when elections are held, for example) and involving routine responses to emerging problems (not filling positions when times are "tight"), and reflecting elaborations of other decisions (people to arrange collection of a new income tax). Also noted are results of a survey of Police and Fire operations in Detroit by the Public Administrative Survey (PAS). Had the resulting changes amounted to more than a 2-1/2% wage increase, the existence of national operating standards for Police and Fire might have been indicated. The PAS functions as a consulting firm and could provide a mechanism for transmitting standards.
### B.3.b. Cleveland Model Residuals

**Cleveland (one-period change model)**

**1956 Budget**

<table>
<thead>
<tr>
<th>Department</th>
<th>Error*</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Engineering</td>
<td>-$596,500</td>
<td>-100.0%</td>
<td>New department—mostly transfers from Police dept.</td>
<td>2.b.i.</td>
</tr>
<tr>
<td>Street Cleaning</td>
<td>-$261,600</td>
<td>-39.6%</td>
<td>Part due to pay increase—remainder missing data</td>
<td>4.a.</td>
</tr>
<tr>
<td>City hospital</td>
<td>-$177,500</td>
<td>-3.3%</td>
<td>General wage increase</td>
<td>4.d.</td>
</tr>
<tr>
<td>Recreation</td>
<td>-$148,700</td>
<td>-10.8%</td>
<td>Wage increase, eight new playgrounds</td>
<td>4.d.</td>
</tr>
<tr>
<td>Public Service—General Admin.</td>
<td>-$15,480</td>
<td>-39.6%</td>
<td>Some due to salary increase—most is model error</td>
<td>4.d.</td>
</tr>
<tr>
<td>Boxing and Wrestling Comm.</td>
<td>-$4,016</td>
<td>-28.0%</td>
<td>Small error?</td>
<td></td>
</tr>
<tr>
<td>Finance—General Admin.</td>
<td>-$7,222</td>
<td>-22.3%</td>
<td>One new secretary (at $7,218)</td>
<td>4.d.</td>
</tr>
<tr>
<td>Port—General Admin.</td>
<td>$17,980</td>
<td>+27.1%</td>
<td>Dept. new in 1954—growth &quot;slowing down&quot;</td>
<td>4.d.</td>
</tr>
<tr>
<td>Police</td>
<td>$430,500</td>
<td>+4.3%</td>
<td>Transfers to new Traffic Engineering and Parking department.</td>
<td>2.b.i.</td>
</tr>
</tbody>
</table>

* (Model predictions - observed)
### 1957 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel</td>
<td>-$111,500</td>
<td>-76.8%</td>
<td>Bad data, causing unstable model parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>Traffic Engineering</td>
<td>-$148,100</td>
<td>-23.9%</td>
<td>Department new in 1956, so 'normal' data missing</td>
<td>2.b.i.</td>
</tr>
<tr>
<td>Port -- Gen. Admin.</td>
<td>-$25,070</td>
<td>-29.1%</td>
<td>Doubled engineering staff (Seaway?)</td>
<td>1.b.</td>
</tr>
<tr>
<td>Police</td>
<td>-$161,900</td>
<td>-1.5%</td>
<td>10% uniformed personnel salary increase, 50 new policemen</td>
<td>4.d.</td>
</tr>
<tr>
<td>Street Cleaning</td>
<td>-$143,000</td>
<td>-2.4%</td>
<td>8% general salary increase and 50 new people due to increase in state gasoline tax receipts</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Engineering and Construction</td>
<td>-$137,900</td>
<td>-23.5%</td>
<td>8% general salary increase and dept. model error</td>
<td>4.d.</td>
</tr>
<tr>
<td>City Hospital</td>
<td>-$104,000</td>
<td>-1.8%</td>
<td>Increase in hospital receipts (Patient charges)</td>
<td>3.b.</td>
</tr>
</tbody>
</table>
### 1958 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous</td>
<td>-$23,990</td>
<td>-85.7%</td>
<td>Bad data</td>
<td>4.a.</td>
</tr>
<tr>
<td>City Hospital</td>
<td>+$5,275,000</td>
<td>----</td>
<td>Transferred to County</td>
<td>1.a.ii.</td>
</tr>
<tr>
<td>Architecture</td>
<td>-$84,950</td>
<td>-82.4%</td>
<td>Bad dept. parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>Public Service--General Admin.</td>
<td>-$24,140</td>
<td>-54.3%</td>
<td>Bad dept. parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>UR-Gen. Admin.</td>
<td>-$38,660</td>
<td>-100%</td>
<td>New dept. (transfers from Public Safety)</td>
<td>2.b.ii.</td>
</tr>
<tr>
<td>Harvard Yards</td>
<td>-$47,900</td>
<td>-100%</td>
<td>New unit of Parks Department</td>
<td>2.b.ii.</td>
</tr>
<tr>
<td>Police</td>
<td>-$1,368,000</td>
<td>-11.7%</td>
<td>5% pay increase for uniform ranks plus 122 new patrol men</td>
<td>4.c.</td>
</tr>
<tr>
<td>Fire</td>
<td>-$795,700</td>
<td>-11.1%</td>
<td>5% pay increase for uniform ranks plus 34 new firemen</td>
<td>5.c.</td>
</tr>
<tr>
<td>Street Cleaning</td>
<td>-$747,000</td>
<td>-11.4%</td>
<td>80 new people (hourly) rental of lake-front crane--increased receipts from state gasoline tax</td>
<td>3.b.</td>
</tr>
<tr>
<td>Street Lighting</td>
<td>-$543,000</td>
<td>-32.7%</td>
<td>Bad DEPT. Parameters</td>
<td>4.a.</td>
</tr>
</tbody>
</table>
### 1959 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel</td>
<td>+$110,000</td>
<td>+258.4%</td>
<td>Unstable model parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>City Hospital</td>
<td>+$1,115,000</td>
<td>----</td>
<td>Transferred to county</td>
<td>1.a.ii.</td>
</tr>
<tr>
<td>Urban Renewal --Housing</td>
<td>-$201,000</td>
<td>-100%</td>
<td>Dept. of UR-building and housing split</td>
<td>3.c.</td>
</tr>
<tr>
<td>UR-Building</td>
<td>+$138,200</td>
<td>+23.9%</td>
<td>Dept. of UR-Building and Housing split</td>
<td>2.b.i.</td>
</tr>
<tr>
<td>UR-General Admin.</td>
<td>-$22,080</td>
<td>-60.4%</td>
<td>Dept. new in 1958</td>
<td>2.b.i.</td>
</tr>
<tr>
<td>Sewer Maintenance</td>
<td>-$478,700</td>
<td>-64.5%</td>
<td>Bad data</td>
<td>4.a.</td>
</tr>
<tr>
<td>Police</td>
<td>-$446,600</td>
<td>-3.5%</td>
<td>5% salary increase for uniformed personal</td>
<td>4.a.</td>
</tr>
<tr>
<td>Community Relations</td>
<td>-$36,320</td>
<td>-60.5%</td>
<td>9 new clerks</td>
<td>1.b.</td>
</tr>
<tr>
<td>Department</td>
<td>Error</td>
<td>% Error</td>
<td>&quot;Cause&quot;</td>
<td>Type</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>---------</td>
<td>--------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Finance-Treasurer</td>
<td>+$58,680</td>
<td>+110.3%</td>
<td>Bad data</td>
<td>4.a.</td>
</tr>
<tr>
<td>Harvard Yards</td>
<td>+$8,962</td>
<td>+34.6%</td>
<td>Department of Park Streets and Roads function transferred</td>
<td>2.b.i.</td>
</tr>
<tr>
<td>Police</td>
<td>-$155,600</td>
<td>-1.2%</td>
<td>14 new school guards model error</td>
<td>4.a.</td>
</tr>
<tr>
<td>Recreation</td>
<td>-$115,100</td>
<td>-5.7%</td>
<td>2 new ice rinks opened (land issue)</td>
<td>3.a.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 new playgrounds, 3 new recreation centers (buildings) opened</td>
<td></td>
</tr>
<tr>
<td>Urban Renewal-Housing</td>
<td>-$24,380</td>
<td>-11.0%</td>
<td>Personnel increase paid for out of UR</td>
<td>1.a.i.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>bonds (capital item)</td>
<td>3.b.</td>
</tr>
<tr>
<td>Street Cleaning</td>
<td>-$86,010</td>
<td>-1.2%</td>
<td>Increase in state gasoline tax receipts and opening of new city incinerator (capital item) with increase of 50 people</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Safety--Gen. Admin.</td>
<td>-$8,897</td>
<td>-27.4%</td>
<td>New secretary to director</td>
<td>4.a.</td>
</tr>
<tr>
<td>Community Relations</td>
<td>-$1,046</td>
<td>-1.2%</td>
<td>New research director</td>
<td>4.a.</td>
</tr>
</tbody>
</table>
### 1961 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finance-Treasurer</td>
<td>-$51,910</td>
<td>-47.9%</td>
<td>Bad 1960 data</td>
<td>4.a.</td>
</tr>
<tr>
<td>Architecture</td>
<td>-$43,540</td>
<td>-36.5%</td>
<td>Bad dept. model parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>Urban Renewal --Housing</td>
<td>-$95,280</td>
<td>-26.7%</td>
<td>Need for &quot;certificate of occupancy&quot;</td>
<td>1.a.i.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>permit&quot; produced $150,000 in extra</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dept. revenue</td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>-$310,800</td>
<td>-3.6%</td>
<td>Increased salaries</td>
<td>4.a.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5%, shortened work week (needed 55 new</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>men)</td>
<td></td>
</tr>
<tr>
<td>Sewer Maintenance</td>
<td>-$76,140</td>
<td>-9.9%</td>
<td>Missing data</td>
<td>4.a.</td>
</tr>
<tr>
<td>Finance--Gen. Admin.</td>
<td>+$6,343</td>
<td>+25.9%</td>
<td>Secretary to director dropped</td>
<td>4.a.</td>
</tr>
<tr>
<td>Auditorium and Stadium</td>
<td>+$60,260</td>
<td>+5.1%</td>
<td></td>
<td>4.a.</td>
</tr>
<tr>
<td>Personnel</td>
<td>-$9,753</td>
<td>-18.2%</td>
<td>Bad data</td>
<td>4.a.</td>
</tr>
<tr>
<td>Engineering and Construction</td>
<td>-$127,800</td>
<td>-17.6%</td>
<td>Model Error</td>
<td>4.d.</td>
</tr>
</tbody>
</table>
### 1962 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Cleaning</td>
<td>+$64,020</td>
<td>+9.8%</td>
<td>New employees starting at bottom of pay scale</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Job Retraining</td>
<td>-$17,500</td>
<td>-100%</td>
<td>New department</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Harbor</td>
<td>-$63,470</td>
<td>-14.7%</td>
<td>Model error (dept.)</td>
<td>2.b.ii.</td>
</tr>
<tr>
<td>Fire</td>
<td>-$54,920</td>
<td>-0.6%</td>
<td>&quot;unusual&quot; increase last year carried over</td>
<td>4.a.</td>
</tr>
<tr>
<td>Urban Renewal - Housing</td>
<td>+$54,740</td>
<td>15.1%</td>
<td>&quot;unusual&quot; increase last year carried over</td>
<td>4.a.</td>
</tr>
<tr>
<td>Council</td>
<td>-$61,730</td>
<td>-12.5%</td>
<td>Councilmen salary increases (+$1500/yr., 32 councilmen)</td>
<td>4.a.</td>
</tr>
<tr>
<td>Community Relations</td>
<td>+$21,340</td>
<td>+40.8%</td>
<td>Office staff reduction</td>
<td>4.c.</td>
</tr>
<tr>
<td>Welfare Institutions - Gen. Admin.</td>
<td>+$8,472</td>
<td>+42.4%</td>
<td>Commissioner's job made part time during 1961 (new Commissioner)</td>
<td>4.c.</td>
</tr>
<tr>
<td>Architecture</td>
<td>-$24,130</td>
<td>-21.3%</td>
<td>Bad model parameters (dept.)</td>
<td>4.a.</td>
</tr>
</tbody>
</table>
### 1963 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare Institutions</td>
<td>-$10,830</td>
<td>-37.4%</td>
<td>Commissioner's job reinstated to full time (see 1962)</td>
<td>4.c.</td>
</tr>
<tr>
<td>Job Retraining</td>
<td>-$4,631</td>
<td>-21.7%</td>
<td>Consultants hired</td>
<td>4.c.</td>
</tr>
<tr>
<td>Urban Renewal--Housing</td>
<td>-$50,90</td>
<td>-12.9%</td>
<td>Increase in payroll support from urban renewal bonds (for capital items)</td>
<td>3.b.</td>
</tr>
<tr>
<td>Dog Pound</td>
<td>-$4,691</td>
<td>-11.4%</td>
<td>Open one more day per week after 1 yr. experiment</td>
<td>3.b.</td>
</tr>
<tr>
<td>Street Lighting</td>
<td>-$133,900</td>
<td>-7.4%</td>
<td>Rise in cost of contractual services--street lighting by privately-owned utility</td>
<td>3.d.</td>
</tr>
<tr>
<td>Airport</td>
<td>-$101,500</td>
<td>-8.2%</td>
<td>14 new employees-- engineers</td>
<td>4.a.</td>
</tr>
<tr>
<td>Engineering Construction</td>
<td>-$56,640</td>
<td>-7.7%</td>
<td>4.c.</td>
<td>4.a.</td>
</tr>
<tr>
<td>Sewer Maintenance</td>
<td>$751,400</td>
<td>--</td>
<td>Transferred out of Gen. Fund</td>
<td>1.a.ii</td>
</tr>
<tr>
<td>Health</td>
<td>-$52,870</td>
<td>-3.5%</td>
<td>Opening of new health center (capital item)</td>
<td>3.a.</td>
</tr>
</tbody>
</table>
### 1964 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Police</td>
<td>-$1,177,000</td>
<td>-7.6%</td>
<td>10% salary increase 4.a. ($200,000 for 1.b. additional men)</td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>-$654,100</td>
<td>-6.9%</td>
<td>10% salary increase 4.a.</td>
<td></td>
</tr>
<tr>
<td>Street Cleaning</td>
<td>-$640,800</td>
<td>-7.5%</td>
<td>10% salary increase 4.a.</td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>-$250,700</td>
<td>-30.9%</td>
<td>10% salary increase 4.a. and additional personnel to help administer a $5M increase on contracts (capital items)</td>
<td></td>
</tr>
<tr>
<td>Docks and Bridges</td>
<td>-$101,400</td>
<td>-30.5%</td>
<td>Increase in payroll 3.b. supported by increased billings to special funds and land issues (capital items)</td>
<td></td>
</tr>
<tr>
<td>Port--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen. Admin.</td>
<td>-$22,640</td>
<td>-19.6%</td>
<td>Airpot activity 4.a. +10% salary increase 4.c.</td>
<td></td>
</tr>
<tr>
<td>Architecture</td>
<td>-$24,230</td>
<td>-19.1%</td>
<td>+10% salary increase and increases in payroll support by billings to special funds and bond issues</td>
<td></td>
</tr>
<tr>
<td>Welfare Institutions</td>
<td>+$5,009</td>
<td>+24.6%</td>
<td>Commissioner replaced by clerk</td>
<td>4.c.</td>
</tr>
<tr>
<td>Street Lighting</td>
<td>+$230,900</td>
<td>+14.3%</td>
<td>Carryover from last year's increase in contractual costs</td>
<td>4.a.</td>
</tr>
</tbody>
</table>
## 1965 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>-$56,470</td>
<td>-44.4%</td>
<td>Unstable parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>Engineering and Construction</td>
<td>-$248,500</td>
<td>-32.8%</td>
<td>Missing data</td>
<td>4.a.</td>
</tr>
<tr>
<td>Health and Welfare--</td>
<td>-$14,940</td>
<td>-35.2%</td>
<td>$15,000 additional contractual service charge (visiting doctors and nurses)</td>
<td>1.</td>
</tr>
<tr>
<td>General Admin.</td>
<td></td>
<td></td>
<td></td>
<td>3.d.</td>
</tr>
<tr>
<td>Auditorium and Stadium</td>
<td>-$217,600</td>
<td>-13.5%</td>
<td>Underground exhibition hall opened (capital item)</td>
<td>3.a.</td>
</tr>
<tr>
<td>Police</td>
<td>-$349,900</td>
<td>-2.2%</td>
<td>200 new policemen</td>
<td>1.b.</td>
</tr>
<tr>
<td>Street Cleaning</td>
<td>$132,300</td>
<td>+1.6%</td>
<td>Carryover from unusual increase in 1964.</td>
<td>4.a.</td>
</tr>
<tr>
<td>Urban Renewal--</td>
<td>-$68,730</td>
<td>-14.0%</td>
<td>Error in budget book (and data)</td>
<td>4.a.</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare Institutions</td>
<td>-$5,058</td>
<td>-19.0%</td>
<td>Increase in contractual service totals</td>
<td>3.d.</td>
</tr>
<tr>
<td>Community Relations</td>
<td>-$11,560</td>
<td>-17.2%</td>
<td>Increase in operations (Civil Rights disturbances?)</td>
<td>1.b.</td>
</tr>
</tbody>
</table>
Summary of Type of "Causes" for Cleveland:

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.a.i.</td>
<td>6</td>
</tr>
<tr>
<td>1.a.ii.</td>
<td>5</td>
</tr>
<tr>
<td>1.b.</td>
<td>6</td>
</tr>
<tr>
<td>2.a.</td>
<td>0</td>
</tr>
<tr>
<td>2.b.i.</td>
<td>10</td>
</tr>
<tr>
<td>2.b.ii.</td>
<td>1</td>
</tr>
<tr>
<td>3.a.</td>
<td>5</td>
</tr>
<tr>
<td>3.b.</td>
<td>7</td>
</tr>
<tr>
<td>3.c.</td>
<td>2</td>
</tr>
<tr>
<td>3.d.</td>
<td>4</td>
</tr>
<tr>
<td>4.a.</td>
<td>42</td>
</tr>
<tr>
<td>4.b.</td>
<td>0</td>
</tr>
<tr>
<td>4.c.</td>
<td>13</td>
</tr>
<tr>
<td>4.d.</td>
<td>10</td>
</tr>
</tbody>
</table>

Many of the errors in the Cleveland model involve missing data (4.a.) in Engineering and Construction and Architecture. The measurement errors or omissions, in turn, produce model errors. "Bad data" are used to calculate model parameters, and in some cases, generate erratic model behavior in specific departments. The net effect, of course, is to blur the revenue constraint, thus affecting the entire model. Much of this could be corrected by either tracing down the missing data or by making reasonable guesses of data values.  

12 Estimates of values for missing data could be obtained in a number of ways -- two that are feasible:
1. take the average of the data values at t-1 and t+1 to estimate the data at t.
2. use the model-generated estimate for the value at t.
As the model was run, missing data was assumed to have a zero value.

A primary, systematic source of model deviations has to do with funding. The Cleveland accounting system presents somewhat of a special case because many contributions to the general fund are not "general" at all. Many revenues are earmarked for particular departments. Consequently, many departments' appropriations are dependent upon revenue estimates from a particular source (3.b.). For example, in the Division of Housing, Department of Urban Renewal and Housing, an increase was observed in departmental appropriations of over $150,000 for one year. This was a direct result of a new ordinance requiring "certificates of occupancy." The fee associated with the certificate was given to the Housing Division, providing $155,000 (estimated) in additional department revenue. The model ought not to be required to explain changes in special revenues. On the other hand, it may have been reasonable to include earmarked general-fund revenue estimates as part of the DEPT. Submodel of some departments. If we were constructing a model of budgeting in Cleveland instead of budgeting in large municipalities, the additional complexity would clearly be appropriate.

A second, systematic source of deviation is related to relationships with other organizations and governments. For instance, part of Cleveland's street lighting is performed by private utility companies under a contract. A major portion of the Bureau of Street Lighting's budget is tied up in the contractual negotiations with private utility companies. The Bureau of Street Cleaning obtains a significant portion
of its appropriation through State gasoline tax receipts. Urban Renewal funds (Federal and bond issues) provide explicit portions of general fund revenues for particular departments.

Transfer of personnel to form new administrative units provides the third major class of deviations. Examples are the Bureau of Traffic Engineering and Parking and the Bureaus comprising of the Department of Urban Renewal and Housing.

In general, we note the same kinds of responses to urban renewal and civil rights as we observed in Detroit.
B.3.c. Pittsburgh Model Deviations

Pittsburgh (one-period change model)

1960 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error*</th>
<th>% Error</th>
<th>&quot;Causes&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Works-Refuse</td>
<td>-$282,400</td>
<td>-6.0%</td>
<td>Contract for rubbish collection</td>
<td>1.</td>
</tr>
<tr>
<td>Public Works-Bridges &amp; Highways</td>
<td>-$235,400</td>
<td>-5.0%</td>
<td>Street lighting cost</td>
<td>1.</td>
</tr>
<tr>
<td>Public Works-Auto Equipment</td>
<td>-$148,100</td>
<td>-11.0%</td>
<td>Mechanization of dept. function--increase in police fleet--step up coverage without adding men</td>
<td>1.b.</td>
</tr>
<tr>
<td>Treasurer</td>
<td>+$52,490</td>
<td>+3.8%</td>
<td>Unfilled positions due to poor economic conditions in area</td>
<td>1.b.</td>
</tr>
<tr>
<td>Land &amp; Building--accounts &amp; admin.</td>
<td>+$46,890</td>
<td>+9.0%</td>
<td>new department</td>
<td>4.a.</td>
</tr>
<tr>
<td>Service Center</td>
<td>-$34,400</td>
<td>-100.0%</td>
<td>new department</td>
<td>4.d.</td>
</tr>
<tr>
<td>Human Relations</td>
<td>-$11,260</td>
<td>-15.4%</td>
<td>2 staff positions to implement Federal Fair Housing Bill</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Public Safety--Youth Bureau</td>
<td>+$13,210</td>
<td>+51.8%</td>
<td>Transfer from Police Dept.</td>
<td>1.a.ii</td>
</tr>
<tr>
<td>Civil Defense</td>
<td>+$6,136</td>
<td>+27.4%</td>
<td>Carryover from capital item in 1959</td>
<td>3.a.</td>
</tr>
</tbody>
</table>

* (Model predictions - observed)
### 1961 Budget (new mayor)

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Safety Police</td>
<td>-$287,800</td>
<td>-3.0%</td>
<td>Part of wage hike financed by income tax increase</td>
<td>4.d.</td>
</tr>
<tr>
<td>Lands &amp; Buildings Accounts &amp; Admin.</td>
<td>-$174,500</td>
<td>-29.5%</td>
<td>Reduction in liquid fuels tax reimbursement from state (reflects city's loss in population)</td>
<td>4.d.</td>
</tr>
<tr>
<td>Public Works- Gen. office</td>
<td>+$159,800</td>
<td>+7.7%</td>
<td>Part of wage hike financed by income tax increase</td>
<td>4.d.</td>
</tr>
<tr>
<td>Public Works- Refuse</td>
<td>-$154,100</td>
<td>-3.4%</td>
<td>Part of wage hike financed by income tax increase</td>
<td>4.a.</td>
</tr>
<tr>
<td>P.S.--Fire</td>
<td>-$93,970</td>
<td>-1.4%</td>
<td>New department in 1961</td>
<td>4.d.</td>
</tr>
<tr>
<td>P.S.--Youth Bureau</td>
<td>-$19,660</td>
<td>-71.6%</td>
<td>New department in 1961</td>
<td>4.d.</td>
</tr>
<tr>
<td>Art Commission</td>
<td>-$5,064</td>
<td>-11.8%</td>
<td>--</td>
<td>4.d.</td>
</tr>
<tr>
<td>Police Magistrates</td>
<td>+$6,872</td>
<td>+13.5%</td>
<td>Personnel officer to administer job classification and pay plan program</td>
<td>2.b.ii, 3.d, 4.c.</td>
</tr>
<tr>
<td>Mayor</td>
<td>-$12,870</td>
<td>-10.3%</td>
<td>--</td>
<td>4.d.</td>
</tr>
</tbody>
</table>
### 1962 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Works-Gen. Office</td>
<td>-$206,000</td>
<td>-9.5%</td>
<td>Street lighting contract and liquid fuels tax program- increased responsibilities - intergovernmental</td>
<td>1.</td>
</tr>
<tr>
<td>Public Safety Police</td>
<td>+$749,800</td>
<td>+8.5%</td>
<td>Carryover from last year's increase, moratorium on step increases</td>
<td>4.d.</td>
</tr>
<tr>
<td>P.S.-Fire</td>
<td>-$115,100</td>
<td>-1.7%</td>
<td>Increments 1st, 2nd, 3rd, year new</td>
<td>4.d.</td>
</tr>
<tr>
<td>P.S.-Youth Bureau</td>
<td>-$100,600</td>
<td>-78.6%</td>
<td>New dept. in 1961</td>
<td>2.b.i.</td>
</tr>
<tr>
<td>P.W.-Automotive Equipment</td>
<td>-$67,580</td>
<td>-4.9%</td>
<td>Increased parts costs</td>
<td>1.</td>
</tr>
<tr>
<td>Council</td>
<td>-$10,500</td>
<td>-8.6%</td>
<td></td>
<td>2.d.</td>
</tr>
<tr>
<td>P.W.-Engineering</td>
<td>-$8,827</td>
<td>-8.3%</td>
<td></td>
<td>4.d.</td>
</tr>
<tr>
<td>Department</td>
<td>Error</td>
<td>% Error</td>
<td>&quot;Cause&quot;</td>
<td>Type</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------</td>
<td>---------</td>
<td>----------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>P.W.-Gen. Office</td>
<td>-$611,100</td>
<td>-22.3%</td>
<td>Liquid fuels (state) program</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>P.S.-Police</td>
<td>-$548,300</td>
<td>-5.9%</td>
<td>Social security increases, service increments</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>P.S.-Fire</td>
<td>+$212,500</td>
<td>+3.2%</td>
<td>Moratorium on hirings</td>
<td>1.b.</td>
</tr>
<tr>
<td>Parks &amp; Recreation</td>
<td>+$144,900</td>
<td>+19.3%</td>
<td>Took over school board's recreation program in 1954-now &quot;forced&quot; to drop it</td>
<td>1.b.</td>
</tr>
<tr>
<td>Recreation Division</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P.W.-Auto Equip.</td>
<td>+$134,300</td>
<td>+10.9%</td>
<td>Carryover from previous budgets</td>
<td>4.a.</td>
</tr>
<tr>
<td>P.W.-Engineering</td>
<td>+$85,490</td>
<td>+4.4%</td>
<td>Contract schedules</td>
<td>3.a.</td>
</tr>
<tr>
<td>P.S.-Youth Bureau</td>
<td>+$63,940</td>
<td>+100.2%</td>
<td>Rapid growth tapering off &quot;unstable&quot; model parameters</td>
<td>4.a.</td>
</tr>
<tr>
<td>Human Relations Commission</td>
<td>+$21,640</td>
<td>+38.9%</td>
<td>Rapid growth tapering off</td>
<td>4.d.</td>
</tr>
<tr>
<td>Sinking Fund Comm.</td>
<td>+$1,010</td>
<td>+29.7%</td>
<td>Small error</td>
<td>--</td>
</tr>
</tbody>
</table>
### 1964 Budget

<table>
<thead>
<tr>
<th>Department</th>
<th>Error</th>
<th>% Error</th>
<th>&quot;Cause&quot;</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.S.-Police</td>
<td>-$105,700</td>
<td>-1.0%</td>
<td>5% pay raise (step increases)</td>
<td>4.d.</td>
</tr>
<tr>
<td>P.R.-Grounds</td>
<td>-$68,620</td>
<td>-3.8%</td>
<td>Staff for new parks (capital item)</td>
<td>3.a.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>and step increase</td>
<td></td>
</tr>
<tr>
<td>P.W.-General Office</td>
<td>+$189,000</td>
<td>+8.1%</td>
<td>State liquid fuels</td>
<td>1.a.i.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>program for street lighting (contract)</td>
<td>3.d.</td>
</tr>
<tr>
<td>Treasurer</td>
<td>-$68,350</td>
<td>-3.9%</td>
<td>Step increases in wages</td>
<td>4.d.</td>
</tr>
<tr>
<td>P.W.-Refuse</td>
<td>+$62,400</td>
<td>+1.3%</td>
<td>1/2% pay increase for laborers</td>
<td>4.a.</td>
</tr>
<tr>
<td>Human Relations</td>
<td>-$20,900</td>
<td>-21.2%</td>
<td>More staff, mayor notes &quot;40 tension cases&quot; over past summer</td>
<td>1.b.</td>
</tr>
<tr>
<td>Mayors</td>
<td>-$21,670</td>
<td>-13.6%</td>
<td>Coordination of federal job re-training programs</td>
<td>1.a.i.</td>
</tr>
<tr>
<td>Police Magistrates</td>
<td>+$6,775</td>
<td>+12.6%</td>
<td></td>
<td>4.c.</td>
</tr>
<tr>
<td>Sinking fund comm.</td>
<td>-$5,116</td>
<td>-10.2%</td>
<td>Small error</td>
<td>--</td>
</tr>
<tr>
<td>Department</td>
<td>Error</td>
<td>% Error</td>
<td>&quot;Cause&quot;</td>
<td>Type</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
<td>---------</td>
<td>----------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>P.S.-Police</td>
<td>-$596,900</td>
<td>-5.4%</td>
<td>Cost of 100 new patrolmen</td>
<td>1.b.</td>
</tr>
<tr>
<td>P.W.-Gen. Office</td>
<td>-$126,800</td>
<td>-5.2%</td>
<td>Outside contract-street lighting, increase in responsibility--inter-governmental decision</td>
<td>1. a.i.</td>
</tr>
<tr>
<td>Supplies-Accounts and Admin.</td>
<td>-$121,600</td>
<td>-46.0%</td>
<td>Outside contract</td>
<td>1. 3.d.</td>
</tr>
<tr>
<td>P.R.-Recreation</td>
<td>-$109,400</td>
<td>-11.9%</td>
<td>Reinstated recreation program dropped two years ago</td>
<td>1. a.ii.</td>
</tr>
<tr>
<td>P.S.-Traffic Planning</td>
<td>-$86,820</td>
<td>-9.4%</td>
<td>Meter Maid program</td>
<td>2.b.ii.</td>
</tr>
<tr>
<td>Police Magistrates</td>
<td>-$12,800</td>
<td>-19.3%</td>
<td></td>
<td>4.a.</td>
</tr>
<tr>
<td>Clerk</td>
<td>-$14,850</td>
<td>-13.9%</td>
<td></td>
<td>4.a.</td>
</tr>
</tbody>
</table>
Summary of Pittsburgh Deviation types:

<table>
<thead>
<tr>
<th>Types</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>1.a.i.</td>
<td>7</td>
</tr>
<tr>
<td>1.a.ii.</td>
<td>2</td>
</tr>
<tr>
<td>1.b.</td>
<td>7</td>
</tr>
<tr>
<td>2.a.</td>
<td>0</td>
</tr>
<tr>
<td>2.b.i.</td>
<td>1</td>
</tr>
<tr>
<td>2.b.ii.</td>
<td>4</td>
</tr>
<tr>
<td>3.a.</td>
<td>3</td>
</tr>
<tr>
<td>3.b.</td>
<td>2</td>
</tr>
<tr>
<td>3.c.</td>
<td>0</td>
</tr>
<tr>
<td>3.d.</td>
<td>7</td>
</tr>
<tr>
<td>4.a.</td>
<td>7</td>
</tr>
<tr>
<td>4.b.</td>
<td>0</td>
</tr>
<tr>
<td>4.c.</td>
<td>4</td>
</tr>
<tr>
<td>4.d.</td>
<td>15</td>
</tr>
</tbody>
</table>

In Pittsburgh, we experienced relatively more errors to which a "cause" could not be attributed (4.d.). Perhaps this is due to the fewer data points and the more completely specified system of accounts. (See figure 5-4). A more completely specified system of accounts leads to smaller account sizes, on the average. A moderate error, otherwise, will be large, percentage-wise, with small accounts. Because of the large numbers of departments, at least some account errors can be expected to be cumulative.

We observe that the primary source of model "error" is due to the external environment (1.). The dependence of the city on the "liquid fuels" program (share of state gasoline tax) to finance
various public works programs, leads to deviations whenever the State's contribution drops (because of a declining city population relative to the rest of the State). This closely parallels the Cleveland experience. In addition, many fluctuations seem to be caused by variations in the terms of negotiated contracts. Rubbish collection is contracted out in some areas, as is street lighting. Another source of "error" entered when the Recreation Department picked up, dropped, then picked up again, a summer program formerly run by the Board of Education.

The impact of Federal programs on the budget is noticeable in the Civil-rights, Economic-Opportunity and Human Relations areas. The responses, as highlighted by model "errors" (l.a.i.) consist of the formation of departments (Human Relation's Commission) and the addition of personnel (1964 Mayors Office) to administer Federal programs and to seek Federal funds. An implied response to the "Civil Rights problem" might be the addition of 100 new to the police force in 1965 after an increase in the Human Relations Commission Staff in 1964.

**General Patterns of "Policy Shifts" in Detroit, Cleveland, and Pittsburgh**

By studying model deviations, we note unusual or unprogrammed changes in the decision system - decisions our model was unable to predict. Some of these unusual changes were dictated changes - changes the external environment imposed on the municipal government. Other unprogrammed changes represented conscious, optional policy shifts on the part of municipalities.
Although there seems to be a consistent pattern of unprogrammed change with respect to outside, contractual agreements, this is of less interest to us because the change is, within broad limits, forced upon the city. We also note that the larger the municipality, the smaller the number of unusual changes that involve contractual relations. It is not clear whether this represents an "economies-of-scale" kind of argument where big cities can afford to provide a service for the entire area (serving as contractor instead of consumer) and cities smaller in relation to the total area must rely on an area-wide (and possibly private) organizations to provide the service, or whether this reflects the bargaining power of the bigger city (can "force" contracts to result in programmed change). Another common situation where the municipality is forced to react concerns revenue derived from the State. Welfare contributions in Detroit and gasoline and fuel tax shares for public works items in Cleveland and Pittsburgh provide vivid illustrations of the city at the mercy of its revenue sources (the State in this case). In all cases, the municipality "makes plenty of noise," but only Detroit has succeeded in convincing the State to increase its contribution.

13 The presence or absence of contractual services as a percentage of total budget is discussed in Section 8 in relation to the models applicability to other sizes of municipalities.
If there are any general patterns of 'unprogrammed decisions' that can be classified as 'policy shifts' in Cleveland, Detroit, and Pittsburgh, they occur in the same problem areas in which we find the Federal Government active. Urban Renewal Departments or commissions have been established as separate units in Detroit and Cleveland. In Pittsburgh, as we have noted above while discussing "invisible changes," the growth of this kind of activity has taken place within the City Planning Department.

The requirement of a Comprehensive Master Plan in order to participate (obtain funds) in the Federal Community Renewal Program has provided a substantive change in the urban planning process as well as a "level" change.

The presence of Federal Funds has also led to the establishment of Job Retraining Commissions in Detroit and Cleveland and a new staff position in the Mayor's Office in Pittsburgh to take advantage of the availability of funds.

The emergence of Human Relations Commissions in all three cities is at least partially a result of Federal interest in this area, and it is probably due in part to fear of racial violence on the part of the city administrations (note increases in the number of patrolmen in all three police bureaus in 1964 and 1965).

---

14 Due more to the presence of the first Democratically-controlled State legislature in many decades (because of reapportionment) than to any convincing on Detroit's part.
The conclusion that the Federal government is having a great impact on the real allocation of resources in urban areas is as obvious as it is important. The real magnitude of the impact is not reflected in the operating budget, however. Nearly all the "new departments" are set up to administer and coordinate a number of Federal programs and monies which do not appear in the operating budget. These observations are not new or particularly interesting. They do lead to a "profound" question concerning Federal involvement in urban affairs, however.  

Urban government has been perpetually plagued by a lack of revenues. Federal Funds effectively relax the severe revenue constraints in some fields of municipal activity. One important question that could be raised is: "If Federal funds came with 'no strings attached,' would municipal resources be allocated in roughly the same ways they are being allocated now, 'with the strings'?"

Because "planning" and "long-range" problems appear to be the target of Federal monies, if we believe "...the 'Gresham's Law' of planning: Daily routine drives out planning," then the answer to our question would probably be "no." March and Simon, in discussing "Gresham's Law" of planning cite one condition that brings about "unprogrammed activity" -- "... allocate resources to goals requiring

---

15 If the new cabinet post of Housing and Urban Affairs and the Federal Anti-Poverty Program can be taken as an indication of things to come, we can expect dramatic reallocations of urban resources in the near future.

unprogrammed activity, and ... refuse to provide substitutes or alternative goals that can be reached by programmed activity." The Federal government has done just that in the area of Urban Planning and Urban Renewal. Federally financed projects, if they are to be approved, must be consistent with a Comprehensive Master Plan of the urban area's growth. Planning and renewal "must be done" in the context of a program and not as a series of ad hoc projects.

C. Long-Run Characteristics of Budget Process

C.1. Model Drift

The formal model describes a somewhat "drifting" budgetary process. The sensitivity tests in Section 10 should tell us, generally, the "direction of drift."

The traditional studies of public finance, by trying to couple economic, political, and population characteristics to municipal expenditure items, attempt to identify those forces that determine the direction of drift. Their contention is that the role of governmental decision makers is that of a passive translator of environmental characteristics into expenditure items. These studies have met with only marginal success (see Section 2, pp. 23-24).

\[17\] March and Simon, op. cit., pp. 185-186.
Environmental Factors in Municipal Finance

Figure 7-1
By emphasizing the short-run decision process, we have emphasized the internal characteristics of the "Government" decision process and the relationship between current and historical decisions. In Figure 7-1, our findings are that in the short-run, items 5 and 6 are the most significant. By studying the budgetary phenomena over time, others have emphasized items 1, 2, 3, and 4 almost to the exclusion of 5. The question now remains -- do our short-run findings apply in the long run?

C.2. Causes of Model Drift

Model drift could be biased by external constraints. "Expenditures" would be "allowed" to drift only so far without being corrected. They would be brought back into line with national standards, party or pressure group demands, population needs or tastes, etc. If, in fact, this were the case, evidence of the use of correcting mechanisms should exist in our model deviations because our model has no provisions for these mechanisms.

C.3. Observed Environmental Corrections in Drift

In Detroit corrections in drift (model deviations) seemed to consist of establishing new departments in the urban renewal area, adjusting appropriations to correspond with State and user revenue changes, and one adjustment in Police and Fire salaries resulting from a Public Administration Survey report (that could be interpreted as a correction in drift to correspond to some national operating standard.)
Cleveland's drift corrections consisted of new departments in the urban renewal area, adjustments in appropriations because of changes in State and user revenue contributions and costs for negotiated contracts, and special wage increases for Police and Fire (corresponding to national rates?).

Pittsburgh appears much the same, with changes in State revenue contributions, the terms of negotiated service contracts (street lighting), and the emergence of city activities in areas of Federal program involvement accounting for most of the environmental corrections in model drift.

It appears from an analysis of our residuals over time that environmental corrections:

1. are seldom (if ever) evoked directly to bring specific expenditure items "into line," or
2. are filtered through the revenue constraint (see Figure 7-1), blurring the "cause" of increased (decreased) revenues and blunting possible direct impact on specific budget items.

In any event, environmental corrections appear to be more related to revenue changes than expenditure changes. Hence, their impact on expenditures appears to be a blurred one that is exercised through the administrative allocation and decision process rather than through any direct expenditure-correction mechanism.

The nature of this somewhat-random drift (see Section 10, pp. 372-377, for a discussion of some "non-random" features of this
drift) is examined under a number of revenue-change patterns in Section 10.

Some direct environmental corrections were observed however. Negotiated contracts and changes in earmarked revenue (State and user) provided some clear "corrections." The existence of Federal monies for municipal programs also appears to have "caused" a change in the budgetary drift.

What seems to emerge from this study is an opportunity model of budgetary change. The broad pattern of drift is accelerated or depressed due to changes in general revenues. The drift in specific expenditure items changes in response to changes in earmarked revenues or the terms of negotiated contracts. Rapid spurts of growth are observed in those areas where the city has the opportunity to expand activities because of the presence of revenues (Federal funds), rather than in areas having rapid changes or spurts in needs. This also could be due to the fact that needs do not change in spurts either.

From a normative standpoint, the drifting general fund budget has some appeal. If, in fact, we are able to specify desired changes in municipal expenditures as a function of environmental changes, the "system" (if we have a Darwinian view of the world) would tend to place these expenditures outside of the general fund. The funding of activities where we can "logically" connect environmental changes (demands, ability to pay, etc.) to expenditure (or activity) changes, is common. The extreme case results in a private
good where "supply equals demand" and level of activity is determined by the price mechanism. Somewhere in between lie the public power and utility companies where price roughly equals cost of goods sold and supply (activity level) equals "demand." Public transportation companies, hospitals, community colleges, etc., all have a system of user taxes where the municipal government provides a partial subsidy. Generally, only activities where user-tax financing is not feasible or undesirable receive a full municipal subsidy and hence are "eligible" for inclusion into the general fund. It should not be surprising, then, that in the absence of a system of standard costs or ways of determining activity levels (characteristics of general fund activities) the decision systems exhibit drifting, opportunistic characteristics.
SECTION 8

REPRESENTATIVENESS OF SAMPLE

Questions relating to the applicability of the municipal resource allocation model presented here can be divided into two major parts:

1. To what kinds of "real situations will the model of internal resource allocation apply?, and
2. To what kinds of theoretical discussions will the model relate?

The first question will be dealt with in this section, while the second will provide the subject matter for Section 9.

The applicability of our model and findings to other real situations is, in the final analysis, an empirical question.

It has been demonstrated that the model describes a significant portion of the internal resource allocation process in three, large municipal governments. Are the three cities of Pittsburgh, Detroit, and Cleveland representative of a class of cities in the United States? Would we expect to find the same behavioral mechanisms operating in smaller municipal governments? In other forms of local government (counties, townships, school boards, etc.)? At other levels of government -- state or federal? In other kinds of public and semipublic institutions in our society? Naturally, the further we venture from the three data points used by the model, the less, substantively, we will be able to say.
A. Applicability to Central Cities of Large Urban Areas

Referring back to the model's intent, our objective was to demonstrate (among other things) that a single, process model could be constructed to describe core-city operating budget decision making in areas with over 1,000,000 population. The model fits three cities in that category quite well -- what are its chances of describing the remainder (in 1960, twenty-four Standard Metropolitan Statistical areas had a population exceeding 1,000,000 persons)? One reasonable way to approach the problem would be to examine certain characteristics or dimensions of the sample of three to see how representative they are of the "population" (total of twenty-four SMSA's).

Sample and SMSA's over 1,000,000

Several relevant environmental characteristics are:

1. Political Characteristics of SMSA's
   a. Form of government (Mayor-Council, Commission, or City Manager)
   b. Role of "party" in local government.

2. Economic characteristics of SMSA's
   a. Tax base and revenues
   b. Economic base

---

3. Population characteristics
   a. Size
   b. Mobility
   c. Educational level
   d. Racial and ethnic composition

A.1. Political Characteristics of SMSA's over One Million
   a. Form of government in Central Cities: Detroit, Pittsburgh, and Cleveland all have a Mayor-Council form of government. Of the remaining twenty-one areas in our sample (twenty-four cities), the majority also have Mayor-Council forms. Six have City Manager forms, Washington, D.C. is "governed" by Congress, and St. Paul is governed by Commission.²

   Inasmuch as our model described an administrative problem-solving process and the "goal" of a balanced operating budget is an almost universal constraint (supplied by State legislature), the actor(s) occupying the role of the "MAYORS" Submodel are probably of less overall importance than the characteristics of the problem facing the actor. Unless it can be demonstrated that a City Manager or Finance Commissioner in a large city can collect significantly different kinds of data and make significantly "better"forecasts of future events than a mayor's staff,

then the three submodels (appropriately renamed) could apply equally well to all major governmental forms.\(^3\)

Conclusion: Our sample is reasonably representative with respect to form of government.

b. Role of "Party" in Local Government: In a municipality like Pittsburgh (or Chicago) where other administration officials are elected along with the mayor, the presence of a strong party organization, "machine," etc. that can "always elect" the "organization's" slate will eliminate the possibility of intra-administration conflict over the budget.

Cleveland elects only the mayor, so he is able to surround himself with a "sympathetic" administration. The election is partisan, so "party" can act as an additional control device in minimizing conflict. Where the election rules provide for administration officials independent from the chief executive, we expect relatively more conflict in the budgetary decision process.

Detroit on the other hand has a non-partisan election procedure and additional, elected administrative officials. Although the candidates themselves are usually partisans, "party" has not proved to be an effective conflict-reducing device. The model assumes a stable set of expectations and relationships between departments and the mayor's office. We expect different decision procedures to be used in those

\(^3\)Preliminary analysis of the Kansas City, Missouri, budget data for the last fifteen years indicates that the model presented here should work equally well for this City Manager form of government.
cases where there are continuing turnovers of entire administrations so stable relationships cannot develop, or where the "opposition" is an antagonistic member of the administration and "conflict" becomes a relevant variable. We expect that a change in administration (or governmental form) will not change the elements of the participants' cognitive maps or the form of the decision rules (because of informational constraints - only the weights attached (perceptions) to variables. The model structure will not change, only the parameters.

   c. Central City -- Suburb Relationship: Many writers have stressed the interrelationship of governmental units in an area. Some have attempted to attribute a complementary quality to total government expenditures in an area -- if one unit, say, the city, does not provide a service, another unit, county for example, will make up the difference. 4 No evidence of such a complementary relationship was found in our study of the budgetary process. The effect of suburbs on central city finances enters our model through the revenue constraint, however. Attempts to transfer central-city activities to regional (county) governments have been noted. In addition, through city income taxes, user taxes, and occupation taxes, cities have attempted to get suburb-anites to pay for the use of city facilities.

Observations can be made to determine the representativeness of our sample for the Central City-Suburb relationship.

1. Magnitude of the "Problem" -- How many workers are commuters?

4Sacks, S., and Hellmuth, W.F., op. cit. Simon H.A. FISCAL ASPECTS OF METROPOLITAN CONSOLIDATION, Berkeley; University of California, 1943.
If we subtract the per cent outward-bound commuters from the per cent inward-bound commuters, we get a measure of the net influx of workers each day. This should give some indication of the degree to which a city could be "disadvantaged" by commuters. This net influx of workers, in some sense, measures a "city's balance-of-payments deficit."

The entire set of central cities for SMSA's areas over 1,000,000 had net deficits fairly evenly distributed from ten percent to thirty-five per cent. Deficits in our sample were:

- Cleveland 34%
- Detroit 17%
- Pittsburgh 25%

On the basis of these statistics, our sample appears to be a typical one from the standpoint of commuter flows.

One significant difference between our sample and some large cities should be mentioned, however.

The physical boundaries of all three cities are such that annexation is not a feasible form of expansion. While the metropolitan areas in our sample can grow, the cities themselves cannot (geographically); cities like Houston, Dallas, and Los Angeles can. If annexation of geographical expansion rapidly increases the tax base and revenues, we would expect a good deal more diversity and change in the budgetary decision process. This "change" might very well represent erratic

---

behavior because the system is continually in a state of flux. Since our model is based on notions of man's inability to reach rational decisions on municipal resource allocation and the ambiguity of decisional cues from the environment, situations characterized by a more rapidly changing environment would imply a greater reliance on the kinds of "rules of thumb" present in our model. There is no reason to believe the variations in behavior will be any more goal-directed, rational, or enlightened than those produced in a more stable environment. In short, our sample is clearly non-representative concerning the ability of a city to expand geographically, but the effects of rapid geographical expansion tend to satisfy the psychological "assumptions" of the model even more so than in more stable surroundings.

A.2. Economic Characteristics of SMSA's over IM Population

a. Tax Base and Revenues: The following illustrates the relative levels of population and per capita revenue:
<table>
<thead>
<tr>
<th>SMSA totals</th>
<th>1960 Population</th>
<th>Total Revenue</th>
<th>Intergovernmental Revenue</th>
<th>Revenue from Own Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>State</td>
<td>Federal</td>
</tr>
<tr>
<td>Cleveland</td>
<td>1,797,000</td>
<td>$261.44</td>
<td>$43.77</td>
<td>$2.86</td>
</tr>
<tr>
<td>Detroit</td>
<td>3,762,000</td>
<td>268.14</td>
<td>63.69</td>
<td>3.36</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>2,405,000</td>
<td>185.08</td>
<td>35.11</td>
<td>3.23</td>
</tr>
<tr>
<td>No. of SMSA's</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(over 1,000,000</td>
<td>13 of 24</td>
<td>0 of 24</td>
<td>6 of 24</td>
<td>6 of 24</td>
</tr>
<tr>
<td>population)</td>
<td>smaller</td>
<td>smaller</td>
<td>smaller</td>
<td>smaller</td>
</tr>
<tr>
<td>outside sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>4 of 24</td>
<td>10 of 24</td>
<td>10 of 24</td>
<td>11 of 24</td>
</tr>
<tr>
<td></td>
<td>larger</td>
<td>larger</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---


Figure 8-1
As a sample of SMSA's over one million population, Cleveland, Detroit, and Pittsburgh are among the larger areas, population-wise, but generate less per capita revenue than most. The diversity in both mix and level of revenue sources within the sample indicates we could reasonably expect our model to hold over a range of revenue situations.

b. Economic Base: The economic base for all three cities in our sample is primarily industrial. Cleveland has a more diverse industrial base than either Pittsburgh (steel) or Detroit (auto industry).

The fact that Pittsburgh and Detroit are primarily "one-industry towns" should affect the budgetary process through the revenue constraint. With a single industry as the primary economic base, one would expect wider fluctuations in municipal revenues than would be experienced in a more diversified economic climate. The model describes Cleveland as well as Detroit and Pittsburgh, so the effects of the one-industry economy apparently do not lead to significant changes in decision structure (Although there may be a systematic relationship between industrial concentration and model parameters).\(^7\) In short, there is no reason to believe that the model would not apply to municipalities with a significantly different economic base than those found in our sample.

\(^7\)Preliminary analysis of budget data from Kansas City (diversified commercial economy) indicates the model should accurately describe the budgetary decision process there also. This suggests that the nature of the urban economy has little to do with allocation decision process although it might have a great deal of influence on total municipal expenditures.
A.3. Population Characteristics of SMSA's over 1M

a. Size: As can be seen in Figure 8-1, the metropolitan areas in Detroit, Cleveland, and Pittsburgh are somewhat larger than the average for the group of SMSA's over 1M. If we look at the population of the Central Cities we see that, in 1960, (discounting New York City) our sample is reasonably representative of the SMSA's population range. In our sample, per cent change from 1950-60 for the entire metropolitan area ranged from 8.7% to 24.7%, while the range for Central Cities was -10.7% to -4.2%. Except for Atlanta, Houston, Dallas, and the West Coast Cities, our sample ranges correspond to the other SMSA's. The possible effects of an expanding, growing population and tax base on the municipal operating budget were covered above in a discussion of the effects of geographic expansion of central cities.

B. Applicability to Other Levels of Government

There is little reason to believe the model would not describe the budget process in most large United States cities. Our argument was based on the assumption that if political, economic, and population characteristics represented in our sample were similar to the characteristics of other large municipalities, the model should apply.

8MUNICIPAL YEARBOOK: 1962, op. cit., pp. 36-37.

In discussing the likelihood of the model's applicability to other levels of government, and, ultimately, to other non-market organizations, it would be wise to review the environmental, informational, and cognitive "assumptions" of the simulation model. We might ask what sort of decisional situation our model describes. We could then ask whether the "situation" likely to be found in other levels of government and non-market institutions is sufficiently similar to warrant the prediction that the model presented here would apply.

Briefly, our model is one where:

1. The need for a decision (appropriations bill) exists.
2. A large number of goals, programs, activities, etc., exist.
3. These goals, programs, activities, etc., cannot be reduced to a common dimension -- they are incomparable.\(^\text{10}\)
4. Few "objective" measures of goal achievement, program output, activity level, etc., exist to aid the decision maker(s).\(^\text{11}\)
5. Little is known about relationships among variables (effect of one department's programs on those of another or the effect of a department's program on the variable in society the program is designed to affect).

\(^{10}\)In a business firm such diverse activities as production and sales can be compared (in theory at least) through their effects on profit, share of market, etc.

\(^{11}\)While dollar inputs can be measured, outputs cannot -- hence "efficiency" cannot be used as an effective criteria or measure.
Faced with the situation outlined above, the organization structures the problem (through a system of standard accounts and administrative units), separates or disengages it from other, somewhat-related decisions (operating budget takes capital budget as given, revenue as given, and largely ignores actual activities of component departments), redefines the problem and makes it more manageable (problem becomes one of balancing the budget, rather than the optimal allocation of resources), and finally solves the problem using procedures that have worked in the past and by using available reference points and standards (historical standards -- last year's budget) together with summary kinds of impressions, perceptions and attitudes (certain departments perceived as "growing," "efficient," etc.).

B.1. Application of the Model to Smaller Municipalities and Local Governments

Will the model describe budgetary decision processes in medium-sized cities (100,000 to 500,000)? The response to this question will depend on two items:

1. The extent to which the "decisional situation" described above corresponds to that of a medium-sized city, and

2. Evidence in the form of a verbal model of budgeting in medium-sized cities.

We would expect all medium-sized cities to be faced with the same kinds of problem complexities as were found in the larger cities: large numbers of goals and variables, and largely unknown relationships
between key variables. None of the general conditions of decision should be radically different from those "assumed" by our model.

If the city itself is the center and focal point of its own urban system, we would expect our model to apply as well as it did in the larger cities. A smaller city is faced with somewhat less complex problems involving fewer variables and interrelationships. This simplification is more than offset by the fact that the small cities also have fewer sources of information and computational abilities. In general, the higher the government level, the more informational and computational resources. This advantage is roughly balanced by the increased problem complexities at higher levels -- leading to use of simplified decision processes.

In a report of budget making in three medium-sized municipalities in Illinois, Anton describes a decision process remarkably similar to ours.

---

12 For example, Detroit compiles the final budget and puts together departmental requests and the mayor's recommendations using "Electronic Data Processing" equipment. Smaller cities, having less manpower to start with, probably would have to do the same work manually -- taking much more time to complete and leaving less time for analysis.

The fact that he describes an information processing procedure consistent with ours in each of the three cities is heartening. Especially, when it is realized that different forms of government are involved, (Mayor-Council and Commission) using radically different formal procedures for arriving at final appropriations because of the ambiguity of Illinois law. The same basic strategy is followed in all cases -- sequential reduction of the difference between anticipated revenues and expenditure estimates. The three cities involved all form the "core" of the metropolitan area in which they are located, however.

If a municipal government is the "central city" in its region, its range of governmental activities will be reasonably well-determined and constant over time. If a municipality is really a suburb or satellite of a larger municipality, then we might expect three different kinds of budgetary behavior:

1. The larger city could provide a meaningful set of service standards for the satellite. The central city would provide a comparable organization that could be relevant for the goal-setting process in the satellite -- providing an alternative for historical standards and comparisons.

2. There could be a much greater tendency for the satellite government to perform a supplemental role in its community by adding to services provided by the central city and other area governments to bring them "up to par."
3. Because of "spill-over" effects of central-city and metropolitan-area services, satellite governments might tend to focus on services of special interest to their residents ("education" in Shaker Heights, Ohio, Mt. Lebanon, Pennsylvania, and Grosse Point, Michigan in our sample).

We would also expect that, because of its supplemental role, the budget of a satellite city would include a great number of contract items where the satellite would reimburse other area governments for services performed (utilities and some forms of public works, for example). The greater the number of contract items, the fewer budget items actually under the control of the satellite government.

In the special case where the adjacent cities are of roughly equal size, we would expect a form of competition through tax rates and municipal services. Other than saying the tax rates and service levels in Dallas and Ft. Worth, Minneapolis and St. Paul, Duluth and Superior should be identical, it is not clear what these levels should be. Does "competition" lead to lower tax rates, higher service standards, or does it just provide cities with a set of reference points for comparable organizations?

In summary, except in the special cases of twin cities and "satellites," we have every reason to believe our model would apply to smaller municipalities than Cleveland, Detroit, or Pittsburgh.14

---

14 Simon, found that suburbs in the San Francisco area felt some obligation to maintain uniform property tax rates but no pressure to equalize service levels. Simon, H.A., op. cit., pp. 2-4.
It would be possible to modify our model to take care of these special cases by "adding a term" in our model's preliminary calculations procedures (4-A1-3, 4-B1-4, 4-C1-9) to reflect the existence of another point of reference in addition to historical budget levels. In those activities in which the satellite assumed a "supplemental role," the preliminary calculation procedure would involve a kind of two-stage process. The first stage would calculate the desired level of activity on the basis of historical and central-city standards. The second stage would subtract the central city's "contribution" to that activity for a particular year from the desired level to obtain the satellite's preliminary calculation or contribution.

B.2. Applicability to State and Federal Governments

In general, problem complexity is even greater at the State and Federal levels than at the municipal level. There are more variables to be considered and the relationships between policy and result are even more tenuous than those in the urban area. Hence, we would expect an even greater reliance on the kinds of decisional aids and rules of thumb described in our model in State and Federal resource allocation.

Two major studies contain verbal models of the budgetary process in the State and Federal government. Anton's description of the budgetary process in Illinois is nearly identical to the Federal budgetary process described by Wildavsky.\(^\text{15}\) The only difference of any significance is

\(^{15}\) Anton, Thomas, POLITICS OF STATE EXPENDITURE IN ILLINOIS, (forthcoming).
Wildavsky, Aaron, op. cit.
that the budget constraint for the State is anticipated revenues, whereas for the Federal budget, it is the figure provided by the President (based, usually, on a desire to keep the deficit less than a certain amount). The rest of the process seems identical. Wildavsky's description of the Federal process has been discussed in great length elsewhere (See pp. 33-36 and Section 8) in this report. Little would be accomplished by repeating the discussion here. Anton's description is so similar that to discuss it in detail would be repetitious also.

Legislative Review

An important element of the State and Federal process, as described by Anton and Wildavsky, is missing from our model of the municipal process. COUNCIL plays a very minor role in the municipal resource allocation process whereas Congress and the State Legislature are key elements in this process. The reasons for differences in the legislative processes are found in two constraints imposed on municipal legislatures but not on State or Federal:

1. Balanced budget -- the demands on council members are one-sided. Increase expenditures or decrease taxes. With a balanced-budget constraint, the "logical" thing to do is "nothing."

2. Lack of staff to compile information necessary for an effective review. (See pp. 126-130).
If the mayor were required to leave a relatively large estimated surplus in his executive budget and council were provided with a staff, one would expect council behavior to parallel that of its State and Federal counterparts.

B.3. Applicability of Model to Other Non-Market Organizations

Four major remaining categories of non-market organizations are:

1. Institutions of higher learning
2. Foundations and charities
3. Quasi-governmental, special-purpose organizations (school boards, public hospitals, private welfare agencies (local), political parties, etc.)
4. Professional societies, unions, etc.

Our model of resource allocation is predicated on multiple-goal problems dealing with intangible, diverse, and loosely-related variables. To the extent that resource allocation decisions are not characterized this way, we would expect our model to be inapplicable. With this in mind, two kinds of organizations will be discussed in some detail: a local board of education and a university.

Board of Education

Gerwin, in a study of internal resource allocation in the Pittsburgh Board of Education cites

"... six key decisions that must be made in compiling the budget. These involve:
"1. legal and contractural obligations such as prescribed salary increases and debt service on existing bond issues,
2. department requests,
3. a general salary increase,
4. debt service for a new bond issue,
5. improvements in educational services,
6. a reserve to provide additional funds for the year after
next."\(^{16}\)

How does this correspond to our resource allocation model? The 

\[ \text{effect} \] of "legal and contractual obligations" in our model is minimal. The "legal-obligation" feature could easily be added to our model (and technically, it should be added) by including the proper data inputs, and subtracting the contractual amounts from both revenues and expenditure estimates. The effect would be an accounting procedure that removed the item from budgetary negotiations. The increased descriptive power would not be worth the effort for our purposes, however.\(^ {17}\)

"Debt service" was handled by our model in much the same way Gerwin outlines in his. The amount is deducted automatically from the revenue estimates and never enters into the allocation process (i.e., its allocation is taken as given).

\[^{16}\text{Gerwin, Donald, "A Process Model of Budgeting in a Public Organization: Thesis Proposal, "Graduate School of Industrial Administration, Carnegie Institute of Technology (mimeo), 1965, p. 13.}\]

\[^{17}\text{If our guesses about "satellite cities" and their "supplemental role" are correct, the "legal and contractual obligations" feature of the Gerwin model would be a necessary one for a model of resource allocation in a "satellite city" or auxiliary government.}\]
"Department requests" and "salary increases" are parallel mechanisms in our MAYORS Submodel. Gerwin indicates that departmental requests within 5% of last year's appropriation are automatically given preliminary approval. Our model has an identical mechanism (4-B1-16 and 17). The MAYORS Submodel, like Gerwin's, grants a general salary increase as the first item on the agenda if there is an anticipated surplus and if it is large enough (4-B1-9).

The "reserve to provide additional funds for the year after next" is a "key decision" for Gerwin only because the Pittsburgh Board of Education's revenue supply (the Pennsylvania Legislature) meets only every other year. This means their budget must really be a two-year budget. This being the case, much of Gerwin's model consists of a description of how a "cushion" is build up the first year as a hedge against the second. If, for example, departments were allowed to carry over upspent appropriations from one year to the next we might find that "slack-generation" routines were an important feature of the DEPT, Submodel.

The real difference between mechanisms cited by Gerwin and ones uncovered in our investigation highlights differences we are likely to find between general governmental resource allocation (cities, States, and Federal) and "quasi-governmental, special-purpose organizations." That difference concerns the measurability of performance and the existence of standards. Performance measures and non-historical standards play no role at all in our model -- they do not exist in the real world
for urban centers. In Gerwin's model, a key question is "Is Department Performance Meeting Acceptable Levels?" Taken literally, this implies both performance measurability and a standard of performance. The question "Has the Salary Scale Fallen to the Bottom When Compared to Other Districts?" is another key item that involves external standards.19

In summary, Gerwin's model is roughly consistent with ours with the exception of key environmental differences like the existence of performance measures and standards, and a two-year, carryover budget.

A University

In general, we would expect a university to exhibit great similarities to a large municipality in resource allocation. It too must deal with large numbers of loosely connected variables (Physical Education and Physics, Drama and Political Science, etc.), allocate resources within a budget constraint, etc. The system, like a municipal government, possesses minimal information about its component parts.


19 In Detroit there is a regular survey of "prevailing wages" in the area that the city tries to match. This process, however, is loose and salary increases depend at least as much on the revenue picture as on the wage discrepancy. In addition, we have noted the differential ability of uniformed police and fire personnel to secure salary increases (See Figure 5-3). This could be explained by the existence of published (MUNICIPAL YEARBOOK) salary figures for other cities.
In general, we would expect to find the same kind of structured problem solving (1) with departments as DEPT., Administrative Vice President as MAYOR, and Board of Regents as COUNCIL; (2) with academic departments as the primary administrative units; (3) with "functions" as the account categorization scheme (teaching, research, staff, expenses). We would expect the resource allocation process to be an incremental one, exhibiting a great deal of organizational inertia, to be responsive only to long-run, cumulative political pressures or to reasonably catastrophic events in the short-run.

We expect one major difference in internal resource allocation in a university and allocation in a municipality. Where external, "objective" standards exist, we expect they will be used. Three general measures of performance seem to exist: (1) Number of students -- budgets geared to dollars per student; (2) Measures of student excellence, like Graduate Record exam scores (percentiles) of both department graduates (undergraduates) and new students (graduate students) and (3) Measures of faculty excellence --- research grants and publications. We would expect budget increases to gravitate to populous and "successful" departments. Those departments with the largest number of outside research grants can also expect the largest budget increases.

Summary

The psychological assumptions of the model are consistent with many "real world" situations involving governmental and non-market
organizational resource allocation.

The possibilities of the general applicability of this model of internal resource allocation to non-market organizations are highly encouraging.

Next, the "representativeness" of the model for other theories of decision making will be examined.
Section 9

BUDGETING FROM DIFFERENT VIEWPOINTS

In Sections 1 and 2 references were made to a number of works and approaches to our problem of municipal resource allocation. We have studied one aspect of municipal resource allocation in great detail -- the process of operating (or general fund) budget formation. A rather detailed and explicit conceptualization of the process has been presented and largely confirmed (at least not disconfirmed). How does the decision process model of municipal budgeting relate to other approaches in the literature? It is to this question we now turn. The discussion will take the formal model of municipal resource allocation presented in Section 4 as its reference point. In a sort of consistency test, other academic theories and findings will be examined for points of convergence and divergence with our process model.

As was pointed out in Section 2, conceptions (or theories applicable to the problem) of municipal resource allocation fall into roughly two categories:

1. The Budget as an Externally-Determined Event.
2. The Budget as an Internal Bureaucratic Process.

1. Budget as an Externally Determined Event

The more traditional social science approaches to governmental resource allocation generally describe the decision making as a sort of response mechanism. Generally, "government" perceives pressure, influence, needs, etc. and translates these perceptions
into public policy, governmental actions or inactions. There appears to be a disciplinary breakdown based on the kinds of stimuli emphasized in this external "influence"-response conception, with (in general) political scientists and sociologists emphasizing the influencing groups, "political" decision maker, economic and social elite kind of stimuli and the economists and public administrators emphasizing the citizenry-demand-for-services, needs, and service standards as the stimuli leading to a budgetary response. Quite clearly, our model does not view these external events or stimuli as being particularly important in the formation of a municipal operating budget.

If we define "influence" to be any kind of "external force" that impinges on the budgetary process, it is immediately apparent that our formal model "allows" for only certain kinds of influence, requires that it be elaborated in well-defined ways, and permits it to enter the system at only a few points. Specification of the kinds of influence permitted by the formal model will precede a detailed comparison of our simulation model with others appearing in the literature.

"Influence" and the Simulation Model

Basically, external "influence" (either "political" or "demand for services") consistent with the simulation model can enter the process in two ways:

1. Through empirically-determined parameter values.
2. As informational inputs.
1.1 Parameters and "Influence" or "Demands"

The model assumes parameters are constant over time and vary only by department and account category. As we saw in Sections 4 and 6, the model is one of programmed change, subject to a set of "imposed" constraints. If we assume that pressure, external influences, or service demands are important in the budgetary process, what assumptions concerning external factors, etc. must be made in order to make an external-influence model consistent with ours? A basic relationship may be of use here:

\[ A. \ (\text{Quan}_{ij}) \times (\text{Qual}_{ij}) \times (\text{U Cost}_{ij}) = \text{Budget}_{ij} \]

where

Quan\(_{ij}\) = Quantity of service "demanded" from department \(i\), expenditure category \(j\).

Qual\(_{ij}\) = Quality of service "demanded" from department \(i\), expenditure category \(j\).

U Cost\(_{ij}\) = Unit cost of the above service.

As we saw in Section 6, our model implies that budget behavior, "Budget\(_{ij}\)", is either constant or exhibits regular, programmed changes. Referring to A), above, systematic change in "Budget\(_{ij}\)" can result from unsystematic changes in quality, quantity, and cost of services as long as changes tend to balance one another.

---

1 Implied by the preliminary-calculation, goal-setting, and aspiration-level functions in the submodels (4-A1-3, 4-B1-4, and 4-C1-9). "Demand" is used with its economic meaning as a measure of relative value of services.
Systematic changes in quality, quantity, and cost of services would also produce (according to A) a systematic change in "Budget_{ij}". These considerations have some definite implications for the way the "real" system would have to deal with external influences, pressures, needs, or demands for services, if it is to be consistent with our decision system.

If we remember that the budget is a plan or a forecast of future influences or needs, the decision-maker's assumption (implied in the simulation model) that next year's influences, demands, needs, etc., will be nearly the same as this year's, is not an unreasonable one.

To pursue this point a bit further -- if the simulation model accurately portrays the budgetary process, "Budget_{ij}" changes systematically. Relationship A, in turn, indicates a particular kind of response-to-pressure or needs during the budget period. The response is not to change budget levels ("Budget_{ij}") necessarily, but to take the budget ceiling as a given and respond to "pressures" or needs within the ceiling. Referring back to relationship A:

1. Changing pressures and demands can be met within a fixed "Budget_{ij}" by:
   1. Varying the quantity of service-(Quan_{ij})
   2. Varying the quality of service-(Qual_{ij})
   3. Increasing efficiency (lowering the "unit cost")
      or increasing "organizational slack"^2 (raising costs)-(U Cost_{ij})

^2See Cyert and March, op. cit., for a discussion of "organizational slack" and its uses, pp. 36-38.
This means that the street maintenance department would have a stable or constantly increasing budget, but might respond to an unusually "hard" winter (leaving more than the usual amount of pot-holes in streets) as follows:

1. The demand for quantity of service increases ("hard winter").

2. Spend less time on each pot-hole filled -- fail to "roll" the asphalt even with the other pavement, ignore small pot-holes, etc.

3. Pull people out of the garage or warehouse and put them to work filling pot-holes, use asphalt instead of bituminous concrete, etc.

In what other ways can departments respond to pressures created by community influentials, economic elites, interest groups, etc.? The fact that model parameters are constant over time indicates that if interest groups, elites, etc. have an influence on budget amounts for various departments, then it is a constant influence and reflected in parameters. The presence of external "influence" or "pressure" in the political sense was not detected in the budget formation process during interviews with city officials.\(^4\) A much more likely response pattern for the department

---

\(^3\)Relative to other municipal departments.

\(^4\)The same groups show up at the public (budget) hearings every year. They all want more money. Employee groups want a pay raise, (continued on following page)
is to change the agenda in response to political or elite pressure (if, in fact, it is exerted). The relevant question for the department head is "Whose street gets repaired first?" and not "How many dollars should be spent on street repair?." "Which neighborhood will the new park be placed in?" not "How many new parks?". In the short run, the simulation model implies that responses to "political," "interest group," or "elite" pressure (if it exists), could also take the form of:

ii. Response to "political" pressures and "elite" influences is a change in departmental attention rules and not a change in budget levels. 5

(continued from preceding page) cultural groups want more money for their interests, and some citizen group is always ready to complain about taxes (being too high). Our costs keep rising, but revenues don't. We just don't have the revenues to satisfy them even if we wanted to." Aldo Colautti, Mayor's Executive Secretary, Pittsburgh, Pennsylvania. Interview, October, 1964.

"It's impossible for me to consider all the requests for increased spending. No one seems to want anything cut out of the budget." Hon. Joseph M. Barr, Mayor, City of Pittsburgh, December 1964.

"Of course, many individual and groups come to the City with what some might term "legitimate" requests for municipal funds. The City simply does not have the resources necessary to satisfy these requests." Alfred M. Pelham, Controller, City of Detroit, December, 1964.

5See Section 5, pp. 101-103, for a discussion of the budget limit as one of a series of departmental decisions.
Long-run changes in budget levels would be in response to a large number of cumulative short-run pressures, demands, and influences and not a relatively-immediate response to a single influential or a "one-shot" demand. Similarly,

iii. The decision system appears to be responsive only to long-run, cumulative "political" pressures and citizenry needs or to reasonably "catastrophic" events in the short-run.6

1.2 Informational Inputs to the Model as External "Influence"

Perhaps the only widely perceived exertion of "political" influence, if it can be called that, in all three cities during all years studied was through the revenue estimate. This influence was not exerted in any direct sense or dictated by anyone. As has been indicated by the chief budget officers in all three cities, the "only interest the business community has in the operating budget is that they don't want taxes increased." This, of course, is a highly general kind of interest or potential influence most people in the community are aware of. Adding to this consideration is the fear on the part of the mayors in our three cities that business and industry will move to the suburbs or to a different region. This "fear" (especially acute during the 1958-62 period), coupled with the "knowledge" that the average voter takes a dim view of tax increases

---

6 One such cumulative (or constant) pressure comes from city employees for pay increases (see Section 5, pp. 122-125. See analysis of model residuals in Section 7 for the effects of "catastrophic" events.
conspires to keep tax rates constant, if at all possible, in light of citizenry "service demands."  

In summary, the complexity of the problem of estimating external demands, pressures, influences, etc. for the budget period conspires to prescribe that the municipal government perceive these "influences" to be relatively constant while planning and to respond to variable demands and influences (when they occur) by:

1. varying service quantity
2. varying service quality
3. varying service cost
4. changing attention rules,

rather than by changing the budget-level rules. In addition, the requirement of a balanced budget makes pressure appear black and white. Hold the line on taxes versus increase expenditures. The problem is usually mediated by financing increased expenditures through increasing tax yields (not rates).

Budget as Externally-Determined Event: Literature

The decision process is, briefly:

1. Different interests are present in the community.
2. These interests have different amounts of "force," "power," or "influence."

7"Just when cumulative service demands are great enough to force a step increase in revenues (tax rise)" is a question that lack of time series data reluctantly forces us to avoid. See discussion on revenues in Section 5.
3. The outcome is determined by the "sum of the (exerted) forces." The most powerful "wins."

Dahl, in *Who Governs?* (a study of decision making in New Haven, Connecticut), contends that the "influentials" are a function of the particular decision and that different influentials are found in different decision areas at different points in time. He also contends that many influence groups arise quickly in response to a problem, attempt to exert influence, and disappear with the problem. Hunter, in a study of community decision making in Atlanta (*Community Lower Structure*) concludes that there is a single group of influentials whose influence is pervasive over all decision areas (and over time). While these studies cover a much broader range of community decisions than our simulation model, the operating budget for a city covers a very significant class of community decisions and hence, will have a good deal to say about community decision making in general. Both Dahl and Hunter emphasize the importance of extra-governmental influence as being a crucial determinant of community decisions. Extra-governmental influence plays a very minor role in our simulation model, entering the process explicitly only through the revenue estimate and the model parameters.

---


9While it is true that by assuming a "stable" group of influentials with a "stable" set of interests, the influence of extra-governmental groups *could* be reflected in the empirically-determined model parameters, no indications that this might be the case were uncovered in the interviews. The only "stable" interest group of importance appears to be internal -- municipal employees.
A tentative conclusion of our study, relative to budget-level decisions, is that influence groups are either an unimportant part of the process or that a "stable" influence group exists.

The works of Truman and Key suggest that governmental decisions are the result of an interaction of interest group pressures. Evidence that extra-governmental groups and individuals are important in determining municipal budgets is not an explicit part of our model. The process uncovered in this study can be characterized as a problem-solving situation involving a great deal of uncertainty. Few effective guidelines for reducing the uncertainty are found in the extra-governmental environment and hence, "influentials" play a very minor role in the formulation of municipal operating budgets. To the extent that budgets represent an allocation of resources between functions, influentials play a very minor role in the gross allocation of governmental resources.

1.3 External Influences -- Summary

It would be naive and probably false to suggest that no extra-governmental influence exists in a community and that governments do not respond, in some fashion, to this influence. It is not naive or inaccurate to suggest that governments do not respond through the municipal operating budget. Rather, response to "pressure" and

10Truman, D. B., op. cit.
Key, V. O., Jr., op. cit.

11A similar conclusion is reached by Martin and Munger, op. cit., p. 14.
"influence" appears to take place at different levels of decision making altogether.

Our model suggests that a convergence of voter and business interests helps "hold the line" on tax rates and hence tends to limit the total amount of resources available for governmental allocation. Within this total-resource (revenue) constraint, an allocation is made among departments and expenditure categories. Effective guidelines for the allocation of total resources to departments consist of historical level and trend data. Effective cues from the environment are not received from community interest groups either because they are not articulated or because the cues, taken in toto, add up to an infeasible set of demands on the system (i.e., every interest group wants more money spent in a particular area, but no increase in taxes, etc.). The perceived incomparability of data ("Pittsburgh's hills make it impossible to compare Detroit street expenditures with ours.") also means that few cues are received from other cities. In this context, a series of decisions are made, resulting in a municipal operating budget.

Once the operating budget is formulated, it provides a set of guidelines for actual expenditure decisions. Within the budget constraints, departments are free to "allocate resources" as they

---

12 Although a specification of governmental response-to-pressure-and-influence is outside the scope of this study, the scheme reported was suggested from some of the interviews with governmental officials. Evidence in support of a stable system of community interests or power is found in the naive models (A1, A2, and A3) tested in Section 6. The fact that simple models fit the data very well indicates a great deal of stability in the decision process.
see fit during the fiscal year. It is at this stage -- actual expenditures versus planned expenditure -- totals -- that "influence" appears to be an important consideration. It is at this stage that influence groups appear to articulate their demands. A neighborhood "pressure" group may influence the location of one new park in a particular year, but will not have much to say about the total number of new parks to be opened in that year. What our model suggests is that budgets, in municipal governments, are reasonably abstracted documents, bearing little direct relationship to specific community pressures.

The budget provides the limits, within which the response to pressure and influence must be conducted. The entire process could be viewed as a hierarchical system or sequence of constraints. The revenue estimate is fixed first. Then, a budget is formulated (using historical guidelines) within the revenue constraints. The final budget or appropriations then provides constraints for an entirely different class of expenditure decisions. We suggest that response to "political pressure" and citizenry needs (at least in the short run for one city administration) is almost always exercised within budgetary constraints. We suggest that the budgetary constraints are set using a procedure independent (at least consciously) of "political" or interest group pressure. Little or no conscious attempt is made by administrators to translate present "influence" into future spending plans. The only behavior observed, consistent with the theory that budgets are responses to community "pressure,"
is that departments always try to increase appropriations. It appears, then, that "power," "influence," and "pressure" are so far removed from the budget-formation decision process that they lose much of their usefulness in a positive theory of municipal budgeting.

The presence of power, influence, and pressure in a community is neither confirmed or denied. Governmental response to power, influence, and pressure is seldom found in the municipal operating budget however. Rather, their effects can be found in the tax rates which are general responses to the vague, unarticulated interests of voters (property owners) and businessmen. The effects of power, influence, pressure and variations in citizenry needs can probably be found in changes in:

1. The frequency of municipal services.
2. The quality of municipal services.
3. The order in which municipal services are performed -- pressure accommodated by changing the agenda of things to do.

rather than in budget changes.

---

Much of the literature on municipal services consists of attempts to relate municipal expenditures, by function, to variables expressing a demand for services (population) and an ability to pay. Related attempts to define "service standards" and "unit costs" are also widespread.¹⁴ (See discussion in Section 2, pp. 23-26.)

The implied model of budget making focusing on demands for services is also a "force" model, similar to the one discussed above. The "service standard-unit cost" approach implies that budget makers translate the sum of "forces" into dollar amounts. The "forces" in this formulation are public demands for services levels (amount of service) and for service quality (cost of services).

The discussion related to forces as community influentials and pressure groups also applies when the forces are service demands or needs. Our model does not view the budget maker as a passive instrument -- as a person who merely translates forces, needs, demands, etc., into dollar budgetary amounts. The budget maker in our model is a problem solver who is unable (due primarily to cognitive and informational limitations and conditions of economic scarcity) to make this direct, deterministic translation of expected "demands" and needs to budget requirements. Consequently, our model

¹⁴Sacks and Hellmuth, op. cit.
Brazer, Harvey, E., op. cit.
Burkhead, Jesse, op. cit.
Smithies, Arthur, op. cit.
is also at variance with the "service-standard-unit cost" approach to budgeting.

Related to the "service standard-unit cost" conceptualization of the budgetary process is the idea of a performance budget where a desired level of activity is specified (x miles of streets, y applications processed, etc.) or a particular program is expressed as a combination of personnel and materials. The "activities" are then multiplied by "unit costs" and the dollar amount resulting constitutes the budget. Obviously, our budget model first calculates dollar amounts and then transforms this into personnel and materials. The model is one of a line-item budget, not a performance budget.

2. Budget as Internal, Bureaucratic Process: Literature

Budget as System of Precedents and Commitments:

Many organizational theorists have emphasized the role of precedent in decision making, especially in regard to the budget.\(^\text{15}\)

Our model is heavily history-dependent and relies almost exclusively on historical data. The DEPT. Submodel has, as informational inputs, current appropriations, recent trends in appropriations, and the most "current" expenditure data available (4-A1-1, 2). Goals, constraints, and aspiration levels are based upon the relationship of preliminary calculations and problem solutions to historical appropriations data (4-A1-5, 4-A1-6, 4-A1-7). DEPT.

\(^{15}\)See Section 2, pp. 29, 30, 34; for a discussion of this approach.
submodel parameters indicate that, relative to other information and "influences," current appropriations are more important than anything else in determining the department budget request for the next year.16

The effect of historical data on the MAYORS and COUNCIL Submodels is exerted through informational inputs and the providing of standards and constraints:

1. Information -- Previous budgets and recent appropriations trends (4-B1-3 and 4-C1-1).

2. Goals, constraints, and aspiration levels stated in terms of historical standards (4-B1-4, 16, 21, 25 and 4-C1-15).

In general, the historical character of the municipal budgetary process indicated above is certainly "well represented" in our formal model.

2.1 Budget as Result of Subunit Conflict:

Another set of conceptualizations emphasize the competitive nature of a budget.17

---

16 In 4-Al-3, the values of the parameter A_{ij} (multiplier of APPRI_{ij}) are generally much larger than any of the others. Wildavsky, A., *op. cit.*, pp. 16-17.

17 See Section 2, pp. 26-28, for a discussion of this approach.
Our formal model of municipal resource allocation contains no mechanisms that explicitly allow for the agency-conflict conceptualization of municipal budgeting. Features of the model could be related to subunit-conflict, however. The relative values of parameters in the preliminary-calculations mechanisms (4-B1-4 and 4-C1-9) for various departments in the MAYORS and COUNCIL submodels could provide a measure of the differential ability of departments to secure funds. The nearest thing to evidence indicating a competition for funds discovered in the interviews was the fact that departments were perceived differentially in Detroit relative to the "honesty" or "accuracy" of their departmental request. In all three cities different departments were perceived by participants in the budgetary process as "growing" or "declining" departments. The assumption inherent in our model is that if there is conflict between subunits (departments), the relative strengths of departments in this competition are reasonably constant over time.

The agency-conflict view of budgeting is a prominent one in the literature and merits further investigation. For instance, March and Simon, commenting on "conflict centering on budget allocations," state that where funds are limited, conflict between subunits over the budget is likely to be high. This hypothesis is clearly relevant

---

18 See footnote 12, Section 5.

19 March, J. G. and Simon, H.A., *op.cit.*, p. 123. "Conflict among subunits in an organization will be particularly acute with respect to budgeting...."
to municipal resource allocation.

2.1.a "Raw" Conflict

We should be able to find indications of departmental conflict in our data (if conflict does, in fact, exist). Consider a "raw" conflict situation, where the unit or department with the most leverage, "pull," resources, etc., wins. In our case, the competition for funds, if any, clearly is a fight over increases in appropriations from year to year, rather than over the total budget amount for a department. Several models of "raw conflict" over resources between business firms exist in the literature. It may be useful to draw an analogy between (a) the conflict of many firms over sales in an industry with a fixed demand for the industry's product on the one hand and (b) the conflict of many departments for budget appropriations where the city has a revenue constraint. Haire cites the situation where larger firms (departments) in the industry find it easier to obtain bigger sales increases (appropriations increases) than the smaller firms (departments) — magnitude of growth being directly proportional to size. The "explanation"

\[ \frac{dN}{dt} = AN - BN^2 \]

where \( N \) = number of employees, time \( t \). The second term lowers the rate of increase in \( N \) as \( N \) becomes larger. We have dropped the second term \((-BN^2)\) in our discussion because it is felt that none of the accounts have approached their "maximum" or limiting size.

---

for this phenomena is that large firms have more resources available to aid in securing additional portions of the market. If this is the case in the municipal resource allocation process, we should expect to find a significant, positive correlation between account growth and account size. 21 An analysis of cross-sectional account data in each city should shed some light on a "raw-conflict-for-funds" situation where success is a function of account size.

Below are the correlations between account growth
\[(\text{APPR}_{2i} - \text{APPR}_{1i})\] and size \[(\text{APPR}_{1i})^{22}\]

<table>
<thead>
<tr>
<th>Account</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleveland</td>
<td></td>
</tr>
<tr>
<td>Salaries and Wages</td>
<td>.049</td>
</tr>
<tr>
<td>Other</td>
<td>.245</td>
</tr>
<tr>
<td>Detroit</td>
<td></td>
</tr>
<tr>
<td>Salaries and Wages</td>
<td>.187</td>
</tr>
<tr>
<td>Expenses</td>
<td>-.533</td>
</tr>
<tr>
<td>Equipment</td>
<td>-.688</td>
</tr>
</tbody>
</table>

21 Simon and Bonini make the same assumption (the "law of proportionate effect") while investigating the distribution of changes in the sizes of firms, "The Size Distribution of Business Firms," AMERICAN ECONOMIC REVIEW, 1958, 48, p. 610.

22 Appropriation increases for a standard account category in a particular department versus corresponding account size.
The findings do not support the hypothesis that large accounts in large administrative units are more able to secure increases than smaller units. In fact, the reverse seems to be true. At least in Detroit, for non-salary accounts, the larger accounts appear to be more vulnerable to cuts in appropriations. In the Cyert-March formulation of organizational decision making, this would be explained by the visibility of large departments or accounts. In a situation where funds are scarce, search for ways to cut costs would tend to focus on the larger expenditure categories rather than small ones.  

---

23Cyert and March contend search is triggered by a problem (estimated costs exceed estimated revenues). They also hypothesize that the search for a solution to the problem is "simple-minded" and initial search is "...based initially on ... simple rules: (1) search in the neighborhood of the problem symptom..." (p. 121) If the "symptom" is costs which are "too high", then Cyert and March would predict search in those departments having the greatest costs (size). Our model does not formally include this kind of search behavior. However, it appears that this mechanism is "important" only in Detroit. As the computer model now stands, this "bias in search" could be "easily" incorporated by reading in large departments first -- the largest department (i) would be numbered "1" and the smallest would be numbered "N," so that the deficit elimination routines in the MAYORS model would have a "meaningful" priority list for departments as well as for account types. (4-B1-15, 16, 18, 19). Cyert and March, op. cit., p. 121.
2.1.1. "Log-Rolling"

Another form of conflict is one that features a "negotiated peace" rather than all-out combat. Cyert and March envision the organization as a coalition of members (departments), each having separate goals (increases for a member's department). The "conflict" between the goals of the coalition members (obtaining as large an appropriation as possible in our case) is "resolved" by using "local rationality, acceptable-level decision rules, and sequential attention to goals." Briefly, the goals of the department heads would be treated as independent constraints that the organization must satisfy (in the final appropriations bill). Quite clearly, this is the way subunit demands are dealt with in our model (see Section 4). For instance, one set of model constraints, or department goals, requires that there be no overall cuts in departmental appropriations from one year to the next (4-B1-16, 21). Another conflict-resolving device cited by Cyert and March is "sequential attention to goals." In the allocation of scarce municipal resources, this might imply that one year, one department gets an increase and the next year another department is chosen. Increases are passed around year after year.

An analogous situation is cited by Dexter in a study of Congressional voting behavior. Members of a block or voting coalition were observed to have "traded votes" -- "you vote for my project and I'll vote for yours." Perhaps the budget is really a set of "transactions"

24Cyert and March, op. cit., p. 117.

between departments where attention to one department's goals in one period is "traded" for attention to another department's goals in a preceding period. This way of viewing the problem implies that each department knows something about the internal operations of other departments (so department heads can "demand" special treatment "this time" to make up for the special treatment another department(s) got "last time"). With this in mind, we would expect to find more sequential-attention-to-goals, transaction, or trade-off behavior in those account categories that are most visible\textsuperscript{26} -- administrative salaries and equipment.

If the "transaction" view of the world is a proper one, we would expect to find a very small or negative correlation between increases "this year" and increases "last year," where total resources are rationed.

Another way of stating the above is that "if a department received an increase last year it is unlikely to receive one this year."

\textsuperscript{26}Organizations resolve conflict among goals, in part, by attending to different goals at different times. Just as the political organization is likely to resolve conflicting pressures to "go left" and "go right" by first doing one and then the other ...", (p. 118) the city administration is likely to resolve conflicting pressures for budget increases by first granting one and then the other. Cyert and March, \textit{op. cit.}, p. 118.

In the above situation, awareness of the "conflict" (and hence, the need to resolve it) is crucial. We would then expect more sequential-attention-to-department-demands to occur in "visible" accounts in visible departments.
Correlations between "this year's increase" ($\text{APPR}_{ij} - \text{APPR}_{ij}$) and last year's increase" ($\text{APPR}_{ij} - \text{APPRO}_{ij}$) were calculated:²⁷

<table>
<thead>
<tr>
<th>Account</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cleveland</strong></td>
<td></td>
</tr>
<tr>
<td>Salaries and Wages</td>
<td>-.079</td>
</tr>
<tr>
<td>Other</td>
<td>.210</td>
</tr>
<tr>
<td>All Accounts</td>
<td>.028</td>
</tr>
<tr>
<td><strong>Detroit</strong></td>
<td></td>
</tr>
<tr>
<td>Salaries and Wages</td>
<td>.028</td>
</tr>
<tr>
<td>Expenses</td>
<td>-.687</td>
</tr>
<tr>
<td>Equipment</td>
<td>-.362</td>
</tr>
<tr>
<td><strong>Pittsburgh</strong></td>
<td></td>
</tr>
<tr>
<td>Administrative Salaries</td>
<td>-.237</td>
</tr>
<tr>
<td>Nonadministrative Salaries</td>
<td>-.278</td>
</tr>
<tr>
<td>Materials, Supplies, Expenses</td>
<td>.393</td>
</tr>
<tr>
<td>Equipment</td>
<td>-.391</td>
</tr>
<tr>
<td>Maintenance</td>
<td>-.119</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.245</td>
</tr>
<tr>
<td>All Accounts</td>
<td>-.190</td>
</tr>
</tbody>
</table>

The statistics cited above indicate that there is probably some "transaction" behavior in Detroit and Pittsburgh, but probably very little in Cleveland. This kind of behavior is implicitly present in our formal model through coefficients attached to the trend term ($\text{APPR}_{ij} - \text{APPRO}_{ij}$) in some of the preliminary screening mechanisms (4-A1-3, 4-B1-4, 4-C1-9).

²⁷ Appropriations increase for a standard account category in a particular department versus corresponding increase "last time."
Perhaps we can summarize our discussion of conflict by noting that the data (interview and statistical) agree with our formal model in suggesting that conflict is not a particularly important feature of the budgetary problem-solving process.\textsuperscript{28} Rather, we would generally agree with Cyert and March who contend that "(w)here resource rationing is necessary, we expect ... a tendency to use arbitrary allocation rules that maintain the relative positions of the members of the coalition."\textsuperscript{28a} The presence of "arbitrary" rules is clearly what our model describes.

2.2 Budget Formation as Problem-Solving and as a Decision Process

We have spent a great deal of time elsewhere in this report, describing the model as a problem-solving routine or a decision process (see Section 5 and Section 2, pp. 28-37). Repeating these notions in their entirety would serve little purpose. Instead, we will note that the model of municipal resource allocation presented can very usefully be described as decision making or problem solving in the face of a great deal of uncertainty, a large number of constraints, and few cues from the extra-governmental environment, rather than as a process having a great deal of "political" content.

The remainder of the section will discuss the areas of agreement between this study and other theories and investigations in

\textsuperscript{28} See footnote 12, Section 5.

\textsuperscript{28a} Cyert, R. M., and March, J. G., \textit{op. cit.}, p. 270.

2.2a Organizational Behavior

Behavioral Theory of the Firm

The broad outlines of a model of internal resource allocation have been sketched by Cyert and March. Although based on research focusing on the business firm, they have contended that it is applicable to other, non-business, organizations. The model of municipal resource allocation presented here is certainly consistent (though it is considerably more detailed) with the Cyert-March hypotheses.

---

29 Cyert and March, op. cit., Chapters 1-6.
30 March and Simon, op. cit., Chapters 6-7.
32 Wildavsky, A., op. cit., pp. 1-123.
The Cyert-March theory of organizational behavior consists of four major relational concepts.  

1. **Quasi-resolution of conflict** where goal conflicts are "resolved" by viewing goals as a set of independent constraints which an acceptable policy must satisfy; by subdividing problems and delegating them to subunits thereby insuring that subunits deal with a "limited set of problems and a limited set of goals," and reducing the potential for goal conflict between subunits; by using acceptable-level decision rules, and by sequential attention to goals rather than simultaneous consideration of all goals.

Our model of municipal resource allocation clearly possesses all of the characteristics cited above. The model in its entirety can be viewed as a system of constraints, applied sequentially. Whenever a constraint is violated, a "search" or problem-solving procedure is evoked to correct the condition. For instance, the following is part of the MAYORS deficit elimination procedures, (a): (4-B-9), "Is the anticipated surplus large enough to finance a minimum salary increase?" (b): (4-B-10), "If so, increase salary levels for all departments and reduce calculated surplus." The "goal" above is a subgoal of the "balanced-budget" goal. The factoring of the budgetary problem into subproblems (i.e., departments prepare budget requests

---

36 See Section 2, pp. 28-32, for a more complete discussion of the Cyert-March theory.
independently, the mayor's office puts the solutions to the subproblems together to arrive at the solution to the overall budgetary problem) is an obvious feature of our model. This subdivision of problems is reflected in our choice of submodels: DEPT., MAYORS, and COUNCIL.

2. **Uncertainty avoidance** where uncertainty is circumvented rather than faced by resorting to feedback-react decision rules to solve problems when they arise; and by negotiating with the environment to insure stability and predictability of the organization's surroundings through standard practices in an industry, or budgets within a firm.

   The mere fact that we have been able to program the budgetary process can be cited as evidence that we are dealing with a "negotiated environment" (or at least a highly predictable one).

3. **Problemistic search** where the search for alternatives or solutions is activated by the presence of a perceived problem and depressed by a perceived solution; where the search for solutions "proceeds on the basis of a simple model of causality" based on the characteristics of the problem until failure to discover a solution forces use of a more complex model; and where search is biased and aimed in the direction of previous, successful problem solutions, existing organizational information, experience, and training.
Again, our model is very compatible with this notion of the relationship of problem characteristics and search activity. For example, one "perceived problem" in the MAYORS submodel occurs when the budget is not in balance. If the problem is one of a budget surplus, "previous, successful" surplus-elimination routines are evoked. If it is a budget deficit problem, similar deficit elimination routines are evoked. Cyert and March argue for the presence of a hierarchy of search routines, which are tried, sequentially until the problem is solved. This kind of behavior is most clearly present in the MAYORS submodel. For instance, in the case of a deficit, the first search routine involves checking, department by department, account by account, to see if the preliminary budget estimate is within the limits set by the mayors office (4-B1-16.) Even this procedure is executed sequentially, starting with the lowest priority accounts (maintenance and equipment) and progressing up the hierarchy until either a solution is reached (deficit eliminated) or all accounts have been processed (4-B1-16, 17, 18, 19, 20). The next (expanded) search activity is a check to see if the preliminary budget request exceeds current appropriations (4-B1-21, 22, 23). This search is also carried on sequentially, first checking low priority accounts and moving up the hierarchy of accounts until all are exhausted or the deficit has been eliminated (4-B1-24, 25, 26, 27). If a deficit still exists, the model eliminates it by scaling down all non-salary accounts equally (i.e., the deficit is allocated proportionally to all departments). Quite clearly, our model has not 'exhausted the
hierarchy of search routines in the "real" budgetary process. There are surely other ways that deficits and surpluses are eliminated in practice. It is contended, however, that the principal search routines (those evoked "first") have been identified by our model.

4. **Organizational learning** where learning is conceived of as the adaptation, with experience, of goals, attention rules, and search rules. Goals are changed on the basis of past experience, past goals, and the performance of comparable organizations. Attention rules are reasonably fixed in the short run but shift in the long run towards those that generally indicate satisfactory performance for the subunit involved. Search rules change slowly in the direction of success. "(W)hen an organization discovers a solution to a problem by searching in a particular way, it will be more likely to search that way in future problems of the same type..." and conversely.

Of the kinds of organizational learning cited by Cyert and March, we have captured only one -- adaptation of goals with experience. The "preliminary-calculation" parts of each of our three submodels are really adjustments in goals based on past experience (expenditure data), past performance (current appropriations and trends in appropriations), but **not** on performance of comparable organizations.

As we have argued elsewhere, no comparable organizations exist in the cognitive maps of our decision makers. The absence of concrete reference points like sales, profits, price, etc., and the lack of
performance and service standards means that adaptation of goals is achieved merely through the elaboration of historical data.

Because of the comparatively short period of time covered in our study, we have no "hard" data on the adaptation of the attention rules and search rules over time. Indeed, one of our principal findings is that there have been no substantial adaptations during our study period. Once again, we are referring only to one fragmented decision in the series of decisions comprising the municipal governing process. (See Figure 9-1).

We have implicitly argued that the adaptation in attention rules is not a key part of the budgetary decision process. Operating Budget Decisions have a fixed focus of attention. They are fixed on things like existing administrative units and standard account categories and the balanced budget. Only rarely (as our 'analysis of residuals demonstrated in Section 7) is an event in the external
environment so "catastrophic" as to dictate a change in attention rules at the budgetary-decision level.

Attention Rules

On the other hand, attention rules seem to be an extremely important part of the decision procedures at the operating level. Whose street to fix first?, who to hire to fill a particular vacancy?, where to assign social caseworkers?, etc. -- (See Section 9, item 1.3) Operations are within a budget constraint, however. The budget constraint for the department is isolated from the external environment and subject to a very stable set of attention rules.

Organizational learning with respect to search rules is also absent from our model. Part of the reason for relatively fixed sets of search procedures undoubtedly rests with the system of legal constraints the city must operate within. The balanced-budget requirement clearly limits the scope of search activity as well as dictating the broad directions of search. The public-accountability requirement which limits fund transfers between accounts and departments, while spending appropriated money is another key factor in the limited and stable nature of search activity in the municipal budgeting decision process (to be discussed more fully in Section 12). More simply put, "Public accountability" leads to a relatively stable and detailed system of accounts. A detailed system of accounts and the need for tight controls limits the form of problem (budgetary) solutions and hence the variety of search procedures that can be successfully employed in reaching a publicly-accountable solution.
Cyert and March, when discussing internal resource allocation specifically, make two predictions where resource rationing is necessary. "First a tendency to use arbitrary allocation rules that maintain the relative positions of the members of the coalition (departments); second, a tendency to re-evaluate those estimates that are relatively difficult to defend in terms of traditional organizational practice, standard accounting procedure, or immediacy of tangible return."\(^{37}\) In general, our study confirms Cyert and March's expectations. "Arbitrary"\(^{38}\) allocation rules abound in our model. The rule that if there is an anticipated deficit, all departmental requests must be within a certain percentage of current appropriations, \((4\text{-}B\text{-}16)\) is an arbitrary rule in at least one sense of the word. Our model "re-evaluates" (i.e., cuts) those items most difficult to defend first before moving on to other items. A key part of the "deficit elimination" procedure is the hierarchy of account categories with maintenance and equipment being lowest on the list (and most subject to re-evaluation) and salaries being highest. The success of the alternative model cited in Section 6 that hypothesizes that each department and each account maintains a constant

\(^{37}\)Cyert and March, \textit{op. cit.}, p. 270.

\(^{38}\)"Arbitrary" in the sense that they bear little or no relationship to "worth of program, department, etc.," but not arbitrary in the sense that they lead to a balanced budget.
share of the total budget indicates that relative positions of coalition members tend to be maintained in the "real world" and in our model. Whether this is "caused" by the "arbitrary" allocation rules used when resources must be rationed or by the fluctuating revenue conditions during the study period is not clear.

In summary, our findings are highly consistent with the Cyert-March theory of organizational decision making and could clearly be cited as evidence for the validity of their model in the public as well as the private sector.

Organization Theories of Simon and March and Simon

Reviewing Herbert Simon's pioneering work, Administrative Behavior, we have found that things have not changed much in twenty years.

39 No useful role is played by the concept of "organizational slack" in our model (although the built-in-surplus feature of the Pittsburgh budget due to its detailed system of appropriations might be cited as an example). This is the only "important" departure of our model from theirs.

40 "Pioneering" in an evolutionary sense, at least. Simon's ADMINISTRATIVE BEHAVIOR (1947) led, after a fashion, to March and Simon's ORGANIZATIONS (1958) followed by Cyert and March's BEHAVIORAL THEORY OF THE FIRM (1963). Each work has built upon the previous ones and forms a core of a significant portion of present-day literature on organizational decision making.
"Inadequacy of Customary Budget Methods"

"What does the typical governmental budget include? It tells how much each department will be allowed to spend during the subsequent year, and how it may spend it. How are the particular figures to be found in budgets arrived at? How is it determined that 14 per cent of the budget shall be devoted to fire protection and 11.6 per cent of highways?

"A different answer to this question would be given in every community in which it was asked. Some budgets are made by copying off the figures of the previous year's expenditures. Some are constructed by increasing or decreasing appropriations by a fixed percentage. Some are determined by allotting to each department a certain percentage of its request—"he who shouts loudest gets most. Some have even less systematic plans."

Aside from the comment that it is not obvious how one would go about improving upon these "inadequate methods," little more needs to be said about the consistency of Simon's view of governmental budgeting in 1947 with ours of 1965. The model of municipal resource allocation presented in this report is largely a mixture of the decision rules cited, above, by Simon. In the class of communities chosen for study, (those over 500,000), it appears likely that we would get the same answer to the question "How are the particular figures found in budgets arrived at?"

---


42 Lindblom (A STRATEGY FOR DECISION) would argue that these methods are not necessarily inadequate.

43 Wildavsky (POLITICS OF THE BUDGETARY PROCESS) reports similar budget methods in use in the Federal Government as well.
In Organizations, March and Simon generally "agree" with the notions found in Simon's Administrative Behavior and suggest a set of relationships similar to those found in Cyert and March (see above). Consequently, our findings are generally supportive of their theories. This is true, however, only if the budgetary decision process is viewed as an "ordinary" organizational decision process. While discussing internal resource allocation in general, and budgeting in particular, the findings here do not agree with March and Simon's theory.

"Finally, as to conflict centering on budget allocations, intensity of the pressure toward joint decision-making will depend on how limited funds are for the organization as a whole. There is no particular problem associated with dividing an unlimited pie, and so long as the available resources of the organization permit allocations as large or larger than the allocations in the preceding budget period, organizational subunits do not feel any great pressure toward coordination and discussion. So long as such a condition obtains, conflict about budget is probably considerably less than where the supply of money resources is tight."44

Exactly what this means in a situation where the supply of money is "tight," but still large enough to permit allocations as large as last period's, is not clear. We can only report our findings -- "conflict" is not a meaningful concept in the budgetary decision process observed. Certainly, no conflict between departments (organizational subunits) was observed. The conflict -- if it can be called that -- takes place between the departments and the mayor's office, not between departments. (See discussion, Section 9, item 2.1).

44March and Simon, op. cit., p. 123.
Lindblom and Incrementalism

In Lindblom's works, he has concentrated on the connection between potential problem complexity and decision techniques used to deal with the problem. Briefly, in problem areas where the "level of understanding" is low, the observed policy-making process is one involving incremental adjustments of existing policies (Lindblom points out that most "political" or public policies represent a continuing attack on ever-present problems, hence there is "always" a precedent to follow and adjust). He also observes that the incremental adjustments are responses to difficulties with the present policy (very similar to the Cyert-March problem-oriented search notions). Another feature of the Lindblom view of policy making is that policy features are fragmented and dealt with as individual problems, rather than "comprehensively." He argues, much as we have in Section 5, that to do otherwise creates an impossible problem for the decision maker. The Lindblom notions could actually be viewed as a "subset" of the Cyert-March model of organizational decision making.

---

Braybrooke and Lindblom, op. cit.

46 Lindblom has chosen to concentrate on "justifying" or illustrating the advantages of "incrementalism" as a decision procedure where knowledge is incomplete, and cognitive abilities are limited. Cyert and March, on the other hand, have approached the problem from a more psychological viewpoint and have seen fit to place great emphasis on the empirical validity of their theory.

Lindblom's model is consistent with the Cyert-March model, but the key features of the Cyert-March model could not be "derived" from Lindblom.
Our findings certainly exhibit the broad characteristics of "incrementalism." It is not clear, however, how Lindblom would deal with the very real balanced-budget constraints and the fact that, at some level of detail, the results of initial, incremental adjustments at the department level must be modified so that the entire budget is balanced. Let it suffice to say that our findings are generally consistent with Lindblom's hypotheses.

Wildavsky, Davis and the Federal Budget

Aaron Wildavsky in *The Politics of the Budgetary Process* presents a descriptive model of the decision process surrounding the formation of the Federal Budget. His description is similar to our description of the municipal budgetary process in many respects. Wildavsky's description, also, is very consistent with the ideas expressed by Braybrooke and Lindblom, and Cyert and March.\(^\text{47}\)

Wildavsky's basic methodology was the same as ours — reliance on interview data from participants to construct a description of the decision process. Our model of municipal resource allocation was formalized, quantified, placed in the form of a computer program, and used to regenerate municipal budgetary decisions in an attempt to assess the validity of our theory. Although Wildavsky did not formalize his model, Davis\(^\text{48}\) did formulate the Congressional decision


process in a series of regression models. Davis' results confirmed many of the behavioral mechanisms described by Wildavsky for Congress. The unavailability of agency and departmental request data has prevented further tests to date.

Wildavsky, via Davis has a partially verified theory of the budgetary decision process in the Federal Government. How does it compare with the municipal process?

Wildavsky's model attributes the traditional bureaucratic roles to participants -- as does ours:

- department or agency: ask for more than they expect to obtain -- advocate of agency's activity.
- chief executive and staff: scale down agency requests.
- legislative body: tends to cut executive budget.

Other than in the role of the legislative body, our findings agree with Wildavsky's. As has been seen, the municipal legislative body generally serves as a "rubber stamp" for the executive operating budget. 49 Congress, on the other hand, plays a much more important role. The primary reasons for this role differential seem to be:

1. Lack of staff in city councils (no "Congressional" committee staffs, etc.) and lack of specialization on part of individual councilmen.

---

49 On several occasions during the study periods, city councils have "vetoed" the mayor's tax policy, but not the distribution of expenditures within a given budget ceiling (revenue estimate).
2. Balanced budget requirement in city charters --
   Congressmen can "add" or "subtract" freely without
   having to arrive at a predetermined total (revenue
   estimate).

   In a section on "aids to calculation," Wildavsky cites two that
   seem especially relevant:

1. Satisficing -- rather than maximize, budget officials
   "satisfy and suffice." Clearly, our model is centered
   around a series of satisfactory or acceptable-level
   goals or decision criterion.

2. Incrementalism -- "The largest determining factor of
   the size and content of this year's budget is last
   year's budget. "(I)t is based on last year's budget
   with special attention given to a narrow range of
   increases or decreases."50 The municipal budgetary process
   is an example of government-by-precedent, organizational
   inertia, and the result of a highly constrained decision
   process.

   Closely tied in with the "incrementalism" concept are two
   widely-held notions in the federal budgetary process -- "base" and
   "fair share."

   "Base" refers to the "general expectation among participants
   that a department's activities will be carried on at close to the going

   50 Wildavsky, op. cit., pp. 11-16.
Calculations of a "base" from which adjustments are made is a prominent part of each of our submodels (4-A1-3, 4-B1-4, 4-C1-5, 9).

"Fair Share" refers to the expectation that a department will receive its "fair share" of any increases in the total budget. If, over time, we assume that each department's "fair share" of the total budget increases is constant, the following relationship should be statistically significant:

\[
(APPR_{ij}^{2} - APPR_{ij}^{1}) = d_{ij}(TBUD_{2} - TBUD_{1})
\]

This, of course, corresponds to our "alternative model 3" (see Section 6). The relationship did not hold. Davis has also shown that "fair share" does not hold for the Congressional portion of the Federal budgetary process.\(^{52}\)

While the description of the federal budgetary process is extremely consistent with the municipal case, there is one very important difference. The "key" motivational concept or decision criterion in the MAYORS Submodel is that of the balanced budget. All "model activity" in the MAYORS Submodel is directed towards eliminating a deficit or a surplus (i.e., achieving a balanced budget). True, the President does indicate a budget ceiling for the Bureau of the Budget to follow in the federal process,\(^{53}\) but according to

\(^{51}\) Wildavsky, _op. cit._, p. 17.

\(^{52}\) Davis, O. A., _et. al._, _op. cit._

\(^{53}\) Wildavsky, _op. cit._, pp. 183-4.
Wildavsky, the Presidential "ceiling" does not play nearly the role in the federal process as does the "balanced budget" or "revenue constraint" in the municipal process. Therefore, one might expect a somewhat different process in a Presidential-staff model (of the Bureau of the Budget) than in our MAYORS Submodel. One would expect that fewer "coordinating" mechanisms would be found in the federal process than in the municipal, and that there would be a greater reliance on ad hoc, "independent" decision rules as opposed to the more systematic treatments in the MAYORS process.

In summary, although important differences exist between the federal budgetary process as described by Wildavsky (and supported by Davis), and the municipal process, most of the decisional mechanisms (Wildavsky's "aids to calculation") are remarkably similar.

This strong similarity in resource allocation procedures suggests that there may be some global kinds of decision processes at work here. First, consider internal resource allocation in non-market organizations. As was seen in Section 8, the same decision procedures found in metropolitan budget making were also relevant for State and local governments, universities, and school boards.

54Wildavsky, op. cit., p. 37.

55A system of linear regression models might be a more "appropriate" way to formalize the federal process than the simulation model used in our municipal study.
Secondly, had we chosen the Cyert-March theory of organizational decision making (based on private sector observations), we would have arrived at a theory much like the one we have by just "studying the process as found." Does this fact suggest a set of pervasive decision mechanisms? We now turn to another, growing body of literature to help shed some light on the latter question.

2.2.b. Computer Simulation of Human Thinking and Problem Solving

Recently, there have been a number of attempts to simulate the thought and problem-solving processes of human subjects. The object has been to construct a computer program that attempts to solve a particular problem or complete a particular task "in the same way" as humans. By "in the same way" we mean the computer program uses the same symbolic information at each stage of the problem solving sequence and manipulates the information in the same ways as human subjects.

Ignoring for the moment the question as to whether collectivities of people behave like individuals, it might be interesting to compare our model of human decisional behavior with a more general model. A computer program called the General Problem Solver (GPS) exists that purports to contain a "system of methods -- believed to be those commonly possessed by intelligent college students -- that turn out to be helpful in many situations where a person confronts problems for which he does not possess special methods of attack."56

This program and modified versions of it, has successfully simulated human problem solving in proving algebraic and geometric theorems, in puzzle-solving situations in problems in symbolic logic, and in chess playing. What are the general characteristics of this program, and how do they compare with the problem-solving simulation attempted in this report?

**Structure of GPS**

"The program deals with symbolic objects that describe or characterize situations—the given situation, the desired situation, various intermediate possible situations. The program also deals with symbols representing differences between pairs of objects and with symbols representing operators that are capable of inducing changes in the objects to which they are applied.

**Goal types.** The processes of GPS are organized around goals of three types:

1. **Transformation goals:** to transform object \( a \) into object \( b \).
2. **Difference Reduction goals:** to eliminate or reduce difference \( d \) between objects \( a \) and \( b \).
3. **Operator Application goals:** to apply operator \( q \) to object \( a \).

**Methods.** With each type of goal in GPS there is associated one or more methods, or processes, that may contribute to the attainment of the goal. The principal methods in the present version of GPS are three in number, one for each type of goal:

1. Method for transformation goals: to transform \( a \) into \( b \).
   a. Notice a difference, \( d \), between \( a \) and \( b \);
   b. Establish the goal of reducing \( d \) between \( a \) and \( b \);
   c. Try to attain this new goal;
   d. If successful, find a new difference and repeat.

---

2. Method for difference reduction goals: to reduce \( d \) between \( a \) and \( b \),
   a. Recall an operator, \( c_j \), that is relevant to differences of the type of \( d \);
   b. Establish the goal of applying \( c_j \) to \( a \);
   c. Try to attain this new goal;
   d. If successful, return to the previous transform goal.

3. Method for operator application goals: to apply operator \( c_j \) to \( a \),
   a. Compare conditions for application of \( c_j \) with object \( a \);
   b. If these are not satisfied, establish and try to attain the goal of transforming \( a \) into an object that meets these conditions;
   c. When the conditions are satisfied, apply \( c_j \) to \( a \), and return to the previous difference reduction goal with the modified object, \( a' \).

This is a rather simplified description of what goes on in GPS, but it gives the broad outline of the program. GPS, to put it simply, is a program that reasons about ends and means. It is capable of defining ends, seeking means to attain them, and, in the process of so doing, defining new subsidiary ends, or subgoals, to the original end.\(^{58}\)

A reasonably detailed comparison of the features of GPS and aspects of our simulation model should prove enlightening. Because the MAYORS Submodel is by far the most significant of the three and "it" is involved more in problem solving than in estimating (unlike the DEPT. Submodel), it will be compared in detail with the "Methods" outline, above. In essence, the verbal flow chart in Section 4 is presented with the appropriate references to the General Problem Solver "Methods." For instance, "Check of preliminary total against revenue estimate to determine if a surplus or a deficit is anticipated "

is an example of Method 1.a, "Notice a difference, δ, between a and b."

Since we are trying to transform a into b, a refers to the "preliminary total" and b refers to the "revenue estimate."
GPS and MAYORS Budget Recommendation Model

1. Department regular and supplemental budget requests received \((a')\)

2. Latest Revenue Estimate \((b)\)

3. Historical Date -- Current appropriations, last year's expenditures, and appropriation trends \((a')\)

Object Code

- \(a'\) Department requests, other data inputs
- \(b\) revenue estimate
- \(a\) mayor's set of budget recommendations
- \(d\) difference between \(a\) and \(b\)
- \(q\) operator

Note: Underscored letters refer to "objects," others refer to GPS outline in text.

4. Preliminary check of all departmental requests -- if departmental request is less than current appropriations \((3,a)\), it is tentatively accepted \((3,b)\); otherwise a tentative "calculation" of the mayor's recommendation is made based on the department's regular and supplemental requests together with the change in appropriation from last year to the current year and the last available expenditure data \((3,c)\).

5. Preliminary calculation of total budget -- sum of preliminary calculations \((a)\).

6. Check of preliminary total \((a)\) against revenue estimate \((b)\) to determine if a surplus or a deficit is anticipated \((l.a.)\). If "surplus" \((d)\), a set of "surplus reduction" routines is evoked \((l.b.)\). If "deficit" \((d)\), "deficit elimination" routines are evoked \((l.b.)\).

surplus reduction procedures \((q)\)

7. Calculate magnitude of anticipated surplus or residual \((l.a.)\) \((d)\)

8. Find total salaries and wages for the city (preliminary estimates) \((2.a.)\) \((a'\)"

9. \(\)
8.

9. Is the anticipated surplus (d) large enough to finance a minimum salary increase? (2.b.), (2.c.), (3.a.)
   yes no

10. If so, increase salary levels for all departments and reduce calculated surplus (3.c.), (a), (1.d.), (d).

11. Is there enough anticipated surplus (d) left to distribute among departments? (2.a.), (3.a.), (1.c.)
   yes no

12. Consider the highest priority non-salary account category (that has not yet been considered) starting with general expense accounts and ending with equipment and maintenance accounts (2.b.).

13. Increase the budget recommendation for the account category under consideration (a) for all departments (until the surplus (d) is exhausted) by granting a portion (2.c.) of each department's supplemental request. When (and if) money runs out, prepare final budget recommendation (a). money runs out (2.d.), (1.d.)

14. Move to next highest priority account category and go to 12. If all categories have been considered, prepare final budget recommendations (Go to 26) (3.a.).

Deficit Elimination Procedures (g)

6. Surplus reduction procedures (g) deficit elimination procedures (2.a.)

15. Consider accounts in reverse order (2.q.) of their priority (consider equipment and maintenance first, salaries last).
16. Check, department by department, to see if the preliminary budget estimate (mayor's) (a) for the account category under consideration is within the limits (b') (% of current appropriations) implied in the mayor's budget letter to departments (3.a.).

17. If within limits, no change in preliminary budget estimate (a)

18. Decrease preliminary estimate of budget so that it falls within mayor's limits (a'), (d), (3.c.).

19. Repeat 16.-18. until deficit (d) is eliminated or departments have all been considered (1.d.).

20. Consider next lowest priority account (Go to 16.), unless all account categories have been examined (2.a.), (2.b.), (2.c.).

21. For non-standard account categories (not found in all departments), check -- for all departments -- to see if the preliminary budget request exceeds current appropriations (2.a.), (2.b.), (3.a.).

22. Adjust preliminary budget (3.c.), (a) recommendation so that it equals current appropriations (a) (d).

23. No change in preliminary (a) figure.
22. After all departments have been considered (by 21, 22, 23) calculate a new preliminary budget total based on adjusted recommendations.

23. If "deficit" still exists, (2.a) consider standard account categories in order of decreasing priority (2.b), department by department, until deficit is eliminated (2.c) repeat steps 21, 22, 23, 24, or list of account categories has been exhausted.

deficit eliminated (2.d), (2.a) all accounts in all departments examined (2.a)

24. After all departments have been considered (by 21, 22, 23) calculate a new preliminary budget total based on adjusted recommendations.

25. If "deficit" still exists, (2.a) consider standard account categories in order of decreasing priority (2.b), department by department, until deficit is eliminated (2.c) repeat steps 21, 22, 23, 24, or list of account categories has been exhausted.

26. Calculate total budget (3.a), (3.b), (3.c), (3.d) based on existing preliminary totals, making sure that no mayor's budget recommendation exceeds the total (d) of department's regular plus supplemental request (b).

27. Check to see if there is a deficit (d), (1.a), (1.b).

no deficit no deficit

28. Eliminate deficit (d) by scaling all non-salary accounts (a) to make budget balance (b) -- proportional allocation of deficit. (Go to 20) (3.b), (3.c), (3.d), (2.a), (2.b)

29. Final Budget to council

GPS's correspondence with the municipal resource allocation model appears to be extremely close. The "goal" is to transform "preliminary budget recommendation totals" to the "revenue estimate" total. A "difference" between anticipated expenditures and revenue is calculated and the goal of reducing this difference (i.e., eliminating the "surplus" or deficit) is established. A set of operators relevant to the differences of a given type is evoked -- "deficit elimination procedures" or "surplus reduction procedures," depending on whether the difference is positive or negative. The various difference - reduction routines are
tested to see if the conditions for applying a particular operator are met ("Is the anticipated surplus large enough to finance a minimum salary increase?"). If so, the operator (raise salaries uniformly) is applied, and so on. Two conclusions emerge:

1. Our model of municipal resource allocation is consistent with the information-processing approach found in GPS.

2. A means-ends analysis of the municipal resource allocation process appears to be a reasonable one, where the "end" is a balanced budget and the "means" consists of a fixed set of residual elimination routines ("surplus reduction" for positive residuals and "deficit elimination" for negative residuals). 59

"Profitable" Vantage Points

Looking back on the determinants of the municipal operating budget, it is easily seen that theories that assumed the city budget was the result of some kind of external event, did not prove to be consistent with the process uncovered in this study. Concepts like "influence," "community needs," "service standards," "interest group," "politician," and "elite" did not prove to be very useful in understanding the process by which budget level decisions are made. Neither were internal bureaucratic phenomena like "conflict" and "competition for resources."

59 The questions relating to the genesis of the formal, budgeting process and how it "developed" into a GPS-type process are extremely interesting and worthy of further study.
The useful conceptualizations of the budgetary phenomena tend to deal with administrative decision processes, human information processing and problem solving, organizational decision making, "satisficing," "sequential-attention-to-goals," and the like. In general, those theories which appear to be most descriptive of the way in which municipal operating budgets are formulated, tend to emphasize the more goal-directed behavior of man, cognitive processes, and administrative behavior.
Our computer model of municipal resource allocation represents a partially-tested theory of governmental decision making. It describes a system of human behavior and makes some strong assertions about that behavior. The purpose of this section is to find out more about the system of behavior, the relative importance of some of the assertions, and the logical implications of the theory under differing conditions.

The model as a closed, dynamic system, where model outputs one period can serve as inputs for the next, facilitates an analysis of the model's dynamic properties. Changing individual model mechanisms or parameters is a relatively simple task and allows the researcher to unambiguously trace theory implications.

The choice of alternative mechanisms and parameters is not independent of the model's dynamic properties.

Length of Model Runs

Our model is basically one describing the short-run decision process. An integral part of the process (although not formally a part of the model) concerns the external environment. The environmental corrections as revealed in the analysis of residuals in Section 7

---

1See pp. 163-166, for a discussion of different types of model runs. We will use "simulation" runs here.
constitute an important set of variables. Although we have argued that these "corrections" are somewhat random and out of the control of the decision makers, government does respond to them in fairly predictable ways. How long should we let the model run without environmental interventions? A somewhat arbitrary period of ten years was chosen as being "long enough" so that patterns and shifts can emerge, but not so long a period as to lose all relevance for the real-world process.

**Detroit as Test Model**

Rather than experiment with all three cities, it was decided to test the model's properties using data from just one. Detroit was chosen because it had a complete set of departmental request data. It was feared that cumulative effects of DEPT parameter instability, due to a lack of data in Cleveland and Pittsburgh, could lead to an unstable system (if not subject to environmental corrections).

**What to Measure?**

Inasmuch as preliminary calculations parameters constitute a system of mutual expectations, they were not varied in the test runs described below. It might have made sense to change parameters in one or two departments and note the effects on resource allocation. This was not done, however. In all probability, only the one or two departments would have been affected. Also, the study has focused (rightly or wrongly) on the total process, not on individual, micro elements.
Presumably, we are interested in the relative allocation of resources rather than just dollar amounts or single departments. With this in mind, share-of-the-total-budget appears to be a reasonable dependent variable for model tests.

The formal model presented in Section 4 is generally an administrative, problem-solving model. The analysis of the model's residuals in Section 7 revealed that the external environment enters the process either on a random, *ad hoc* basis or through the revenue constraint. With this in mind, we will undertake two different kinds of analyses: One (A., below) relating to administrative constraints and guidelines and the other (B.) relating to the systematic, externally-imposed revenue constraint.

**A. Model Test -- Administrative Constraints and Guidelines**

In testing the model, we assumed a stable system of interaction and consequently held the preliminary-calculations parameters (See 4-A1-3, 4-B1-4, 4-C1-9) constant, while loosening a number of constraints. In particular, effects of the following parameters and variables were investigated:

1. Tone-of-mayor's letter or mayor's limit on increments -- XL
2. Minimum salary increase -- XK
3. Balanced-budget tolerance limit -- XLMT

---

2"XL," see (4-B1-18)
"XK," see (4-B1-9, 10)
"XLMT," see (4-B1-11)
Two model runs were undertaken to see what effect (if any) the relaxing of tight mayor's guidelines, wage increases, and solution criteria ("XLMT") would have on the relative allocation of community resources. Revenue was held constant throughout (at 1964-65 levels) the ten-year runs in order to isolate possible effects of the three parameters.

Parameter values used were:

<table>
<thead>
<tr>
<th></th>
<th>Run 1 (Normal)</th>
<th>Run 2 (Relaxed Administrative Constraints)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit on Regular increments, tone of mayor's letter</td>
<td>$XL = 0.05$</td>
<td>$XL = 0.15$</td>
</tr>
<tr>
<td>Salary increment</td>
<td>$XK = 0.05$</td>
<td>$XK = 0.10$</td>
</tr>
<tr>
<td>Tolerance limit -- stops search for balanced budget</td>
<td>$XLMT = 150,000$</td>
<td>$XLMT = 1,000,000$</td>
</tr>
<tr>
<td>Revenue (constant)</td>
<td>$153,000,000$</td>
<td>$153,000,000$</td>
</tr>
</tbody>
</table>

Alternative Administrative-Constraint Conditions

Figure 10-1

Included are graphs of budget shares over time (1965-1975) implied under normal administrative-constraint conditions and shares under a looser system of constraints.
Although results for all accounts in all departments were plotted, only three are included here. The three are highly representative of the others.
CITY OF DETROIT - CIVIC CENTER

10-Year Forecast of Appropriations (constant revenues)

Key: ——— Normal Constraints
     ——— Loose Constraints

Expenses

Salaries and Wages

Equipment

Figure 10-2
CITY OF DETROIT - COUNCIL

10-Year Forecast of Appropriations
(constant revenues)

Key: ———- Normal Constraints

———- Loose Constraints

Salaries and Wages

Expenses

Equipment

Figure 10-3
CITY OF DETROIT - HOUSE OF CORRECTION

10-Year Forecast of Appropriations
(constant revenues)

Key: __________ Normal Constraints
_________ Loose Constraints

Salaries and Wages

Expenses

Equipment

Figure 10-4
A.1. Results

The following observations can be made:

a. For all but a very few account categories in a very few departments, the "relaxed" constraints led to \textbf{no large shifts} in budget share for the ten-year model run (assuming constant revenues) relative to "normal" constraints.

b. Most account categories experienced \textbf{no} change in budget share from 1965 to 1975 under a constant revenue assumption in either Runs 1 or 2.

c. The looser constraints \textit{slightly} disadvantaged the salary and wage accounts. For all years (10), in all departments (48), salary and wage budget share was (slightly) lower than, or equal to the share under normal constraints.

d. Related to c., the expense and equipment accounts, in a majority of departments tended to pick up the small loss in salary shares.

Some crude statistics may help identify some dynamic properties of the system at a "revenue equilibrium." Three questions seem relevant:

i. How are trends distributed among account categories?

ii. How are trends distributed within departments? Are account trends cumulative for a department?

iii. How many large, discrete differences are there under the two constraint assumptions?
Figure 10-5 addresses itself to those departments and accounts where both normal and loose administrative constraints lead to the same trend (nor necessarily level).

<table>
<thead>
<tr>
<th>Account type</th>
<th>down</th>
<th>stable</th>
<th>up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages and Salaries</td>
<td>8</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Materials, Supplies, and Expenses</td>
<td>7</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Equipment</td>
<td>1</td>
<td>44</td>
<td>4</td>
</tr>
</tbody>
</table>

Trends in Budget Share with Constant Revenues

Figure 10-5

Under a constant revenue assumption, relative and absolute account growth appears reasonably independent of administrative constraints and occurs in the Material, Supplies, and Expense categories at the expense of Salary and Wage accounts.

Are these trends cumulative? If one account in a department grows, do they all grow?
Cumulative Properties of Trends in Departments
(Constant Total Budget)

Figure 10-6

Figure 10-6 indicates that accounts within a department are independent of one another for the most part.

We have ascertained that budget-share trends are distributed somewhat differently between accounts, and, within departments, few cumulative effects are observed. How are the significant differences in level distributed?

Of the nearly 150 accounts observed, a significant difference in budget-share level was found only nine times. Seven involved the "Materials, Supplies, and Expenses" account. Two of the seven were better off under normal constraints and the remainder had better fortune with "loose" conditions. Two Equipment accounts experienced significantly better luck under loose administrative constraints. There are few significant, level differences under the
two constraint conditions and they are concentrated in the "Expense" accounts.

A.2. Conclusions -- Role of Internal Constraints

The empirical observations, above, suggest some possibilities:

1. If the three internal constraints tested are important at all, they are not important under a constant-revenue assumption.

2. The model constraints investigated are deeply embedded in the empirically determined parameters and hence our "test" was not really a test at all.

3. External constraints (revenues) dominate internal constraints.

We know the second point has a great deal of merit because we were forced to use model outputs to estimate internal model parameters. 3

Points one and three refer to the revenue constraint and its effect on resource allocation.

B. Model Test -- Revenue Constraint

Throughout this report, the revenue constraint (through the balanced-budget requirement) has played a key role. It defines the

3 See Section 6.A., for estimation methods, and Appendix, pp. A1-A5, for a discussion of the reasonableness of this approach. In Section 6 we find the parameters tested in this section were not empirically estimated. Test results here indicate precise estimation was not crucial.
primary problem for the MAYORS Submodel as well as providing the filter through which external pressures exert their influences. Unlike internal constraints, the revenue constraint is probably not embedded in the estimated model parameters. What kinds of revenue patterns are reasonable? Which ranges of revenue behavior should be examined for possible effect on the allocation of resources?

Using the stable system of interaction-parameters and "normal" constraint values, the model was run with three patterns of revenue:

1. Constant (same as Run 1 -- normal -- in part A of this Section).
2. Accelerating — 10% increase per year.
3. Fluctuating — a "base" revenue increasing at 5% per year with a random fluctuation about this base to calculate revenue for a given year.  

\[ \text{BASE}_t = 1.05(\text{BASE}_{t-1}) \]
\[ \text{REVEST}_t = \text{BASE}_t + Z \]

where Z is a normally distributed random variable with mean zero and a standard deviation of $10,000,000.
<table>
<thead>
<tr>
<th>Year</th>
<th>Constant</th>
<th>Accelerating</th>
<th>Fluctuating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965-66</td>
<td>153,000,000</td>
<td>153,000,000</td>
<td>153,000,000</td>
</tr>
<tr>
<td>1966-67</td>
<td>153,000,000</td>
<td>168,300,000</td>
<td>154,700,000</td>
</tr>
<tr>
<td>1967-68</td>
<td>153,000,000</td>
<td>185,200,000</td>
<td>160,900,000</td>
</tr>
<tr>
<td>1968-69</td>
<td>153,000,000</td>
<td>203,700,000</td>
<td>167,900,000</td>
</tr>
<tr>
<td>1969-70</td>
<td>153,000,000</td>
<td>224,100,000</td>
<td>191,000,000</td>
</tr>
<tr>
<td>1970-71</td>
<td>153,000,000</td>
<td>246,500,000</td>
<td>197,600,000</td>
</tr>
<tr>
<td>1971-72</td>
<td>153,000,000</td>
<td>271,100,000</td>
<td>184,700,000</td>
</tr>
<tr>
<td>1972-73</td>
<td>153,000,000</td>
<td>298,200,000</td>
<td>227,000,000</td>
</tr>
<tr>
<td>1973-74</td>
<td>153,000,000</td>
<td>328,000,000</td>
<td>239,900,000</td>
</tr>
<tr>
<td>1974-75</td>
<td>153,000,000</td>
<td>360,800,000</td>
<td>221,400,000</td>
</tr>
<tr>
<td>1975-76</td>
<td>153,000,000</td>
<td>396,900,000</td>
<td>249,700,000</td>
</tr>
</tbody>
</table>

**Alternative Revenue Patterns**

Figure 10-7

The model was run for a ten-year period, changing only the revenue estimate or constraint. The constant-revenue assumption defines a very tight revenue constraint, whereas the accelerating-revenue condition specifies an extremely loose or non-existent constraint. The fluctuating assumption is more realistic and provides for moderate growth (on the average) with the spurts and occasional downturn common in the last decade.

**B.1. Results**

Below are time-series plots of budget share\(^5\) for three departments.

---

\(^5\)The use of "share" rather than dollar amounts allows us to compare outcomes under the three revenue conditions.
Again, the dynamic behavior of the model is such that each department exhibits nearly the same pattern of behavior. Although all departments were graphed, little is lost by presenting just three graphs.

Some general observations can be made. As the total budget size increases, the share (though not dollar amount) for Wages and Salaries nearly always decreases. The reasons for this are not entirely clear. Perhaps this is an inevitable result of "automation" (one policeman in a patrol car can cover many times the area that he could on foot). It could reflect the fact that city revenues have really never grown more than 2%-3% per year, if that. Employees are much harder to dispose of than Equipment and other standard expense items. The reluctance of the model (and city administration) to take on employees at a rate of increase the same as (or higher than) the total budget, might reflect a cautious approach to hirings. Employees involve long-run commitments of funds.

Another interesting phenomena was noted. The constant and accelerating revenue assumptions create a kind of funnel or envelope (See Figures 10-8, 9, 10) for appropriations, within which appropriations under fluctuating revenues usually remain. In most cases, a change in revenue growth rate accelerates or depresses the trend in budget share for an account. Yet, we notice some accounts break out of this envelope by obtaining a larger share of the total (in the model) under fluctuating revenues than under accelerating, while some receive an even smaller share than under a constant revenue situation. Are there any regularities in this deviant behavior? No
CITY OF DETROIT, RECORDERS COURT - TRAFFIC DIVISION

10-Year Forecast of Appropriations

Key:
- Constant Revenues
- Fluctuating Revenues
- Accelerating Revenues

Salaries and Wages

Expenses

Equipment

Figure 10-8
10-Year Forecast of Appropriations

Key:
-Constant Revenues
-Fluctuating Revenues
-Accelerating Revenues

Salaries and Wages

Figure 10-9
10-Year Forecast of Appropriations

Key:

- Constant Revenues
- Fluctuating Revenues
- Accelerating Revenues

Figure 10-10
department or group of departments seemed to be helped or hurt by fluctuating, erratic revenues to the extent that they systematically fall outside the constant-accelerating limits.

Relation to "Limits"

<table>
<thead>
<tr>
<th>Account type</th>
<th>Above</th>
<th>Within</th>
<th>Below</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and Wages</td>
<td>1</td>
<td>44</td>
<td>1</td>
</tr>
<tr>
<td>Materials, Supplies, and Expenses</td>
<td>8</td>
<td>33</td>
<td>4</td>
</tr>
<tr>
<td>Equipment</td>
<td>11</td>
<td>36</td>
<td>0</td>
</tr>
</tbody>
</table>

Fluctuating-Revenue Accounts
Outside of Constant or Accelerating Limits

Figure 10-11

Figure 10-11 suggests that the "Expense" account fluctuates with fluctuating revenue more than "Salaries," for instance. The 8-4 split suggests little in the way of consistent "advantage" for "Expense" under fluctuating conditions, however. The Equipment account is a different matter. One third of the departments (according to the model) were able to do better under somewhat erratic revenue conditions than under either stable or steadily expanding conditions. Of the eleven departments that somehow "managed to use" fluctuating revenues to their advantage by securing an increased share for their Equipment account, ten of the eleven time-series plots of fluctuating revenues "broke out of the envelope" in 1972-73. What was so unusual about that year? Looking back at "Fluctuating" Revenues in Figure 10-7, we see
that after a revenue decline (of nearly $7,000,000) for 1971-72, the system received a sudden spurt in the form of an increase of more than 20%. Equipment accounts, for some reason, were able to siphon off more than "its share" of the increase. Interestingly enough, the eleventh case "broke out" of the constant-accelerating-revenue envelope in 1969-70. This was a year with another sudden spurt in revenues (nearly a 20% increase). Once the Equipment accounts reached this new plateau, the model implied they would stay there.

B.2. Conclusions -- Role of Revenue Constraint

The experiments with the revenue constraint suggest some additional dynamic properties of our model:

1. Revenue increases (decreases) seem to accelerate or depress the rate of change in budget share for all accounts, but do not usually change the direction of drift.
2. As the total budget increases, our model indicates that the share (not dollar amount) of wage and salary costs, declines.
3. When the decision system is "kicked" through revenue changes:
   a. Salary and Wages accounts are least responsive to the change.
   b. Expenses accounts are most responsive to the change and its direction.
   c. Some Equipment accounts are responsive to accelerating revenues and are able to maintain their new levels after revenue acceleration tapers off.
C. Summary — Internal and External Parameters

Experiments with our decision model have revealed some interesting behavioral characteristics of the system (see items A.2. and B.2., this Section). The inertial qualities of the model were apparent in both sets of tests. Analysis of budget shares by accounts over time, revealed, under changing revenue conditions, that a substantial reallocation of resources can occur. Although this change in budget share is an inertial one for most accounts, we have noted some interesting departures.

The primacy of the revenue constraint in the reallocation of resources is the major finding of this section.6

---

6See also, pp. 278-283.
Our study of budgetary decision processes led to the construction of a positive, formal model of individual and organizational problem solving. This model was then tested by comparing its output and characteristics with that of three municipal governments. In the process of constructing and testing, the model much has been learned, both about the substantive aspects of the problem and the methodology employed.

Broadly speaking, we were able to show that a "political" decision process is not really very much different from other organizational behaviors. By viewing the municipal operating budget as a problem to be solved we were able to draw on several theories of organizational and individual decision making.

We found the same, basic set of problem-solving heuristics being used in all three cities. These heuristics have evolved over time and have the same general features as many theories of individual problem solving. The heuristics involve a type of means-ends analysis where the end for the department is increased revenues and a balanced budget for the mayor and the council. Through a series of successive approximations, the mayor converges on the problem "solution." The problem, as dealt with, is primarily one of balancing the budget rather than optimally allocating resources.
The budget represents but one decision in a series. Generally, a particular decision provides constraints or guidelines for decisions that follow. Allocation decisions are made within the confines of the revenue decision; actual department activities are made within the constraints provided by the allocation decision.

**Implications for Political Research**

The findings of this study have both substantive and methodological implications for the field of political science and the study of "political" decision making. Below are some differences between the approach presented here and the more familiar political science approaches:

1. **Role Theory** — "role" has been used in this study to describe a decision or information-processing program (three submodels illustrating three roles). "Role" as a position is described by a computer program. The interaction of individuals and "role" is defined in terms of empirically determined parameters.

2. **Case Study** — a. one of the central "problems" with the case-study approach is the identification of relevant cases. The use of a process model to filter out "normal" or predictable decisions (similar to our analysis in Section 7) can help identify relevant cases.
b. Another problem with case studies is that they are seldom comparable. The model presented here can easily be adapted to other cities, or governments (See Section 8), and in so doing, provides an excellent organizing device for a case study.

3. Cumulative Effects of Marginal Changes -- Many times, a change or shift in policy is relatively minor at the time it is made, but because of cumulative effects, may actually represent a major change. A computer simulation model allows us to logically deduce the long-run or cumulative implications of such a shift.

4. Institutionalists vs. Behavioralists -- there has been some controversy over the proper emphasis for political research -- individuals or institutions, etc? What should be the unit of analysis? In our study, both elements proved important. The "institutions" provided constraints for the individual decision makers. For a process-oriented study, the question of the relative importance of institution and individual is an empirical one, and, in the context of a particular situation, a hollow one.

For the most part, political science literature in general and the community decision literature in particular, has focused on the identification of "key" variables (who makes decisions?). The use of a simulation model requires a logically complete specification of the decision units in the process as well as a
precise definition of the research problem. In addition, a process model requires not only that the "key" variables be identified, but that the relationships between key variables be specified.

One common argument against the formalization of political phenomena has been that "political behavior is too complex" and involves too many interrelationships to formalize. Given the capabilities of the computer, this argument loses much of its appeal. There are no inherent reasons why political researchers cannot realize the advantages of formalization (See Section 3).
We have described in great detail a viable system of decision making in large urban governments. We have also suggested that many of the key mechanisms in this decision system are found in other parts of our society. By concentrating on a description of how municipalities do make resource allocation decisions, we have explicitly avoided the normative question of how they ought to make decisions.

There are two approaches that could be used in discussing the normative implications of our positive theory of budgeting:

1. Outline the key features of a "comprehensive" model of budgeting together with its necessary informational and cognitive requirements.

a. Compare our positive theory with the normative model by noting instances where our positive description does not "measure up" and suggest means for reducing these differences.

---

1The congruence of our description of decision systems and those of Cyert and March (A BEHAVIORAL THEORY OF THE FIRM) for the business firm, Wildavsky (POLITICS OF THE BUDGETARY PROCESS) and Davis, et al. (ON THE PROCESS OF BUDGETING: AN EMPIRICAL STUDY OF CONGRESSIONAL APPROPRIATIONS) for the Federal government, Anton (BUDGETING IN THREE ILLINOIS CITIES and POLITICS OF STATE EXPENDITURES IN ILLINOIS) for smaller municipalities and State governments, and Simon and Newell (General Problem Solver in "Computer Simulation of Human Thinking and Problem Solving") for individual problem solving is suggestive of a set of widely-held cognitive mechanisms in our society. (See Section 9.)
2. Take the positive theory as given (status quo) and suggest a set of desirable attributes for municipal decision systems.

a. Note which "desirable attributes" of municipal decision systems are not found in the status quo (our positive theory) and suggest modifications to correct these conditions.

The primary approach taken will be to suggest marginal adjustments in the present system, rather than to outline a new system.

As Wildavsky notes in relation to the Federal budget, comprehensive budgeting is infeasible because it implies a completely defined system of values, a completely specified set of alternatives, and costs for achieving those alternatives. He goes on to argue that the budgeting process is really a reflection of the political decision system and a drastic alteration of the budgetary process would also require a drastic alteration of the entire political system. This argument applies equally well to the urban budget.

The informational and cognitive requirements for comprehensive, normative budgeting are enormous. To reformulate an entire budget "from scratch" each year and to compare each item (or program) in the budget with every other item implies that one know something of the relative costs and benefits of "Activities A" versus "B". To know "benefits" at any particular dollar level one must have some notion

---

2Wildavsky, A. op. cit., pp. 128-129. The relative success of program budgeting in the Department of Defense indicates that comprehensive budgeting is more likely in some problem areas than in others.
of the diminishing utility of the alternatives relative to all other alternatives. At the extreme, one must also know at which point it becomes more beneficial to allocate one more dollar to the private sector rather than to use that dollar in the public sector. The infissibility of this kind of approach to public policy is apparent in the Section 5 discussion.

Only one "experiment" with a comprehensive budget has been reported in the literature. It concerned an attempt by the Department of Agriculture to formulate its Budget Request using comprehensive techniques. What happened was perfectly predictable. Participants found it impossible to "calculate" the relative benefits of programs within the Department, let alone justify particular levels of particular programs. Instead, the Department in effect reverted back to the "old," incremental approach to arrive at its budget estimate.3

Wishing to deal with "reforms" or "normative improvements" that have some possibility of being implemented, it appears more useful to take the process and the existing allocation schemes as given. By using the present budget (allocation scheme) as a base that the decision system adjusts, we are merely reflecting political and psychological realities. Normative questions now become questions of how the present decision system can be adjusted to improve the performance of the system.

Incremental Adjustments of an Incremental Decision System

Taking the decision system as given, it is reasonable to ask: "What do we expect of it?" and "How 'well' does the system perform?" If performance does not meet expectations, a "search" for adjustments should be undertaken to reduce this difference.

The following requirements of a budgetary decision system seem appropriate:

Operationality:
A. Does it work? Does it solve the budgetary problem, reach a decision?

Attention-Directing Mechanisms:
B. What does the system attend to? Is it responsive to public demands?
C. Does the system allow for "innovation?"
D. Does the system provide incentives for "innovation?"
E. Can the system be made "more rational?"

The Future:
F. How will advances in the information sciences affect the budgetary process?

The "answers" to many of these questions will involve extra-budgetary behavior, so in a sense the discussion really involves the entire system of municipal government.

A. Does the System Work? Does It Solve the Budgetary Problem, Reach a Decision?

The model (decision system) described in this report "guarantees" a solution as long as anticipated revenues are "in the same ballpark"
as the previous year's. This is accomplished through a system of constraints, guidelines, and perceptions that assume "Last year's" budget represents a kind of "equilibrium solution" to the municipal resource allocation problem for city officials. "This year's" budget represents marginal adjustments to "last year's" solution to obtain "this year's" solution. By "guaranteeing" that the parts do not change drastically (the major's budget letter to departments provides guidelines consistent with the general revenue picture), the mayor "guarantees" the total budget, when he receives it, will be "nearly equal" to available revenues.

In short, the budgetary decision process described guarantees a solution to the balanced-budget problem by holding the components as "nearly constant" as possible.

B. Is the System Responsive to Public "Demands" and "Needs?"

One important characteristic of any decision system concerns its attention-directing mechanisms. What sorts of problems does the system focus upon?

Our formal model implies that the set of activities carried on "next year" will consist of roughly the same activities that are being carried on "this year." In addition, attention is focused on those areas where outside funds are available (i.e., Federal Programs). It seems reasonable to ask that our system's attention-directing mechanisms generally focus on those problems where public demands and basic needs are not being met.
If, we assume that either:

a. Public needs and demands change incrementally from year to year, or

b. Public needs and demands change in such a way that activities representing new demands replace activities representing needs currently being filled (so that actual governmental activities can change drastically, without changing the necessary resource allocations to departments and major account categories within departments),

then, we can say our decision system is able to respond to public demands and needs. If one asks "Are public demands and needs being met?", this implies we know what the demands or needs are and that we have some criteria for deciding if they are being satisfied. As has already been pointed out, assumptions a) and b) are untestable because of our inability to measure "needs" and "demands".

Rather, we can observe municipal policy changes and see if they correspond to some public need -- i.e. is the system responding to citizenry demands? The analysis of unprogrammed budgetary changes (see Section 7) demonstrated that most changes represented responses, not necessarily to demands of the public or citizenry but to other, more limited "publics" in the government's environment. The unprogrammed responses seemed to be directed towards Federal monies and programs, other governmental decisions (capital items, income tax necessitating collectors), and service contracts negotiated with other governments and firms. In the government's internal environment, all
municipalities in our sample seemed to be continually responsive to the needs of their employees through periodic salary increases, some of which the model expected or programmed and some of which it missed.

Either the decision system is not responsive to citizenry demands, needs, or problems or the response is systematic, programmed, and periodic (and "explained" in our formal model). This would imply that citizenry needs change in systematic, incremental ways also (condition (a) above).

Let us assume that public needs are rapidly changing: Could the decision system we have uncovered respond to fluctuating, rapidly-changing needs? Probably not. Examining the reasons why the system is a slowly responding one dealing with small adjustments, we can easily see why it cannot respond rapidly.

A key element of the decision system is stability. Stability guarantees the ability to reach a decision -- to come up with a balanced budget, while "upsetting" a minimum number of people and programs. The balanced-budget requirement forces a simultaneous consideration of all city activities, etc. This potentially-difficult problem is solved by holding most of the budget constant. If public needs were fluctuating and rapidly changing, and the decision system were forced to be extremely sensitive to changing needs, sizable changes in individual budget items would result. A great number of changes in budget items could, in turn, lead to an "unsolvable" problem and failure to come up with a balanced budget where the budget constraint is "tight".

Two issues appear relevant. How can we make our system more
responsive? How should we alter the system to make it responsive to the "right" things?

The major problem in having a responsive system for allocating municipal resources occurs when resources are scarce. Presumably, a responsive system would take on new functions as new problems arose. This might be a feasible task if problems disappeared as rapidly as new ones came into existence (condition (b), above). This has not been the experience in American cities, however. A responsive system could also be viable if available resources kept pace with "public needs." In short, if municipal government is expected to respond quickly to the needs of its clientele, the government's environment must also respond quickly to the government's needs (revenue).

Responsive municipal government activities require responsive revenue sources.

One way of increasing responsiveness is to increase flexibility. This can be achieved by increasing the size of the pie (although "bigger government" may not be desirable).

B.1. Responsiveness and the Revenue Constraint

Assuming we wish the government to be more responsive, and assuming this requires some relaxation of the revenue constraint, three strategies could bring this about:

1. Eliminate the balanced-budget requirement -- allow deficit spending and operating deficits,
2. Find new revenue sources, and
3. Provide for new funding of some municipal services (through system of user taxes and fees).
1. A municipality could follow the example of the Federal government and partially finance operations with "deficit spending" or borrowed money. This could lead to difficulties for the municipality however. Unlike the Federal government, municipalities cannot "control" either the supply of money or lending rates. While it is doubtful that deficit spending would exist for a long enough period of time to bankrupt a city, it appears as if a long-run policy of continuous deficit spending for operations would raise more problems than it would solve.4

Because municipalities must compete with one another in the money market, there are "dangers" of allowing one political group to pass its deficit along to its predecessor. It becomes apparent that the balanced budget requirement in municipal government is a reasonable substitute for the profit criteria of the business firm as a guarantee

4 Some of these are legal problems involving State constitutions and city charters, others involve the inability to forecast needs, while others relate to participants' perceptions.

"We can only go so far in meeting these needs as is feasible within the limits of these resources without sending the city into a deficit situation. Which certainly we didn't propose to do, of course, which can only lead to ultimate trouble if you follow such a course. Now this is a dilemma which some executives will permit themselves to get into as the result of these pressures when the pressures become so great that they will permit certain kinds of artifical budget-balancing practices in terms of underestimation of expenditures or overestimation of revenues...with the almost sure knowledge that these are not going to be met and there is going to be a resultant deficit...you can do this for just so long and then you run into trouble because eventually you get into the situation where the demands for meeting the deficit are so seriously cutting into your ability to cope with current needs that you actually find yourself in the position of having to cut back services rather than attempting to maintain them at the best possible level consistent with available revenue." Alfred M. Pelham, former Controller, City of Detroit, October 6, 1964 interview.
of a financially-viable organization.

2. The three metropolitan governments in our study are at or near the taxation limits imposed by their State legislatures. This is the rule for large municipal governments, not the exception. Assuming the recent Supreme Court reapportionment guidelines (one man, one vote) result in legislatures more representative of urban populations and assuming the "more urban" legislature is more likely to respond to urban revenue crises by raising taxation limits for municipalities, the future should bring an increased ability for cities to generate new revenues themselves. Increased revenues, as we argued above, are one (but not necessarily desirable) condition for increased responsiveness to public demands and needs.

As we observed in Section 7, additional sources of revenue involve the transfer of municipal functions to other governments, enticing other governments to pay part of the municipal-service bill, the freeing of funds through Federal credits for costs of administering Federal programs and State revenue rebates. In order for increases in these revenues to have the desired effect of creating flexibility (enabling the system to be more responsive) in the budget allocation process, they must result in increases in total resources available for allocation. This means that State or Federal contributions should either not be earmarked for a special activity or if earmarked, should result in the release of municipal contributions to other departments rather than just an increase in one department. As we have observed (especially in Cleveland), the net effect of increases in earmarked funds
is to increase the appropriations to a single department rather than to free funds for other uses. Hence, increases in State funds to the city should not have "strings attached" if the objective is increased system responsiveness. The same criterion, of course, applies to Federal funds (unless the search for earmarked funds is a response to "public needs" rather than to the availability of funds, as appears to be the case).

3. Still another way of relaxing the revenue constraint exists -- the re-funding of municipal services. In most cities, some capital improvement and service items that directly benefit an individual are financed at least partially through a user tax or fee or a special assessment. Patients in a city hospital pay fees that help cover the costs of medical service. Property owners fronting on new or resurfaced streets must pay a portion of the cost of these improvements, etc. Without getting into the very real question of external economies and diseconomies, one possible source of additional revenue could be realized by financing as many services as possible through user fees. The transfer of activities out of the general fund if not accompanied by a decrease in general revenues, could result in an increase in total revenue for the remaining general fund activities. By letting the price mechanism (through user fees) determine the output (level of governmental activities), we would then allow the user fee activities to be completely responsive to a form of public demand in many cases. Essentially, this argument is a variant of our discussion above, on earmarked revenues. Stated differently, activities supported by
user taxes or fees should represent programs where earmarked funds are an appropriate way of measuring public needs. Hence, one might say that the way to make the system completely responsive to public needs is to place "everything" on a pay-as-you-go basis. This kind of funding obviously runs counter to widely-held ideas on the role of government. Essentially, the notions of a minimum level of community services and minimum living standards are part of our political system. Certain minimum conditions ought to be available to all members of the community rather than those individuals who have an "ability to pay." In those areas where services ought not to be a function of ability to pay, refunding is not the answer to the responsiveness problem. Refunding under these conditions could result in a gross misallocation of resources by allowing income distribution to influence responses. In addition, the externality argument applies. While taxpayers or users might not be willing to purchase given service levels separately, they might be more than willing to buy the package of services. By allowing individual decisions (through the price mechanism of user taxes) to determine collective choice the presence of externalities can lead to the "wrong" choice. The sum of individual preferences does not always lead to the collective preference.


6 This is true if external economies or diseconomies are present. See Samuelson P. A., FOUNDATIONS OF ECONOMIC ANALYSIS, New York: Antheneum, 1965, pp. 219-227 for his discussion of social welfare (continued on next page)
If we assume that the government's role is to provide services in areas where:

1. Minimum acceptable social states for individuals exists, and
2. External economies and diseconomies are relatively important,

"general-fund" kinds of financing is called for and resources should not be allocated via the price system. The "ability to pay" criterion inherent in funding through user taxes is not always desirable.

If for no other reason than the difficulty of deciding which activities represent areas where minimum social states or externalities are relevant, refunding of significant numbers of government services appears to be an "inefficient" way of increasing revenues so as to increase the flexibility of the decision system.

Relaxing Revenue Constraint — Summary

We have argued, above, that additional revenues are necessary for changing the attention rules in the direction of increased responsiveness. In addition, these revenues, if they are to have maximal effect, must increase the entire pie, rather than individual slices. A somewhat similar position is taken by Cyert and March:

(continued from preceding page).
functions in relation to the component, individual welfare functions. Also see Arrow, K. J., SOCIAL CHOICE AND INDIVIDUAL VALUES, New York: Wiley. 1951, pp. 59-60, where he discusses the impossibility of moving from individual to collective preferences, unless preferences are imposed.
"...slack is the difference between the payments required to maintain the organization and the resources obtained from the environment by the (organizational) coalition. In general, success (at obtaining revenues) tends to breed slack. One of the main problems of slack is a muting of problems of scarcity. Subunit demands are less likely to conflict with other demands (balanced budget). Resources are more likely to be allocated if they are sought strongly by a single subunit (trying to respond to new public needs). Thus, distributed slack is available for projects that would not necessarily be approved in a tight budget. We have also argued that the criteria of acceptance of organizational courses of action are heavily influenced by traditional procedures and historical rules of thumb. In general, therefore, the tighter the budget, the more expenditures will be controlled by essentially conservative rules (that preclude new responses to new public needs). Slack provides a source of funds for innovations that would not be approved in the face of scarcity but have strong subunit (departmental or public) support."

B.2. Changing Attention-Directing Mechanisms

If we wish to bring about a substantial change in attention-directing behavior, it appears that a precondition for these innovations (perception of new problems and discovery of "radically different" solutions to old problems) is an abundance of organization resources --

7See mechanism 4-B1-6 in our formal model and note by-passing of departmental request reduction routines in "deficit elimination" procedures if a surplus is anticipated.

8See mechanism 4-B1-16 and 4-B1-21 under budget deficit conditions in the MAYORS model.

9If, in fact, the decision system is responsive to public needs, the "public" becomes a "member" of the organization for the purposes of resource allocation decisions.

a relaxation of the revenue constraint.

Before proceeding, one kind of attention-directing mechanism deserves comment. Presumably, the availability of Federal funds in a given problem area represents some sort of response to "public demands" and "needs" in that area throughout the nation. If the Federal government (as is, their intention) succeeds in identifying major public needs in urban affairs and makes funds available in that problem area, the mechanism that directs municipal attention to areas where Federal funds are available, in effect is also responding to "public needs" and demands. So in many cases the municipal government may be responsive to "public needs" at least indirectly. Although this was not part of our formal model, this systematic attention-directing mechanism is clearly identified in an analysis of unprogrammed changes in Section 7.

The relevant information for allocation decisions appears to be primarily historical. The allocations themselves are made to historical administrative units, not to public programs or need responses. Under this kind of allocation scheme, "responsiveness" is left to the individual units and must be within the limits set by the inertial budget procedure. To the extent that administrative units correspond to functions or public responses to needs, the present system of accounts can lead to a "responsive" decision system. To the extent this is not the case, the attention-directing mechanisms (using historical guidelines) cannot lead to a "responsive" system. It is precisely this consideration that makes program budgeting an
appealing reform -- it directs decision makers' attention to programs and outcomes, not administrative units. 11 (See discussion on program budgeting, below).

Something more is needed for a "truly responsive" system, however. "More rational" decisions not only require more and different information, they require some cognitive abilities. We have had a reasonable degree of success in identifying the key elements of the existing set of search routines. While additional revenues allow for a significant expansion in the number of search routines the decision system can handle (and still "guarantee solutions"), revenue alone will not lead to this expansion. The presence or absence of additional search routines (made possible by a relaxed revenue constraint) will depend largely upon those individuals manning the decision structure. What additional "search routines" do public administrators and elected officials bring to their jobs? 12 Decision systems can make innovation easier or harder, but cannot prevent or cause it.

So far, the discussion has centered on the overall allocation of resources to departments and functions. The next issue concerns

11 Some might argue that this indicates a need to change the structure of the organization so that administrative units correspond to functions. In either case, a change in attention-directing mechanisms for the allocation decision is called for.

12 Most works on "role orientation" attempt to show that different orientations of administrators "explain" different kinds of behavior. Implicit in this approach is the notion that a given "role orientation" defines a given set of search routines.
resource allocation within the administrative unit. Does our decision system allow for "learning" within the subunit?

C. Does the System Allow "Innovations?"

By "innovation" we refer to a particular kind of behavioral change. Our rough definition would include "new problems" dealt with by an administrative unit as well as new ways of dealing with "old" problems.

The decision system described here deals with the formation of a line-item, general-fund budget. As we have seen in Pittsburgh, where for one year over half of the City Planning Department's total budget was outside the general-fund budget, the decision system does not prevent a department head from undertaking new programs, providing they are financed with outside funds.

Because the decision system generates only expenditure ceilings by line items, "innovation" or change in actual departmental activities is permissible within the historically-determined line items. A department may have twenty men in each of two successive years. Looking only at the budget we would see little or no change between years, whereas the actual activities of these men may have changed drastically.

If "innovation" requires great flexibility in mix of resources (personnel, expense funds, equipment, etc.), the presence of a series of line-item appropriations really represents a series of constraints on departmental activities. The greater the number of constraints,

13 See Section 7, pp.
(standard line items or account categories) the less operating flexibility for a department or function. Cleveland with an appropriations bill containing only two account categories is potentially more flexible (and by our definition, potentially more "innovative") than Pittsburgh with an extremely detailed appropriations bill. Our model has shown that allocations to a particular account category in a given department have nearly as much historical inertia as the total department allocations. Anything that would increase a department's flexibility in expenditures, would increase the potential for departmental "innovations."

Improved conditions for "innovation" would result from:

1. Having fewer line items in the final appropriations bill
2. Allowing department heads to transfer funds from line item to line item (within department total)
3. Allowing departments to carry over unspent appropriations from year to year.

and, extending our argument to the macro allocation problem:
4. Allowing the mayor to transfer funds from one department to another in a budget period, without special council approval.

These are all marginal changes in the existing system and would be relatively easy to carry out.

In addition, another kind of "innovative" behavior is allowed

\[14\] See Figure 5-4, for a sample of Pittsburgh's appropriations bill.
within a department. Improving efficiency is itself a form of innovation. In addition, a "more efficient" department would be able to undertake new problems within the same budget ceiling. Detroit, in fact, has institutionalized this form of "innovation" through its system of budget examiners.

In summary, limited innovation is allowed in the decision system. The limiting condition is related to the rigid accounting system.

D. Does the System Provide Incentives for "Innovation"?

The conditions for innovation in macro-resource allocation (total between departments) and attention-directing mechanisms have already been discussed and related to the availability of revenues. We have emphasized what Cyert and March refer to as "slack" innovation which depends on an excess of resources to allow the system to experiment. The subunit can accumulate "excesses" either through a "looser" accounting system or increased revenues. "Slack" permits "innovation".

In conditions of scarcity. "innovation" is sometimes "forced." Cyert and March argue "... that failure induces search and search ordinarily results in solutions. Consequently ... everything else being equal, relatively unsuccessful firms would be more likely to innovate than relatively successful firms. ... where 'innovation' means a new solution to a problem that currently faces the organization"15

How do our decision systems deal with problem-oriented innovation?

Under conditions of scarcity -- "tight" budget constraint for a department head -- a subunit must "innovate" if it wishes to expand or add to department activities. "Low ceilings ... can ... permit several rooms."16 "Additional rooms" result only if the ceiling cannot "be raised," and more importantly, only if there is a desire for "additional activities." If the attention-directing mechanisms of municipal government are such that many new problems are perceived and the department and/or mayor agree on a governmental response then and only then will a "low ceiling" result in a form of innovation. If the participants are not "innovators" or do not "possess initiative," then the decision system will definitely discourage, not encourage "innovation." In short, "low ceilings" do not create or foster innovative pressures, but channel them. In order to innovate and remain within the ceiling, one must eliminate activities or increase "efficiency."

One way to encourage innovation is to structure attention-directing mechanisms so new problems are perceived. More will be said on this in conjunction with program budgeting, below.

Another question is "How can municipal government staff itself with innovative people?" The answer is elusive and not within the scope of this report.

16 Sorensen, T. C. op.cit., p. 414.
If the budgetary decision system as described in this paper does not "automatically" encourage innovation and if there are no ways to secure additional revenues, can anything be done? Fortunately, there may be a way of reducing this dilemma.

"All these hypotheses about innovation rest on the assumption that the innovative process is not itself programmed. The stimuli to innovation ... (in our model) are external."[17]

This, of course, suggests that "... 'natural' stimuli to innovation ... can be supplemented by additional programmed stimuli."[18] The Budget Bureau in Detroit, discussed above, really functions as a set of full-time operations analysts and efficiency experts for city governments. Institutionalized innovation is clearly a feasible policy here. There is no reason to believe, for instance, that an operations research staff or something like it, could not function just as well in city government as it does in private industry. Currently, the role of operations analyst, if performed at all is played by private consultants brought in by the city. The innovation of "institutionalizing innovation" is the kind of change observed under "slack" conditions however, so its adoption might seem to depend on an unusually good revenue picture or a private foundation's willingness to finance the venture. Again, program budgeting is often cited as a means for "programming" innovative behavior.


E. Can the System Be Made "More Rational?"

The budget in most cities performs many functions. The two most important are:

1. planning function,
2. auditing or public accountability function.

Our purpose is to make the municipal resource allocation process (planning) in a city "more rational."

E.1. Separation of Functions

A first step is the separation of planning and auditing functions. Because most accounting systems are designed to facilitate auditing or public-accountability goals, most "planning" budgets are hardly recognizable as "plans." The line items in a budget refer to identifiable expenditures, not programs or activities. The extreme detail in municipal budgets (for an example, see Figure 5-4) is testimony to this. Growth or change is stated in terms of changes in expenditures for specific commodities -- personnel, truck rentals, maintenance contracts, etc.

E.2. Program Budget

Perhaps the most widely suggested budget reform concerns the "program budget." Expenditures (proposed) needed for specific programs or governmental activities would replace the standard expenditure categories in the line-item budget. Estimates would (under most proposed program-budget reforms) be based on service standards, work units needed to achieve them, and unit costs for work units. Is a
program budget feasible? In the above form, it is not.

Service standards in municipal government generally do not exist in any "usable" form. "Work units" and "units costs" are not available either. The unavailability of information is one prime reason for the lack of "program" or planning-oriented budgeting in government. As was indicated in Section 5, the absence of "objective" standards in municipal government leads to the use of historical standards. If a program budget were instituted in a short period of time, programs would develop a "history" or set of historical standards. Budgeting decisions could then be made in much the same way they are now — substituting programs under a department's jurisdiction for the current system of standard account categories. In this way, many of the advantages of program budgeting could be obtained without changing the decision system. The "only" change would be in the "cognitive maps" of the participants — substituting programs for standard account categories.

Once the system "learned" to direct its attention to the expansion and contraction of programs rather than expenditure items or commodities, the next step — developing output measures for comparison with program inputs (problems or needs) — would be much easier. Once measures of inputs and outputs were accumulated over

10 If a department administers only one "program" or activity at present, our "proposal" is identical to current practices.
time, the criterion of efficiency\(^{20}\) could become meaningful. Operative efficiency goals for administrative units could then be incorporated in the budget, presumably leading to greater efficiency in government. The traditional approach to this reform has been to predicate the change to program budgeting on the existence of standards, rather than use the change to program budgeting as the means to generate standards.

At present budgeting is only loosely related to the total revenue decision at one end and actual operations at the other. While program budgeting still provides no "guarantee" that it will have any impact on the total revenue decision or available, public resources, it does attempt to couple budgeting to actual activities. By changing the attention-directing mechanisms, we certainly expect different outcomes from the system.

By focusing on programs and outputs (fires put out by the fire department), attention is directed toward different features of the environment ("dollars per fire" as a cost-effectiveness measure), different kinds of goals are suggested (improving fire-insurance ratings vs. increasing department revenue), and in general the need that the program was designed to respond to, is more likely to be closely monitored (preventing and extinguishing fires). The response (program) draws attention to the stimulus (need). Ends draw attention

\[^{20}\text{Efficiency} = \frac{\text{output in units}}{\text{input in dollars}}\]
to means. A system that directs attention to things like dollars per street-mile should produce radically different allocations, over time, than one focusing on dollars appropriated to the Department of Public Works.

The municipality would still be faced with informational and computational constraints (how would one equate dollars-per-fire with dollars-per-street-mile?) Budgeting would still focus on a series of marginal adjustments to solve the balancing problem. It makes more sense for the system to make adjustments in program or activity levels than in item expenditure classifications.

**Long-term Budget?**

"If budgeting is to serve as a basis for the rational allocation of expenditures, two comprehensive budgets must be substituted for the present inadequate documents: an annual budget and a long-term budget. However since the annual budget is merely a segment of the long-term budget, only the latter need be discussed.

The long-term budget will be made up of several parts: (1) long-term estimates of trends in problem-magnitude for the various departments -- distribution and concentration of burnable values which must be protected against fire, mileage of streets which must be kept clean, population which must be served by libraries, etc, (2) long-term estimates of service adequacy -- that is, the level of services which the city intends to provide its citizens, so many acres of park per 1,000 population, a specified fire loss, etc., (3) a long-term work program, showing in work units the services which will have to be provided and facilities to be constructed to achieve the program outlined in items (1) and (2), and (4) a financial program which will relate the work program to the fiscal resources of the community.

---

While the long-term budget is a logical necessity for "rational" resource allocation, it is an infeasible modification of the current system without a program budget. Items (1), (2), and (3) above are not available to budget decision makers. If, for example, State legislatures were to "require" a Master Budget for city expenditures over a period of years similar to the Master Plan required by the Federal government for participation in the Community Renewal Program, the resulting document would probably consist of linear extrapolations of department expenses by standard account category (simple extrapolation of the present, drifting system). For a "dictated" Master Budget to increase "rationality," some service criteria or standards would have to be developed along with techniques for estimating needs. Histories of activities similar to those generated by a "program budget" are required.

Role of the Council

In our model and in the "real world," authentic legislative review of the mayor's budget is not feasible. At best, the council can reject a tax or revenue bill, forcing the mayor to reconsider the entire budget. Significant alterations in the mayor's budget are rare. Given the need for decision, the overall complexity of the budget strategies available in light of "pressures" and the balanced-budget requirement, the council is usually "forced" to rubber stamp the mayor's budget (see pp. 126-128). Increased time for budget consideration and increased staff might make "legislative review" a more rational and meaningful process.
Most of the suggested improvements in the existing budgetary process focus on the need for more information (in the case of the council) or different information (expenditures by "program" rather than standard category) or increased flexibility (more revenues or less-rigid accounting procedures). In the recent past, great advances have been made in the information sciences, which might facilitate these objectives.

F. How Will Advances in the Information Sciences Affect the Budgetary Process?

The budgetary process (as well as municipal government in general) is likely to benefit from the computer age in two ways:

1. Increases in the amount and availability of information.
2. Expansion of the computational abilities of decision makers.

Much of the rationale for the current budgetary process rests in human limitations on information and computational abilities. By relaxing these limitations, some of the marginal adjustments in the existing system presented above become "easier" to make, given the motivation to change. No real improvements in the system can be expected, however, if the same information that is collected and kept today is collected and kept "tomorrow." Lacking information concerning activities and levels of government output the net effect of the "revolution" in information technology will be to speed up the process, not to make it more rational. Unless the existing cognitive map of standard account categories and departments is changed, relatively little can
be done to significantly improve the existing decision system.
Computers make significant improvements more feasible, but are no guarantee.
I. Estimation of Submodel Relationships

DEPT.

Relationship: \( \hat{DEPR}_{2ij} = f(\text{APPR}^{1}_{ij}, \text{APPR}^{0}_{ij}, \text{EXPND}^{ij}) \)

Inputs: \( \{ \text{APPR}^{1}_{ij}, \text{APPR}^{0}_{ij}, \text{EXPND}_{ij} \} \)

---

Submodel procedures encountered before relationship

\( \hat{DEPR}_{2ij} + \hat{DSUPR}_{ij} = f(\text{APPR}^{1}_{ij}, \text{APPRO}^{0}_{ij}, \text{EXPND}_{ij}) \)

Submodel procedures encountered after relationship

Output: \( \{ \text{DEPR}^{2}_{ij}, \text{DSUPR}^{ij} \} \)
In estimating the parameters for the relationship above, the
outputs of the process, $DEPR_{ij}$ and $SUPP_{ij}$, were used in place of
the real preliminary figures $\hat{DEPR}_{ij}$ and $\hat{SUPP}_{ij}$. If we can show
that the expected value of our data ($DEPR_{ij}$ and $SUPP_{ij}$) is equal
to the "true" values in the relationship ($\hat{DEPR}_{ij}$ and $\hat{SUPP}_{ij}$), then
our estimation procedure is reasonable. In the absence of any
observations of the "true" values of $DEPR_{ij}$ and $SUPP_{ij}$, the best
thing to do is to examine what happens in the DEPT. Submodel to
$DEPR_{ij}$ and $SUPP_{ij}$. By referring back to Figure 4-A1, we see that
between state 3 and the final output (state 10), the following
relationships hold:

1. $(DEPR_{ij} + SUPP_{ij}) = \hat{DEPR}_{ij} + \hat{SUPP}_{ij}$

and

2. $\hat{DEPR}_{ij} \geq DEPR_{ij}$

3. $\hat{SUPP}_{ij} \geq SUPP_{ij}$

Since the bias indicated in 2 and 3 has no effect on the estimation
procedure (i.e., 1 holds), linear regression techniques using final
output data instead of intermediate data are unbiased for calculation
of the relationships in 4-A1-3 in the DEPT. Submodel.
MAYORS

Relationship: \( R^{\text{MAY2}_{ij}} = f(\text{DEPR}_{ij}, \text{DSUPR}_{ij}, \text{APPR1}_{ij}, \text{APPRO}_{ij}, \text{EXPND}_{ij}) \)

Inputs:
- \( \text{DEPR}_{ij}, \text{DSUPR}_{ij}, \text{APPR1}_{ij} \)
- \( \text{APPRO}_{ij}, \text{EXPND}_{ij} \)

Submodel procedures encountered before relationship

\( R^{\text{MAY2}_{ij}} = f(\text{DEPR}_{ij}, \text{DSUPR}_{ij}, \text{APPR1}_{ij}, \text{APPRO}_{ij}, \text{EXPND}_{ij}) \)

Submodel procedures encountered after relationship

Outputs: \( R^{\text{MAY2}_{ij}} \)
We are faced, here, with the same kind of problem encountered in the DEPT. Submodel. Since our estimation technique, linear regression, is an unbiased estimator, we have only to show that the input data is unchanged between input and when the relationship is encountered in the Submodel and that \( \hat{\text{RMAY2}}_{ij} \) is unchanged between the time of its calculation in the Submodel and the output stage, \( \text{RMAY2}_{ij} \). (Between stages 4 and 29 in Figure 4-B1.) Obviously, \( \hat{\text{RMAY2}}_{ij} \) is modified by the model to arrive at \( \text{RMAY2}_{ij} \). The question of whether it is reasonable to use data on \( \hat{\text{RMAY2}}_{ij} \) as an approximation for \( \text{RMAY2}_{ij} \) rests on the presence or absence of systematic, biased changes (changes in one direction) between the preliminary screening of applications and the mayor's recommendation to council. Three things can happen to \( \text{RMAY2}_{ij} \) in the MAYORS Submodel before the final mayor's decision.

1. It remains unchanged.
2. Quantity reduced (anticipated deficit evokes deficit elimination routines).
3. Quantity increased (anticipated surplus evokes surplus elimination routines).

If \( \hat{\text{RMAY2}}_{ij} \) goes through the process unchanged, then our use of \( \text{RMAY2}_{ij} \) is reasonable. If \( \hat{\text{RMAY2}}_{ij} \) is increased as often as it is reduced, the use of \( \text{RMAY2}_{ij} \) as an approximation is still justified and reasonable.

On the basis of interviews and model runs (after using \( \text{RMAY2}_{ij} \) as an estimator) it appears that after preliminary screening of requests, deficit elimination procedures get evoked about as often as surplus elimination routines -- in fact, much of the system of constraints the
mayor places on department requests before they reach his office constitute attempts to guarantee this situation. In light of data availability and the above observations, it appears that use of $\hat{RTAY_{ij}}$ as an estimate of $RTAY_{ij}$ is a reasonable procedure.

COUNCIL

The fact that council makes very few changes limits both the observations available for estimating 4-C1-9 in Figure 4-C1 and the importance of this calculation. The fact that the particular branch of the program is seldom used makes almost any procedure used, to estimate the relationship, a relatively reasonable one.
### Pittsburgh

<table>
<thead>
<tr>
<th>100</th>
<th>Council</th>
<th>136</th>
<th>Lands &amp; Bldgs.-Operating Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>Clerk</td>
<td>140</td>
<td>Public Safety-Genl. Office</td>
</tr>
<tr>
<td>101</td>
<td>Mayor</td>
<td>141</td>
<td>Public Safety-Traffic</td>
</tr>
<tr>
<td>102</td>
<td>Police Magistrate</td>
<td>142</td>
<td>Public Safety-Medical</td>
</tr>
<tr>
<td>202</td>
<td>Penn Ave. Court</td>
<td>143</td>
<td>Public Safety-Permits</td>
</tr>
<tr>
<td>302</td>
<td>Traffic Court</td>
<td>144</td>
<td>Public Safety-Police</td>
</tr>
<tr>
<td>201</td>
<td>Service Center</td>
<td>145</td>
<td>Public Safety-Youth</td>
</tr>
<tr>
<td>103</td>
<td>Human Relations Com.</td>
<td>244</td>
<td>Public Safety-Towing</td>
</tr>
<tr>
<td>301</td>
<td>Civil Defense</td>
<td>146</td>
<td>Public Safety-Fire</td>
</tr>
<tr>
<td>401</td>
<td>Art Commission</td>
<td>147</td>
<td>Public Safety-Electricity</td>
</tr>
<tr>
<td>104</td>
<td>Controller</td>
<td>148</td>
<td>Public Safety-Bldgs. Inspection</td>
</tr>
<tr>
<td>204</td>
<td>Sinking Fund Com.</td>
<td>150</td>
<td>Public Works-Genl. Office</td>
</tr>
<tr>
<td>106</td>
<td>Treasurer</td>
<td>151</td>
<td>Public Works-Automotive Equipment</td>
</tr>
<tr>
<td>107</td>
<td>Law</td>
<td>152</td>
<td>Public Works-Accts.</td>
</tr>
<tr>
<td>190</td>
<td>Civil Service</td>
<td>250</td>
<td>Public Works-Photography</td>
</tr>
<tr>
<td>110</td>
<td>Planning</td>
<td>153</td>
<td>Public Works-Engineering</td>
</tr>
<tr>
<td>111</td>
<td>Board of Adjustment</td>
<td>160</td>
<td>Public Works-Bridges, Highways, &amp; Sewers</td>
</tr>
<tr>
<td>112</td>
<td>Supplies-Genl. Office</td>
<td>167</td>
<td>Public Works-Refuse</td>
</tr>
<tr>
<td>113</td>
<td>Supplies-Accts. &amp; Admin.</td>
<td>180</td>
<td>Parks &amp; Recreation-Admin.</td>
</tr>
<tr>
<td>135</td>
<td>Lands &amp; Bldgs.-Genl. Office</td>
<td>181</td>
<td>Parks &amp; Recreation-Grounds</td>
</tr>
<tr>
<td>136</td>
<td>Lands &amp; Bldgs.-Accts. &amp; Admin.</td>
<td>183</td>
<td>Parks &amp; Recreation-Recreational Activities</td>
</tr>
<tr>
<td>137</td>
<td>Lands &amp; Bldgs.-Repairs</td>
<td>149</td>
<td>Public Safety-Traffic Planning</td>
</tr>
</tbody>
</table>

### Detroit

<table>
<thead>
<tr>
<th>101</th>
<th>Art Commission</th>
<th>132</th>
<th>Health-Herman Kiefer Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>145</td>
<td>Assessor</td>
<td>134</td>
<td>Health-Wm. H. Maybury Hospital</td>
</tr>
<tr>
<td>149</td>
<td>Auditor General</td>
<td>136</td>
<td>Health-Receiving Hospital</td>
</tr>
<tr>
<td>102</td>
<td>Bldgs. Fund</td>
<td>174</td>
<td>Historical Com.</td>
</tr>
<tr>
<td>182</td>
<td>Children &amp; Youth Com.</td>
<td>112</td>
<td>House of Correction</td>
</tr>
<tr>
<td>138</td>
<td>Clerk</td>
<td>123</td>
<td>Lighting Com.</td>
</tr>
<tr>
<td>140</td>
<td>Controller</td>
<td>110</td>
<td>Mayor's Committees</td>
</tr>
<tr>
<td>104</td>
<td>Planning</td>
<td>116</td>
<td>Parks &amp; Recreation</td>
</tr>
<tr>
<td>141</td>
<td>Treasurer</td>
<td>118</td>
<td>Police</td>
</tr>
<tr>
<td>175</td>
<td>Civic Center</td>
<td>169</td>
<td>Public Works-Bldgs. Operation &amp; Construction</td>
</tr>
<tr>
<td>111</td>
<td>Civil Defense</td>
<td>170</td>
<td>Public Works-Central Bldgs. Maintenance</td>
</tr>
<tr>
<td>147</td>
<td>Civil Service</td>
<td>125</td>
<td>Public Works-Genl.</td>
</tr>
<tr>
<td>109</td>
<td>Council</td>
<td>115</td>
<td>Public Works-Motor Transportation</td>
</tr>
<tr>
<td>122</td>
<td>Community Relations Com.</td>
<td>117</td>
<td>Public Works-Permits</td>
</tr>
<tr>
<td>165</td>
<td>Corporation Council</td>
<td>144</td>
<td>Public Works-Sanitation</td>
</tr>
<tr>
<td>148</td>
<td>Election Com.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>Fire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>Health-General</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Detroit (cont.)

<table>
<thead>
<tr>
<th>Code</th>
<th>Department Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>143</td>
<td>Public Works-Street Railway</td>
</tr>
<tr>
<td>126</td>
<td>Purchasing</td>
</tr>
<tr>
<td>127</td>
<td>Recorder's Court-Criminal Div.</td>
</tr>
<tr>
<td>128</td>
<td>Recorder's Court-Traffic &amp; Ordinance Div.</td>
</tr>
<tr>
<td>129</td>
<td>Recorder's Court-Psychiatric Div.</td>
</tr>
<tr>
<td>172</td>
<td>Recorder's Court-Jury Com.</td>
</tr>
<tr>
<td>150</td>
<td>Streets &amp; Traffic</td>
</tr>
<tr>
<td>135</td>
<td>Welfare</td>
</tr>
<tr>
<td>146</td>
<td>Zoning Appeal</td>
</tr>
<tr>
<td>131</td>
<td>Zoological Park</td>
</tr>
<tr>
<td>124</td>
<td>Public Works-Sewers</td>
</tr>
<tr>
<td>181</td>
<td>Skid Row Problems</td>
</tr>
<tr>
<td>183</td>
<td>Rehabilitation of Narcotic Adults</td>
</tr>
<tr>
<td>184</td>
<td>Industrial &amp; Commercial Dev.</td>
</tr>
<tr>
<td>186</td>
<td>Dept. Report &amp; Information</td>
</tr>
<tr>
<td>187</td>
<td>Community Action for Detroit's Youth</td>
</tr>
<tr>
<td>188</td>
<td>Community Renewal</td>
</tr>
<tr>
<td>851</td>
<td>Aviation</td>
</tr>
<tr>
<td>940</td>
<td>Municipal Parking</td>
</tr>
<tr>
<td>450</td>
<td>Housing</td>
</tr>
<tr>
<td>185</td>
<td>Rapid Transit Com.</td>
</tr>
<tr>
<td>610</td>
<td>Water</td>
</tr>
<tr>
<td>800</td>
<td>Library</td>
</tr>
</tbody>
</table>

### Cleveland

<table>
<thead>
<tr>
<th>Code</th>
<th>Department Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Council</td>
</tr>
<tr>
<td>003</td>
<td>Mayor</td>
</tr>
<tr>
<td>005</td>
<td>Planning</td>
</tr>
<tr>
<td>006</td>
<td>Building Standards</td>
</tr>
<tr>
<td>007</td>
<td>Zoning Appeals</td>
</tr>
<tr>
<td>008</td>
<td>Civil Service</td>
</tr>
<tr>
<td>009</td>
<td>Community Relations</td>
</tr>
<tr>
<td>010</td>
<td>Personnel Admin.</td>
</tr>
<tr>
<td>011</td>
<td>Job Retraining</td>
</tr>
<tr>
<td>015</td>
<td>Municipal Court-Judicial</td>
</tr>
<tr>
<td>016</td>
<td>Municipal Court-Clerk's Div.</td>
</tr>
<tr>
<td>017</td>
<td>Law</td>
</tr>
<tr>
<td>020</td>
<td>Public Properties-Genl. Admin.</td>
</tr>
<tr>
<td>021</td>
<td>City Hall Bldg.</td>
</tr>
<tr>
<td>022</td>
<td>City Hall Telephone Exchange</td>
</tr>
<tr>
<td>023</td>
<td>Bureau of Harvard Shops</td>
</tr>
<tr>
<td>025</td>
<td>Recreation</td>
</tr>
<tr>
<td>026</td>
<td>Markets, Weights &amp; Measures</td>
</tr>
<tr>
<td>027</td>
<td>Street Lighting</td>
</tr>
<tr>
<td>028</td>
<td>Shade Trees</td>
</tr>
<tr>
<td>029</td>
<td>Design &amp; Construction</td>
</tr>
<tr>
<td>030</td>
<td>Parks</td>
</tr>
<tr>
<td>033</td>
<td>Auditorium and Stadium</td>
</tr>
<tr>
<td>040</td>
<td>Public Service-Genl. Admin.</td>
</tr>
<tr>
<td>041</td>
<td>Architecture</td>
</tr>
<tr>
<td>042</td>
<td>Street Cleaning, Waste Coll. &amp; Disposal</td>
</tr>
<tr>
<td>044</td>
<td>Engineering &amp; Construction</td>
</tr>
<tr>
<td>046</td>
<td>Bridges &amp; Docks</td>
</tr>
<tr>
<td>048</td>
<td>Public Health &amp; Welfare</td>
</tr>
<tr>
<td>056</td>
<td>Correction Farm</td>
</tr>
<tr>
<td>058</td>
<td>Welfare Institutions-Genl. Ad.</td>
</tr>
<tr>
<td>059</td>
<td>Camp Cleveland</td>
</tr>
<tr>
<td>065</td>
<td>Urban Renewal-Genl. Admin.</td>
</tr>
<tr>
<td>066</td>
<td>Urban Renewal-Bldgs.</td>
</tr>
<tr>
<td>067</td>
<td>Urban Renewal-Air &amp; Steam Pollution</td>
</tr>
<tr>
<td>068</td>
<td>Urban Renewal-Housing</td>
</tr>
<tr>
<td>070</td>
<td>Public Safety-Genl. Admin.</td>
</tr>
<tr>
<td>071</td>
<td>Police</td>
</tr>
<tr>
<td>072</td>
<td>Police Signal System</td>
</tr>
<tr>
<td>073</td>
<td>Fire</td>
</tr>
<tr>
<td>074</td>
<td>Fire Alarm Signal System</td>
</tr>
<tr>
<td>076</td>
<td>Traffic Engineering</td>
</tr>
<tr>
<td>060</td>
<td>Health</td>
</tr>
<tr>
<td>077</td>
<td>Dog Pound</td>
</tr>
<tr>
<td>080</td>
<td>Finance-Genl. Admin.</td>
</tr>
<tr>
<td>081</td>
<td>Accts.</td>
</tr>
<tr>
<td>082</td>
<td>Assessments &amp; Licenses</td>
</tr>
<tr>
<td>083</td>
<td>Treasury</td>
</tr>
<tr>
<td>084</td>
<td>Purchases &amp; Supplies</td>
</tr>
<tr>
<td>086</td>
<td>Employees Accident Control</td>
</tr>
<tr>
<td>096</td>
<td>Port Control</td>
</tr>
<tr>
<td>091</td>
<td>Airports</td>
</tr>
<tr>
<td>092</td>
<td>Harbor Div.</td>
</tr>
<tr>
<td>100</td>
<td>Miscellaneous Acct.</td>
</tr>
<tr>
<td>004</td>
<td>Boxing &amp; Wrestling Acct.</td>
</tr>
<tr>
<td>045</td>
<td>Sever Maintenance</td>
</tr>
<tr>
<td>051</td>
<td>Air Pollution</td>
</tr>
<tr>
<td>052</td>
<td>City Hospital</td>
</tr>
<tr>
<td>057</td>
<td>Aid to Returned Servicemen</td>
</tr>
</tbody>
</table>
### III. MODEL PARAMETERS

**NOTE** -- LIST OF VARIABLES WILL BE FOUND IN SECTION 6.

### PART A.

**A. CITY OF CLEVELAND -- MAYORS CORRELATION**

RELATIONSHIPS --

\[
\begin{align*}
(1) & & \text{PREF}(1,i) = C(i,j) \cdot \text{PREF}(1,j) + \text{PREF}(1,i) \cdot \text{APPR}(1,i) \\
(2) & & \text{PREF}(1,i) = C(i,j) \cdot \text{PREF}(1,j) + \text{APPR}(1,i) \cdot \text{APPR}(1,j) \\
(3) & & \text{PREF}(1,i) = C(i,j) \cdot \text{PREF}(1,j) - \text{APPR}(1,i) \cdot \text{APPR}(1,j) \\
(4) & & \text{PREF}(1,i) = C(i,j) \cdot \text{PREF}(1,j) - \text{APPR}(1,i) \cdot \text{APPR}(1,j)
\end{align*}
\]

<table>
<thead>
<tr>
<th>DEPT</th>
<th>AGE</th>
<th>ACC2</th>
<th>MODEL</th>
<th>DUR</th>
<th>Z</th>
<th>Z^2</th>
<th>K-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>33</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>33</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td>25</td>
<td>0.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>0</td>
<td>25</td>
<td>1.00</td>
<td>0.20</td>
<td>2.004</td>
<td>0.3003</td>
<td></td>
</tr>
<tr>
<td>DEPT</td>
<td>ACC</td>
<td>MODEL</td>
<td>C</td>
<td>F</td>
<td>S</td>
<td>H</td>
<td>D-M</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.23</td>
<td>-1.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CITY OF DETROIT -- DEPT. OFFICERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RELATIONSHIPS --</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. $DEP2(i,j) = a(i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. $DEP(i,j) = a(i,j) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. $(DEP2(i,j) + DEP(i,j)) = a(i,j) * (APPR1(i,j) - APPR1(i,j)) + (i,j) * (APPR1(i,j) - APPR1(i,j))$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPT</th>
<th>ACCT</th>
<th>MODEL</th>
<th>r</th>
<th>c</th>
<th>m</th>
<th>d</th>
<th>n</th>
<th>R-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>1.22</td>
<td>0.00</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>67</td>
<td>1.23</td>
<td>0.00</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>68</td>
<td>1.43</td>
<td>0.00</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>68</td>
<td>1.24</td>
<td>0.00</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>69</td>
<td>1.24</td>
<td>-1.42</td>
<td>0.00</td>
<td>1.43</td>
<td>0.00</td>
<td>2.29</td>
<td>2</td>
<td>3.94</td>
</tr>
<tr>
<td>DEPT</td>
<td>ACC</td>
<td>MODEL</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D-B</td>
<td>R-2</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>1</td>
<td>12</td>
<td>1.15</td>
<td>0.96</td>
<td>0.09</td>
<td>1.1832</td>
<td>0.998</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>2</td>
<td>11</td>
<td>1.63</td>
<td>0.75</td>
<td>0.36</td>
<td>1.3041</td>
<td>0.993</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>3</td>
<td>11</td>
<td>0.932</td>
<td>0.334</td>
<td>0.199</td>
<td>1.6731</td>
<td>0.999</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>2</td>
<td>11</td>
<td>1.54</td>
<td>-0.19</td>
<td>0.03</td>
<td>1.5216</td>
<td>0.992</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>3</td>
<td>11</td>
<td>1.773</td>
<td>-1.422</td>
<td>1.001</td>
<td>2.0227</td>
<td>0.918</td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>2</td>
<td>11</td>
<td>0.994</td>
<td>0.16</td>
<td>0.45</td>
<td>2.0979</td>
<td>0.974</td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>3</td>
<td>11</td>
<td>0.932</td>
<td>0.03</td>
<td>0.05</td>
<td>1.9376</td>
<td>0.935</td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>2</td>
<td>11</td>
<td>0.933</td>
<td>0.34</td>
<td>0.11</td>
<td>2.1020</td>
<td>0.997</td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>3</td>
<td>11</td>
<td>0.933</td>
<td>0.03</td>
<td>0.05</td>
<td>1.9376</td>
<td>0.935</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>2</td>
<td>11</td>
<td>0.933</td>
<td>0.34</td>
<td>0.11</td>
<td>2.1020</td>
<td>0.997</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>3</td>
<td>11</td>
<td>0.933</td>
<td>0.03</td>
<td>0.05</td>
<td>1.9376</td>
<td>0.935</td>
<td></td>
</tr>
<tr>
<td>137</td>
<td>2</td>
<td>11</td>
<td>0.933</td>
<td>0.34</td>
<td>0.11</td>
<td>2.1020</td>
<td>0.997</td>
<td></td>
</tr>
<tr>
<td>137</td>
<td>3</td>
<td>11</td>
<td>0.933</td>
<td>0.03</td>
<td>0.05</td>
<td>1.9376</td>
<td>0.935</td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>2</td>
<td>11</td>
<td>0.933</td>
<td>0.34</td>
<td>0.11</td>
<td>2.1020</td>
<td>0.997</td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>3</td>
<td>11</td>
<td>0.933</td>
<td>0.03</td>
<td>0.05</td>
<td>1.9376</td>
<td>0.935</td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>2</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>3</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>2</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>3</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>2</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>3</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>2</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>3</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>2</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>3</td>
<td>11</td>
<td>1.017</td>
<td>0.329</td>
<td>0.13</td>
<td>2.2936</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>DEPT</td>
<td>ACCT</td>
<td>MODEL</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>046</td>
<td>7</td>
<td>1</td>
<td>6.90</td>
<td>6.30</td>
<td>8.62</td>
<td>2.627</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>046</td>
<td>11</td>
<td>1</td>
<td>6.00</td>
<td>6.80</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>047</td>
<td>11</td>
<td>1</td>
<td>6.90</td>
<td>6.90</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>047</td>
<td>3</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>047</td>
<td>11</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>051</td>
<td>11</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>051</td>
<td>11</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
<td></td>
</tr>
</tbody>
</table>

---

**CITY OF DETROIT — MAYORS COUNCIL**

**RELATIONSHIP:**

\[ \text{CITY} = (\text{DEPT} \times \text{ACCT} \times \text{MODEL}) \]

**DEPT**

1. **CITY**

2. **DEPT**

3. **ACCT**

4. **MODEL**

---

### CITY OF DETROIT — MAYORS COUNCIL

<table>
<thead>
<tr>
<th>DEPT</th>
<th>ACCT</th>
<th>MODEL</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>046</td>
<td>7</td>
<td>1</td>
<td>6.90</td>
<td>6.30</td>
<td>8.62</td>
<td>2.627</td>
<td>0.72</td>
</tr>
<tr>
<td>046</td>
<td>11</td>
<td>1</td>
<td>6.00</td>
<td>6.80</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
</tr>
<tr>
<td>047</td>
<td>11</td>
<td>1</td>
<td>6.90</td>
<td>6.90</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
</tr>
<tr>
<td>047</td>
<td>3</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
</tr>
<tr>
<td>047</td>
<td>11</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
</tr>
<tr>
<td>051</td>
<td>11</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
</tr>
<tr>
<td>051</td>
<td>11</td>
<td>1</td>
<td>6.70</td>
<td>6.70</td>
<td>8.70</td>
<td>2.806</td>
<td>0.90</td>
</tr>
<tr>
<td>Column 1</td>
<td>Column 2</td>
<td>Column 3</td>
<td>Column 4</td>
<td>Column 5</td>
<td>Column 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 1</td>
<td>Data 2</td>
<td>Data 3</td>
<td>Data 4</td>
<td>Data 5</td>
<td>Data 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 7</td>
<td>Data 8</td>
<td>Data 9</td>
<td>Data 10</td>
<td>Data 11</td>
<td>Data 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 13</td>
<td>Data 14</td>
<td>Data 15</td>
<td>Data 16</td>
<td>Data 17</td>
<td>Data 18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 19</td>
<td>Data 20</td>
<td>Data 21</td>
<td>Data 22</td>
<td>Data 23</td>
<td>Data 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 25</td>
<td>Data 26</td>
<td>Data 27</td>
<td>Data 28</td>
<td>Data 29</td>
<td>Data 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 31</td>
<td>Data 32</td>
<td>Data 33</td>
<td>Data 34</td>
<td>Data 35</td>
<td>Data 36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 37</td>
<td>Data 38</td>
<td>Data 39</td>
<td>Data 40</td>
<td>Data 41</td>
<td>Data 42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 43</td>
<td>Data 44</td>
<td>Data 45</td>
<td>Data 46</td>
<td>Data 47</td>
<td>Data 48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 49</td>
<td>Data 50</td>
<td>Data 51</td>
<td>Data 52</td>
<td>Data 53</td>
<td>Data 54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data 55</td>
<td>Data 56</td>
<td>Data 57</td>
<td>Data 58</td>
<td>Data 59</td>
<td>Data 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPT</td>
<td>ACCT</td>
<td>MODEL</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>160</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>6</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>6</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>181</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>181</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>181</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>181</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>6</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>2</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>4</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>5</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### C.2. CITY OF PITTSBURGH -- COUNCIL SUBMODEL

#### RELATIONSHIPS

| 31. APPR2(I,J) = PP(I,J)*R2AY2(I,J) + Q(I,J)* (DEPR2(I,J)+DSUPR(I,J)-R2AY2(I,J)) |
| 32. APPR2(I,J) = PP(I,J)*R2AY2(I,J) + R(I,J)*(APPR1(I,J)-APPR2(I,J)) |
| + S(I,J)*(EXPND(I,J)-APPR2(I,J)) |

#### DEPT. ACCT. MODEL D E F G H D-W R-2

<table>
<thead>
<tr>
<th>DEPT</th>
<th>ACCT</th>
<th>MODEL</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>D-W</th>
<th>R-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>1 21</td>
<td>.000</td>
<td>-3.932</td>
<td>1.285</td>
<td>.000</td>
<td>.000</td>
<td>2.2196</td>
<td>.9997</td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>2 21</td>
<td>.000</td>
<td>-0.441</td>
<td>1.016</td>
<td>.000</td>
<td>-0.679</td>
<td>2.6963</td>
<td>.9989</td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>3 21</td>
<td>.000</td>
<td>0.004</td>
<td>1.014</td>
<td>.000</td>
<td>-0.094</td>
<td>1.737</td>
<td>.9992</td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>4 21</td>
<td>.000</td>
<td>-1.149</td>
<td>1.226</td>
<td>.000</td>
<td>.000</td>
<td>1.4246</td>
<td>.9729</td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>5 21</td>
<td>.000</td>
<td>0.000</td>
<td>1.000</td>
<td>.000</td>
<td>.000</td>
<td>1.000</td>
<td>.3333</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>1 21</td>
<td>.000</td>
<td>-5.224</td>
<td>1.350</td>
<td>.000</td>
<td>.000</td>
<td>1.6657</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>2 21</td>
<td>.000</td>
<td>-5.542</td>
<td>1.044</td>
<td>.000</td>
<td>-1.049</td>
<td>1.9425</td>
<td>.9994</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>3 21</td>
<td>.000</td>
<td>-0.461</td>
<td>0.996</td>
<td>.000</td>
<td>.000</td>
<td>1.4417</td>
<td>.9996</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>4 21</td>
<td>.000</td>
<td>0.000</td>
<td>1.000</td>
<td>.000</td>
<td>-1.144</td>
<td>1.000</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>5 21</td>
<td>.000</td>
<td>0.000</td>
<td>0.000</td>
<td>.000</td>
<td>.000</td>
<td>1.000</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>1 21</td>
<td>.000</td>
<td>-3.796</td>
<td>1.341</td>
<td>.000</td>
<td>.000</td>
<td>2.5489</td>
<td>.9976</td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>2 21</td>
<td>.000</td>
<td>0.000</td>
<td>1.044</td>
<td>-1.087</td>
<td>1.5663</td>
<td>.9999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>3 21</td>
<td>.000</td>
<td>0.000</td>
<td>0.000</td>
<td>.000</td>
<td>.000</td>
<td>8.877</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>4 21</td>
<td>.000</td>
<td>0.000</td>
<td>0.000</td>
<td>.000</td>
<td>.000</td>
<td>8.877</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1 31</td>
<td>1.001</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.3157</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>2 31</td>
<td>1.015</td>
<td>-2.289</td>
<td>.000</td>
<td>.000</td>
<td>2.721</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>3 32</td>
<td>1.301</td>
<td>.000</td>
<td>1.577</td>
<td>-2.280</td>
<td>2.0000</td>
<td>.9653</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>4 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.0000</td>
<td>.9653</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>5 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.0000</td>
<td>.9653</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>1 31</td>
<td>1.976</td>
<td>-0.67</td>
<td>.000</td>
<td>.000</td>
<td>.8555</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>2 31</td>
<td>1.013</td>
<td>-2.500</td>
<td>.000</td>
<td>.000</td>
<td>1.9133</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>3 31</td>
<td>.980</td>
<td>-1.177</td>
<td>.000</td>
<td>.000</td>
<td>2.6848</td>
<td>.9981</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>4 31</td>
<td>.947</td>
<td>-0.343</td>
<td>.000</td>
<td>.000</td>
<td>2.2963</td>
<td>.9803</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>5 31</td>
<td>.990</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.979</td>
<td>.9797</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>1 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.979</td>
<td>.9797</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>2 31</td>
<td>1.386</td>
<td>-2.462</td>
<td>.000</td>
<td>.000</td>
<td>2.5724</td>
<td>.9960</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>3 31</td>
<td>1.066</td>
<td>3.708</td>
<td>.000</td>
<td>.000</td>
<td>2.3864</td>
<td>.9549</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>4 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.0000</td>
<td>.8446</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>5 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.0000</td>
<td>.8448</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>1 31</td>
<td>.982</td>
<td>-0.333</td>
<td>.000</td>
<td>.000</td>
<td>2.0400</td>
<td>.9986</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>2 32</td>
<td>1.038</td>
<td>.000</td>
<td>-1.187</td>
<td>.000</td>
<td>2.1743</td>
<td>.9517</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>3 32</td>
<td>.788</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>1.9900</td>
<td>.9490</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>4 32</td>
<td>.866</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.4629</td>
<td>.9961</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>5 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>1.9644</td>
<td>.9948</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>1 31</td>
<td>1.033</td>
<td>-2.591</td>
<td>.000</td>
<td>.000</td>
<td>2.0886</td>
<td>.9787</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>2 31</td>
<td>.989</td>
<td>-4.01</td>
<td>.000</td>
<td>.000</td>
<td>2.1695</td>
<td>.9995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>3 31</td>
<td>.989</td>
<td>-2.888</td>
<td>.000</td>
<td>.000</td>
<td>1.9644</td>
<td>.9948</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>4 31</td>
<td>.948</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.4629</td>
<td>.9961</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>5 31</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>2.0000</td>
<td>.9963</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>6 31</td>
<td>.996</td>
<td>-1.689</td>
<td>.000</td>
<td>.000</td>
<td>2.1284</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>1 31</td>
<td>1.008</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>1.8843</td>
<td>.9999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>2 31</td>
<td>1.039</td>
<td>-1.141</td>
<td>.000</td>
<td>.000</td>
<td>2.0605</td>
<td>.9792</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPT</td>
<td>ACCT</td>
<td>MODEL</td>
<td>PP</td>
<td>Q</td>
<td>R</td>
<td>S</td>
<td>D-R</td>
<td>R-Z</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>----</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>-----</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>3 31</td>
<td>1.000</td>
<td>-0.01</td>
<td>0.00</td>
<td>1.986</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>4 32</td>
<td>1.001</td>
<td>-0.01</td>
<td>0.00</td>
<td>2.986</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>5 31</td>
<td>0.983</td>
<td>0.092</td>
<td>0.00</td>
<td>1.973</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>1 31</td>
<td>0.8</td>
<td>-0.1</td>
<td>0.00</td>
<td>1.799</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>2 31</td>
<td>0.968</td>
<td>0.00</td>
<td>0.00</td>
<td>1.564</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>3 31</td>
<td>0.952</td>
<td>0.085</td>
<td>0.00</td>
<td>1.467</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>4 31</td>
<td>0.904</td>
<td>0.056</td>
<td>0.00</td>
<td>1.349</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>5 31</td>
<td>0.890</td>
<td>0.059</td>
<td>0.00</td>
<td>1.299</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>7 31</td>
<td>0.922</td>
<td>0.00</td>
<td>0.00</td>
<td>1.264</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>8 32</td>
<td>0.900</td>
<td>0.169</td>
<td>0.00</td>
<td>1.119</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>9 31</td>
<td>0.933</td>
<td>0.070</td>
<td>0.00</td>
<td>1.119</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>1 31</td>
<td>1.027</td>
<td>-0.475</td>
<td>0.00</td>
<td>0.552</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>2 31</td>
<td>0.996</td>
<td>0.00</td>
<td>0.00</td>
<td>0.529</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>3 21</td>
<td>0.926</td>
<td>-0.689</td>
<td>0.00</td>
<td>0.437</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>4 31</td>
<td>1.089</td>
<td>-0.401</td>
<td>0.00</td>
<td>0.388</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>5 31</td>
<td>0.995</td>
<td>0.00</td>
<td>0.00</td>
<td>0.388</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>6 32</td>
<td>1.062</td>
<td>-0.410</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>1 31</td>
<td>1.003</td>
<td>0.00</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>2 32</td>
<td>0.995</td>
<td>0.00</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>3 31</td>
<td>0.995</td>
<td>-0.214</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>4 32</td>
<td>1.014</td>
<td>0.00</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>5 31</td>
<td>0.995</td>
<td>0.00</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>1 31</td>
<td>1.000</td>
<td>0.00</td>
<td>0.00</td>
<td>0.358</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>2 31</td>
<td>1.020</td>
<td>-0.599</td>
<td>0.00</td>
<td>0.269</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>3 32</td>
<td>0.940</td>
<td>0.00</td>
<td>0.00</td>
<td>0.269</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>4 32</td>
<td>0.987</td>
<td>0.00</td>
<td>0.00</td>
<td>0.269</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>5 31</td>
<td>0.995</td>
<td>0.00</td>
<td>0.00</td>
<td>0.269</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>6 32</td>
<td>1.003</td>
<td>0.00</td>
<td>0.00</td>
<td>0.269</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>1 31</td>
<td>1.003</td>
<td>0.00</td>
<td>0.00</td>
<td>0.269</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>2 32</td>
<td>1.039</td>
<td>-0.452</td>
<td>0.00</td>
<td>0.227</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>3 31</td>
<td>0.977</td>
<td>0.00</td>
<td>0.00</td>
<td>0.227</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>4 32</td>
<td>0.943</td>
<td>0.00</td>
<td>0.00</td>
<td>0.227</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>5 31</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.227</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>6 32</td>
<td>1.003</td>
<td>-0.462</td>
<td>0.00</td>
<td>0.227</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>1 31</td>
<td>1.003</td>
<td>-0.981</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>2 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>3 31</td>
<td>0.999</td>
<td>-0.32</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>4 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>5 31</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>6 32</td>
<td>1.003</td>
<td>-0.462</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>1 31</td>
<td>1.003</td>
<td>-0.981</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>2 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>3 31</td>
<td>0.999</td>
<td>-0.32</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>4 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>1 31</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>2 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>3 31</td>
<td>0.999</td>
<td>-0.32</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>4 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>5 31</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>6 32</td>
<td>1.003</td>
<td>-0.462</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>1 31</td>
<td>1.003</td>
<td>-0.981</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>2 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>3 31</td>
<td>0.999</td>
<td>-0.32</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>4 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>5 31</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>6 32</td>
<td>1.003</td>
<td>-0.462</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>1 31</td>
<td>1.003</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>2 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>3 31</td>
<td>0.999</td>
<td>-0.32</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>4 32</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>5 31</td>
<td>0.999</td>
<td>0.00</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>6 32</td>
<td>1.003</td>
<td>-0.462</td>
<td>0.00</td>
<td>0.143</td>
<td>9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPT</td>
<td>ACCT</td>
<td>MODEL FP</td>
<td>Q</td>
<td>R</td>
<td>S</td>
<td>D - R</td>
<td>R - 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>----------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-------</td>
<td>-------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>231</td>
<td>1015</td>
<td>-209</td>
<td>0</td>
<td>000</td>
<td>2327</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>231</td>
<td>9995</td>
<td>060</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>231</td>
<td>1014</td>
<td>1174</td>
<td>000</td>
<td>000</td>
<td>1442</td>
<td>9994</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>231</td>
<td>979</td>
<td>1013</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>231</td>
<td>067</td>
<td>332</td>
<td>060</td>
<td>000</td>
<td>2000</td>
<td>1160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>231</td>
<td>040</td>
<td>160</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>231</td>
<td>092</td>
<td>345</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>231</td>
<td>041</td>
<td>434</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>232</td>
<td>1045</td>
<td>-311</td>
<td>575</td>
<td>1166</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>231</td>
<td>906</td>
<td>-343</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>010</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>076</td>
<td>-177</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>037</td>
<td>016</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>232</td>
<td>2050</td>
<td>955</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>1272</td>
<td>-163</td>
<td>915</td>
<td>2390</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>232</td>
<td>1795</td>
<td>000</td>
<td>720</td>
<td>-262</td>
<td>2396</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>799</td>
<td>227</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>032</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>231</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>9998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPT.</td>
<td>ACCT.</td>
<td>MODEL</td>
<td>PP</td>
<td>G</td>
<td>N</td>
<td>S</td>
<td>D-W</td>
<td>K-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>----</td>
<td>----</td>
<td>---</td>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>2 32</td>
<td>.957</td>
<td>.956</td>
<td>1.04</td>
<td>.191</td>
<td>2.0353</td>
<td>.9926</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>3 31</td>
<td>.942</td>
<td>.942</td>
<td>.942</td>
<td>.942</td>
<td>2.3724</td>
<td>.9808</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>190</td>
<td>4 32</td>
<td>.935</td>
<td>.935</td>
<td>.935</td>
<td>.935</td>
<td>2.2139</td>
<td>.9795</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>190</td>
<td>5 31</td>
<td>.925</td>
<td>.925</td>
<td>.925</td>
<td>.925</td>
<td>2.1414</td>
<td>.9754</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>190 6 31</td>
<td>2.61</td>
<td>.901</td>
<td>6 31</td>
<td>.901</td>
<td>2.7354</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 7 32</td>
<td>1.51</td>
<td>.51</td>
<td>7 32</td>
<td>.51</td>
<td>3.5193</td>
<td>.9932</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 1 32</td>
<td>.319</td>
<td>2.975</td>
<td>.975</td>
<td>.975</td>
<td>1.8755</td>
<td>.9922</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 2 31</td>
<td>1.505</td>
<td>.505</td>
<td>2 31</td>
<td>.505</td>
<td>.9996</td>
<td>.9992</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 3 31</td>
<td>.905</td>
<td>.905</td>
<td>3 31</td>
<td>.905</td>
<td>2.8575</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 4 31</td>
<td>.905</td>
<td>.905</td>
<td>4 31</td>
<td>.905</td>
<td>2.8575</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 5 31</td>
<td>.905</td>
<td>.905</td>
<td>5 31</td>
<td>.905</td>
<td>2.8575</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 6 31</td>
<td>.905</td>
<td>.905</td>
<td>6 31</td>
<td>.905</td>
<td>2.8575</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191 7 31</td>
<td>.905</td>
<td>.905</td>
<td>7 31</td>
<td>.905</td>
<td>2.8575</td>
<td>.9996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 1 31</td>
<td>.905</td>
<td>.905</td>
<td>1 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 2 31</td>
<td>.905</td>
<td>.905</td>
<td>2 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 3 31</td>
<td>.905</td>
<td>.905</td>
<td>3 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 4 31</td>
<td>.905</td>
<td>.905</td>
<td>4 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 5 31</td>
<td>.905</td>
<td>.905</td>
<td>5 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 6 31</td>
<td>.905</td>
<td>.905</td>
<td>6 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192 7 31</td>
<td>.905</td>
<td>.905</td>
<td>7 31</td>
<td>.905</td>
<td>2.4911</td>
<td>.9997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td>Freq</td>
<td>Model</td>
<td>Frq</td>
<td>S</td>
<td>Bn</td>
<td>R-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>-------</td>
<td>-----</td>
<td>---</td>
<td>----</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>4.31</td>
<td>996</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.3974</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>2.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>4.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>3.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>1.61</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>2.1354</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>2.92</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>3.32</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>4.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>5.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>6.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>1.81</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.6256</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>2.81</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>3.21</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>4.21</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>5.21</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>6.21</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>1.91</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.6256</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>2.91</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>3.91</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>4.91</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IV. SAMPLE OF MODEL PROGRAMS -- CITY OF DETROIT

ALL PROGRAMS WERE WRITTEN IN FORTRAN II

A. MAIN CALLING PROGRAM FOR UNIFIED CHARGE MODEL

DIMENSION DEPRZ(600), APPR1(600), APPR2(600), CR, NAME(600)

READ 222, BLANK, TOTAL, ORCALC

222 FORMAT (1X, 83, A36)

IUT = 5

AL = 0.05

AL = 0.05

DO 334 J = 1, 900

334 CONTINUE

60 FORMAT (2A2, 15, 6, 15, 9, 87(1X, F3.6, 5))

61 FORMAT (2A2, 15, 87(1X, F3.6, 5))

C = 0

C = 0

402 READ 402, (X, 32.1, 2, 3, 4)

401 K = +1

402 A(9, K) = K

A = K

A(K, K) = K

B(A(K, K)) = A

C(A(K, K)) = A
;WRITE OUTPUT TAPE 6,0,0,RA,RA,RE(VAA),S(NA),C(NA)
WRITE OUTPUT TAPE 6,0,0,RA,RA,RE(VAA),S(NA),C(NA)
WRITE OUTPUT TAPE 6,0,0,RA,RA,RE(VAA),S(NA),C(NA)

40 CONTINUE

10 N=1
20 READ 61,KA,KK,AA,LI,LA,A3,A4,A7
30 IF (KX=K) 71,72,71
71 N=N+1
80 M=N
90 IF (M=KX) 72,72,10

71 READ 60,KK=1,971
90 READ 60,KA,KK=1,9,AA,4,AA,4,AA,4,AA,4
10 IF (KX=K) 61,61,91

72 NRCC(K)=N

62 NRCC(K)=N

4 CONTINUE

30 FORMAT(2A,12)
20 CONTINUE

10 FLAG = 0
11 READ 5,REV57
50 FORMAT(P12=)

10 FORMAT(12=)
10 FORMAT(I12=)
11 FORMAT(12=)
12 FORMAT(12=)
13 FORMAT(12=)
14 FORMAT(12=)
15 FORMAT(12=)
16 FORMAT(12=)
17 FORMAT(12=)
18 FORMAT(12=)
19 FORMAT(12=)
20 FORMAT(12=)
21 FORMAT(12=)
22 FORMAT(12=)
23 FORMAT(12=)
24 FORMAT(12=)
25 FORMAT(12=)
26 FORMAT(12=)
27 FORMAT(12=)
28 FORMAT(12=)
29 FORMAT(12=)
30 FORMAT(12=)
31 FORMAT(12=)
32 FORMAT(12=)
33 FORMAT(12=)
34 FORMAT(12=)
35 FORMAT(12=)
36 FORMAT(12=)
37 FORMAT(12=)
38 FORMAT(12=)
39 FORMAT(12=)
40 FORMAT(12=)
41 FORMAT(12=)
42 FORMAT(12=)
43 FORMAT(12=)
44 FORMAT(12=)
45 FORMAT(12=)
46 FORMAT(12=)
47 FORMAT(12=)
48 FORMAT(12=)
49 FORMAT(12=)
50 FORMAT(12=)
51 FORMAT(12=)
52 FORMAT(12=)
53 FORMAT(12=)
54 FORMAT(12=)
55 FORMAT(12=)
56 FORMAT(12=)
57 FORMAT(12=)
58 FORMAT(12=)
59 FORMAT(12=)
60 FORMAT(12=)
61 FORMAT(12=)
62 FORMAT(12=)
63 FORMAT(12=)
64 FORMAT(12=)
65 FORMAT(12=)
66 FORMAT(12=)
67 FORMAT(12=)
68 FORMAT(12=)
69 FORMAT(12=)
70 FORMAT(12=)
71 FORMAT(12=)
72 FORMAT(12=)
73 FORMAT(12=)
74 FORMAT(12=)
75 FORMAT(12=)
76 FORMAT(12=)
77 FORMAT(12=)
78 FORMAT(12=)
79 FORMAT(12=)
80 FORMAT(12=)
81 FORMAT(12=)
82 FORMAT(12=)
83 FORMAT(12=)
84 FORMAT(12=)
85 FORMAT(12=)
86 FORMAT(12=)
87 FORMAT(12=)
88 FORMAT(12=)
89 FORMAT(12=)
90 FORMAT(12=)
91 FORMAT(12=)
92 FORMAT(12=)
93 FORMAT(12=)
94 FORMAT(12=)
95 FORMAT(12=)
96 FORMAT(12=)
97 FORMAT(12=)
98 FORMAT(12=)
99 FORMAT(12=)
100 FORMAT(12=)
101 FORMAT(12=)
102 FORMAT(12=)
103 FORMAT(12=)
104 FORMAT(12=)
105 FORMAT(12=)
106 FORMAT(12=)
107 FORMAT(12=)
108 FORMAT(12=)
109 FORMAT(12=)
110 FORMAT(12=)
111 FORMAT(12=)
112 FORMAT(12=)
113 FORMAT(12=)
114 FORMAT(12=)
115 FORMAT(12=)
116 FORMAT(12=)
117 FORMAT(12=)
118 FORMAT(12=)
119 FORMAT(12=)
120 FORMAT(12=)
121 FORMAT(12=)
122 FORMAT(12=)
123 FORMAT(12=)
124 FORMAT(12=)
125 FORMAT(12=)
126 FORMAT(12=)
127 FORMAT(12=)
128 FORMAT(12=)
129 FORMAT(12=)
130 FORMAT(12=)
131 FORMAT(12=)
132 FORMAT(12=)
133 FORMAT(12=)
134 FORMAT(12=)
135 FORMAT(12=)
136 FORMAT(12=)
137 FORMAT(12=)
138 FORMAT(12=)
139 FORMAT(12=)
140 FORMAT(12=)
141 FORMAT(12=)
142 FORMAT(12=)
143 FORMAT(12=)
144 FORMAT(12=)
145 FORMAT(12=)
146 FORMAT(12=)
147 FORMAT(12=)
148 FORMAT(12=)
149 FORMAT(12=)
150 FORMAT(12=)
151 FORMAT(12=)
152 FORMAT(12=)
153 FORMAT(12=)
154 FORMAT(12=)
155 FORMAT(12=)
156 FORMAT(12=)
157 FORMAT(12=)
158 FORMAT(12=)
159 FORMAT(12=)
160 FORMAT(12=)
161 FORMAT(12=)
162 FORMAT(12=)
163 FORMAT(12=)
164 FORMAT(12=)
165 FORMAT(12=)
166 FORMAT(12=)
167 FORMAT(12=)
21 J = J+1
22 XACT(J) = I
23 XDIR(J) = ALPHAZ
24 XNUM(J) = NUM2
25 XPRK(I,J) = X1
26 XAPY(J,J) = X2
27 XSEL(J,J) = X3
28 XPR1(I,J) = X5
29 XAP2(I,J) = X6
30 XAP3(I,J) = X7
31 IF (XAP3(I,J)) 21, 25
32 XAP4(I,J) = -2000(XAP3(I,J) - XAP1(I,J))
33 CONTINUE
34 TO 19
35 CONTINUE
36 LDD = 0
37 M = I=1:
38 CALL PROD(I)
39 CONTINUE
40 WRITE OUTPUT TAPE 6,220
41 WRITE OUTPUT TAPE 6,990
42 WRITE OUTPUT TAPE 6,300
43* FORMAT(IH, DEPARTMENTAL REQUESTS, Y)
44* FORMAT(IJ, V3, DEPARTMENTAL REQUESTS, Y)
45 CALL RESULT (DEP1, DEP2)
46 CALL ORDER(I)
47 CALL ORDER(J)
48 CALL ORDER(2)
49 CALL ORDER(3)
50 WRITE OUTPUT TAPE 6,220
51 WRITE OUTPUT TAPE 6,990
52 WRITE OUTPUT TAPE 6,300
53* FORMAT (IX, DEPARTMENTAL REQUESTS, Y)
54* FORMAT (IY, SUPPLEMENTAL REQUESTS, Y)
55* FORMAT (IY, REGULAR PLUS SUPPLEMENTAL REQUESTS, Y)
56 14 I = 1,
57 N = XACT(I)
58 NI = N - 1,
59 XSEL1(I,J) = XPR1(I,J) + XPR2(I,J)
60 XSEL2(I,J) = XAP2(I,J) + XAP3(I,J)
61 CALL RESULT (STRA, STR22)
62 CALL ORDER(I)
63 CALL ORDER(J)
64 CALL ORDER(2)
65 CALL ORDER(3)
66 CALL TYP (EC)
67 WRITE OUTPUT TAPE 6,220
68 WRITE OUTPUT TAPE 6,990
69 WRITE OUTPUT TAPE 6,300
70* FORMAT (IZ, ECONOMY RECOMMENDATIONS, Y)
CALL RESULT(RESULT, ARRAY)
CALL ORDER(1)
CALL ORDER(2)
CALL ORDER(3)
CALL ORDER(4)
CALL ORDER(5)
CALL ORDER(6)
WRITE OUTPUT TAP...
01 CONTINUE
50 FOR(j=1; j<=t(10)+1; j++)
70 FOR(k=1; k<=9; k++)

10 CONTINUE
15 FORMAT (LX,13,1E,6,0.0,6,1A,AB,2,AB,2
18 ARCC(1)=X1
19 XR(X1)=X2
20 IF (XR(X1)) 22,23,23
21 CONTINUE
22 CONTINUE
23 CONTINUE
24 CONTINUE
25 CONTINUE
26 CONTINUE
28 CONTINUE
29 CONTINUE
30 CONTINUE
31 CONTINUE
38 CONTINUE
37 CONTINUE
36 CONTINUE
35 CONTINUE
34 CONTINUE
33 CONTINUE
32 CONTINUE
31 CONTINUE
30 CONTINUE
29 CONTINUE
28 CONTINUE
27 CONTINUE
26 CONTINUE
25 CONTINUE
24 CONTINUE
23 CONTINUE
22 CONTINUE
21 CONTINUE
20 CONTINUE
19 CONTINUE
18 CONTINUE
17 CONTINUE
16 CONTINUE
15 CONTINUE
14 CONTINUE
13 CONTINUE
12 CONTINUE
11 CONTINUE
10 CONTINUE
9 CONTINUE
8 CONTINUE
7 CONTINUE
6 CONTINUE
5 CONTINUE
4 CONTINUE
3 CONTINUE
2 CONTINUE
1 CONTINUE
0 CONTINUE

A-36

WRITE OUTPUT TAPE 6,110
WRITE OUTPUT TAPE 6,120, YR
10 FORMAT (1X,9FM(5,0.9), 'REGULAR PLUS SUPPLEMENTAL REQUESTS',/) DO 14 I=1,N
CN = NACC(T(I)) DO 14 J=1,N
STRA(I,J) = DEP2(I,J) + DSUPR(I,J)
14 STRAX(I,J) = OPR2(I,J) + OSREG(I,J)
CALL RESULT('STRAX(S,T)') CALL ORDER('ORDER') CALL ORDER(1)
CALL ORDER(2)
CALL ORDER(3)
CALL ORDER(4)
CALL ORDER(5)
CALL CAPRO
WRITE OUTPUT TAPE 6,220
WRITE OUTPUT TAPE 6,120, YR
WRITE OUTPUT TAPE 6,130, YR
WRITE OUTPUT TAPE 6,300, YR
12 FORMAT (1X, ' MACHINE RECOMMENDATIONS',/) CALL RESULT('RMA,2,..,N') CALL ORDER(1)
CALL ORDER(2)
CALL ORDER(3)
CALL ORDER(4)
DC 15 J=1,N
CN = NACC(T(J)) CALL ORDER(1)
CALL ORDER(2)
CALL ORDER(3)
CALL ORDER(4)
DO 15 I=1,N
CN = NACC(T(I)) DO 15 J=1,N
CHXLY(I,J) = APPR2(I,J) - APPR1(I,J)
EXPD(I,J) = APPR2(I,J) - APPR1(I,J)
*** APPR1(I,J) = APPR2(I,J)
NTIMES = NTIMES + 1
GO TO 26
END

G. MAIN CALLING PROGRAM FOR 10-YEAR FORECASTS

C O R T R A I N
DIMENSION DEPR2(6,5),APPRI(6,5),RMA(6,5),EXPD(60,5),
1 TEXP2(60),TAPR1(60),TDEP2(60),DSUPR(60),OSREG(60),
2 NACC(60),A1(6,5),A2(6,5),T(60,5),E(60,5),F(60,5),
1 G(6,5),R(6,5),S(6,5),T(60,5),N(60,5),K(60,5),
4 OSREG(60,5),RMA(60,5),APPR2(60,5),ATMA(60),TAPR2(60),
3 APPR1(60,5),STOR2(6,5),STOR1(6,5),STOR1(6,5),REV(60,5),
4 NACC(60),AN(60,5),AI(60,5),A1(60,5),CHGLY(60,5),
7 NACC(999),AN(999),AI(999),A1(999),CHGLY(999),
COMMON DEPR2(6,5),APPRI(6,5),RMA(60,5),EXPD(60,5),
1 TEXP2(60),TAPR1(60),TDEP2(60),DSUPR(60),OSREG(60),
2 NACC(60),A1(6,5),A2(6,5),T(60,5),E(60,5),F(60,5),
1 G(6,5),R(6,5),S(6,5),T(60,5),N(60,5),K(60,5),
4 OSREG(60,5),RMA(60,5),APPR2(60,5),ATMA(60),TAPR2(60),
3 APPR1(60,5),STOR2(6,5),STOR1(6,5),STOR1(6,5),REV(60,5),
4 NACC(60),AN(60,5),AI(60,5),A1(60,5),CHGLY(60,5),
7 NACC(999),AN(999),AI(999),A1(999),CHGLY(999),
**SUBROUTINE TO PLACE MODEL RESIDUALS IN ORDER**

**ORDER**

**SUBROUTINE ORDER(IDENT)**

**DIMENSION** DEPR2(50), APPR1(50,5), KAPP2(50,5), EXPD(50),

1: TAPK1(50), TAPP1(50), TAPP2(50), TAPK2(50), KAPP(50,5), CODE(50),

2: MAPP1(50), MAPP2(50), MAPP(50,5), ECODE(50),

3: G(50,5), H(50,5), PP(50,5), Q(50,5), R(50,5), S(50,5), LREG2(50,5),

4: DREG2(50,5), TAYZ(50), RARMAY(50), RATMAY(50), TAPP2(50), APPK2(50,5),

5: SAPPR1(50,5), STOR2(50,5), STOR1(50,5), DEVE1(50), DEVE1P(50), ANAME(50),

6: ACNM(50), STR1(50), STR2(50,5), CHNGLY(50), NKC(50),

7: NKCC(50), NKCC(50), NMOD(50), nMOD(50),

8: COMMON DEPR2, APPR1, KAPP2, EXPD, TAPK1, TAPP1, TAPP2, KAPP, CODE,

9: MAPP1, MAPP2, MAPP, ECODE, ECODE,

10: G, H, PP, Q, R, S, LREG2,

11: DREG2, TAYZ, RARMAY, RATMAY, TAPP2, APPK2,

12: SAPPR1, STOR2, STOR1, DEVE1, DEVE1P,

13: ACNM, STR1, STR2, CHNGLY, NKCC, NKCC, NMOD, NMOD,

14: COMMON DEPR2, APPR1, KAPP2, EXPD, TAPK1, TAPP1, TAPP2, KAPP, CODE,

15: MAPP1, MAPP2, MAPP, ECODE, ECODE,

16: G, H, PP, Q, R, S, LREG2,

17: DREG2, TAYZ, RARMAY, RATMAY, TAPP2, APPK2,

18: SAPPR1, STOR2, STOR1, DEVE1, DEVE1P,

19: ACNM, STR1, STR2, CHNGLY, NKCC, NKCC, NMOD, NMOD,

20: COMMON DEPR2, APPR1, KAPP2, EXPD, TAPK1, TAPP1, TAPP2, KAPP, CODE,

21: MAPP1, MAPP2, MAPP, ECODE, ECODE,

22: G, H, PP, Q, R, S, LREG2,

23: DREG2, TAYZ, RARMAY, RATMAY, TAPP2, APPK2,

24: SAPPR1, STOR2, STOR1, DEVE1, DEVE1P,

25: ACNM, STR1, STR2, CHNGLY, NKCC, NKCC, NMOD, NMOD,
SUBROUTINE SUMR(EMATR)
DIMENSION DEPR2(60,5), APPR1(60,5), RMAY2(60,5), EXPND(60,5),
1TEXPN(60), TAPR1(60), TDEP2(60), TSUPR(60), DSUPR(60,5), NCODE(60),
2NACCT(60), A(60,5), B(60,5), C(60,5), D(60,5), E(60,5), F(60,5),
3G(60,5), H(60,5), PP(60,5), Q(60,5), R(60,5), S(60,5), DREQ2(60,5),
4DREQ1(60,5), TMAY2(60), ARMAY1(60,5), ATMAY1(60), TAPR2(60), APPR2(60,5),
5AAPRO(60,5), STOR1(60,5), STOR2(60,5), DDEV(60), DDEV2(60), ANAME(999),
6ACTNM(5), ST1(60,5), ST2(60,5), CHNLG1(60,5), CHNLG2(60,5), NCAL(999),
7NRCH(999), NRCC(999), NMOD(999), NM0D(999,5),
DIMENSION EMATR(60,5)
COMMON DEPR2,APP1, RMAY2, EXPND, TEXP, TAPR1, TDEP2, TSUPR, DSUPR,
1NCODE, NACCT, A, B, C, D, E, F, G, H, PP, Q, R, S, DREQ, DREQ1, ANAME, ACTNM,
2ST, ST1, ST2, CHNLG1, NRCD, NRCC, COUNT, DEV, DEVS, TUD, REV, DEVS,
3TAPR2, APPR2, AAPRO, STOR1, STOR2, DDEV, DDEV2, ANAME, ACTNM,
4KESID, X, P, XLMT, XLN, NSTD, TOT, TOTT, BLANK, TOTAL, UNCALC, GG, TSL1, YN,
5FLAG, NM0D, NM0D
CALL FTRAP
WRITE OUTPUT TAPE 6,140
140 FORMAT(1X,49HDEPT, ACCT, ESTIMATED, BUDGET SHARE )
CETOT = 0.0
DO 111 I=1,N
NN = NACCT(I)
DO 111 J=1,NN
111 CETOT = CETOT + EMATR(I,J)
DO 1 I=1,N
EDTOT = 0.0
TALPH = TOTAL
NN = NACCT(I)
NMBR = NCODE(I)
DO 11 J=1,NN
BSHARE = EMATR(I,J)/CETOT
RETURN
END
V. SAMPLE OUTPUT -- MAYORS MODEL OUTCOMES
CITY OF DETROIT, 1964-65 BUDGET
ONE-PERIOD CHANGE MODEL

<table>
<thead>
<tr>
<th>DEPT.</th>
<th>ACCT.</th>
<th>ESTIMATED</th>
<th>ACTUAL</th>
<th>DEV.</th>
<th>PERCENT DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTCOM</td>
<td>WAGE</td>
<td>.4892E 06</td>
<td>.5292E 06</td>
<td>-.4401E 09</td>
<td>-8316E-01</td>
</tr>
<tr>
<td>ARTCOM</td>
<td>SEXP</td>
<td>.9945E 05</td>
<td>.9984E 05</td>
<td>-.3679E 03</td>
<td>-3689E-04</td>
</tr>
<tr>
<td>ARTCOM</td>
<td>EQUIP1</td>
<td>.3957E 05</td>
<td>.3992E 05</td>
<td>-.2671E 04</td>
<td>-7230E-01</td>
</tr>
<tr>
<td>ARTCOM</td>
<td></td>
<td>.6242E 06</td>
<td>.6659E 06</td>
<td>-.4172E 05</td>
<td>-6266E-01</td>
</tr>
<tr>
<td>BLDGSF</td>
<td>WAGE</td>
<td>.2379E 07</td>
<td>.2449E 07</td>
<td>-.6627E 03</td>
<td>-2711E-01</td>
</tr>
<tr>
<td>BLDGSF</td>
<td>SEXP</td>
<td>.1141E 06</td>
<td>.1219E 06</td>
<td>-.7204E 04</td>
<td>-5939E-01</td>
</tr>
<tr>
<td>BLDGSF</td>
<td>EQUIP1</td>
<td>.9732E 04</td>
<td>.9515E 04</td>
<td>.2165E 03</td>
<td>.2276E-01</td>
</tr>
<tr>
<td>BLDGSF</td>
<td></td>
<td>.2563E 07</td>
<td>.2575E 07</td>
<td>-.7326E 05</td>
<td>-2344E-01</td>
</tr>
</tbody>
</table>

TOTAL
<table>
<thead>
<tr>
<th>Department</th>
<th>S.WAGE</th>
<th>M.SEXP</th>
<th>EQUIPI</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANNING</td>
<td>50662</td>
<td>23642</td>
<td>23692</td>
<td>18042</td>
</tr>
<tr>
<td>FIRE</td>
<td>13562</td>
<td>93532</td>
<td>32192</td>
<td>15172</td>
</tr>
<tr>
<td>COUNCIL</td>
<td>18006</td>
<td>61166</td>
<td>61072</td>
<td>34472</td>
</tr>
<tr>
<td>MAYORS</td>
<td>11672</td>
<td>29672</td>
<td>31072</td>
<td>12832</td>
</tr>
<tr>
<td>CIVDEF</td>
<td>13472</td>
<td>16442</td>
<td>41442</td>
<td>11232</td>
</tr>
<tr>
<td>CORREC</td>
<td>12672</td>
<td>52592</td>
<td>59362</td>
<td>19652</td>
</tr>
<tr>
<td>LINER</td>
<td>19551</td>
<td>40000</td>
<td>40000</td>
<td>40000</td>
</tr>
<tr>
<td>Category</td>
<td>Subcategory</td>
<td>11/11/81</td>
<td>12/01/81</td>
<td>12/28/81</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Police</td>
<td>Storage</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Police</td>
<td>M: Sex</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Police</td>
<td>Equip.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Total**
<table>
<thead>
<tr>
<th>DEPT - ACCT</th>
<th>ESTIMATED</th>
<th>ACTUAL</th>
<th>DEVIANCE</th>
<th>PERCENT DEVIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17102.09</td>
<td>16992.09</td>
<td>1084.07</td>
<td>6294.06 TOTAL</td>
</tr>
</tbody>
</table>

\[
\text{ESTIMATED REVENUES} = 17102.09 \\
\text{BUDGET ESTIMATE} = 17102.09 \\
\text{PLANNED SURPLUS} = 2200.02 \\
\text{GOODNESS OF FIT}
\]

\[
\text{\( R^2 \) - SQUARED EQUIVALENT} = 1.0 - \sum \text{OF DEVIATIONS SQUARED / ACTUAL VALUES SQUARED} = 0.9761E 06 \\
\text{\( R^2 \) - SQUARED EQUIVALENT ON BUDGET CHANGES} = 1.0 - \sum \text{OF PREDICTED MINUS ACTUAL CHANGES SQUARED / SUM OF ACTUAL CHANGES SQUARED} = 0.1129E 06 \\
\text{WEIGHTED AVERAGE ABSOLUTE DEVIATION} = 0.1129E 06 \\
\text{CHI-SQUARED STATISTIC BASED ON BUDGET LEVEL} = 0.8210E 07 \\
\text{DEGREES OF FREEDOM CONTRIBUTION} = 1.2006E 03 \\
\text{CHI-SQUARED STATISTIC BASED ON ESTIMATED BUDGET CHARGE} = 0.1752E 09 \\
\text{DEGREES OF FREEDOM CONTRIBUTION} = 1.1981E 03 \\
\text{BAYESIAN INDUCTIVE STATISTIC} = \sum \text{OF DEVIATIONS SQUARED / ACTUAL} = 0.9494E 07 \\
\text{DEGREES OF FREEDOM CONTRIBUTION} = 1.1981E 03 \\
\]
VI. DATA SOURCES

1. Cleveland Appropriations, Expenditure, and Mayor's Budget Recommendation Data 1956-1965:

Supplement to The City Record, Official Publication of the City of Cleveland Containing the Mayor's Estimate for the Year 1965: The Annual Appropriations Ordinance Based Thereon and the Approved Official Certificate of the County Budget Commission -- one copy for each year, 1955-1965

Departmental Request Data, 1960-63 and 1965 obtained from work sheets in the Department of Finance, the City of Cleveland.

2. Detroit Appropriations, Expenditure, Mayor's Budget Recommendation, and Departmental Request Data 1953-59 to 1964-65:

1964-1965 BUDGET ESTIMATES FOR FISCAL YEAR ENDING JUNE 30, 1965, Compiled by: City Controller's Office, Budget Bureau; Revised by: Jerome P. Cavanaugh, Mayor -- one copy for each year, 1958-59 to 1964-65

3. Pittsburgh Appropriations, Expenditures, and Mayor's Budget Estimates 1960-1965:

CITY OF PITTSBURGH BUDGET - 1965: DEPARTMENTAL ESTIMATES, JOSEPH N. TAYLOR, MAYOR -- one copy 1960-1965

Pittsburgh Departmental Request Data, 1965 obtained from Department Request Budget forms on file in Office of the Mayor, City of Pittsburgh.