Model Risk and Culture

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Model Risk Cultures

Andreas Tsanakas
Cass Business School

Society for Economic Measurement 2015 Conference
Acknowledgments

- Institute and Faculty of Actuaries WP on Model Risk
  - A Aggarwal, MB Beck, M Cann, T Ford, D Georgescu, N Morjaria, AD Smith, Y Taylor, AT, L Witts, I Ye
  - M Thompson, IIASA

- *Model Risk: Daring to Open the Black Box*
  - [http://www.researchgate.net/publication/277138848_Model_Risk_Daring_to_Open_the_Black_Box](http://www.researchgate.net/publication/277138848_Model_Risk_Daring_to_Open_the_Black_Box)
What is model risk?
(Federal Reserve, SR Letter 11-7, 2011)

The potential for adverse consequences from decisions based on incorrect or misused model outputs and reports.

Model risk occurs primarily for two reasons:

- The model may have **fundamental errors** and may produce inaccurate outputs when viewed against the design objective and intended business uses. […]

- The model may be **used incorrectly** or inappropriately.
Implicit assumptions

- Agreed-upon decision rule, mechanically followed
- Existence of a “correct model”
- Quantifiable financial impact of model error
- Risk is exogenous
Literatures

● Risk & uncertainty
  ○ Knight (1921), Lane & Maxfield (2005), Skidelsky (2009)

● Quantitative

● Anthropology & sociology of finance

● Environmental & systems science
  ○ Holling (1973), Funtowicz & Ravetz (1990), Beck (2014)
A game

- I will roll a die
- If you roll a 5, I give you £10m
- Otherwise you give me £1m

- Should you take the bet?
How to respond?

- Will he pay even if 5 is rolled?
- Maximise utility
- Is the die 6-sided?
- Is the die fair?
Uncertainties
Knight (1921), Lane & Maxfield (2005), Skidelsky (2009)
Uncertainties

Knight (1921), Lane & Maxfield (2005), Skidelsky (2009)

- Epistemological Uncertainty
- Ontological Uncertainty
- Framing Uncertainty

Meaningful to model
Uncertainties
Knight (1921), Lane & Maxfield (2005), Skidelsky (2009)

Worried about model uncertainty
Sensitivity of annuity value to model choice
(70 year old male, discount at 3%; Richards et al, 2013)
How to respond

Pick whichever model gives convenient outputs / do what others are doing

Too hard to model / should have never taken on this risk

Quantify uncertainty / run multiple models / do more research

Pick whichever model fits best and make good use of it
How to respond

- Pick whichever model gives convenient outputs / do what others are doing
- Pick whichever model fits best and make good use of it
- Too hard to model / should have never taken on this risk
- Quantify uncertainty / run multiple models / do more research
Risks

- Excessive reliance on model outputs
- Excessive deliberation and restrictions on model use
- Paradigm flawed
- Highly suboptimal decisions
- Excessive reliance on intuition
- Model manipulation
Gaussian copulas, CDOs and the crisis

“it could be structured by cows and we would rate it”
(Jones, 2008)

“A device to book P&L”
(MacKenzie & Spears, 2014)

“Out of sample, out of sight”
(Silver, 2012)

“Mathematics applied badly”
(Donnelly & Embrechts, 2010)
Governance: what “we” offer to “them”
Governance: what “they” offer to “us”

Survival instinct

Investment in model

Big picture

Actuaries
What regulators say (1)

A guiding principle for managing model risk is "effective challenge" of models, that is, critical analysis by objective, informed parties [...] 

Unexpectedly large changes in outputs in response to small changes in inputs can indicate an unstable model. [...] If testing indicates that the model may be inaccurate or unstable [...], management should consider modifying certain model properties. [...], placing limits on model use, or developing a new approach. 

(Federal Reserve, SR Letter 11-7, 2011)
What regulators say (2)

A useful starting point might be to take a more sceptical view of the role and robustness of internal risk models in the regulatory framework. [...]  

Only by removing internal models from the regulatory framework can [simplifying the regulatory architecture] be achieved. As an alternative foundation stone, simplified, standardised approaches [...] could be used.

(Haldane and Madouros, The Dog and the Frisbee, 2012)
What regulators say (3)

Actuarial and statistical techniques shall only be considered adequate [if…]

- the outputs of the internal model are **stable** in relation to changes in the input data [...];

- the internal model captures **all the relevant characteristics** of the risk profile [...];

- the outputs of the internal model **do not include a material model error** [...]; the probability distribution forecast shall be adjusted to account for model and estimation errors.

(Solvency II Delegated Acts, October 2014)
Reactions to model-driven regulation

Manipulate the model to give right answer / if anything goes badly blame modellers

Frustration when validation requirements make model less useful

Rage against the machine

Self-censor
Migrate quadrant
Redefine purpose of modelling
## Things to disagree about

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THANK YOU FOR YOUR ATTENTION!