Model Risk Cultures

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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

- Output so far
  - *Model Risk: Daring to Open the Black Box* – BAJ
  - *Taming Uncertainty: The Limits to Quantification* – ASTIN
Literatures

- Quantitative

- Environmental & systems science
  - Holling (1973), Funtowicz & Ravetz (1990), Beck (2014)

- Anthropology & sociology of finance
What is model risk?
(Federal Reserve, SR Letter 11-7, 2011)

[T]he 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
- “Correct model” (or something close to it) exists and is attainable
- Quantifiable financial impact of model error
- Risk is exogenous
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?
- Is the die 6-sided?
- Maximise utility
- Is the die fair?
Uncertainties
Knight (1921), Lane & Maxfield (2005), Skidelsky (2009)

- Risk
- Framing Uncertainty
- Ontological Uncertainty
- Epistemological Uncertainty
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Risk Framing Uncertainty

Ontological Uncertainty

Epistemological Uncertainty

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
  - Manipulate, survive
- Pick whichever model fits best
  - Use the model, today
- Too hard to model / should have never taken on this risk
  - Quantify uncertainty / run multiple models
- Prepare for radically different futures
  - Mark out fitness for purpose
How to respond

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

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(Non-)Model Risks

Model proves wrong
Too many restrictions on model use
Paradigm flawed

Intuition proves wrong
Highly suboptimal decisions
Loss of accountability
Blame

Scapegoat
- Fate

Oneself
- Excessive regulation

The system
- Hubris

Those who abuse and manipulate the rules
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”

- Transparency
- Limitations
- Structure
- Quants
Governance: what “they” offer to “us”

- Survival instinct
- Investment in model
- Big picture
- Quants
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 desired answer**
- **If anything goes badly blame modellers**
- **Frustration when validation requirements make model less useful**
- **Self-censor**
- **Migrate quadrant**
- **Rage against the machine**
- **Redefine purpose of modelling**
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THANK YOU FOR YOUR ATTENTION!