Five Challenges

THE EXPANDING ROLE OF THE ACTUARY IN CATASTROPHE
LOSS ESTIMATION AND MANAGEMENT

CAS Annual Meeting

November 13th 2012

Peter Taylor

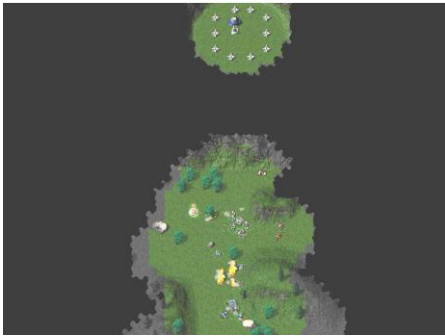## in Outcome Space

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where there be …

"It's not a good idea to take a forecast from someone wearing a tie."

Nassim Nicholas Taleb

Five Challenges

Risks In the Box
- EP Curve uncertainty
- Closed form distributions

Risks Across the Boxes
- Multiple Models

Risks Outside of the Box
- Rumsfeld
- The ORSA

No perfect model

Nullius in verba

Data, data, data

Delusional probability

Taking a view

"Tell me what you know.

Tell me what you don't know.

Then tell me what you think.

Always distinguish which is which."

US Secretary of State, Colin Powell

http://www.thedailybeast.com/newsweek/2012/05/13/colin-powell-on-the-bush-administration-s-iraq-war-mistakes.html

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Another fine mess

2004 Hurricanes

Bonnie	Aug 3 – Aug 14 2004
Charley	Aug 9 – Aug 14 2004
Frances	Aug 25 – Sep 10 2004
Ivan	Sep 2 – Sep 24 2004
Jeanne	Sep 13 – Sep 28 2004
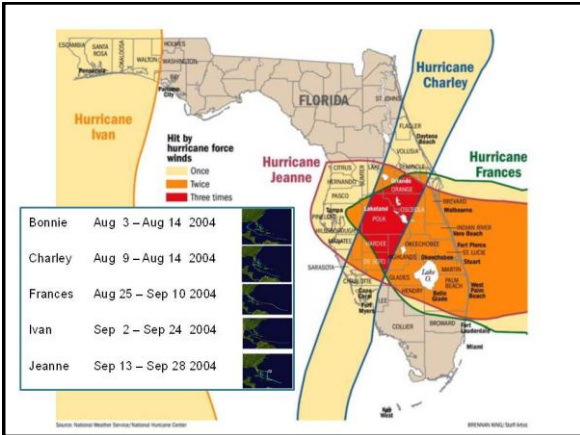
Katrina Storm Surge Footprint (RMS recon)

Government Prediction vs Tohoku EQ

Area	Predicted Magnitude	Chance of EQ within next 30 yrs	Average RP (yrs)
A	M8.0	0.5%-10%	97
C	M7.7 M8.0	80%-90%	105
D	M7.5	90%	87
E	M7.4	7%	400+
F	M6.7-M7.2	90%+	21
H	M8.2	4%-7%	400-750

- Government predicted a EQ combination with only 2 sources (e.g Area C & D)
- Tohoku EQ triggered EQ associated with 6 sources (Area B – G)

SOURCE: *The Great Tohoku Earthquake Casualty Actuarial Society, 2011*

And then …

- Model changes
- Christchurch
- Thailand
- …

Meanwhile, the crowds were stirring…

4

"It is hard to overstate the damage done in the recent past by people who thought they knew more about the world than they really did."

John Kay in "Obliquity" 2010

"— Seek transparency and ease of interrogation of any model, with clear expression of the provenance of assumptions.

— *Communicate the estimates with humility, communicate the uncertainty with confidence.*

— *Fully acknowledge the role of judgement."*

D. J. Spiegelhalter and H. Riesch in "Don't know, can't know: embracing deeper uncertainties when analysing risks" Phil. Trans. R. Soc. A (2011) 369, 4730–4750

"Somewhere along the way, appreciation for the inherent uncertainty in risk has been diminished or even lost.

"Instead of models helping users to become more deeply risk-aware, the opposite can occur.

"Indeed, some now feel more vulnerable to a change in model versions than to the very catastrophes that these models were intended to mitigate."

Hemant Shah, CEO RMS

"Learn to say 'I don't know'. If used when appropriate, it will be often."

Karen Clark, CEO, Karen Clark & Company

"Understanding the models, particularly their limitations and sensitivity to assumptions, is the new task we face.

"Many of the banking and financial institution problems and failures of the past decade can be directly tied to model failure or overly optimistic judgements in the setting of assumptions or the parameterization of a model."

Tad Montross, 2010, Chairman and CEO of GenRe in "Model Mania"
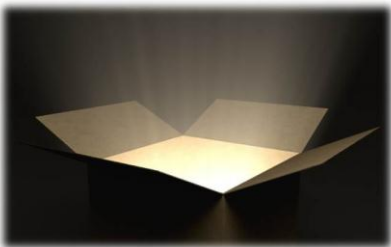
Risks in the Box

1. EP Curve Uncertainty

Uncertainty in the box

Exceedance Probability (EP) Curve

Uncertainty in Loss

Uncertainty in Probability

Probability
p(L) that
losses will
exceed L

Loss, L

Source: AIR

So is the EP Curve this....

Full Uncertainty

Loss ($m)
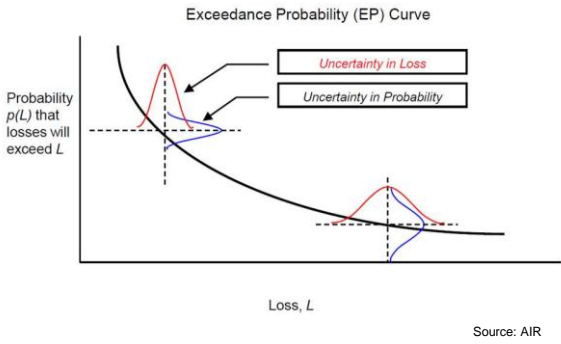
Return Period (Yrs)
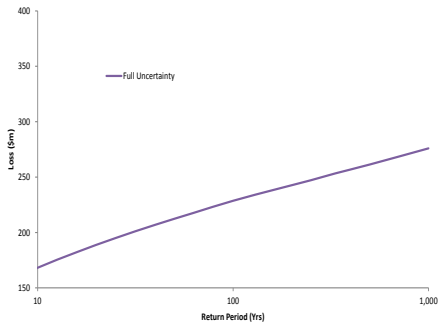
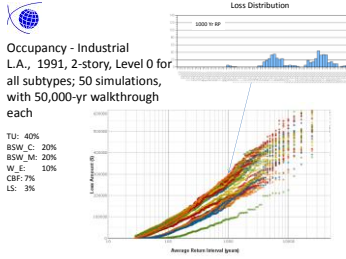## Or this?
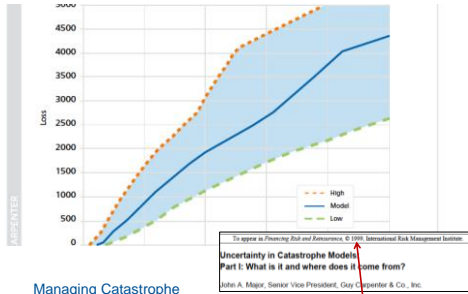
Managing Catastrophe
Model Uncertainty- Guy Carpenter 2011

Sensitivity to data

Occupancy - Industrial
L.A., 1991, 2-story, Level 0 for
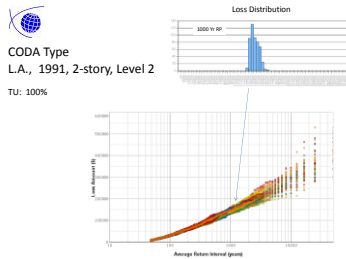all subtypes; 50 simulations,
with 50,000-yr walkthrough
each

TU: 40%
BSW_C: 20%
BSW_M: 20%
W_E: 10%
CBF: 7%
LS: 3%

Sensitivity to data

CODA Type
L.A., 1991, 2-story, Level 2

TU: 100%

Sensitivity to Assumptions

scenario event set selection

clustering

seasonality

damageability

severity

loss amplification

Loss Modelling with knobs on!
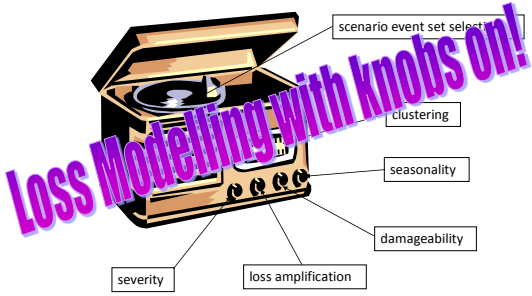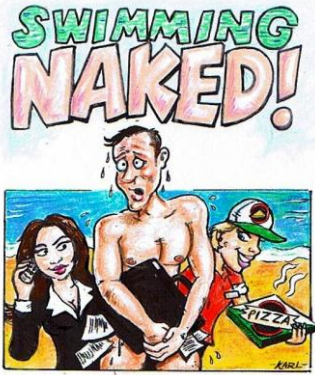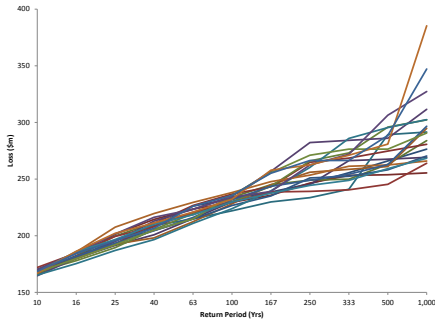
Swimming Naked?

Swimming Naked?
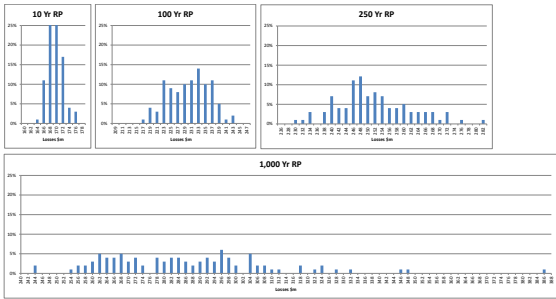
Another Example

- 200 Yr annual VaR: $100m
- Three cases, different spreads
- What is the chance of these losses?
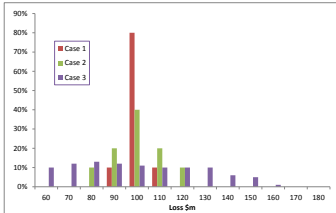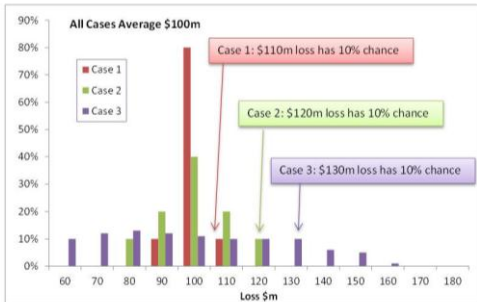

What's the Capital Provision?

All Cases Average $100m

Case 1: $110m loss has 10% chance

Case 2: $120m loss has 10% chance

Case 3: $130m loss has 10% chance

EP Curve Uncertainty

So the question is …

How do you allow for the
uncertainty in the EP Curve?

Ideas include …

- Use confidence ranges
- Quantify as contingent capital

2. Use of Closed Form
Distributions

"*Given the type of distributions adopted in
the context of operational risk, it is
especially difficult to represent the
aggregated loss distributions by closed form
curves.*"

Operational Risk – Supervisory Guidelines for the Advanced
Measurement Approaches, June 2011

Fooled by … Convenience

- Choose a probability distribution
- Here's the toolkit (thank you text books)
  - **Normal** if lots of unrelated random additive quantities
  - **Lognormal** for lost of unrelated random multiplicative quantities
  - **Poisson** if it's infrequent discrete events
  - **Pareto** if infrequent high severity
  - **Beta** if bounded (e.g. between 0 and 1)
- Two parameter distributions easy for Excel, phew!
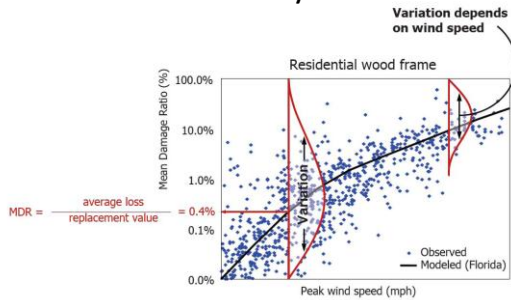- So we choose … Beta
- What could possibly go wrong?

Surely …

Jean-Sébastien Lagacé, Catastrophe Modeling, March 28th 2008 – Université Laval

Hurricane Ike

- Maximum wind speed of 145 mph
- Landfall on 13th September 2008 near Galveston
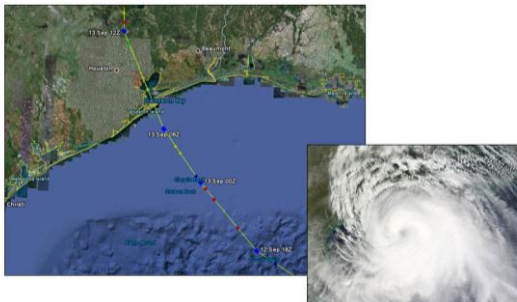
Hurricane Ike

Per-building damage assessment:

•**Undamaged** Green

•**Minor** Yellow (Light)
Brown (Moderate)

•**Major** Orange (Serious)
Red (Total Collapse)

	Total	Undamaged	Minor	Major
La Porte	10,150	28.9% 66.4%	4.7%	

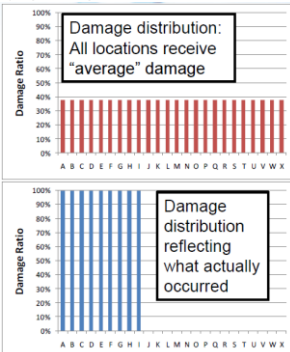Harris County, Hurricane Ike Residential Damage Assessment Dec 2008

Christchurch February 2011

What's really going on here? Hint …

"Loss estimation (net of deductibles, limits) is very sensitive to how damage is modeled"
Tom Larsen

Damage distribution:
All locations receive "average" damage

Damage distribution reflecting what actually occurred

Tom Larsen, Severe Convective Storms in the US, RAA Conference 2012

Damage is discrete not averaged

"Modeled *mean* losses for locations are generally smaller than location-level losses in realizations. The difference is that modeled mean losses are positive for every location, while many locations in the realizations will have zero losses"
Vineet Jain

Fallacy of comparing mean location level losses with actual losses observed from a hurricane
Vineet Jain, Anatomy of a Damage Function: Dispelling the Myths, AIR 2010

Fooled by … Convenience

Note Beta understates severity

EP Curve ELT Approximation

Closed Form Distributions

So the question is …

Can you justify use of
a particular closed-form
Distribution?

Ideas include …

- Don't use them unless you have to
- Test goodness of fit against full stochastic run

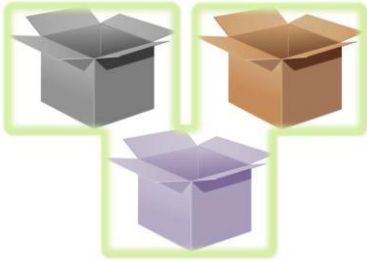**Risks Across the Boxes**

3. Multiple Models

Model Uncertainty
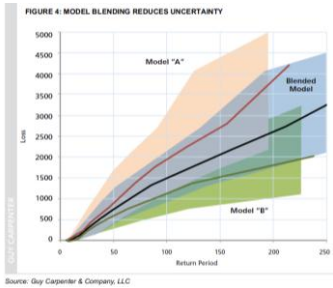
SOURCE: *Guy Carpenter: Managing Catastrophe Model Uncertainty (Dec 2011)*

Model Comparison – Different Models
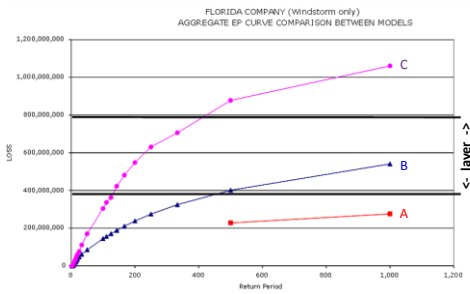
Multiple Models
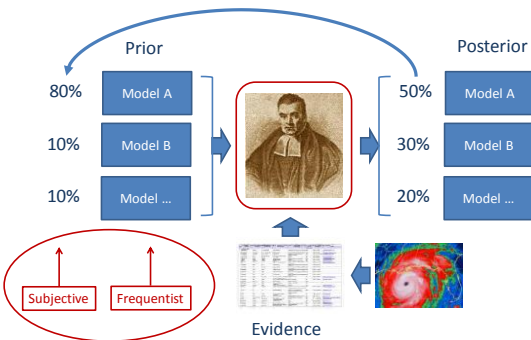
On the Quantitative Definition of Risk
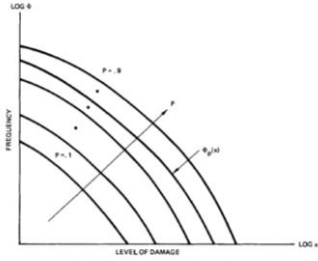

Fig. 7. Risk curve in probability of frequency format.

Kaplan and Garrick, Risk Analysis Vol 1 No 1 1981

Klibanoof, Marinacci, Mukerji, Econometrica, Vol. 73, No. 6 (November, 2005), 1849–1892

Multiple Models

So the question is …

How do you allow for
Model risk?

Ideas include …

- Bayesian framework for model fusion
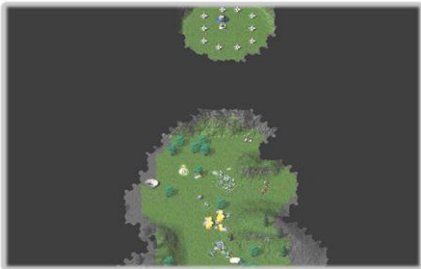
Risks Outside of the Boxes

5. Rumsfeld

"… as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns - - the ones we don't know we don't know."

US Defence Secretary, Donald Rumsfeld

The Rumsfeld Quadrants

Known Unknowns	
Risks in the Box	Unknown Knowns

Another interpretation

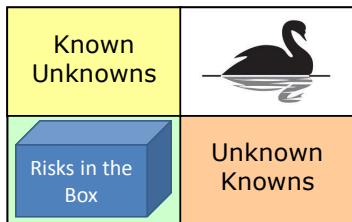|	
Recognised Unknowns	Unrecognised Unknowns
Recognised Knowns	Unrecognised Knowns

Rumsfeldian Allowances

- Model inadequacies (known unknowns)
  - Such as Northridge and Christchurch faults
  - Such as BI

Known Unknowns	Unknown Unknowns
Known Knowns	Unknown Knowns

- Model exclusions (unknown knowns)
  - Such as tsunami, or not modelled policy conditions
  - Such as contingent BI
- Black swans (unknown unknowns)
  - Based on our track record of getting it wrong

The Fog of Uncertainty

The question is …

How can we know what
we don't know about risk?

Ideas include …

- Known unknowns & unknown knowns
- Accept we may not know and say so

" … we do not feel it is generally appropriate to respond to limitations in formal analysis by increasing the complexity of the modelling. Instead, we feel a need to have an external perspective on the adequacy and robustness of the whole modelling endeavour, rather than relying on within-model calculations of uncertainties, which are inevitably contingent on yet more assumptions that may turn out to be misguided. "

D. J. Spiegelhalter and H. Riesch in "Don't know, can't know: embracing deeper uncertainties when analysing risks" Phil. Trans. R. Soc. A (2011) 369, 4730–4750

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5. The ORSA

Solvency II

Slide 1

Objectives	Risks
• What are we trying to achieve? • How do we measure it?	• What are the risks related to these objectives? • What mitigations are in place?

Risk Appetite
• Objectives versus Risk over what timescale?
• Test - Scenarios?
• Test - How robust?

High-return deep-pocket underwriting
vs
Steady marginal underwriting
vs
Opportunistic cycle-based underwriting

The ORSA
"the heart of Solvency II"

Slide 2

Risk Appetite

• Relate risk to business objective - state how much risk we are prepared to take to achieve our objectives over what period of time

• Give examples, implications, and ask for challenge
• Explain level of confidence in each scenario (the chance of the scenario happening and our confidence in this estimate)

Slide 3

Opportunity
Characteristic Events

• NE Wind

• New Orleans Hurricane

Karen Clark & Company "RiskInsight Open"

The ORSA

The question is …

How to define the business's view of risk?

Ideas include …

- Risk appetite not just risk tolerance
- Challenge outside the box

Summary

Risks In the Box
- EP Curve uncertainty   *Contingent capital*
- Closed form distributions *Test goodness of fit*

Risks Across the Boxes
- Multiple Models   *A process for Model Risk*

Risks Outside of the Boxes
- Rumsfeld   *Assess unknowns*
- ORSA   *Think outside the box*

"*Tell me what you know.*

Tell me what you don't know.

Then tell me what you think.

Always distinguish which is which."

US Secretary of State, Colin Powell

http://www.thedailybeast.com/newsweek/2012/05/13/colin-powell-on-the-bush-administration-s-iraq-war-mistakes.html

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Thank You!

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