GUY CARPENTER

CS-19 Using Models With Uncertainty

Applying Postmodern "Robust" Decision Theory

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MARSH & McLENNAN COMPANIES

Antitrust slide

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The Problem

- I'm accustomed to using my risk model in decision making.
- Trouble is, I believed it.
  - Now I find out there's a material degree of uncertainty in the results.
- What am I supposed to do about it?

"As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."
- Albert Einstein

The solution

- Run a parallel analysis using the **most dangerous alternative** model.
- Use those results to inform your decision making.
  - Identify ***robust*** strategies that work well for the base *and* worst case
  - "Protect your downside"

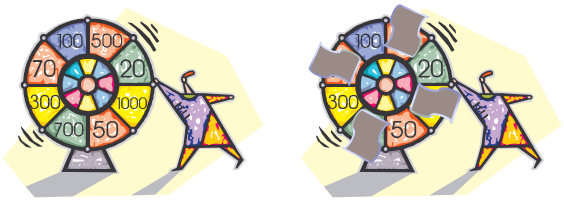
"People talk about black swans but they don't talk about robustness, which is the real lesson of the black swans."
- Nassim Taleb

Example: evaluation of reinsurance programs

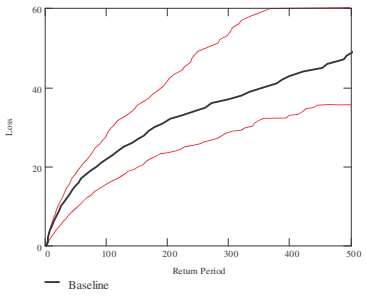
Program	Baseline Rank	Alternate Rank
A	1	4
B	2	1
C	3	5
D	1	3
E	1	2

Approaches to dealing with uncertainty

Risk versus uncertainty

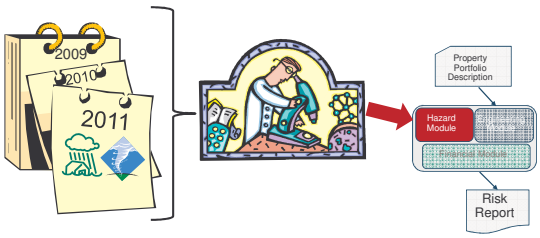


Traditional approaches to dealing with uncertainty (1)

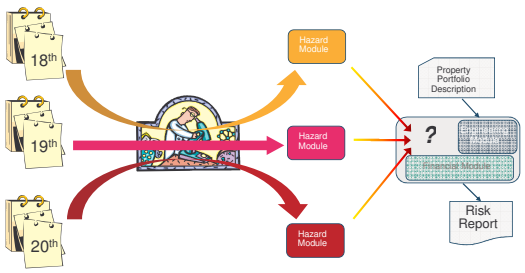


Confidence Intervals

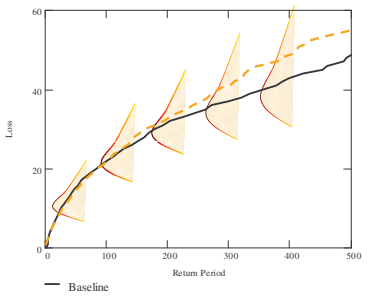
Does a statistical perspective make sense for cat models?



Hypothetical repeated versions



Traditional approaches to dealing with uncertainty (2)



Bayesian Estimates

Pros and cons of traditional approaches

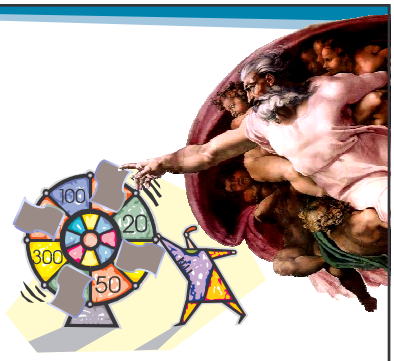
Approach	Pro	Con
Ignore uncertainty	Easiest	Surprise!
Confidence intervals	Fullest expression of uncertainty	Now what do I do with it?
Bayesian estimates	Actionable answer incorporates uncertainty	Hardest, requires more assumptions, subtleties

A new approach

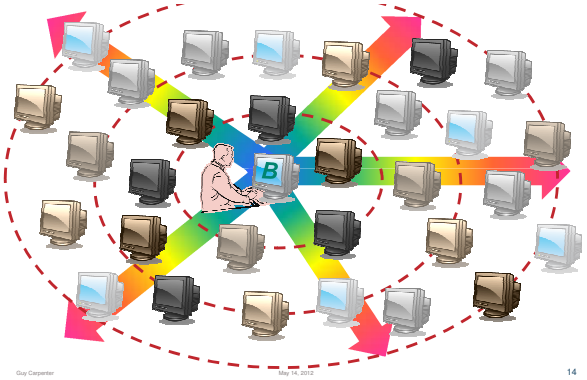
Approach	Pro	Con
Ignore uncertainty	Easiest	Surprise!
Confidence intervals	Fullest expression of uncertainty	Now what do I do with it?
Bayesian estimates	Actionable answer, incorporates uncertainty	Hardest, requires more assumptions, subtleties
Robust control	Actionable answer, full expression of uncertainty, minimal assumptions	Complex implementation, novelty of concept

What is robust control?

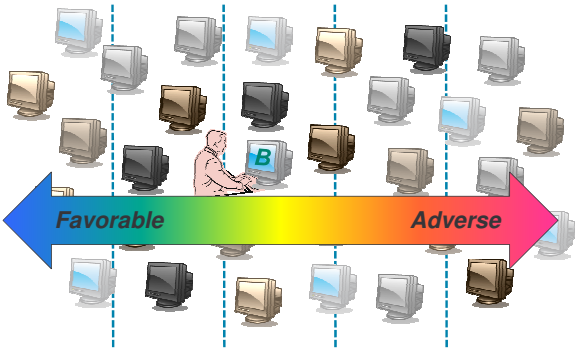
Statistics
+
Game Theory



Plausibility



Utility

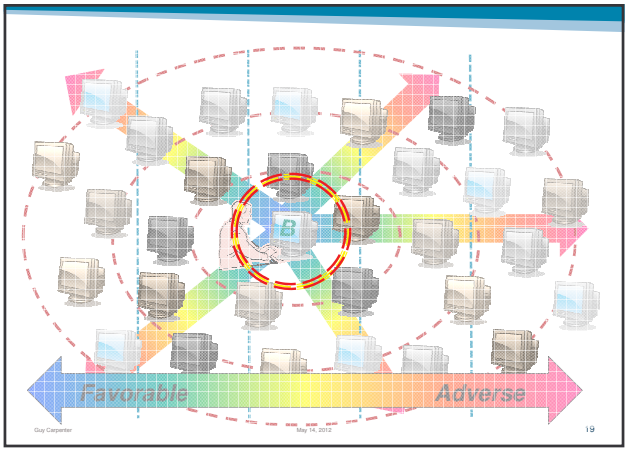


Complication: We are on the outside looking in

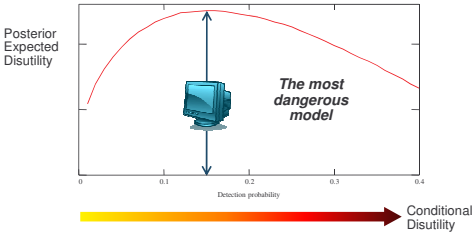
Our key simplifications and assumptions

- Discrete probability distributions
- Known sample size
- Baseline model is ML
- Prior symmetry

MIRANDA: the most dangerous model

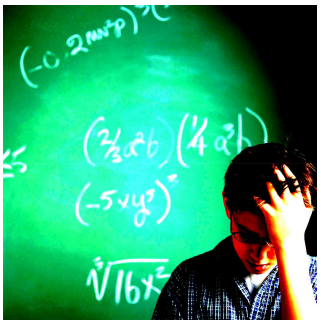


Sample Size + ML + Prior symmetry = Posterior Expected Disutility



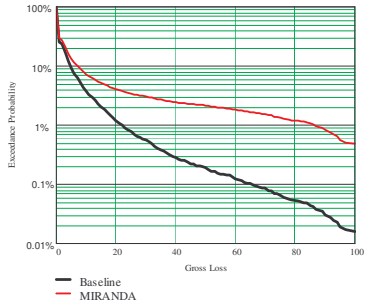
MIRANDA
(Maximum Impact Realized Adverse Non-Detectable Alternative)

Mathematics of MIRANDA

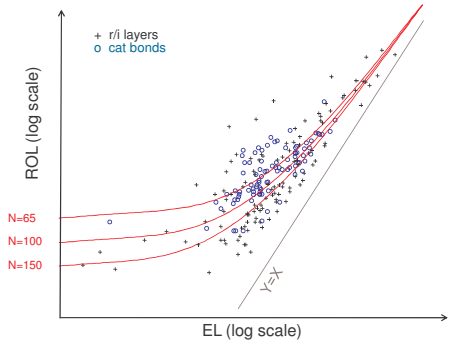


Maybe some other time.

What does MIRANDA look like?



Reinsurance XOL and cat bond pricing

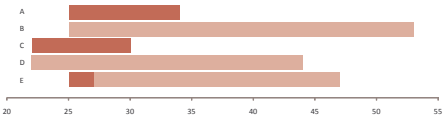


Case study: reinsurance decision

Five programs to consider; all available at $0.32

Program	Attach-ment	Pr{Att}	Limit	Coverage	EL
A	25	0.7%	9	100%	$0.050
B	25	0.7%	14	50%	$0.049
C	22	0.9%	8	100%	$0.057
D	22	0.9%	11	50%	$0.053
E1, 2	25 27	0.7%	2 10	100% 50%	$0.050

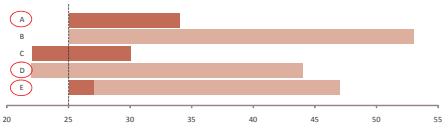
Baseline cat model statistics



Evaluation of programs under baseline

Program	Loss Cost	Reduc-tion	Surplus Deficit	Reduc-tion	Score
Bare	1.527	-	0.130	-	
A	1.477	3.3%	0.080	38.4%	20.9%
B	1.478	3.2%	0.081	37.4%	20.3%
C	1.470	3.7%	0.084	35.3%	19.5%
D	1.474	3.4%	0.080	38.3%	20.9%
E	1.477	3.3%	0.080	38.4%	20.9%

These 3 look quite comparable.

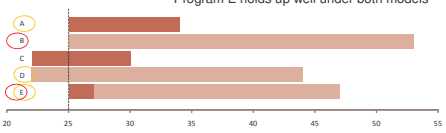


Evaluation of programs under MIRANDA

Program	Loss Cost	Reduc-tion	Surplus Deficit	Reduc-tion	New Score	Previous Score
Bare	3.530	-	1.311	-		
A	3.256	7.8%	1.037	20.9%	14.3%	20.9%
B	3.171	10.1%	0.953	27.3%	18.7%	20.3%
C	3.265	7.5%	1.065	18.8%	13.1%	19.5%
D	3.216	8.9%	1.001	23.6%	16.3%	20.9%
E	3.202	9.3%	0.983	25.0%	17.1%	20.9%

Robust

Program E holds up well under both models



Summary

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  - I'm accustomed to using my risk models in decision making.
  - Trouble is, I believed them. Now I find out there's a material degree of uncertainty in the results.
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- The Solution
  - Run a parallel analysis using MIRANDA: the most dangerous model.
  - Use those results to inform your decision making. Identify ***robust*** strategies that work well for the best estimate *and* worst case.
  - "Protect your downside."

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