GUY CARPENTER

CANE - September 25, 2008

Evaluating Reinsurance
Managing Critical Risk

Jonathan Hayes, Morristown, NJ

Disclaimer

- Opinions expressed herein are, at best, presenter's opinions, and may not even be that

- Opinions expressed herein are **not** opinions of the CAS or the presenter's employer

- Use of Jargon:
  - Speak up
  - Ask for definition

Opening Remarks

- *" . . . We do know who society's winners will be: those who are prepared to face Black Swans, to be exposed to them, to recognize them when they show up and to rigorously exploit them."*

Nassim Nicholas Taleb

- *"It's tough to make predictions, especially about the future."*

Yogi Berra

Thesis

- **Black Swan events happen far more frequently than people predict. Under these circumstances, nice to have risk management is actually mission critical.**

Agenda

- **Thesis**

- **Behavioral Economics**
  - Psychological impediments

- **General Motivations**
  - Maximize value of the firm

- **Program Comparisons**
  - Constrained optimization

- **Conclusions**

Behavioral Economics
Psychology

- 1. Start with $300 and either:
    - a. Collect $100, or
    - b. Flip coin for $200 or $0 gain
  - Most take (a)

- 2. Start with $500 and either:
    - c. Give up $100, or
    - d. Flip coin for $200 or $0 loss
  - Most take (d)

- 1 and 2 have same result set, same mean

- Conclusion: Know your bias
  - Risk averse on gain
  - Gamble on loss

Behavioral Economics
Black Swans - Failure

- "We were seeing things that were 25-standard deviation moves, several days in a row. There have been issues in some of the other quantitative spaces. But nothing like what we saw last week.
  - David Viniar, Goldman Sachs CFO, explaining 27% ytd drop in value of Goldman's flagship Global Alpha fund, quoted in Financial Times, August 13, 2007
  - Recipient, 2001 CFO Excellence Award for Risk Management

- ". . . someone ought to sneak into his office, sweep away the black feathers, and put a copy of Nassim Taleb's *Fooled by Randomness* on his desk chair. **If he and his Goldman quants don't recalibrate their understanding of black swans, the next few months are going to seem an awful lot like Hitchcock's *The Birds*.**
  - Seth Jayson, Motley Fool, August 15, 2007

- "... and remember, the next scream you hear may be your own!"

Behavioral Economics
Black Swans - Success

- Empirica Capital (Taleb hedge fund)
  - Never sells options, only buys them
  - Buys out of money options by the truckload
  - Lose small most days, wins huge occasionally
  - Inverted traditional psychology of investing
  - Result: Retired & best-selling author
  - Takeaway: Reinsurance is this put
    - The joyless prudence of the Sunday-school teacher

- J P Morgan
  - Criticized for earnings underperformance vs peers
  - Fort Knox balance sheet
  - Result: Fed support for $2/share Bear Stearns purchase, less than value of BSC midtown HQ building
  - Takeaway: Ready to prosper on transformational event

Reinsurance Motivations
Overview

- Maximize Value of Firm
  - Preserve/create surplus
  - Ensure (analyst expectations of) earnings
  - Manage volatility
  - Maintain/upgrade rating agency rating level

Motivation
Contingent Capital: Create Franchise

STYLIZED 3-POINT DISTRIBUTION			

Annual Probability	Reinsurance		(Cost)/Benefit
	Bare	Purchase	
	($Ms)	($Ms)	($Ms)
			(1)-(2)
	(1)	(2)	(3)
90%	0.00	7.00	(7.00)
9%	30.00	9.10	20.90
1%	100.00	14.00	86.00
Annl Avg.	3.70	7.26	(3.56)

Cost of Capital = 4.14%

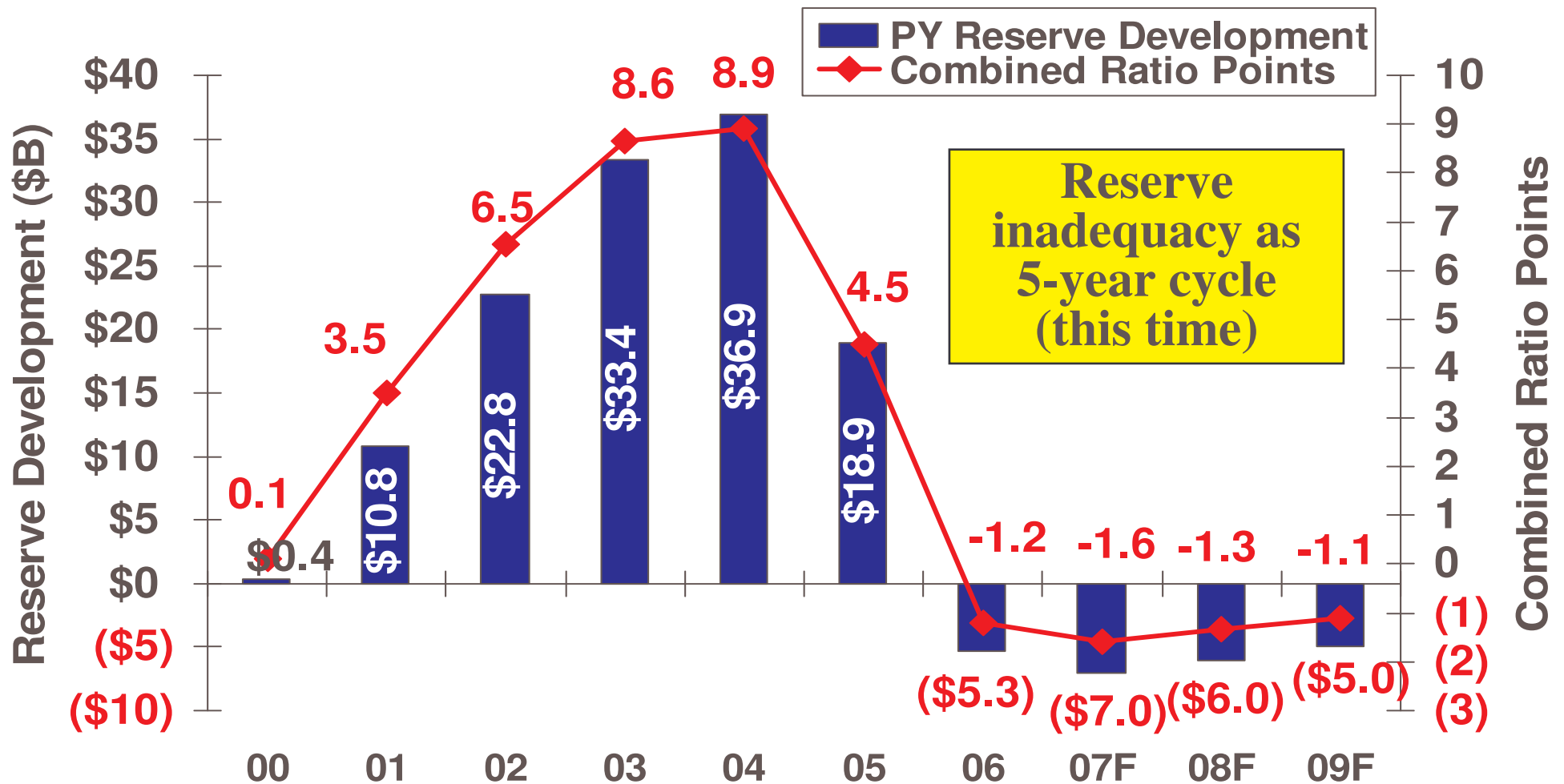## Motivation
ERM Framework: Protect Franchise Value

- Earnings Surprises Destroy Franchise
  - Even if earnings positive and surplus untouched
  - Merrill Lynch: 6% MV write-down = 16.3% MV loss = 2.7 hit ratio
  - Citigroup: 5.3% MV write-down = 24.5% MV loss = 4.6 hit ratio

  MV – Market Value

- Merrill Lynch (2007) Details
  - $3.4b (6.0%) surprise on Oct 24
    - $10.6b (18.6%) market value drop through Nov 7
      - $9.3b (16.3%), adjusting for ^DJI movement
    - Leverage factor of about 2.74

- Citigroup (2007) Details
  - Nov 4 $11b (5.3%) surprise reduced market cap $51b (24.5%)
    - Leverage factor of 4.63
      - Second surprise gets higher leverage

- What is Your (Levered) Cat Limit as % of Market Value of Firm?

Motivation
Impact of Reserve Changes on CY Combined Ratio

Slide from R. Hartwig (III) Feb 1 presentation
Data Sources: A.M. Best, Lehman Brothers estimates for years 2007-2009

Motivation
Drill-down on CY Effects

- 32 points for 5-yr period 2001-2005
  - 5-yr bleed: Reputational damage leveraged for successive hits
  - One 32 point CY addition: Short-term intense damage

- 32 points on *total* premium
  - Most of reserve addition is casualty
  - Not all casualty equally affected

- **Possible 100+ Point Increment on Volatile Lines**

	Impact of Reserve Change on Calendar Year Results		
Year	P/C	Casualty	"At Risk"
2001	3.5%	6.3%	12.5%
2002	6.5%	11.6%	23.2%
2003	8.6%	15.4%	30.7%
2004	8.9%	15.9%	31.8%
2005	4.5%	8.0%	16.1%
5-yr total	32.0%	57.1%	**114.3%**

Est. Casualty Prem./Total Prem.	56.0%
Est. "At Risk" Casualty/Total Casualty	50.0%

Program Comparisons
Constrained Optimization

- Timeframes Matter

- Between Companies
  - Goals differ
  - Constraints differ
  - Weights differ
  - Often there are conflicts
  - Differences even with company

- For Comparisons
  - Aggregate distributions key
  - Scenario testing often useful
   - Yves St Laurent: "All models are flawed, some are useful."

Program Comparisons
Program Definition

- Current
  - □ 4x1 Casualty XOL, $4.41m dep.
  - □ 17x3 Prop Risk, $2.36m dep.
  - □ 24x1 Prop Cat, $1.53m dep.
  - Total Deposit: $8.3m
  - Average Recovery: $5.08m

- Alternative
  - □ 20x30 Stop Loss, $1.98m dep.
  - Total Deposit: $1.98m
  - Average Recovery: $0.98m

- Comparison

|	Deposit	Recovery	ELR	Net Cost
Current	8.3m	5.08m	61%	3.2m
Alternative	1.98m	0.98m	49%	1.0m

Schematic of "Current"
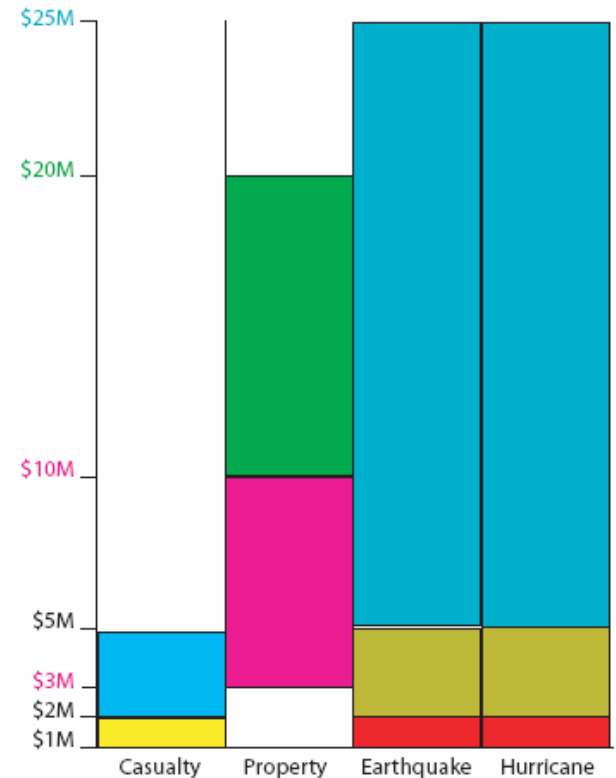
Add'l Info: "Bare" Pre-tax income is $6m ($2.5m u/w inc. and $3.5m inv. inc.)

Source: G. Venter

Program Comparisons
U/W Income Distributions

- In good years, u/w give-up vs bare
  - More with "current"

- In stressed years, smaller loss
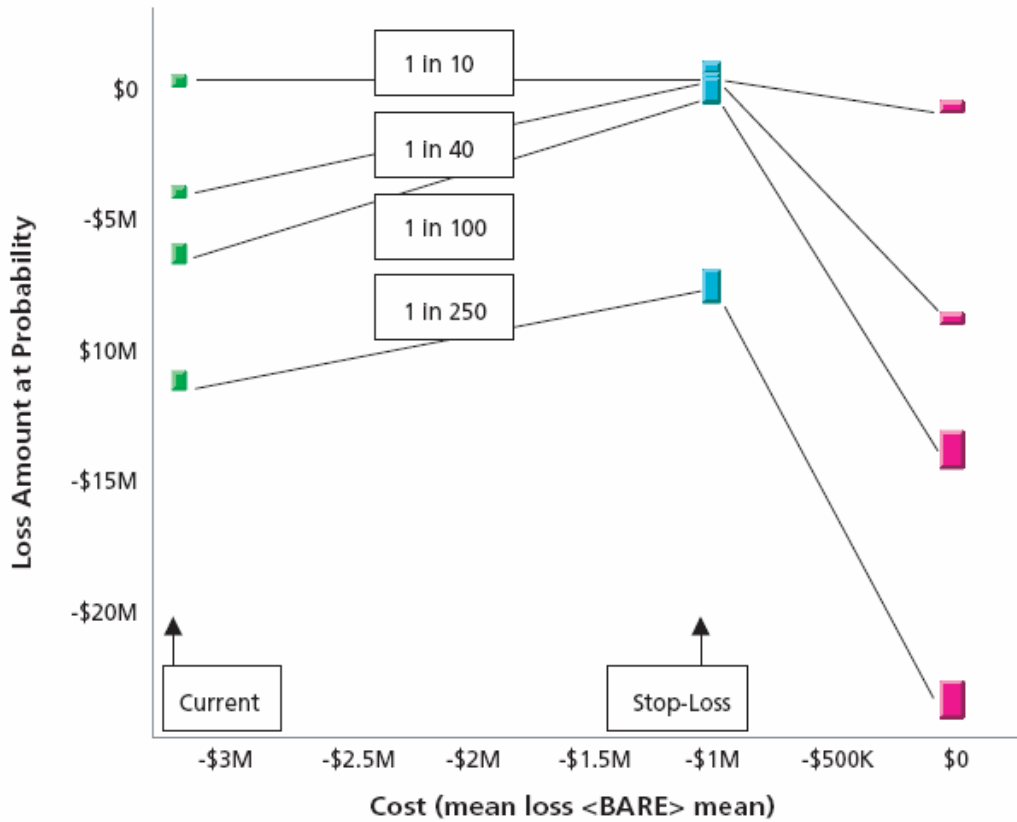 - Often smaller with stop-loss
  - But sometime smaller w/ "current"
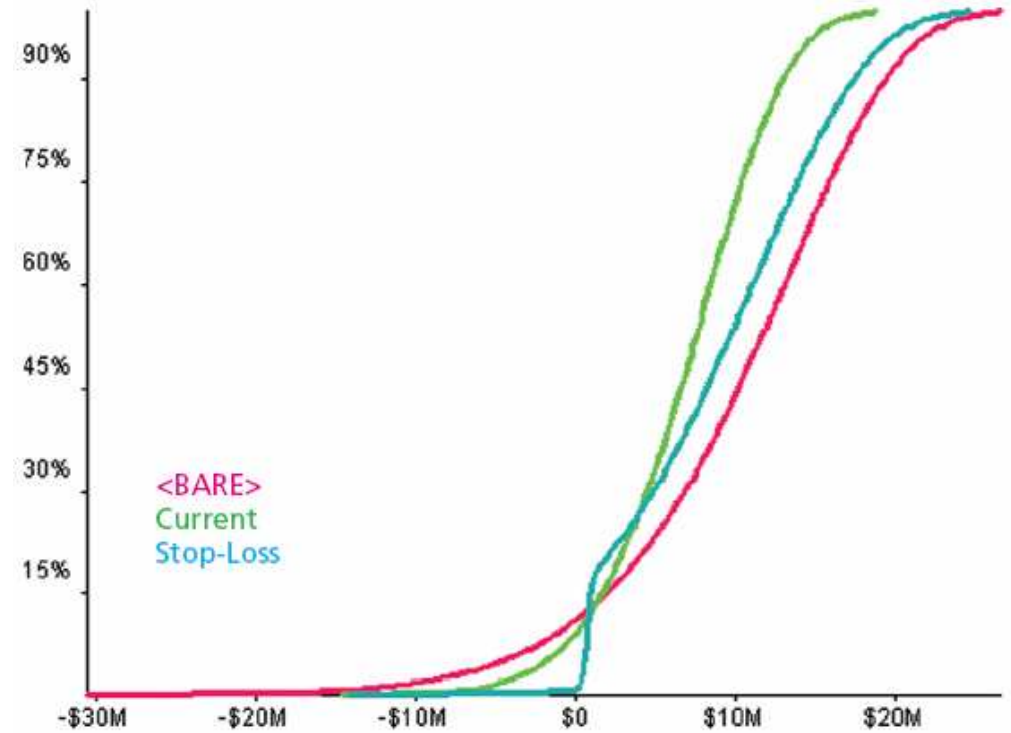
Charts: G. Venter

Program Comparisons
Pre-tax Net Income

Net Income at Select (Downside) VaR Points

PROBABILITY	<BARE>	CURRENT	STOP-LOSS
0.00%	-$55,178,595	-$28,306,230	-$37,630,975
0.25%	-$31,005,991	-$17,189,245	-$14,119,948
0.50%	-$26,892,281	-$15,086,897	-$10,895,456
0.75%	-$22,778,572	-$12,984,549	-$7,670,964
1.00%	-$18,664,862	-$10,882,200	-$4,446,471
1.25%	-$17,421,513	-$10,268,365	-$4,142,799
1.50%	-$16,427,760	-$9,842,270	-$4,093,112
1.75%	-$15,434,007	-$9,416,175	-$4,043,424
2.00%	-$14,440,254	-$8,990,080	-$3,993,736
4.00%	-$10,463,474	-$7,018,476	-$3,794,897
6.00%	-$8,102,434	-$5,744,442	-$3,676,845
8.00%	-$6,458,705	-$4,809,988	-$3,594,659
10.00%	-$5,096,235	-$4,094,278	-$3,526,536
12.00%	-$3,959,159	-$3,406,773	-$3,469,682
14.00%	-$2,894,490	-$2,878,175	-$3,416,448
16.00%	-$1,897,552	-$2,408,648	-$3,366,601
18.00%	-$1,061,245	-$1,925,731	-$3,097,694
20.00%	-$361,149	-$1,498,681	-$2,402,529
22.00%	$307,908	-$1,098,503	-$1,733,472
24.00%	$982,421	-$728,889	-$1,058,959
25.00%	$1,296,808	-$559,048	-$744,572
26.00%	$1,624,777	-$387,412	-$416,603
28.00%	$2,180,935	-$52,412	$139,555
30.00%	$2,716,957	$266,377	$675,577
32.00%	$3,243,264	$589,248	$1,201,884
34.00%	$3,712,176	$918,157	$1,670,796
36.00%	$4,191,560	$1,208,645	$2,150,180
38.00%	$4,645,373	$1,483,405	$2,603,993
40.00%	$5,105,900	$1,759,300	$3,064,520
42.00%	$5,549,810	$2,050,117	$3,508,430
44.00%	$5,943,896	$2,309,246	$3,902,516
46.00%	$6,374,982	$2,603,107	$4,333,602
48.00%	$6,771,059	$2,856,018	$4,729,679
50.00%	$7,150,354	$3,106,480	$5,108,974

Charts: G. Venter

Program Comparisons
Efficient Frontiers

- Some programs are suboptimal

- Other are alternative points on efficient frontier
  - Need to understand company preferences, tolerances, etc.

- 2 dimensions of n-dimensional matrix
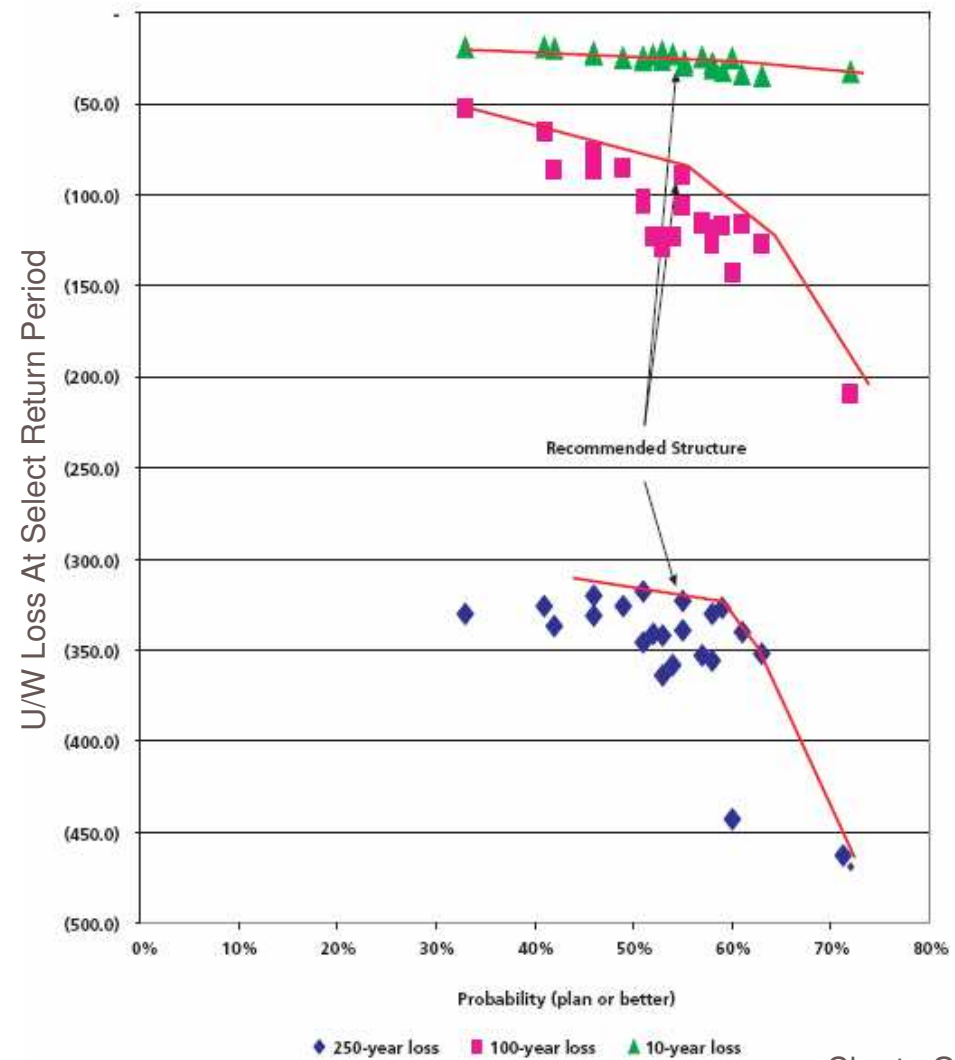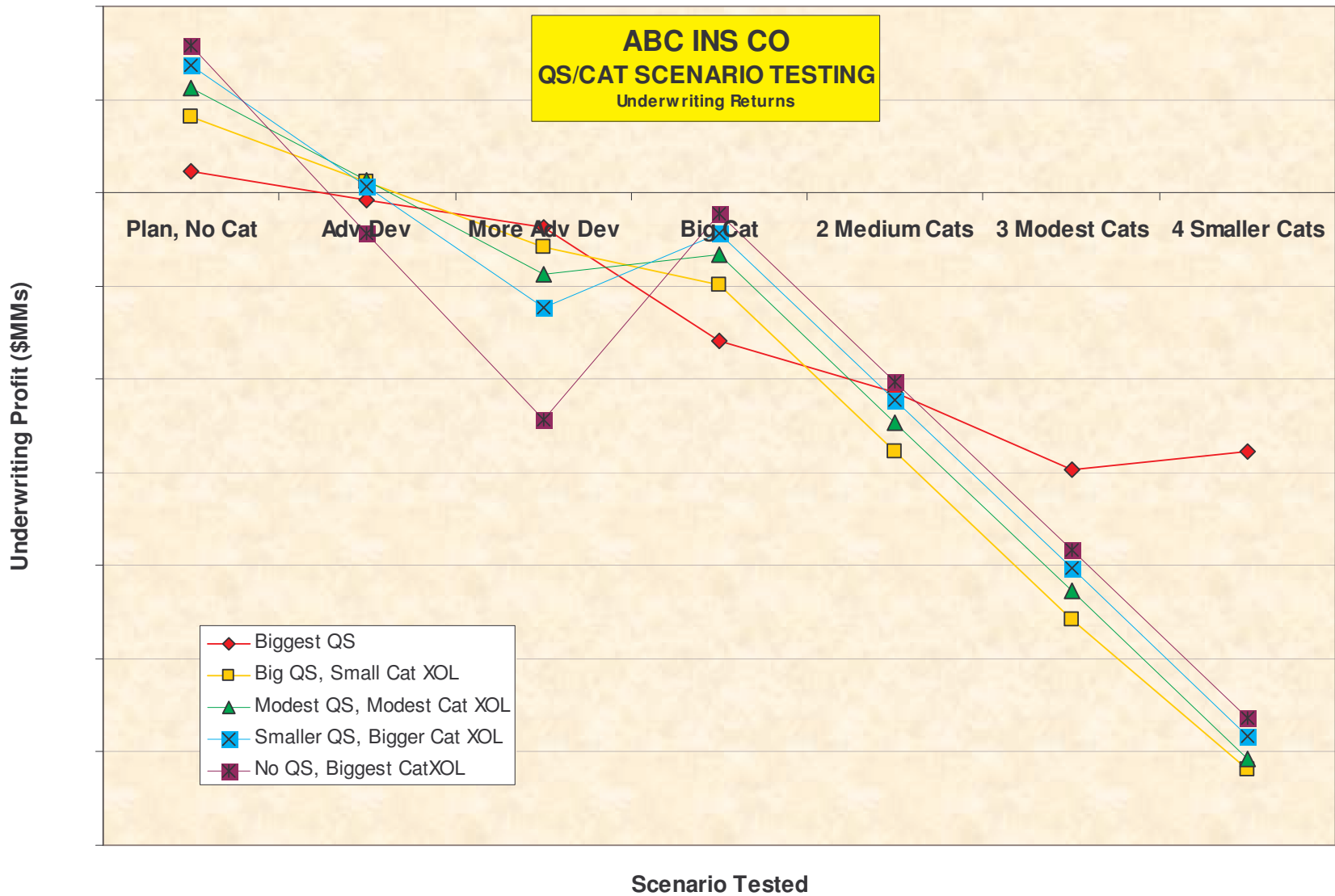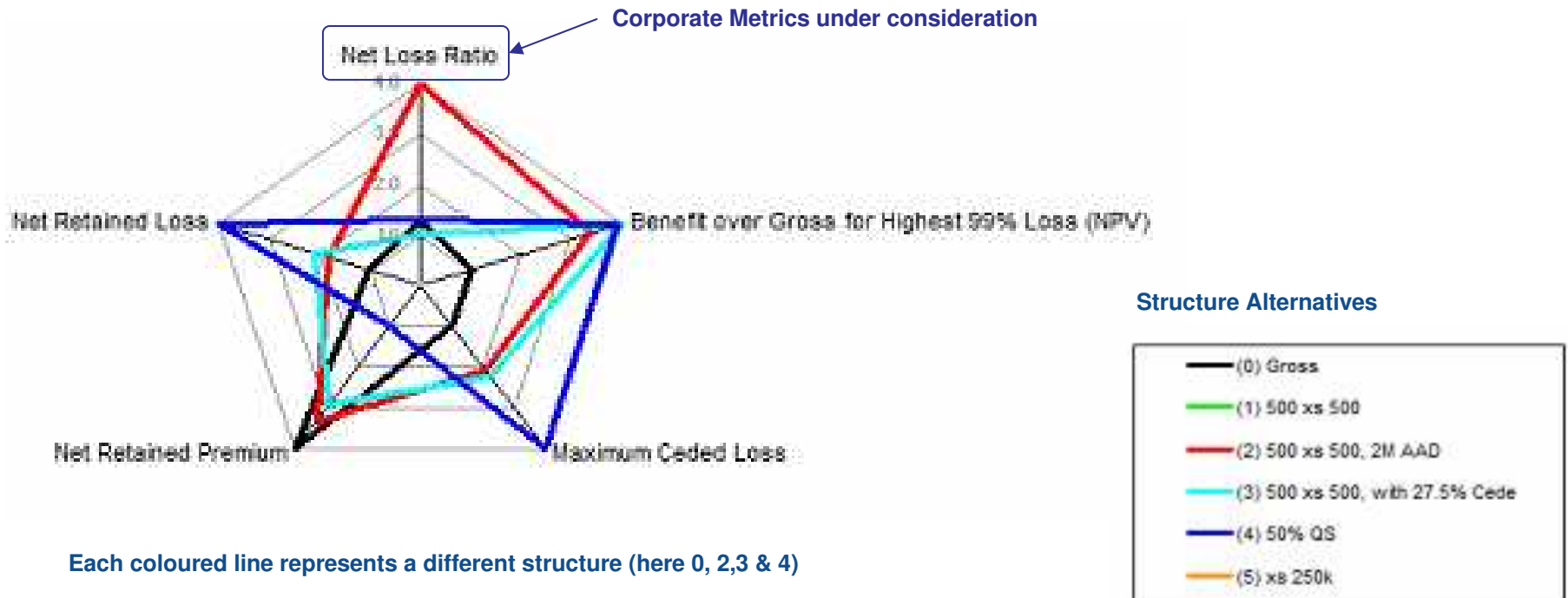
P(Plan) vs Loss at Select Rtn Pds

Chart: G. Venter

Program Comparisons
Scenario Testing: Examining Tradeoffs

Program Comparisons
Scenario Testing: Relative Values via Radar Charts

Corporate Metrics under consideration

Net Loss Ratio

Net Retained Loss

Benefit over Gross for Highest 99% Loss (NPV)

Net Retained Premium

Maximum Ceded Loss

Each coloured line represents a different structure (here 0, 2,3 & 4)

Structure Alternatives

- (0) Gross
- (1) 500 xs 500
- (2) 500 xs 500, 2M AAD
- (3) 500 xs 500, with 27.5% Cede
- (4) 50% QS
- (5) xs 250k

- Goal: Maximize area of polygon
  - Given appropriate metric selections

- Try for a mix of metrics
  - Income, volatility, upside, downside, risk vs reward, rating, plan, etc.

- Avoid duplicative metrics
  - Eg u/w income, pretax income

Program Comparisons
Financial Metrics

	Cat Option		
	A	**B**	**C**
Estimated BCAR			
Original	139.5%	140.0%	154.8%
With Cat Stress Test	121.4%	125.4%	137.0%
Implied Rating			
Original	A-	A-	A
With Cat Stress Test	B++	B++	A-
Percent of Annual Earnings			
Retention	50%	25%	50%
Net 1 in 100 AEP	125%	97%	131%
Net 1 in 250 AEP	350%	333%	150%
Percent of Surplus			
Retention	5%	3%	5%
Net 1 in 100 AEP	13%	10%	13%
Net 1 in 250 AEP	35%	33%	15%

- A Current

- B New lower layer
  - More earnings protection

- C New top layer
  - Tail protection to 1 in 250

- Tradeoffs
  - Add'l spend budget
  - 1 v 2 quarter earnings hit
  - Possible upgrade

- Plan, Goals, Constraints, Preferences, etc, matter

BCAR - Best Capital Adequacy Ratio, a numerical score necessary, though not sufficient for a rating level.

Conclusions

- Reinsurance, if Well-designed:

  – Adds Value To The Firm By

    ▫ Freeing Up Capital

    ▫ Providing Earnings Stability

    ▫ Helping with Ratings

Closing Remarks

- *The purposes of the CAS are to advance the body of knowledge of actuarial science applied to property, casualty, and similar risk exposures . . .*

  CAS Constitution, Article II, Statement of Purpose

- *A prince who will not undergo the difficulty of understanding must undergo the danger of trusting.*

  Sir George Savile (1633-95), 1st Marquis of Halifax

- *Concentrate on consequences of Black Swans, which can be known, rather that the probability that they will occur, which can't.*

 Nassim Taleb, via The Economist book review

- *Wise venturing is the most commendable part of human prudence.*

  Sir George Savile (1633-95), 1st Marquis of Halifax

Appendix
"*Black Swan*" Primer
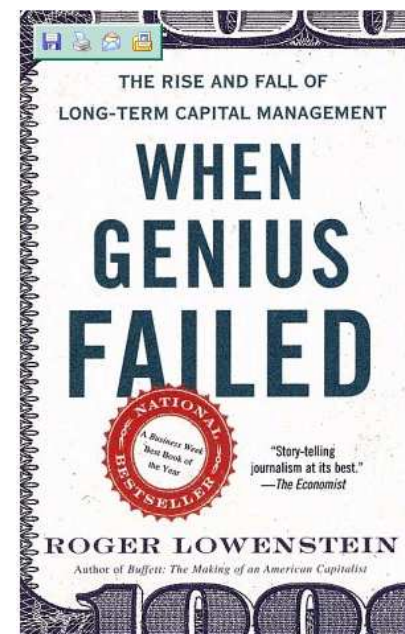
Black Swan Definition
via Karl Popper

- Black Swan via Karl Popper (1902-1994), philosopher

  – No amount of observations of white swans can allow the inference that all swans are white, but the observation of a single black swan is sufficient to refute that conclusion
  - Bird once thought not to exist, until found in Australia in 17th century

  – Author, *All Life is Problem Solving*

KARL POPPER

ALL LIFE IS PROBLEM SOLVING
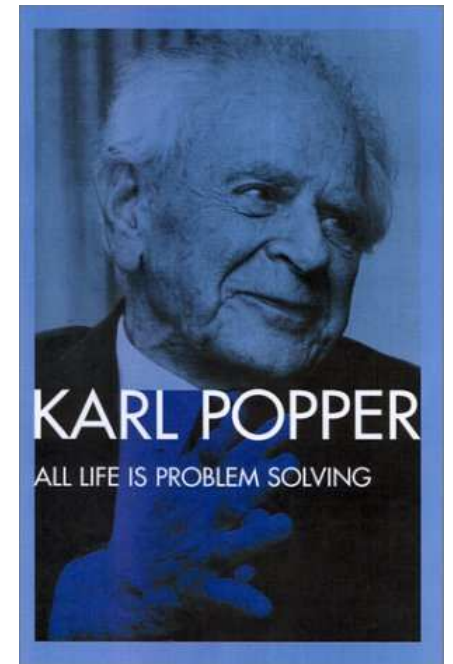
Black Swan Definition
via Nassim Nicholas Taleb

- Black Swan via Nicholas Taleb (b.1960)
  - An event that is unexpected, has an extreme impact and is made to seem predictable by explanations concocted afterwards
    - 1987 – Oct stock market crash
    - 1992 – Latin American debt crisis
    - 1998 – LTCM collapse (Russian debt crisis)
    - 2000 – Tech bubble bursts
    - 2001 – Enron bankruptcy
    - 2007 – Subprime crisis
    - 2008 – Societe Generale trading loss
  - All handicapped, a priori, at over 1000:1

THE RISE AND FALL OF
LONG-TERM CAPITAL MANAGEMENT

WHEN GENIUS FAILED

NATIONAL BESTSELLER

A Business Week Best Book of the Year

"Story-telling journalism at its best."
—The Economist

ROGER LOWENSTEIN
Author of Buffett: The Making of an American Capitalist

Black Swan Cliff Notes
Mediocristan vs Extremistan

- "Mediocristan"
  - For large samples, average converges to the middle
    - Bell-shaped curve/Gaussian
  - Extreme event probability very low
  - Long-term observations provide information about probable outcomes
  - Impervious to the Black Swan

- "Extremistan"
  - Average outcomes have little meaning
    - Hurricanes: 1% chance of $100m loss, 99% chance of no loss
    - Power Law rules
  - Hard to predict from past observations
  - Financial markets like medicine in the 1800s
    - Hospital visit multiplies risk of death 4x
    - Flawed quant models exacerbate market swings
  - Vulnerable to the Black Swan

Black Swan Cliff Notes
Seduction of Mediocristan

- Seduction
  - Confirmation Bias
    - Tendency to reaffirm beliefs, not contradict them
  - Narrative Fallacy
    - Weakness for compelling stories
  - Silent Evidence
    - Failure to account for what we do not see
  - Ludic Fallacy
    - Willingness to oversimplify, take games/models too seriously
  - Epistemic Fallacy
    - Overestimate our knowledge, underestimate our ignorance

- Unfortunate Observations
  - "What is surprising is not the magnitude of our forecast errors, but our absence of awareness of it."
  - Unfortunate lesson: Better to be wrong than alone