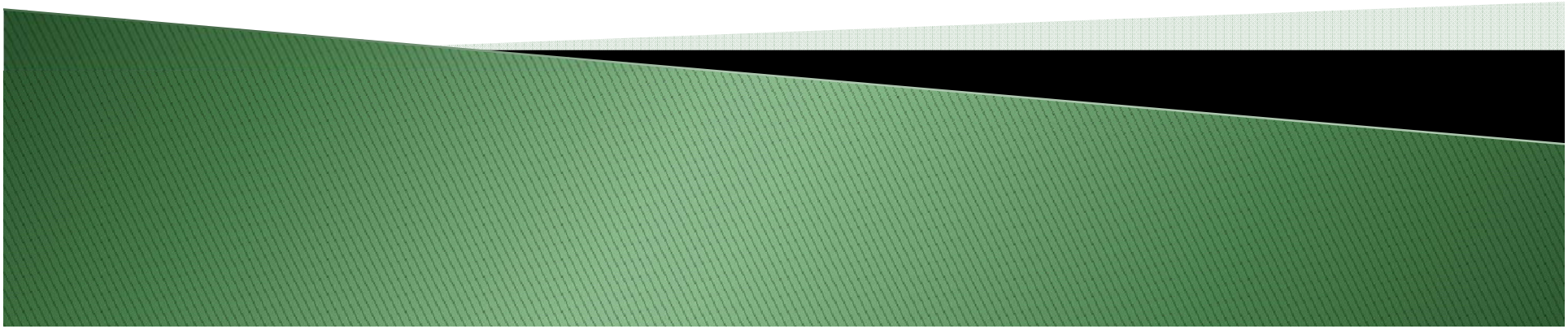
Uses of Catastrophe Modeling Output

CAS Ratemaking and Product Management Seminar

March 15, 2010



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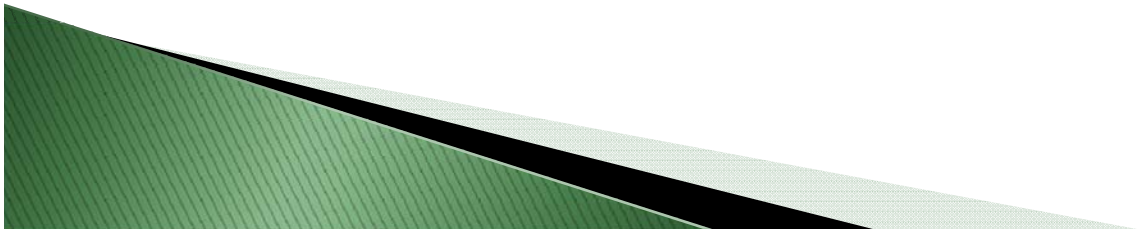
Agenda

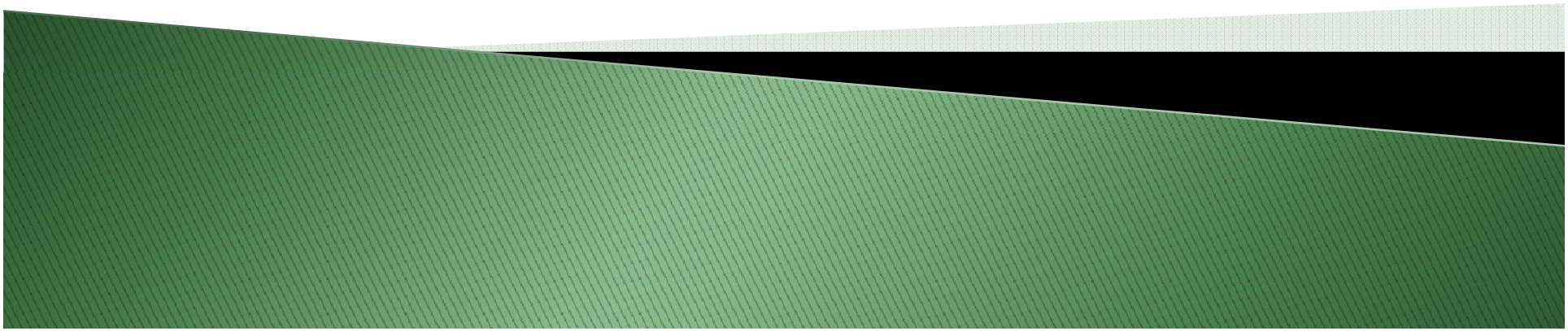
- Introductions
- Reinsurance / Capital Issues
  - Reinsurance Program Analysis
  - What do the Reinsurers do?
- Capital Adequacy – views of rating agencies / regulatory
- Classification plans
- Exposure management
- Miscellaneous issues
- Workers Compensation Catastrophe Modeling

Introductions

- Elliot Burn, FCAS, MAAA, Managing Director, Instrat, Guy Carpenter
- Shawna Ackerman, FCAS, MAAA, Principal & Consulting Actuary, Pinnacle Actuarial Resources
- Charles Parsons, FCAS, MAAA, Sr. Actuary, Allstate Insurance Company



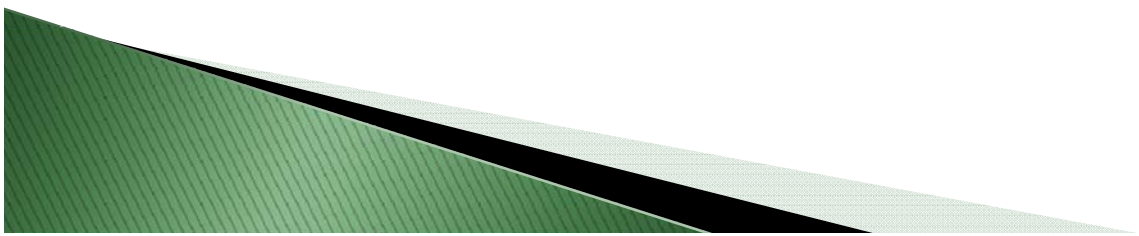
Reinsurance / Capital Issues



Basics of Reinsurance

Definition

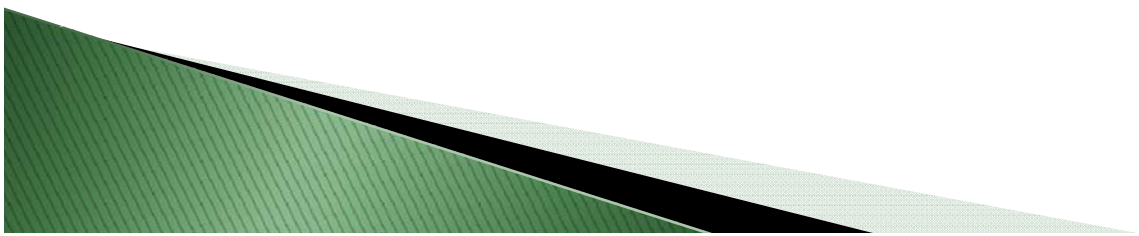
- Insurance for insurance companies
  - An insurance company, called the “primary” or “ceding” company, shares portions of its liability with another insurance company, known as a reinsurer
- Reinsurance is a transaction between insurance companies only
- The heart of reinsurance is “utmost good faith” (uberrimae fides) and follow-the-fortunes



Basics of Reinsurance

Functions

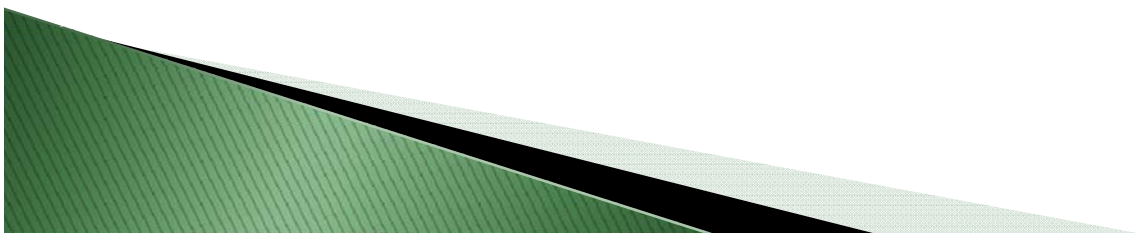
- Large line capacity
  - write large exposures
- Spread of risk
  - protect ceding company against unanticipated losses
- Stabilization of loss experience
  - control accumulation of losses over a period of time
- Catastrophe relief
  - catastrophic loss is shared with one or more reinsurers
- Premium capacity
  - ability to write additional premium while maintaining a healthy ratio between premiums and surplus



Excess of Loss Reinsurance – Catastrophe Excess of Loss

Definition

- Form of excess of loss covering an accumulation of losses resulting from a catastrophic event
- Applies to the ceding company's net retention after reduction by recoveries from all other reinsurances
- Coverage can be limited by co-participation (i.e., reinsurers would cover 95% of loss)



Excess of Loss Reinsurance – Catastrophe Excess of Loss

Example

1st Catastrophe Excess: 95% of $5,000,000 in excess of $1,000,000 per occurrence

A windstorm loss involves the following risks:

	Risk	Net Loss Paid
1)	Apartment Building	$ 1,000,000
2)	Restaurant	2,000,000
3)	Single Family Dwelling	600,000
	TOTAL	$ 3,600,000
	less Retention	1,000,000
		2,600,000
	Times Percent of Coverage	x 95%
	Reinsurance Recoverable	$ 2,470,000
	Ceding Company Pays ($1,000,000 + 5% of $2,600,000)	**$ 1,130,000**
	Reinsurers Pay	**$ 2,470,000**

Excess of Loss Reinsurance – Catastrophe Excess of Loss

Reinstatement Formula

$$\frac{\text{Reinsurance Loss}}{\text{Reinsurance Limit}} \times \frac{\text{Number of days remaining in the period}}{\text{Number of days in the period}} \times \text{Reinstatement Premium}$$

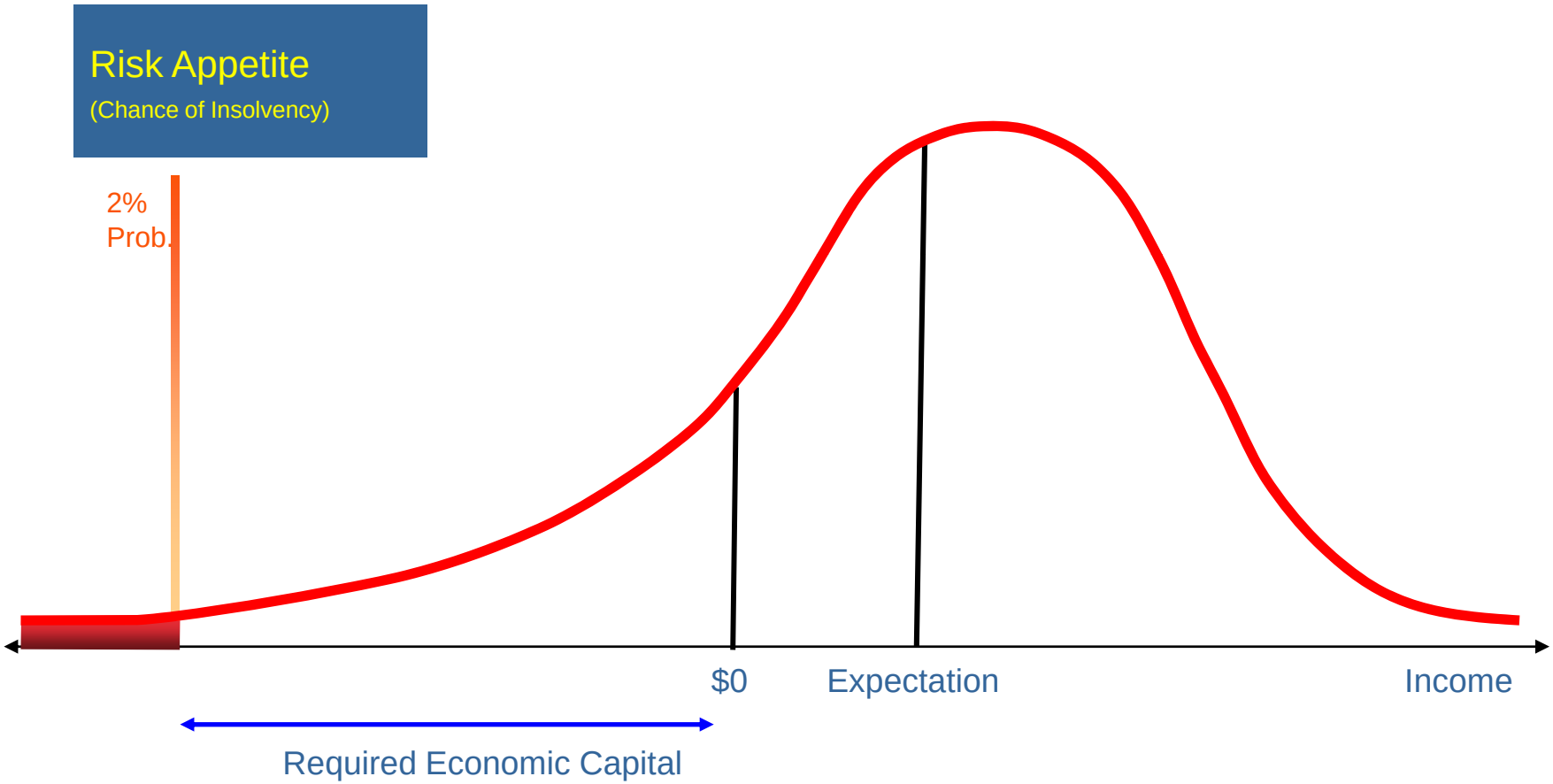
Example:

$$\frac{5{,}000{,}000}{20{,}000{,}000} \times \frac{292}{365} \times 400{,}000$$

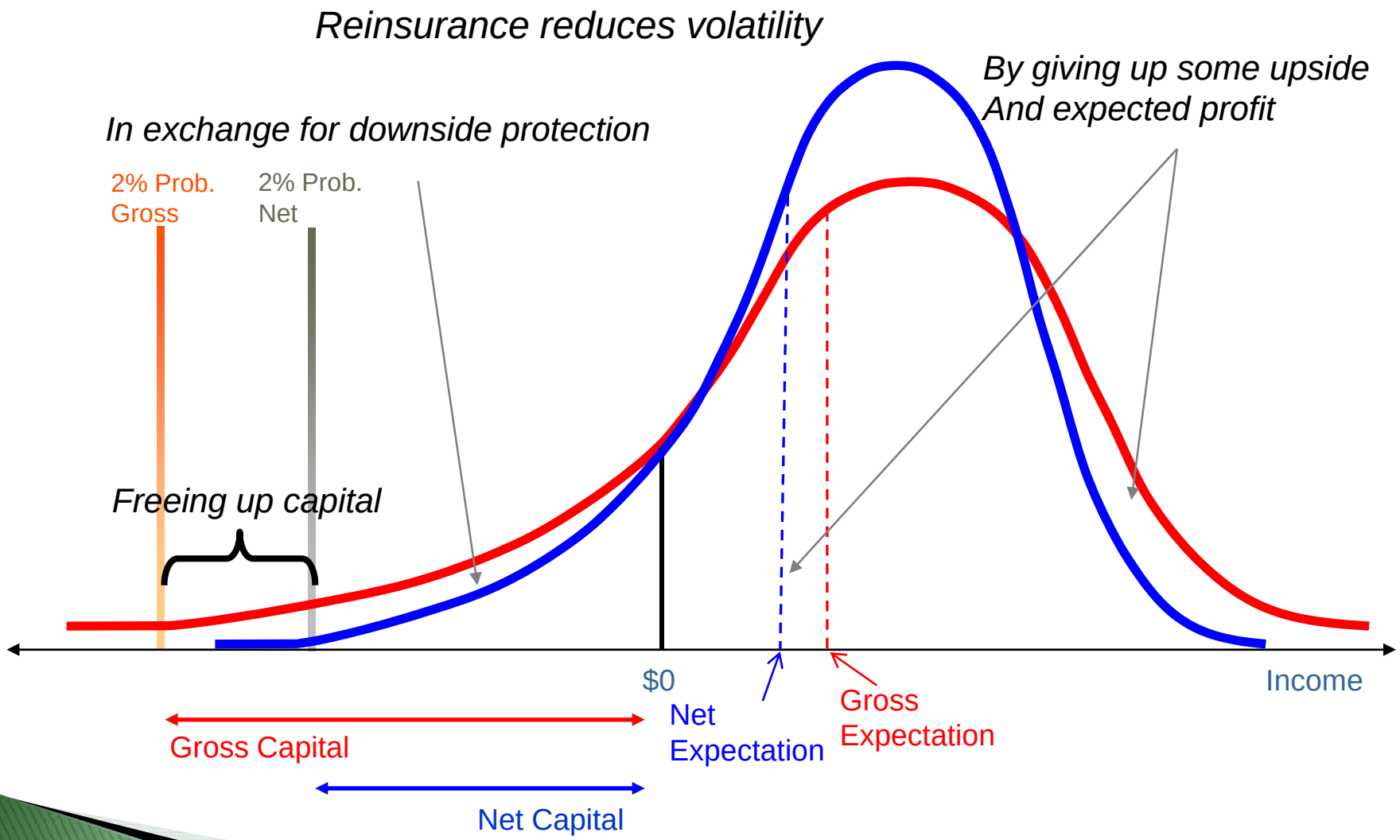
= $80,000 Reinstatement Premium

Required Capital

Capital is a function of risk profile and risk appetite

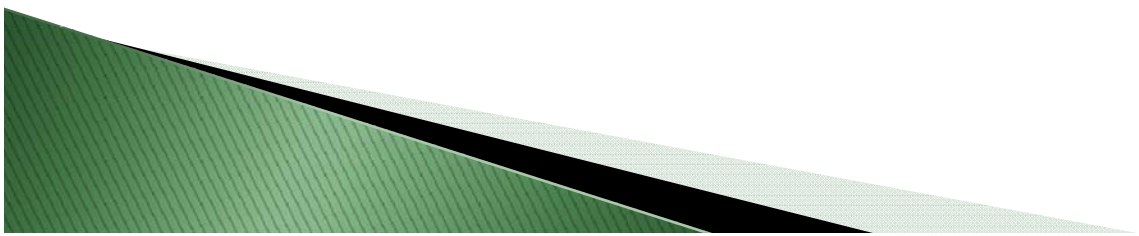


Required Capital

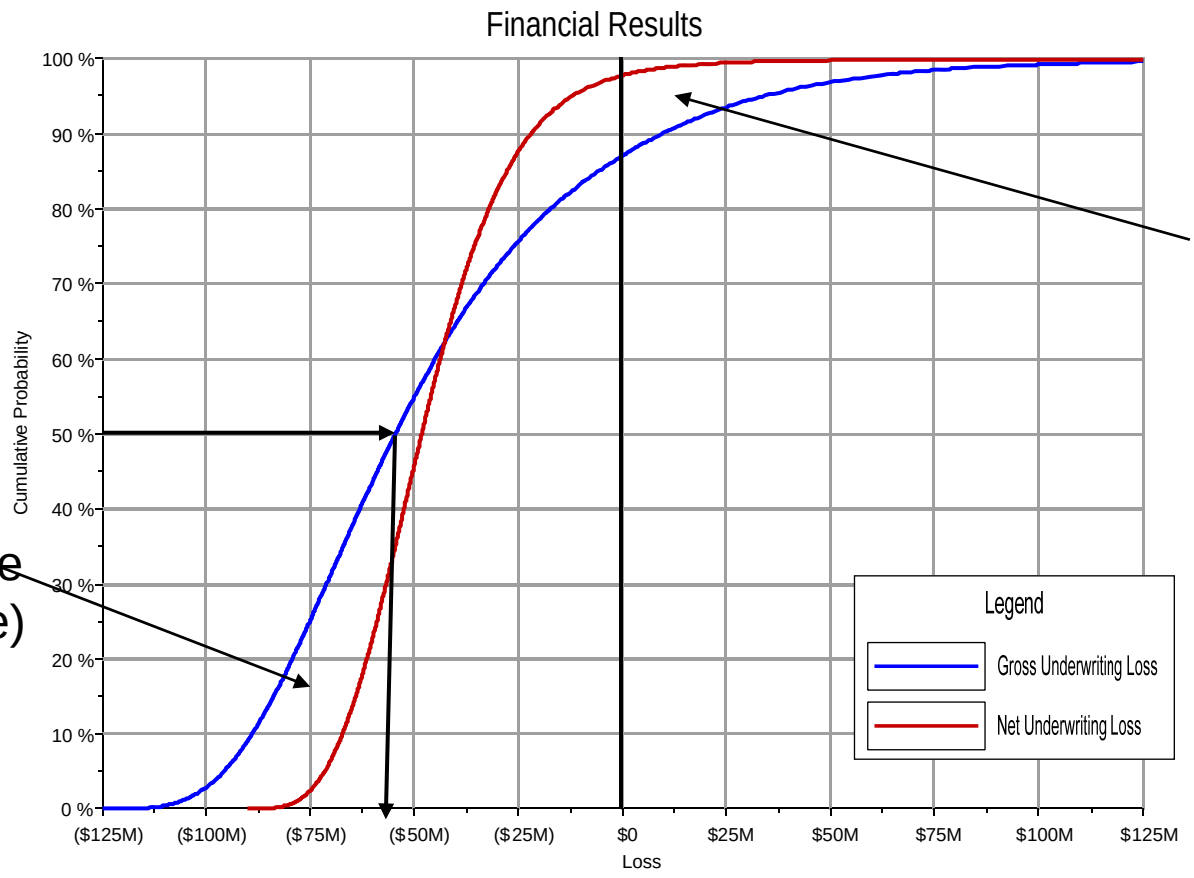


Reinsurance Motivations Overview

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



Reinsurance Cost/Benefit



Benefit of Reinsurance (less downside)

Cost of Reinsurance (less upside)

Good (negative loss)

Bad (positive loss)

Motivation
Contingent Capital: Create Franchise Value

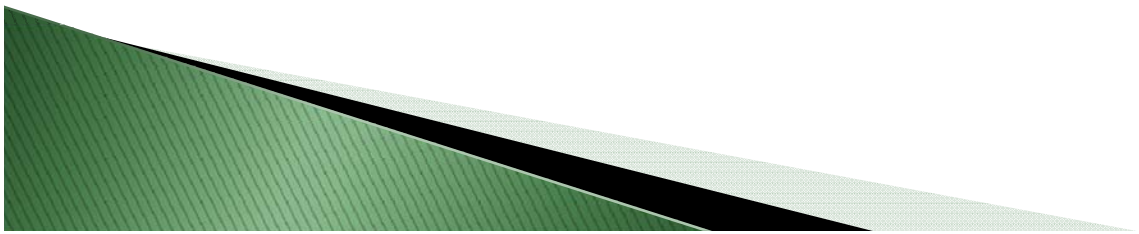
STYLIZED 3-POINT DISTRIBUTION

Annual Probability	Reinsurance		
	Bare	Purchase	(Cost)/Benefit
	($Ms)	($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)

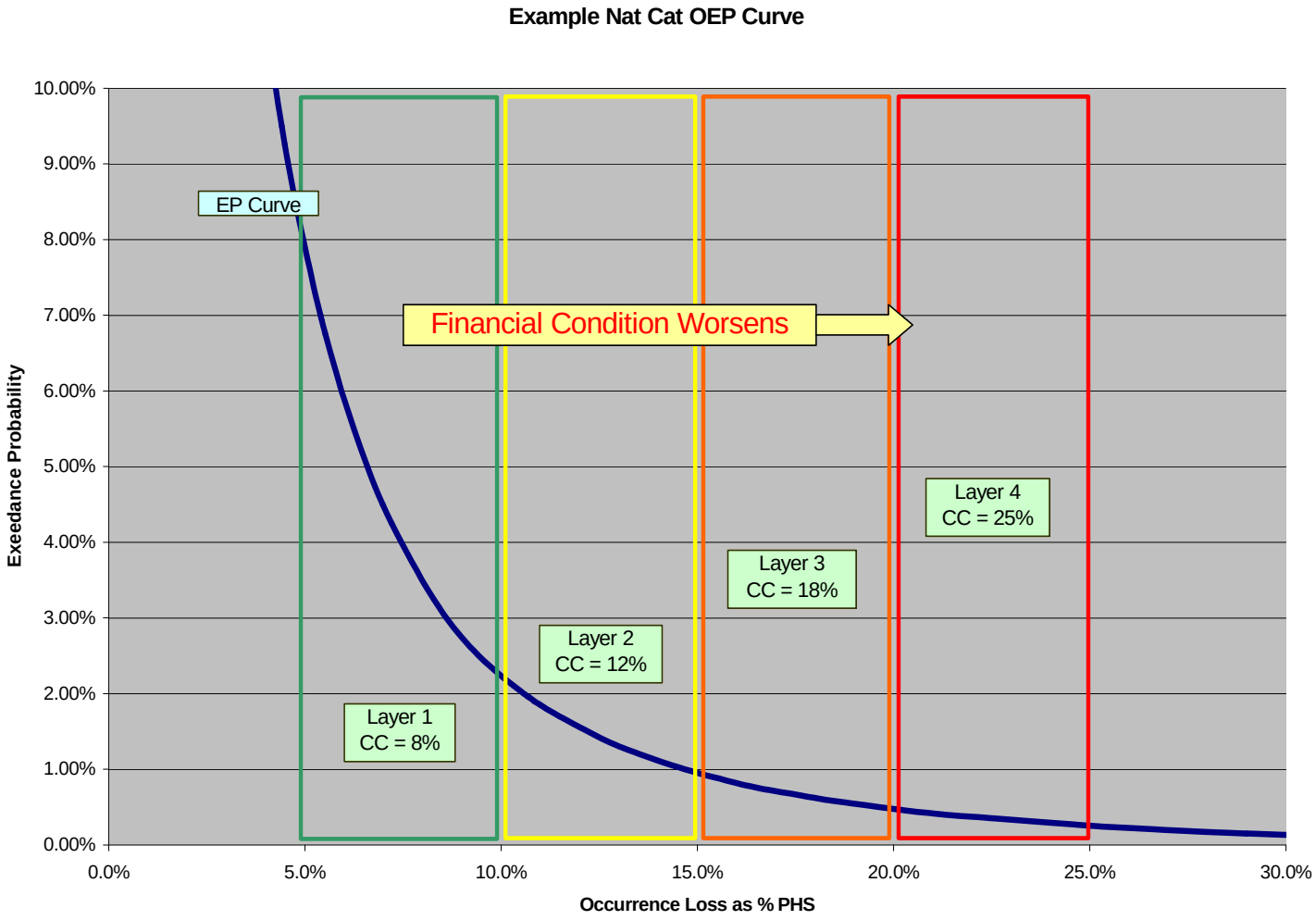
Cost of Capital = 4.14%

Change in Required Capital

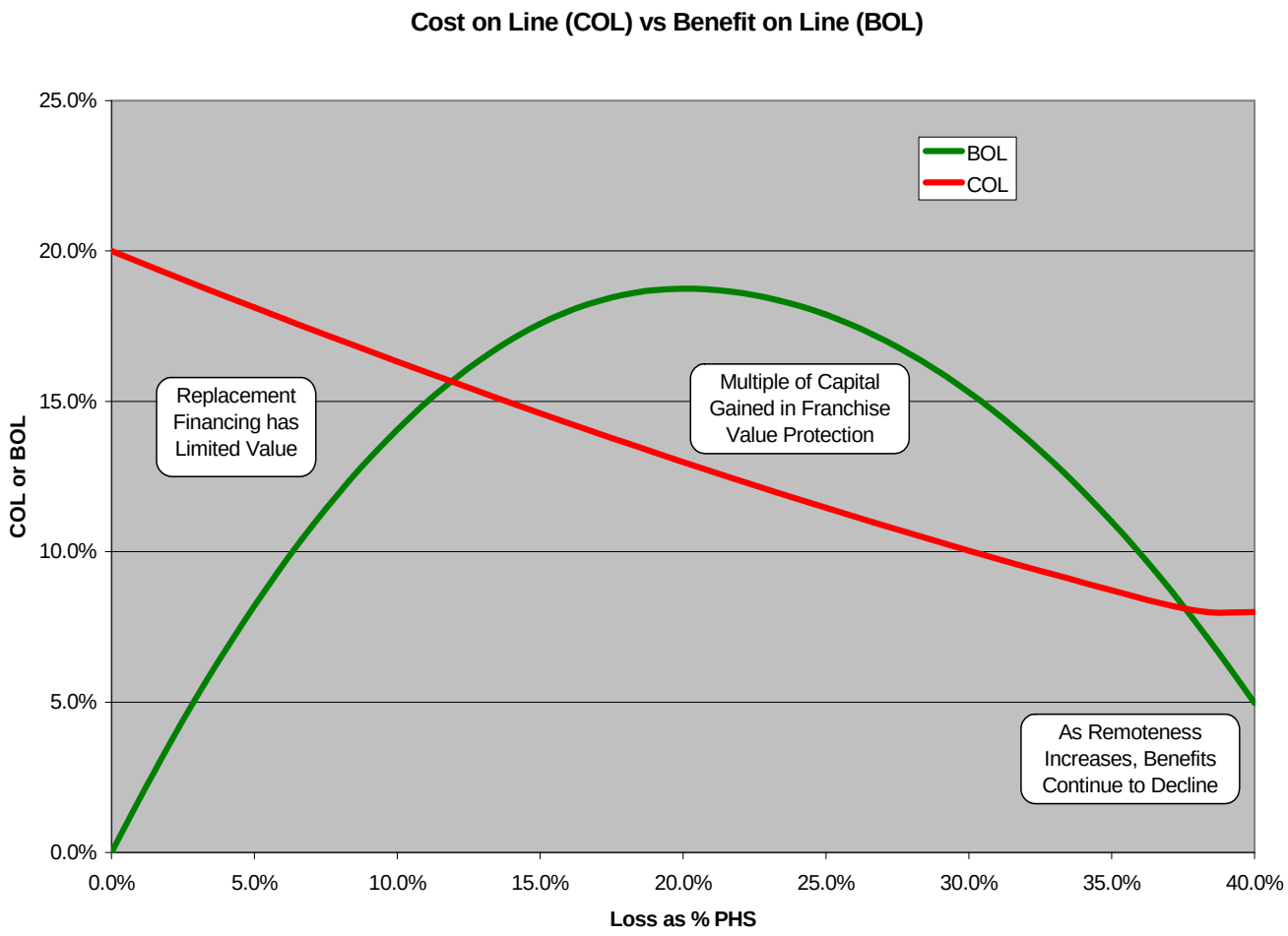
- Calculate Required Capital via a probabilistic measure (e.g., TVaR 98%) with and without the reinsurance program. Difference is Δ *required capital*
- Multiply Δ required capital by a cost of capital rate
  - Company capital cost rate using CAPM:
  - Risk-free (5%) + Equity Premium (4-8%) * β
- Product is net benefit in terms of capital cost savings
- Compare net benefit to "Net Cost of Reinsurance" = NPV ceded premium – NPV expected recovery
- Only buy layers where costs are less than benefit



Cost of Capital by Layer



Cost of Capital by Layer



Setting Risk Tolerance

Potential Criteria

Metric	Tolerance	Probability
BCAR	<200%	1.0%
BCAR	<225%	5.0%
Loss of PHS	10%	2.5%
Loss of PHS	5%	5.0%
Net U/W Loss	$100M	2.0%

- Often a constraint on meeting corporate objectives
- Needs to be quantified
  - Every additional (subtraction of) exposure bends the EP curve upwards (downwards)
  - Where do you want it to bend?
- Considerations
  - Trade off between profit, volume and risk of ruin
  - X% increase in premium for Y% increase in PML/TVaR
  - Timing
  - Near term financial results vs. long term relationships

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

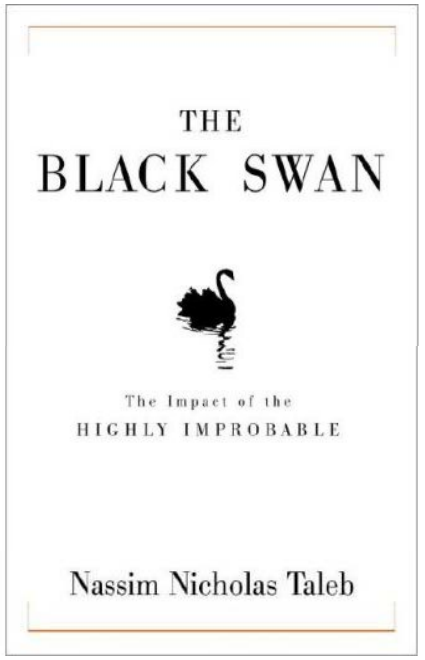
MV – Market Value

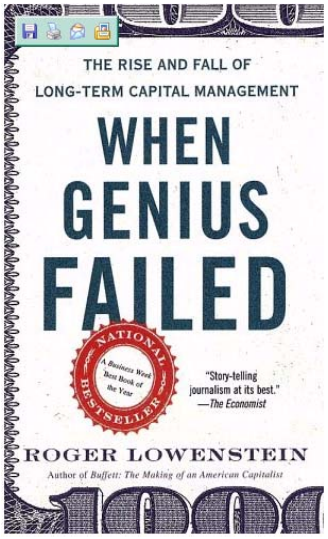
- Merrill Lynch (2007) Details
  - $3.4b (6.0%) surprise on Oct 24
    - $10.6b (18.6%) market value drop through Nov 7
      - $9.3b (16.3%), adjusting for ^DJI movement
    - Leverage factor of about 2.74
- Citigroup (2007) Details
  - Nov 4 $11b (5.3%) surprise reduced market cap $51b (24.5%)
    - Leverage factor of 4.63
      - Second surprise gets higher leverage
- What is Your (Levered) Cat Limit as % of Market Value of Firm?

Motivation
It's the Black Swan

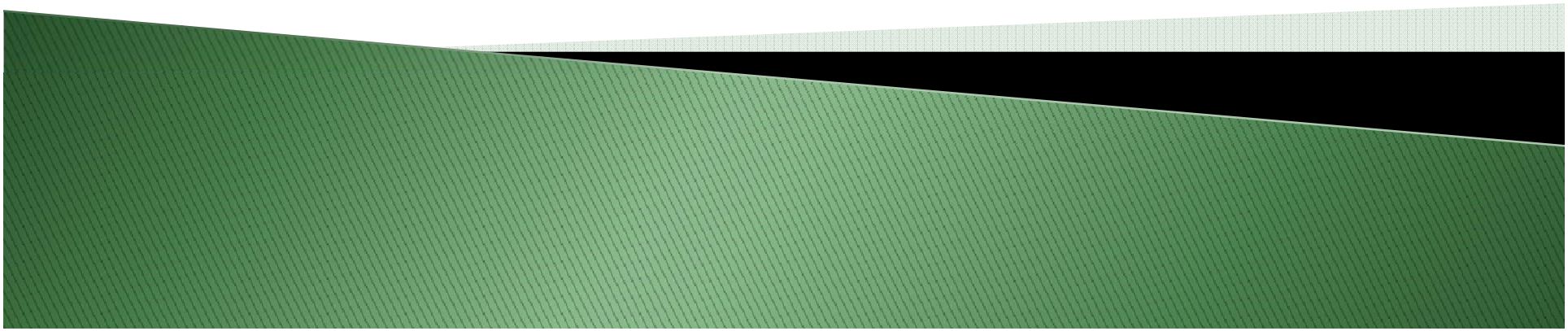
- Quantitative Limitations
  - "We were seeing things that were 25-standard deviation moves, several days in a row. There have been issues in some of the other quantitative spaces. But nothing like what we saw last week.
  - David Viniar, Goldman Sachs CFO, explaining 27% ytd drop in value of Goldman's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

  - ". . . 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





Reinsurance Program Analysis



Modeled Cat Losses By Peril

		All Perils		Hurricane		EQ		Tornado/Hail	
		AEP	OEP	AEP	OEP	AEP	OEP	AEP	OEP
Mean		54.6		25.2		1.6		27.7	
StdDev		45.0		43.7		5.1		9.3	
CV		82.4%		173.2%		311.1%		33.4%	
Probability	Years								
50.00%	2	41.9	10.8	10.2	7.9	0.0	0.0	26.5	4.6
80.00%	5	70.3	29.7	38.4	28.7	1.0	0.9	34.6	7.5
90.00%	10	97.0	50.1	65.4	49.7	4.8	4.5	39.7	10.0
95.00%	20	129.4	77.5	98.4	77.3	10.0	9.3	44.5	12.8
96.00%	25	142.0	88.2	110.8	88.1	11.7	11.0	46.0	13.8
98.00%	50	184.8	128.4	154.5	128.3	18.0	16.8	50.9	17.4
99.00%	100	238.8	179.9	208.3	179.9	25.0	23.3	55.9	21.9
99.50%	200	302.0	241.9	272.8	241.9	33.0	31.0	61.2	26.9
99.60%	250	326.2	264.5	296.2	264.5	35.8	33.5	62.7	28.4
99.80%	500	395.4	329.5	365.5	329.5	44.4	41.8	67.6	32.8
99.90%	1000	463.7	405.2	432.5	405.2	53.5	51.1	72.7	37.5

Notes: RMS with Loss Amplification, no storm surge, Near Term. Data as of December 2008
Amounts in Millions

Cat Program Pricing – Proposed A

	Modeled AAL ($000's)	Standard Dev. ($000's)	Rate on Line	Loss on Line	Loss Cost Multiple	100% Deposit Premium ($000's)	Place-ment	Placed Deposit Premium
Proposed Program								
15M xs 20M xs 15M	425	2,431	30.0%	2.8%	10.59	4,500	100%	4,500
25M xs 35M	2,869	7,838	32.5%	11.5%	2.83	8,125	100%	8,125
50M xs 60M	2,194	9,490	22.0%	4.4%	5.01	11,000	100%	11,000
90M xs 110M	1,261	9,552	12.0%	1.4%	8.56	10,800	100%	10,800
150M xs 200M	556	7,905	5.5%	0.4%	14.84	8,250	67%	5,500
Total	7,305		12.9%	2.2%	5.84	42,675		**39,925**
Current Program								
20M xs 20M	4,817	8,911	40.0%	24.1%	1.66	8,000	35%	2,800
40M xs 40M	3,428	10,480	30.0%	8.6%	3.50	12,000	100%	12,000
80M xs 80M	1,863	10,670	15.0%	2.3%	6.44	12,000	69%	8,330
80M xs 80M Shortfall	1,863	10,670	20.0%	2.3%	8.59	16,000	31%	4,893
90M xs 160M	578	6,515	7.5%	0.6%	11.68	6,750	79%	5,321
90M xs 160M Shortball	578	6,515	10.0%	0.6%	15.57	9,000	21%	1,905
100M xs 250M	203	4,036	4.5%	0.2%	22.14	4,500	50%	2,250
20M xs 20M 2nd Event	512	3,004	31.0%	2.6%	12.10	6,200	65%	4,030
						Total 2009 Cat Premium		**41,530**

Current Cat Program Statistics

Limit	20,000,000 xs	40,000,000 xs	80,000,000 xs	90,000,000 xs	100,000,000 xs	20,000,000 xs
Attachment	20,000,000	40,000,000	80,000,000	160,000,000	250,000,000	20,000,000
						2nd Event
A. Key Statistics						
AAL	4,805,971	3,419,970	1,870,291	568,260	194,652	507,997
SD	8,896,355	10,475,292	10,691,242	6,428,226	3,957,455	3,000,239
CV	185%	306%	572%	1131%	2033%	591%
Prob(Attach)	32.00%	15.00%	4.75%	1.10%	0.35%	4.50%
Prob(Exhaust)	15.00%	4.75%	1.15%	0.35%	0.15%	1.20%
RP(Attach)	3.1	6.7	21.1	90.9	285.7	22.2
RP(Exhaust)	6.7	21.1	87.0	285.7	666.7	83.3
Loss on Line	24.0%	8.5%	2.3%	0.6%	0.2%	2.5%
B. Pricing - June 2008 Data						
Deposit Premium	8,000,000	12,000,000	12,000,000	6,750,000	4,500,000	6,200,000
Rate on Line	40.0%	30.0%	15.0%	7.5%	4.5%	31.0%
Margin = Deposit - AAL	3,194,029	8,580,030	10,129,709	6,181,740	4,305,348	5,692,003
Loss Cost Multiple	1.66	3.51	6.42	11.88	23.12	12.20
Standard Dev Load	35.9%	81.9%	94.7%	96.2%	108.8%	189.7%
Implied Reinsurers' Yield	13.4%	23.8%	14.4%	11.7%	24.6%	38.2%
B. Pricing - December 2009 Data						
AAL	4,546,087	3,255,135	1,895,963	671,092	267,524	460,261
SD	8,666,060	10,284,258	10,912,197	7,100,360	4,726,261	2,843,227
CV	191%	316%	576%	1058%	1767%	618%
% Change in AAL	-5.4%	-4.8%	1.4%	18.1%	37.4%	-9.4%
Margin = Deposit - AAL	3,453,913	8,744,865	10,104,037	6,078,908	4,232,476	5,739,739
Loss Cost Multiple	1.76	3.69	6.33	10.06	16.82	13.47
Standard Dev Load	39.9%	85.0%	92.6%	85.6%	89.6%	201.9%
C. Loss Distribution						
Probability	Return Pd					
50.00%	2	0	0	0	0	0	0
75.00%	4	5,391,177	0	0	0	0	0
80.00%	5	11,238,331	0	0	0	0	0
90.00%	10	20,000,000	10,720,228	0	0	0	0
95.00%	20	20,000,000	37,385,019	0	0	0	0
96.00%	25	21,118,957	40,000,000	6,084,302	0	0	1,120,289
98.00%	50	31,423,891	40,000,000	42,268,213	0	0	11,428,848
99.00%	100	40,000,000	40,000,000	80,000,000	6,127,587	0	20,000,000
99.60%	250	40,000,000	51,622,063	80,000,000	76,107,700	0	20,000,000
99.80%	500	40,000,000	66,858,009	80,000,000	90,000,000	41,358,375	26,432,210
99.90%	1000	40,000,000	80,000,000	80,000,000	90,000,000	100,000,000	34,200,579
99.95%	2000	40,000,000	80,000,000	84,869,973	90,000,000	100,000,000	40,000,000

Cat Program Statistics

	Proposed A						Proposed B			
Limit	15,000,000	25,000,000	50,000,000	90,000,000	150,000,000	330,000,000	65,000,000	100,000,000	200,000,000	365,000,000
	xs	xs	xs	xs	xs	xs	xs	xs	xs	xs
Attachment	20,000,000	35,000,000	60,000,000	110,000,000	200,000,000	20,000,000	35,000,000	100,000,000	200,000,000	35,000,000
OWR	15,000,000									
A. Key Statistics										
AAL	425,069	2,869,216	2,193,800	1,261,006	555,824	7,304,914	4,805,284	1,542,175	624,344	6,971,804
SD	2,431,049	7,837,955	9,489,524	9,551,733	7,904,609		14,956,248	10,947,631	9,213,429	
CV										
Prob(Attach)	4.50%	17.00%	7.25%	2.50%	0.80%		17.00%	3.00%	0.80%	
Prob(Exhaust)	1.50%	7.50%	2.75%	0.80%	0.20%		3.25%	0.80%	0.10%	
RP(Attach)	22.2	5.9	13.8	40.0	125.0		5.9	33.3	125.0	
RP(Exhaust)	66.7	13.3	36.4	125.0	500.0		30.8	125.0	1,000.0	
Loss on Line	2.8%	11.5%	4.4%	1.4%	0.4%	2.2%	7.4%	1.5%	0.3%	1.9%
B. Pricing - December 2009 Data										
Deposit Premium	4,500,000	8,125,000	11,000,000	10,800,000	8,250,000	42,675,000	17,875,000	11,000,000	10,000,000	38,875,000
Rate on Line	30.0%	32.5%	22.0%	12.0%	5.5%	12.9%	27.5%	11.0%	5.0%	10.7%
Margin = Deposit - AAL	4,074,931	5,255,784	8,806,200	9,538,994	7,694,176	35,370,086	13,069,716	9,457,825	9,375,656	31,903,196
Loss Cost Multiple	10.59	2.83	5.01	8.56	14.84	5.84	3.72	7.13	16.02	5.58
Standard Dev Load	167.6%	67.1%	92.8%	99.9%	97.3%		87.4%	86.4%	101.8%	
C. Loss Distribution										
Probability / Return Pd										
50.00% / 2	0	0	0	0	0		0	0	0	
75.00% / 4	0	0	0	0	0		0	0	0	
80.00% / 5	0	0	0	0	0		0	0	0	
90.00% / 10	0	14,054,356	0	0	0		14,210,970	0	0	
95.00% / 20	0	25,000,000	15,176,066	0	0		41,548,865	0	0	
96.00% / 25	1,155,118	25,000,000	25,242,843	0	0		52,058,941	0	0	
98.00% / 50	10,655,499	25,000,000	50,000,000	14,034,409	0		65,000,000	24,230,546	0	
99.00% / 100	15,000,000	26,647,691	50,000,000	64,848,158	0		65,000,000	75,425,320	0	
99.60% / 250	15,000,000	43,604,018	50,000,000	90,000,000	58,794,089		75,397,800	100,000,000	60,993,491	
99.80% / 500	21,175,664	50,000,000	50,000,000	90,000,000	120,962,560		93,001,595	100,000,000	122,804,850	
99.90% / 1000	28,401,649	50,000,000	68,515,549	90,000,000	150,000,000		110,958,904	100,000,000	196,728,109	
99.95% / 2000	30,000,000	50,000,000	90,162,136	90,000,000	150,000,000		130,000,000	100,000,000	200,000,000	

Cat Program Performance – Proposal A

	Ground-up Incurred	Trended, Indexed Incurred	As If Reinsurance Recoveries			
			Current Program		Proposed Program A	
			Incurred	Trended/Indexed	Incurred	Trended/Indexed
1996	33.7	127.7	-	39.6	-	37.6
1997	9.7	30.0	-	-	-	-
1998	29.9	76.1	-	-	-	-
1999	52.7	120.2	5.8	50.3	1.5	48.3
2000	8.8	18.0	-	-	-	-
2001	18.6	35.5	-	-	-	-
2002	32.5	55.6	-	0.2	-	-
2003	36.0	57.7	-	-	-	-
2004	54.2	83.0	-	3.2	-	-
2005	192.8	291.0	115.3	202.0	113.3	201.7
2006	22.8	32.2	-	-	-	-
2007	23.9	29.6	-	-	-	-
2008	150.1	161.6	55.0	63.2	53.0	61.2
Total	665.6	1,118.1	176.1	358.6	167.9	348.9
Average	51.2	86.0	13.5	27.6	12.9	26.8

Note: Includes Cat events of $500K and Greater.
Amounts in Millions

Increasing Retention of First Layer Does Not Significantly Change Recoveries

Cat Program Performance – Proposal B

	Ground-up Incurred	Trended, Indexed Incurred	As If Reinsurance Recoveries			
			Current Program		Proposed Program B	
			Incurred	Trended/Indexed	Incurred	Trended/Indexed
1996	33.7	127.7	-	39.6	-	37.6
1997	9.7	30.0	-	-	-	-
1998	29.9	76.1	-	-	-	-
1999	52.7	120.2	5.8	50.3	1.5	48.3
2000	8.8	18.0	-	-	-	-
2001	18.6	35.5	-	-	-	-
2002	32.5	55.6	-	0.2	-	-
2003	36.0	57.7	-	-	-	-
2004	54.2	83.0	-	3.2	-	-
2005	192.8	291.0	115.3	202.0	98.3	184.1
2006	22.8	32.2	-	-	-	-
2007	23.9	29.6	-	-	-	-
2008	150.1	161.6	55.0	63.2	38.0	46.2
Total	665.6	1,118.1	176.1	358.6	137.9	316.3
Average	51.2	86.0	13.5	27.6	10.6	24.3

Reduction in Average Recoveries	3.3
Annual Premium savings	7.7

Reduced Recoveries are More than Offset by Premium Savings

Comparing Alternate Structures Using Various Metrics

Results of Metric Calculations

	CA02-45.0m x 05.0m	**CA06-42.5m x 07.5m**	CA11-47.0m x 03.0m	CA15-40.0m x 10.0m	CA52-45.0m x 05.0m-w 10% QS
Net Profit	16,460	18,864	11,890	19,365	15,692
Net Combined Ratio	78.4%	77.1%	81.8%	77.5%	77.5%
Cost of Reinsurance	7,686	5,282	12,256	4,780	8,454
Net Retention (Plus AAD)	5,000	7,500	3,000	10,000	5,000
Net Ceded Premium	20,200	14,000	31,000	10,500	24,050
Comb Ratio CV - Relative To Expiring	88.7%	100.0%	72.9%	110.5%	89.9%
5th Percentile UW'ing Result	(1,647)	(3,097)	(1,219)	(6,294)	(1,205)

Scores Based On Calculation Results

	CA02-45.0m x 05.0m	**CA06-42.5m x 07.5m**	CA11-47.0m x 03.0m	CA15-40.0m x 10.0m	CA52-45.0m x 05.0m-w 10% QS
Net Profit	3.0	4.0	1.0	5.0	2.0
Net Combined Ratio	2.0	5.0	1.0	4.0	3.0
Cost of Reinsurance	3.0	4.0	1.0	5.0	2.0
Net Retention (Plus AAD)	3.0	2.0	5.0	1.0	3.0
Net Ceded Premium	3.0	4.0	1.0	5.0	2.0
Comb Ratio CV - Relative To Expiring	4.0	2.0	5.0	1.0	3.0
5th Percentile UW'ing Result	3.0	2.0	4.0	1.0	5.0
Overall Score - Unweighted	3.0	**3.3**	2.6	3.1	2.9
Overall Score - Weighted	3.0	**3.2**	2.7	3.1	2.7

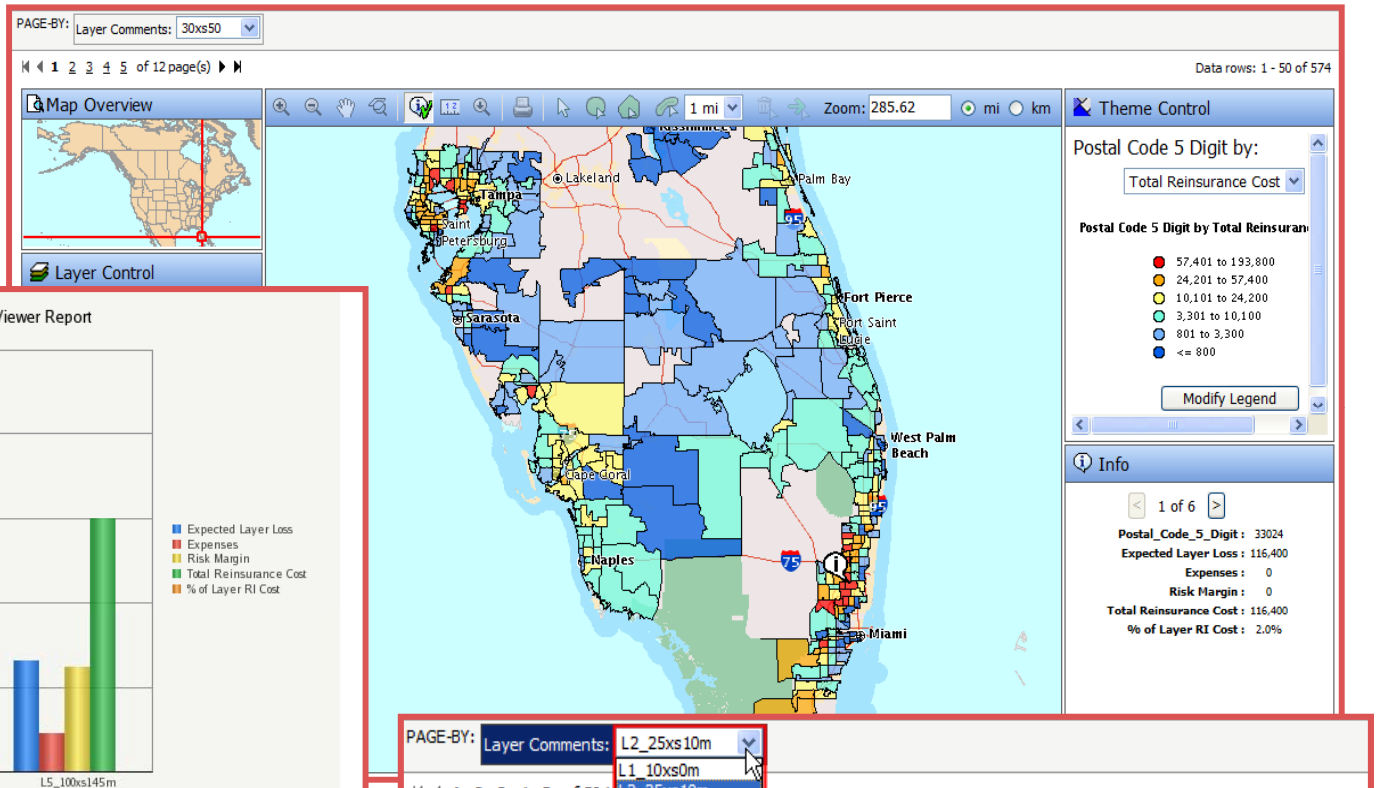
Program Comparisons
Financial Metrics

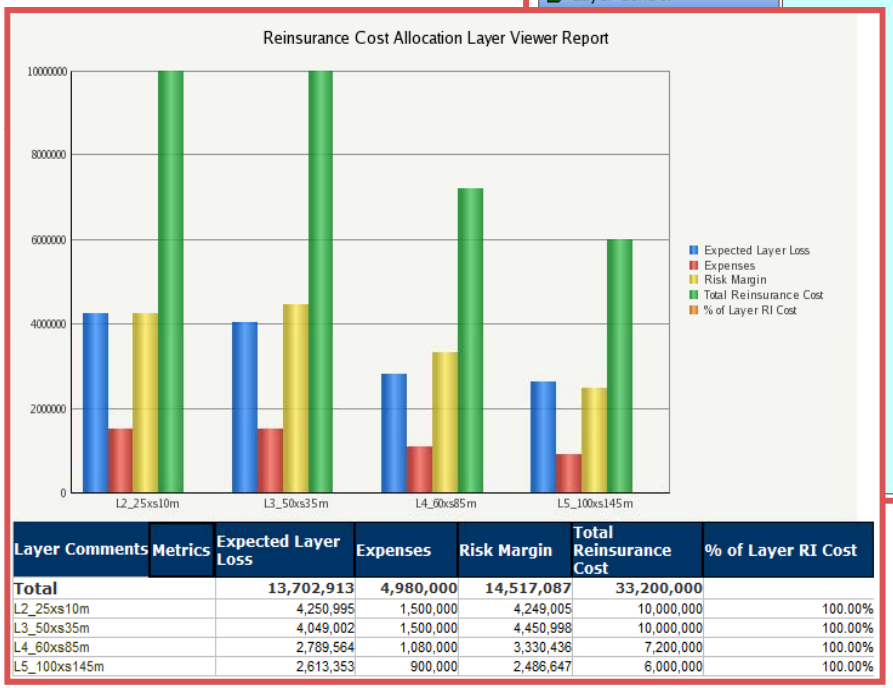
	Cat Option		
	A	B	C
Estimated BCAR			
Original	139.5%	140.0%	154.8%
With Cat Stress Test	121.4%	125.4%	137.0%
Implied Rating			
Original	A-	A-	A
With Cat Stress Test	B++	B++	A-
Percent of Annual Earnings			
Retention	50%	25%	50%
Net 1 in 100 AEP	125%	97%	131%
Net 1 in 250 AEP	350%	333%	150%
Percent of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

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

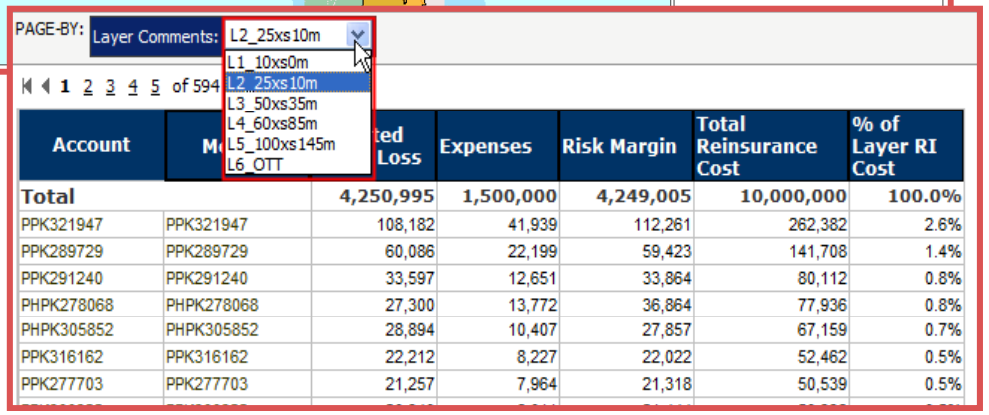
- A Current
- B Proposal A
  - 2nd Event only down low
- C Proposal B
  - No protection to $35M Retention
- Tradeoffs
  - Add'l spend budget
  - 1 v 2 quarter earnings hit
  - Possible upgrade
- Plan, Goals, Constraints, Preferences, etc, matter

Cat Reinsurance Cost Allocation





Layer Comments	Metrics	Expected Layer Loss	Expenses	Risk Margin	Total Reinsurance Cost	% of Layer RI Cost
Total		**13,702,913**	**4,980,000**	**14,517,087**	**33,200,000**	
L2_25xs10m		4,250,995	1,500,000	4,249,005	10,000,000	100.00%
L3_50xs35m		4,049,002	1,500,000	4,450,998	10,000,000	100.00%
L4_60xs85m		2,789,564	1,080,000	3,330,436	7,200,000	100.00%
L5_100xs145m		2,613,353	900,000	2,486,647	6,000,000	100.00%

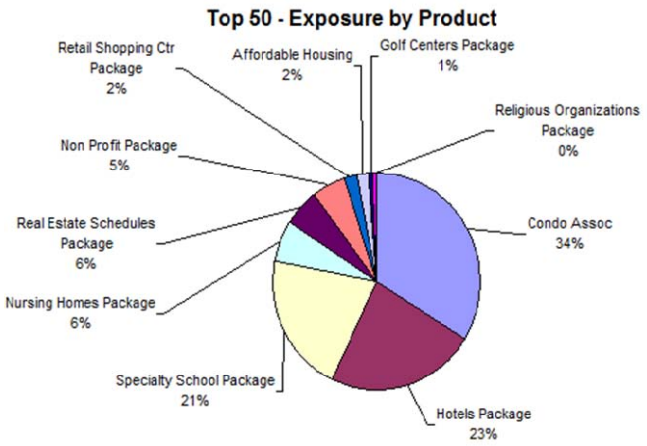


Account	M	ted Loss	Expenses	Risk Margin	Total Reinsurance Cost	% of Layer RI Cost
Total		**4,250,995**	**1,500,000**	**4,249,005**	**10,000,000**	**100.0%**
PPK321947	PPK321947	108,182	41,939	112,261	262,382	2.6%
PPK289729	PPK289729	60,086	22,199	59,423	141,708	1.4%
PPK291240	PPK291240	33,597	12,651	33,864	80,112	0.8%
PHPK278068	PHPK278068	27,300	13,772	36,864	77,936	0.8%
PHPK305852	PHPK305852	28,894	10,407	27,857	67,159	0.7%
PPK316162	PPK316162	22,212	8,227	22,022	52,462	0.5%
PPK277703	PPK277703	21,257	7,964	21,318	50,539	0.5%

Policy Ranking

Re-underwrite your existing portfolio or redeploy capital

- Optimizes known policies
- Blended ranking of multiple models
- Multiple performance metrics supported



PAGE-BY: Model: RMS

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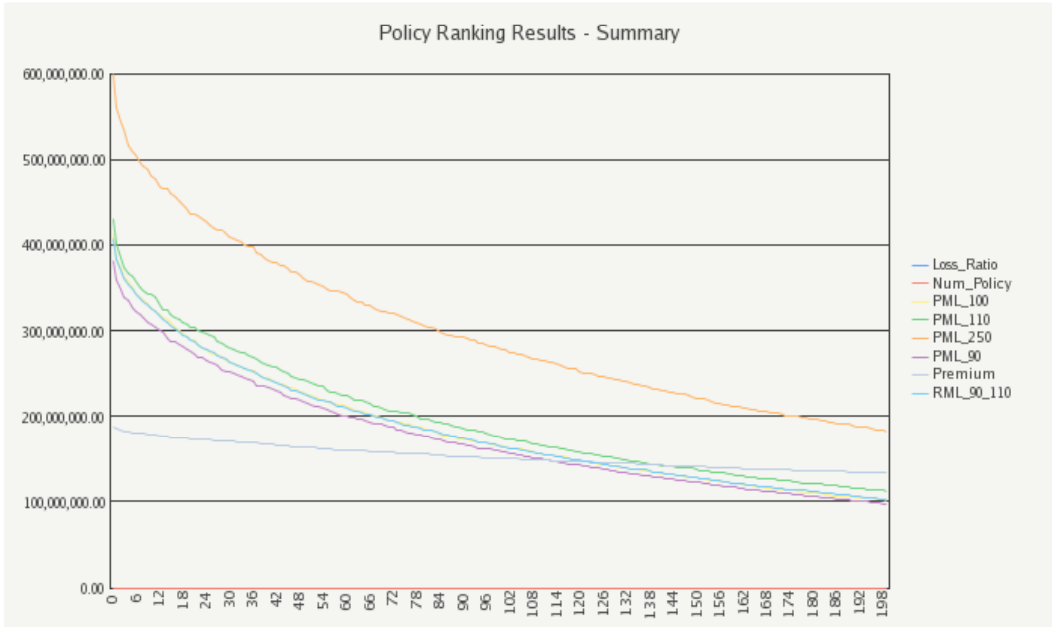
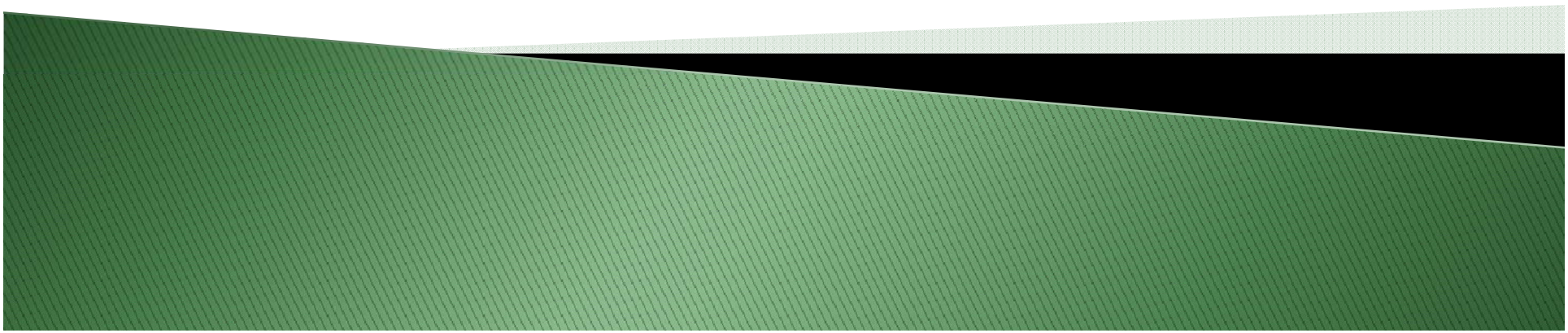


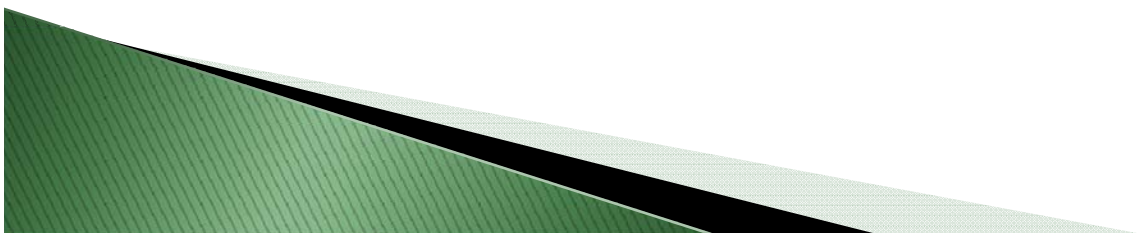
Iteration / Metrics Item	Loss_Ratio	Num_Policy	PML_100	PML_110	PML_250	PML_90	Premium	RML_90_110
0	2.18	0.00	412,760,780.62	431,514,393.12	599,536,210.87	382,419,212.06	187,083,369.17	408,164,237.32
1	2.07	10.00	383,974,292.50	402,412,899.54	559,938,808.36	360,083,206.27	185,008,713.17	383,810,689.77
2	2.03	20.00	374,519,986.44	386,087,227.71	543,803,830.21	348,663,956.31	183,030,675.17	371,168,209.79
3	1.99	30.00	363,914,521.49	374,878,815.44	535,466,132.85	339,680,062.68	182,018,501.17	361,755,033.33
4	1.95	40.00	357,228,870.19	367,155,274.54	517,137,145.52	335,173,910.30	181,559,178.17	354,596,728.00
5	1.93	50.00	349,723,862.61	363,683,923.04	509,902,729.57	326,876,222.10	180,774,372.17	348,685,267.87
6	1.90	60.00	343,467,196.15	357,073,097.23	505,559,485.44	321,575,528.80	180,294,767.17	342,843,624.75

What do the Reinsurers Do?



Reinsurers use of the Modeled Output

- Verify consistency from the prior year's exposure and loss information
- Re-run the models using the dials they prefer, and in some cases, in their own proprietary models
- Evaluate the correlation of the company's exposure with their current book of business
- Submit statistics to the underwriter for their consideration



Overview of the Pricing Process

- Basic experience & exposure rating
- Everyone prices differently
  - Expected loss + volatility load
  - Investment Equivalent Pricing
  - Follow the leader

- Common considerations:
  - Modeling Results
  - Contract Experience
  - Market Conditions
  - Size of Placement
  - Relationships

Investment Equivalent Pricing

- Financial institutions have investment options. Reinsurance contracts can be considered an investment with a target ROE.
- % Yield = (1 + expected profit/safety dollars)*(1 + risk-free rate) – 1
- Expected profit = deposit premium – expected losses + reinstatement premium – expenses
- Safety dollars = capital allocated to fund the contract, e.g. 99% VaR or 98% TVaR.

Operating Assumptions	
Capital	$10,000,000
Target ROE	12%
Risk-free rate	3%
Expense ratio	15%

Reinsurance Opportunity	
Limit	$10,000,000
Retention	$10,000,000
Expected Loss	$2,000,000
Price	$3,500,000

Example

Allocate Capital

99% VaR = $10,000,000
Required Return @ 12% = $1,200,000

→ Earns 3% risk free = $300,000
Return needed from
reinsurance = $900,000

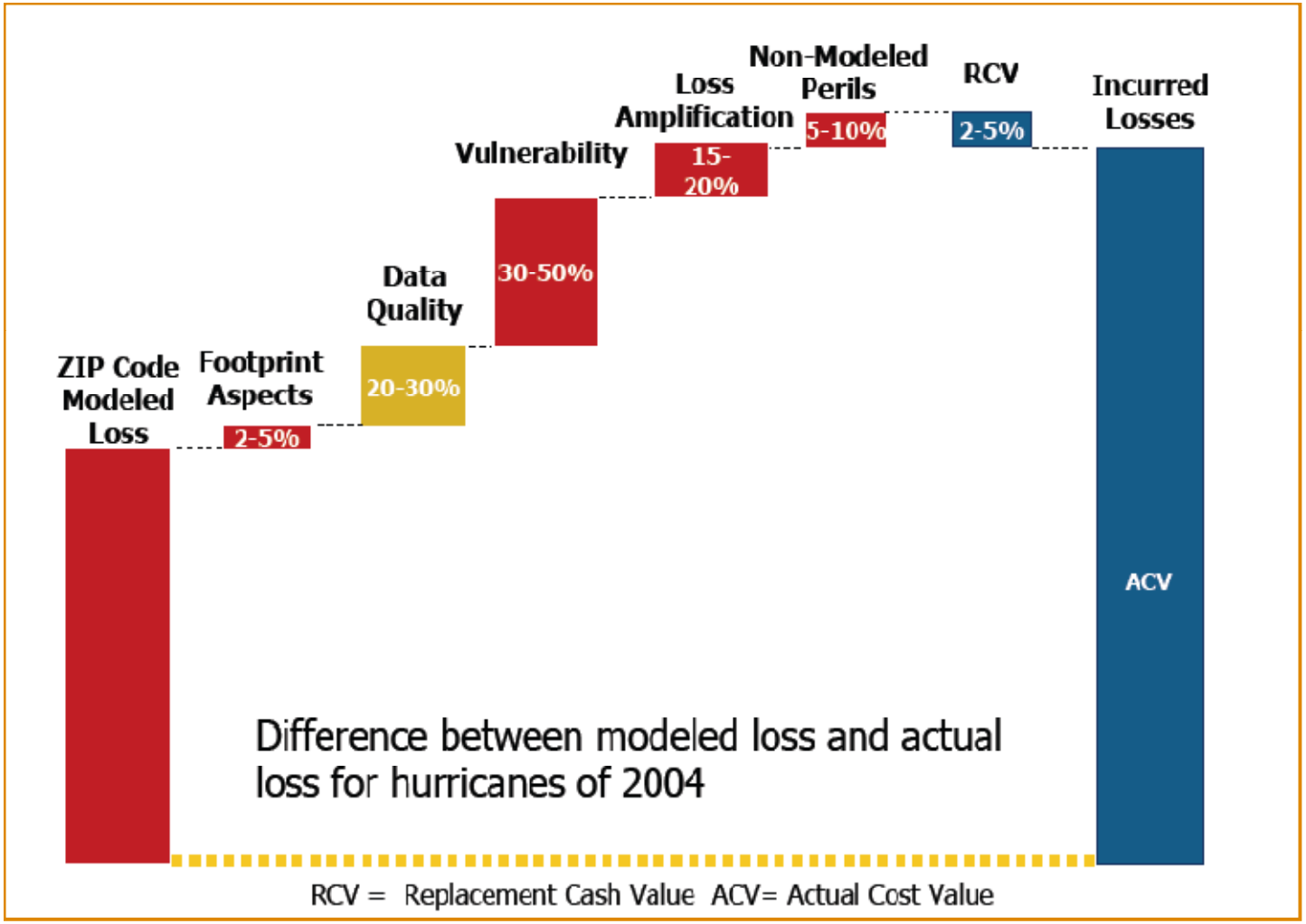
Reinsurance Economics

Price = $3,500,000
Losses = $2,000,000
Expenses @ 15% = $525,000

→ Makes $975,000 from reinsurance
Takes the deal @ 12.75% ROE
Would have participated at a price of $3,425,

Pricing

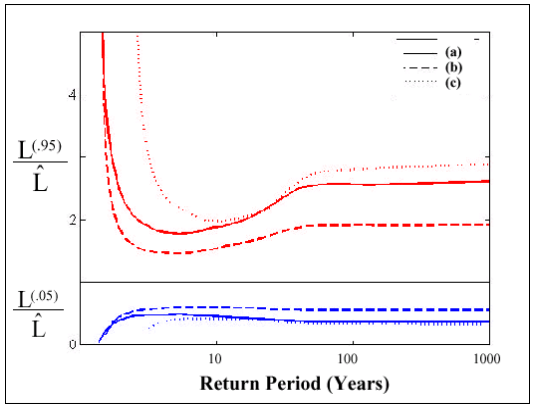
Modeled Loss Costs ≠ Carried Loss Cost (1)



Source: RMS

Pricing
Modeled Loss Costs ≠ Carried Loss Cost (2)

- Non-modeled Increments
  - LAE, APD, Manual Policies, Inland Marine, Cargo, Fine Arts
  - Statistical record vs. policy system
  - ITV, inflation, new business
  - Flood, some low level wind
  - Policy reinterpretation, red tagging
- Modeling Uncertainty
  - Sampling error, specification error, non-sampling error, knowledge uncertainty, approximation error[1]
  - 90% confidence bound is 50 to 250% of point estimate beyond 1 in 80 return period[2]



[1] Major, John A., "Uncertainty in Catastrophe Models," ***Financing Risk and Reinsurance***, International Risk Management Institute, Feb/Mar 1999.

[2] Miller, David, "Uncertainty in Hurricane Risk Modeling and Implications for Securitization," ***CAS Discussion Papers on Securitization of Risk,*** 1999.

Pricing
Insurance to Value

Table 1: Comparison of Replacement Values for Representative Properties

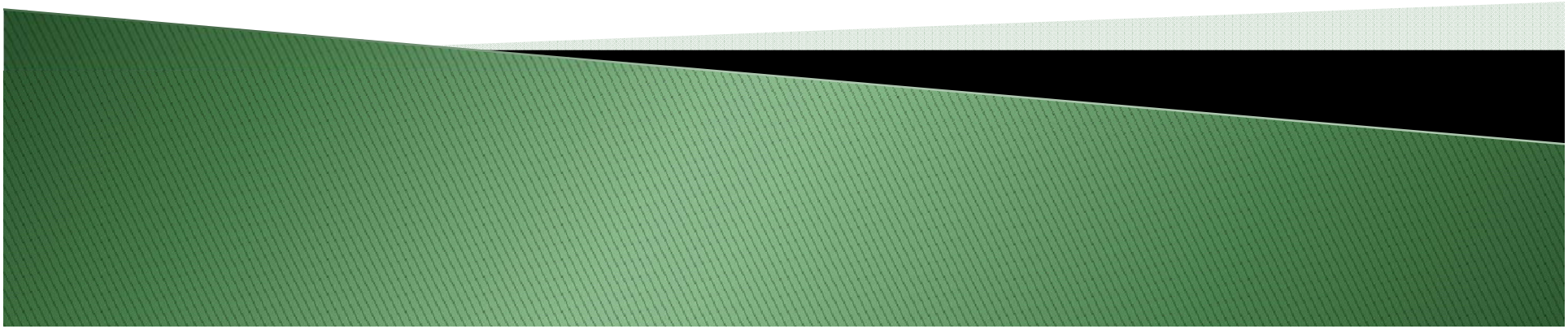
	Occupancy	Con-struction	Approx. Gross Area (sq. ft.)	Replacement Value		
				Company Provided Value	AIR Estimate	Ratio
	Hotel	Wood Frame	30,000	$1,692,702	$3,509,831	48%
	Retail	Masonry	100,000	$1,243,816	$8,484,046	15%

Overall, **nine out of ten** commercial properties analyzed had replacement values less than the amount estimated using a standard engineering-based cost estimation process.

AIR, Nov. 2005

- 58 percent of homes in the U.S. were underinsured last year by an average 21 percent.
  - Marshall & Swift/Boeckh, quoted in USA Today, Nov. 1, 2007
- Model calibration will pick some underinsurance

Capital Adequacy

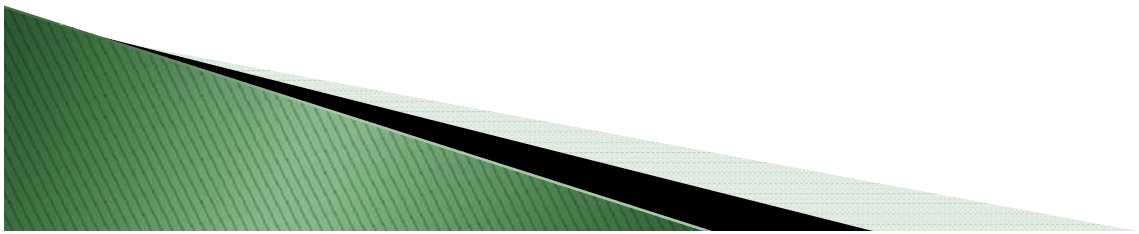


Capital Adequacy – A.M. Best View

- "Catastrophes are the No. 1 threat to solvency in the industry"
- BCAR baseline treatment of natural catastrophe risk
  - Greater of per-occurrence
    - 100-year hurricane net PML
    - 250-year earthquake net PML
    - Or a recent, large loss
  - Net PML loss recognizes 35% tax rate
  - Amount of loss determined from company's exposure and model
    - Subject to adjustments by AMB

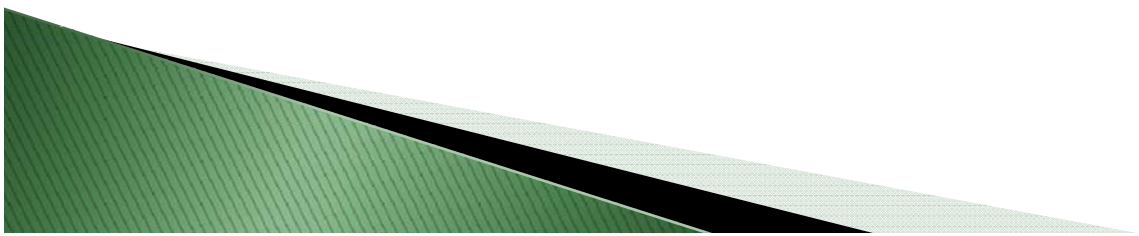
Capital Adequacy – A.M. Best View

- Natural catastrophe stress test
  - Greater of per-occurrence
    - 100-year hurricane net PML
    - 100-year earthquake net PML
- Evaluation of company's overall risk management process
  - Judgmental margin given for quality RM processes



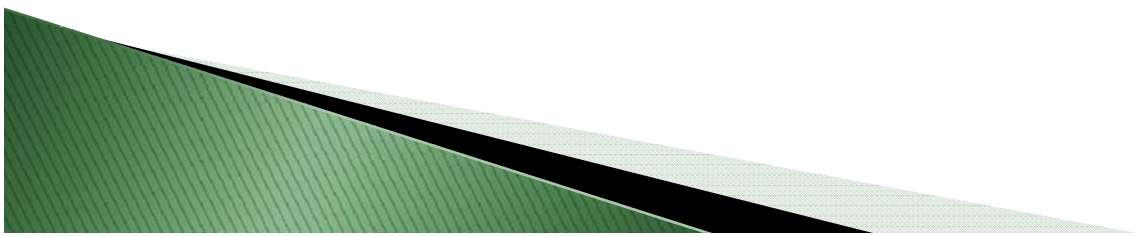
Capital Adequacy – A.M. Best View

- Risk management best practices
  - Data quality
    - Accurate, complete and timely
  - Monitoring exposure
    - Frequently and consistently
  - Establishing acceptability controls
  - Integration to underwriting process
- Other considerations
  - Exposure to multiple events
  - Type and availability of funding



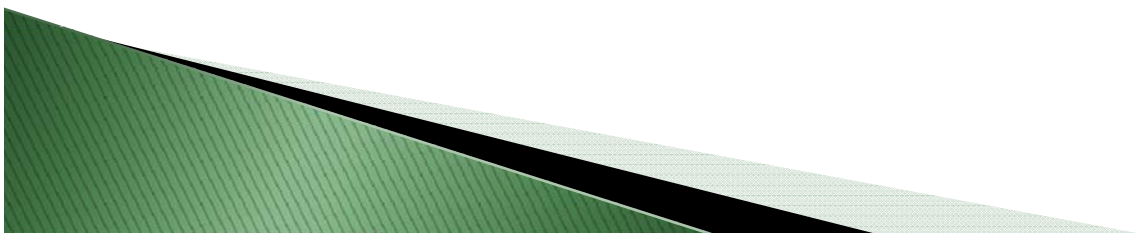
Capital Adequacy – A.M. Best View

- BCAR treatment of terrorism risk
  - Larger of terrorism and natural catastrophe charge
  - Stress test large event assuming no federal backstop
  - Similar review of risk management
    - e.g., monitoring, mitigation, underwriting



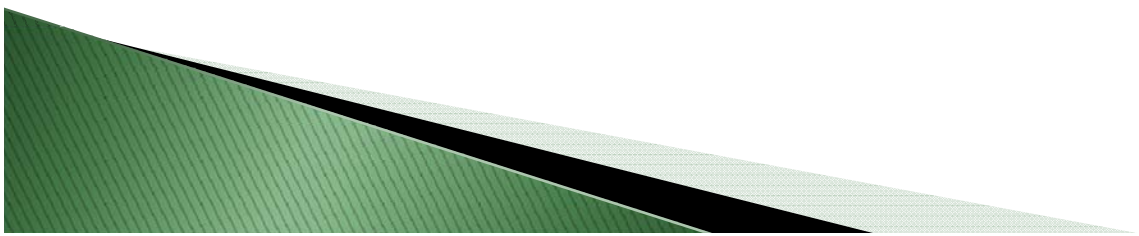
Capital Adequacy – Moody's View

- "Catastrophes are the most significant and volatile risk to capital over the short term"
- Evaluates company's
  - Ability to monitor and manage risk exposure
  - Reliance on reinsurance
  - Gross and net 250-year PML risk relative to earnings and equity
  - Incorporates views of
    - Company's 3rd party vendors, internal surveys, relative market share analysis and stress scenarios



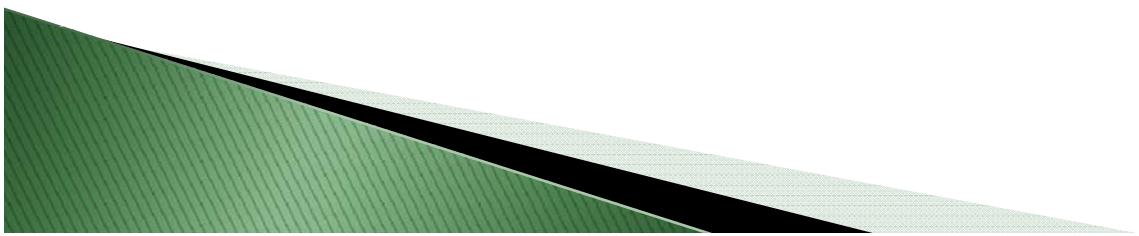
Capital Adequacy –Standard & Poors View

- Exposure driven property catastrophe capital charge
  - Net after-tax aggregate 250-year PML
    - Includes demand surge, fire following, storm surge and secondary uncertainty
    - Considers natural catastrophes
- Reduce premium risk charge by removing catastrophe load in premium
  - As computed by insurer, or 5%

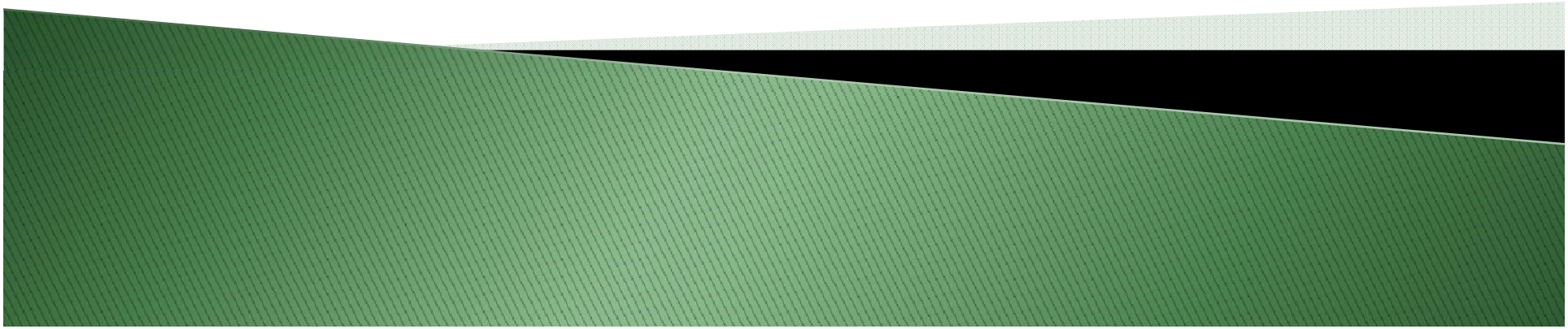


Capital Adequacy – Regulatory Views

- NAIC RBC
  - Implicit charge in place via the Premium charge
  - Explicit charge for catastrophes under review
- Solvency II
  - Factor-based, relies on premium
  - Scenario-based, regulator provides regional scenarios
  - Company-specific scenarios

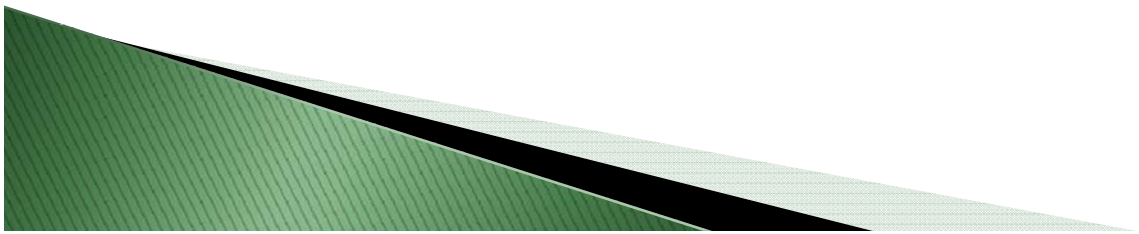


Classification Plans



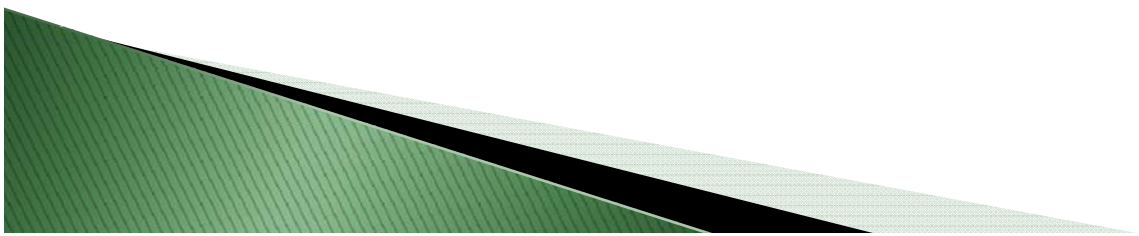
Location

- Zip
  - Administratively straightforward
  - Subject to the whim of the USPS
- Census tract
  - Static longer than zip
  - More refined boundaries than zip
  - But, not drawn with catastrophe risk in mind



Location

- Geocode / Site specific
  - Needed for model input
  - Can be create a refined, more homogeneous system
    - Acceptability
    - Affordability



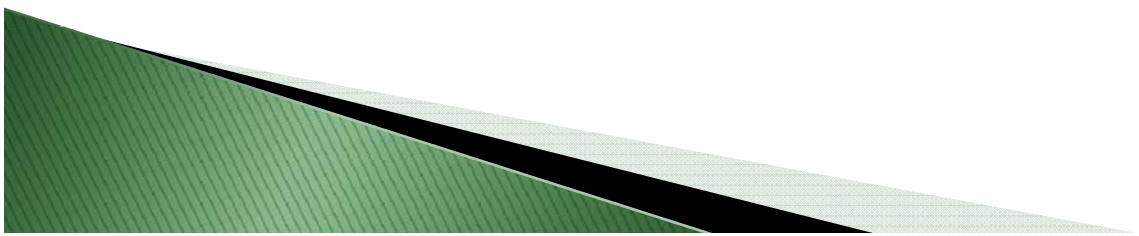
Location

Location	AAL	Territory Relativity
1	4.93	2.71
2	3.59	1.97
3	2.94	1.62
4	0.91	0.50
5	0.60	0.33
6	0.20	0.11
7	0.17	0.10
8	1.19	0.66

Location	AAL	Standard Deviation	Rate	Territory Relativity
1	4.93	35.01	22.44	3.05
2	3.59	18.58	12.88	1.75
3	2.94	15.52	10.70	1.45
4	0.91	5.15	3.49	0.47
5	0.60	3.66	2.43	0.33
6	0.20	1.21	0.80	0.11
7	0.17	1.12	0.74	0.10
8	1.19	8.45	5.42	0.74

Structural Attributes

- Age of construction
- Type of construction
- Secondary features
  - Roof
  - Foundation
  - Retrofitting / mitigation features
- Building code enforcement



Exposure Management

Exposure Management

When establishing goals, strategies and tactics around exposure management, it is important to consider:

- Risk Tolerance
- Rating agency requirements
- Impairment/Solvency thresholds
- Return on capital
- Efficiency & stability of strategy
- Volatility of returns

Catastrophe models are the primary tool for correlating exposures to risk

Cat Models & Exposure Management

Modeling provides a view of catastrophic loss potential and the tools needed to consider alternative strategies for managing the risk.

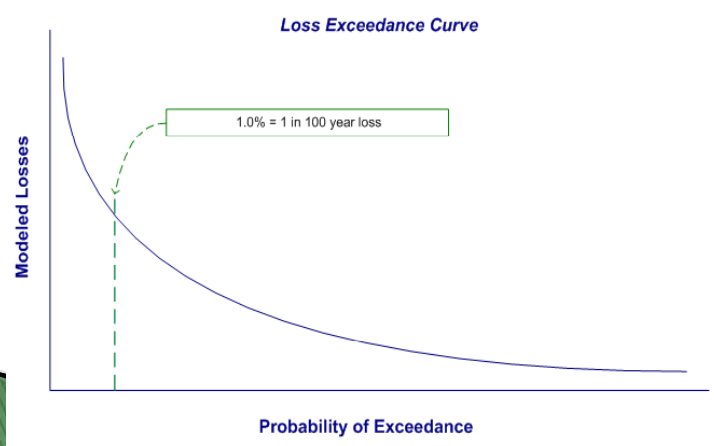
Modeled output can be used for:

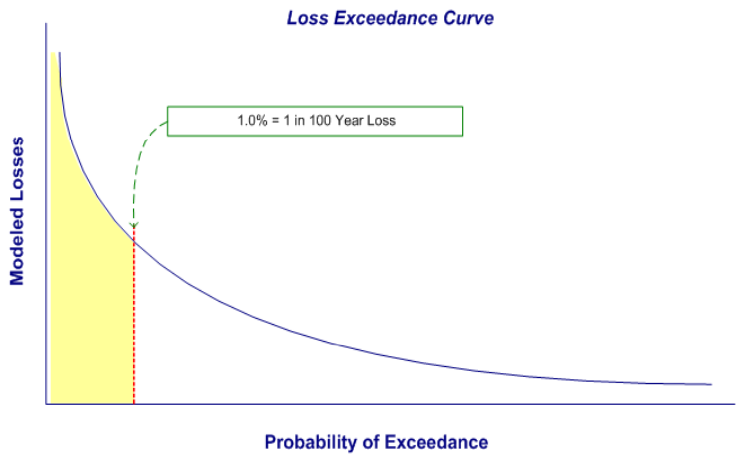
- Pricing:
  - Appropriate rate level (AAL & Risk Load)
  - Rate segmentation
- Risk Management:
  - Portfolio optimization
  - Point of sale modeling
  - Underwriting guides (distance to coast, property characteristics, mitigation devices, year built, deductible, etc)
- Risk Transfer
- "What-if" Analysis & Sensitivity Testing

Exposure Management

Potential exposure management metrics/goals:

- PML: CW/Geographical at various probabilities
- TVAR
- Event loss (concentration of risk)





Miscellaneous Issues

Considerations/Adjustments

- Actuarial Standard of Practice 38
- Warm Sea Surface Temperatures (WSST)
- Demand Surge
- Storm Surge
- Secondary Uncertainty
- Additional considerations (LAE, Data Quality, Variance, Ground-up vs Gross, Model Selection)

Actuarial Standard of Practice (ASOP) 38

ASOP 38: Using Models Outside the Actuary's Area of Expertise

Five key responsibilities:

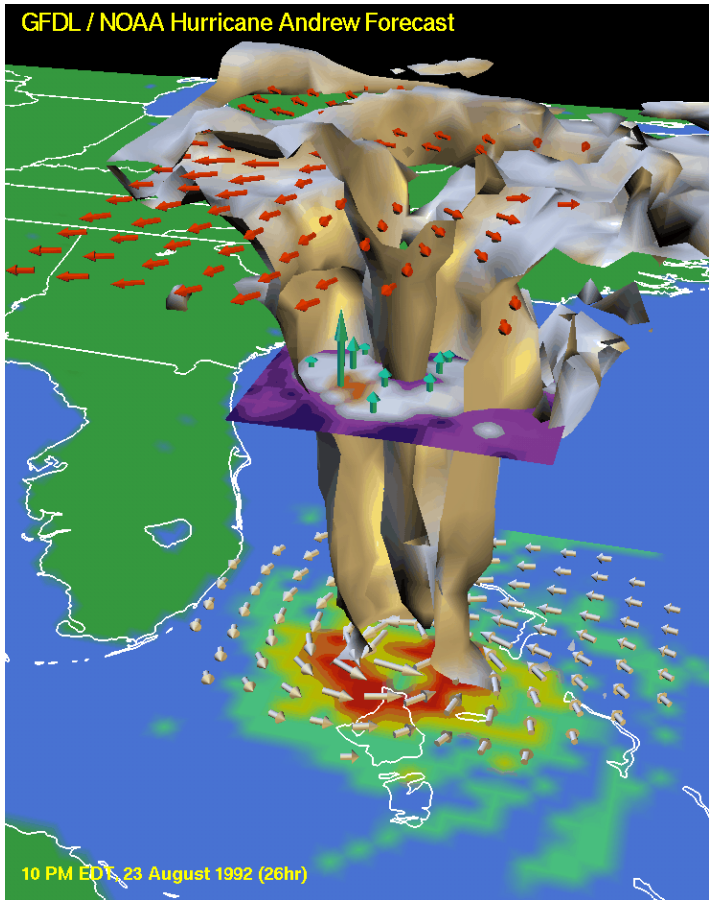
1) Determine appropriate reliance on experts
2) Have a basic understanding of the model
3) Evaluate whether the model is appropriate for the intended application
4) Determine that appropriate validation has occurred
5) Determine the appropriate use of the model

"The model said so" is not sufficient

Warm Sea Surface Temperature

There are many mechanisms that influence Atlantic Hurricane activity, including:

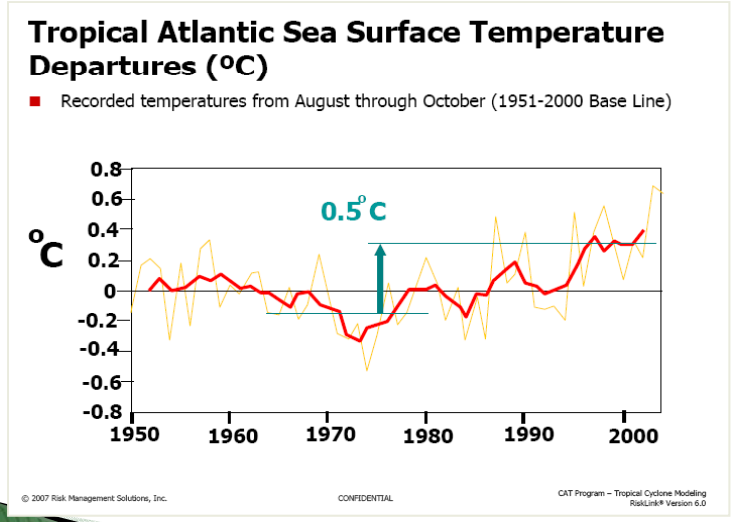
- Atlantic sea surface temperatures
- El-Nino; Vertical wind shear (ENSO)
- Upper atmosphere winds (QBO)
- Atlantic pressure distribution (NAO; Bermuda High)

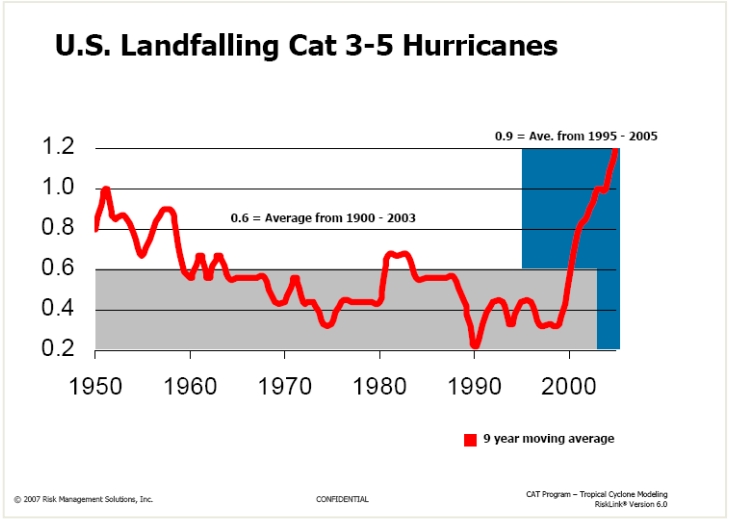


Warm Sea Surface Temperature

There has been a historical correlation between Atlantic Sea Surface temperatures and the frequency and intensity of hurricane landfalls in the United States.

- Modelers use different terminology to represent: Near-Term, Medium-Term, Warm Sea Surface, prospective frequency





Note: Models are probabilistic, they are not prediction models.

Demand Surge

Demand Surge:

A sudden and usually temporary increase in the cost of materials, services, and labor due to the increased demand following a catastrophe.

Also referred to as Loss Amplification.

Sources of demand surge

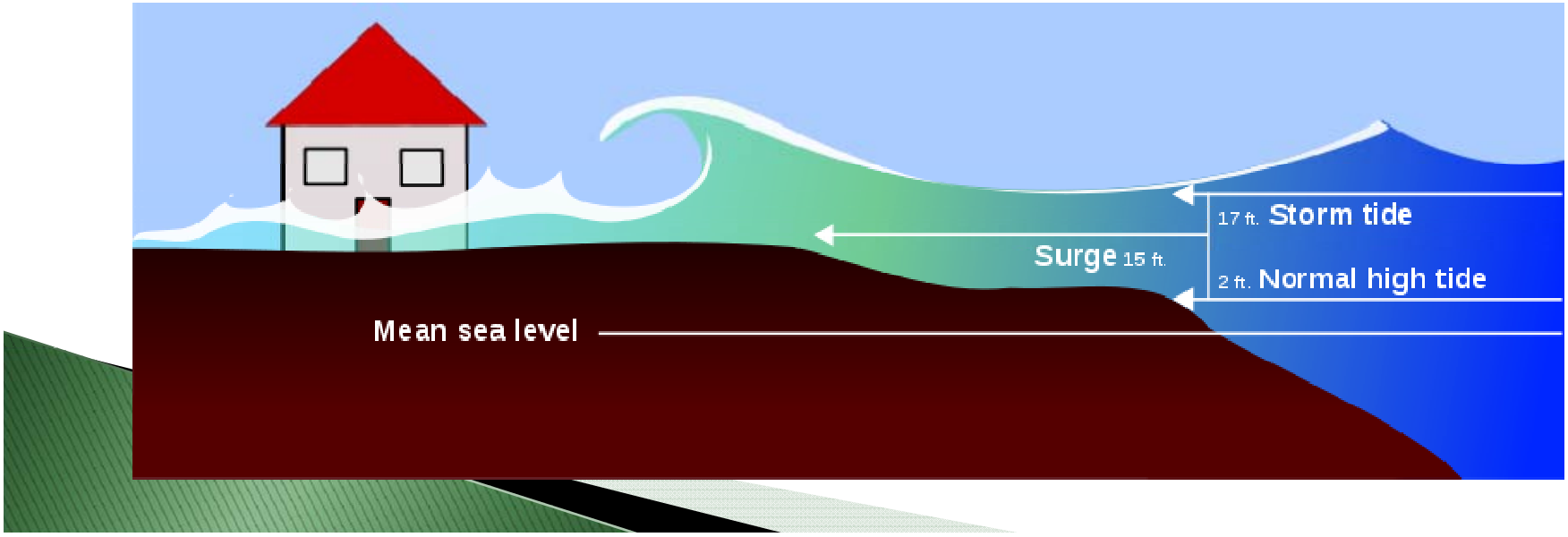
- Cost of materials: supply shortages; demand > supply; potential price gouging
- Labor: limited labor in impacted area leads to labor shortage; imported labor is expensive (travel & housing costs – limited housing available) & not familiar with local building codes
- Services: pressure on transportation, warehousing and packaging

Storm Surge

Storm Surge:

Rising sea surface due to hurricane winds

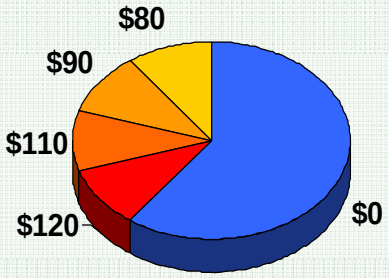
- Amount of surge impacted by intensity of winds (stronger winds = more surge) and depth of offshore water (shallower = more surge)
- Katrina generated a 27-foot storm tide in Mississippi



Secondary Uncertainty

Secondary Uncertainty:

Uncertainty in the size of loss, given that a specific event has occurred.



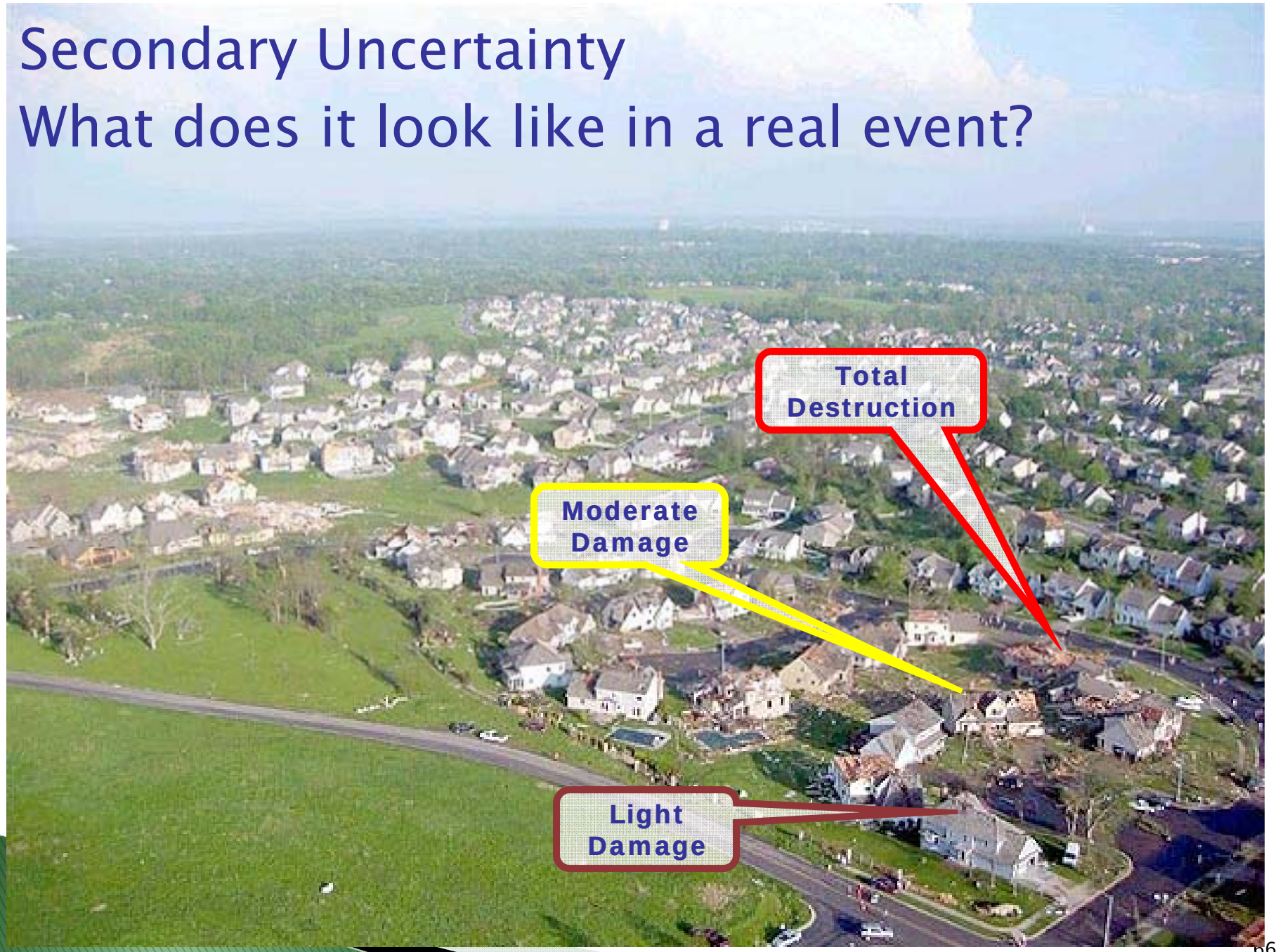
Payout is $0 or a range between $80 and $120. The uncertainty in amount (given a payout) is the secondary uncertainty.

Identical events can cause different amounts of loss, resulting in a range of possible values with different probabilities.

Primary Uncertainty:

Uncertainty around the occurrence or non-occurrence of unknown events.

Secondary Uncertainty
What does it look like in a real event?

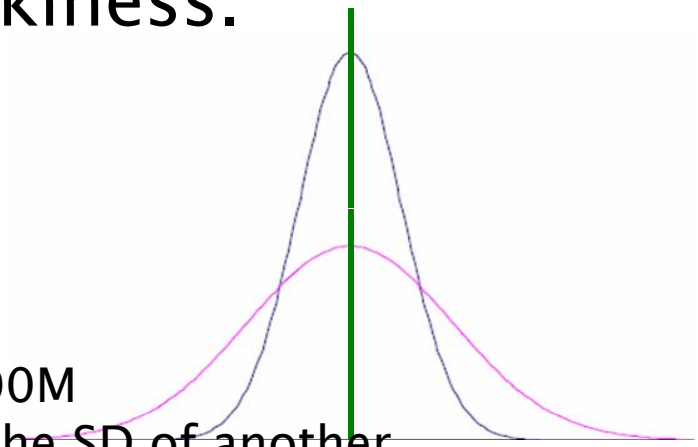


Secondary Uncertainty

Probability of Non-Exceed	Avg Return Time (Years)	[1] w/Sec Unc. (000s)	[2] w/o Sec Unc. (000s)	Impact [2] vs. [1] % Change
99.99%	10,000	$722,725	$655,641	-9.3%
99.95%	2,000	$528,513	$510,665	-3.4%
99.90%	1,000	$419,679	$383,027	-8.7%
99.80%	500	$307,386	$301,641	-1.9%
99.60%	250	$203,773	$184,426	-9.5%
99.50%	200	$176,720	$159,126	-10.0%
99.00%	100	$115,590	$101,876	-11.9%
98.00%	50	$78,449	$70,866	-9.7%
96.00%	25	$52,776	$46,609	-11.7%
95.00%	20	$45,750	$40,613	-11.2%
90.00%	10	$26,161	$25,632	-2.0%

Variance

The amount of variance is important to consider in order to gauge the relative riskiness.



Measures:

Standard Deviation (SD)

- Measure of volatility around a number
- Measured in same currency
- Example: 100-year EP of $100M, SD of $300M
- Cannot compare the SD of one analysis to the SD of another

Coefficient of Variation (CV or COV)

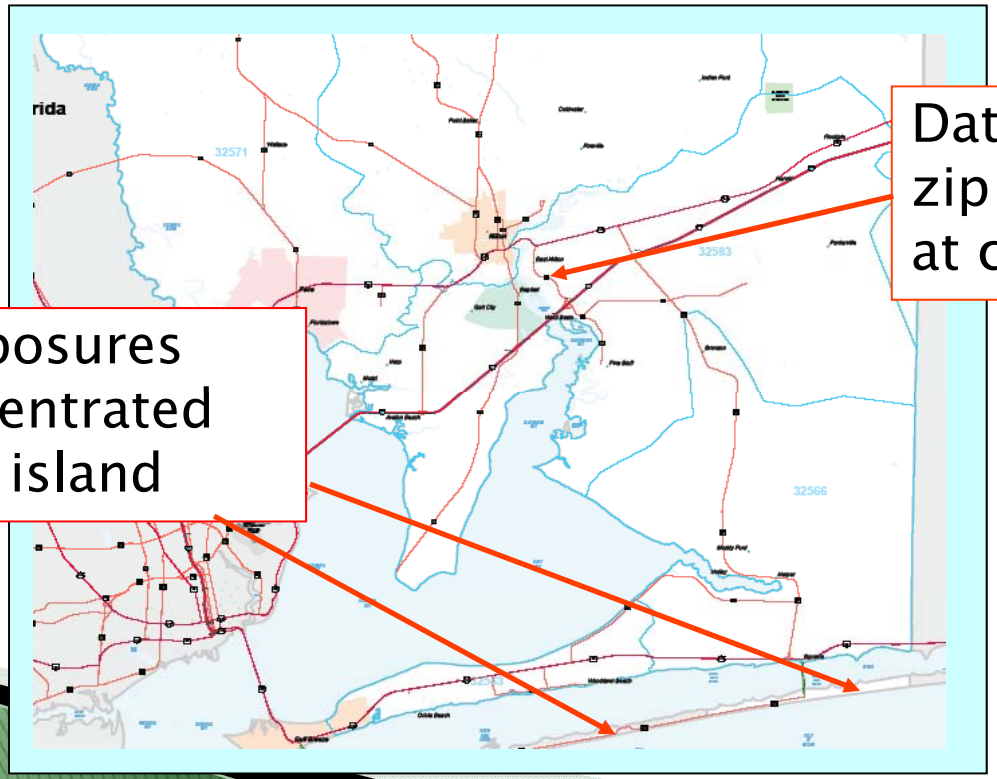
- Standard Deviation ÷ Mean
- The larger the CV, the greater the variability around the mean loss
- CV has no "units" (better than using SD for comparison purposes)
- "Secondary Uncertainty" in the size of a loss

Data Quality

High Quality Exposure Information Is Critical

The model can be run without policy level detail or other location specific attributes, but the more detail the better.

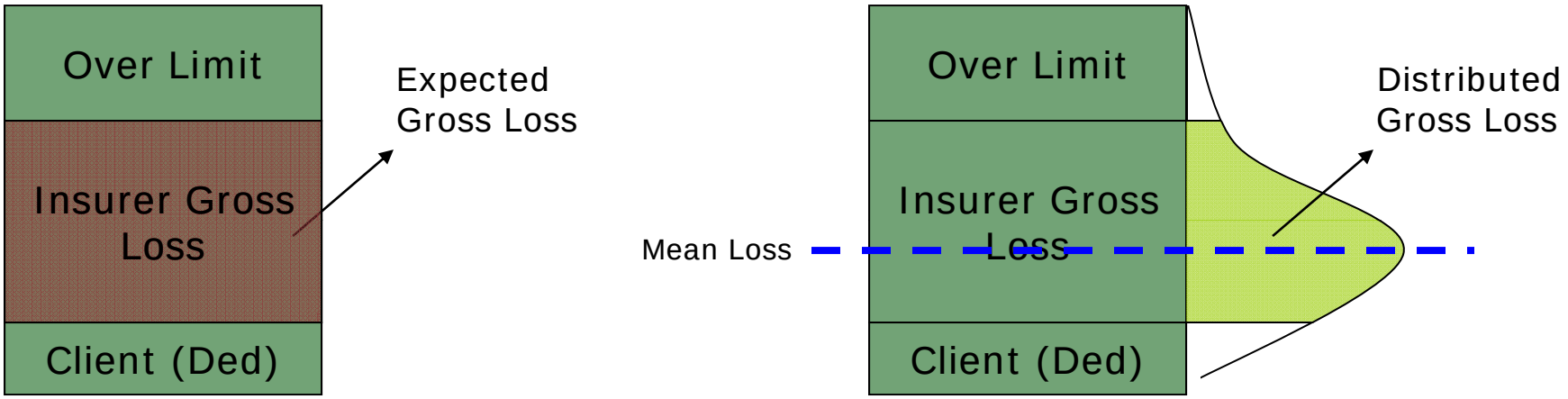
Example:



Ground-up vs Gross

This slide still needs work

- Expected vs. Distributed (analysis mode)



Deductible	100
Limit	1000
Event Loss	500
Insurer Loss	400
Over Limit Loss	0
Client Loss	100

Ground-up Loss

Gross Loss

Deductible	100
Limit	1000
Event Loss	500
Insurer Loss	415
Over Limit Loss	10
Client Loss	75

Other Considerations

Missing pieces of loss estimates…

- inconsistent claims adjusting (1 vs. 100s vs. 1000s of claims)
- inconsistent claims paying practices (flood vs. surge, whole vs. part)
- loss adjustment expense
- legal and regulatory environment
- others…

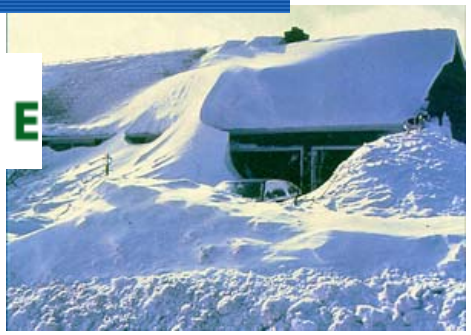
Model Selection

It is important to consider several factors when considering which models to use (vendors/perils):

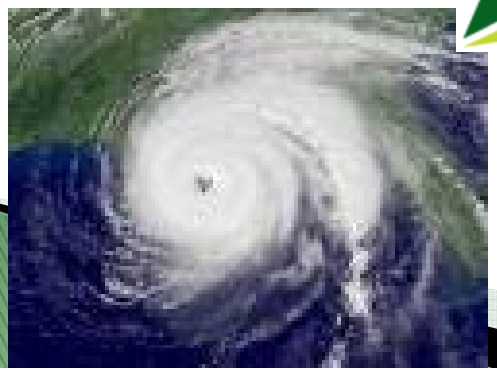
- Market share / acceptance
- Ease of use
- Corporate cat management plans
- Underwriting guidelines
- Reinsurance buying history
- Peril / geographic coverage
- The "Best" answer

Risk Management Solutions RMS

EQECAT



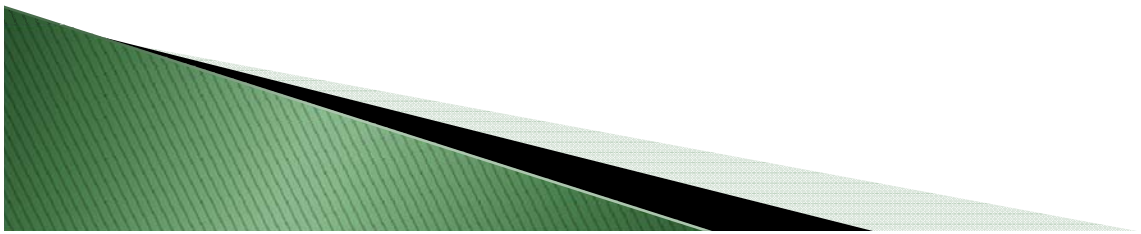
AIR WORLDWIDE



Workers Compensation Catastrophe Modeling Issues

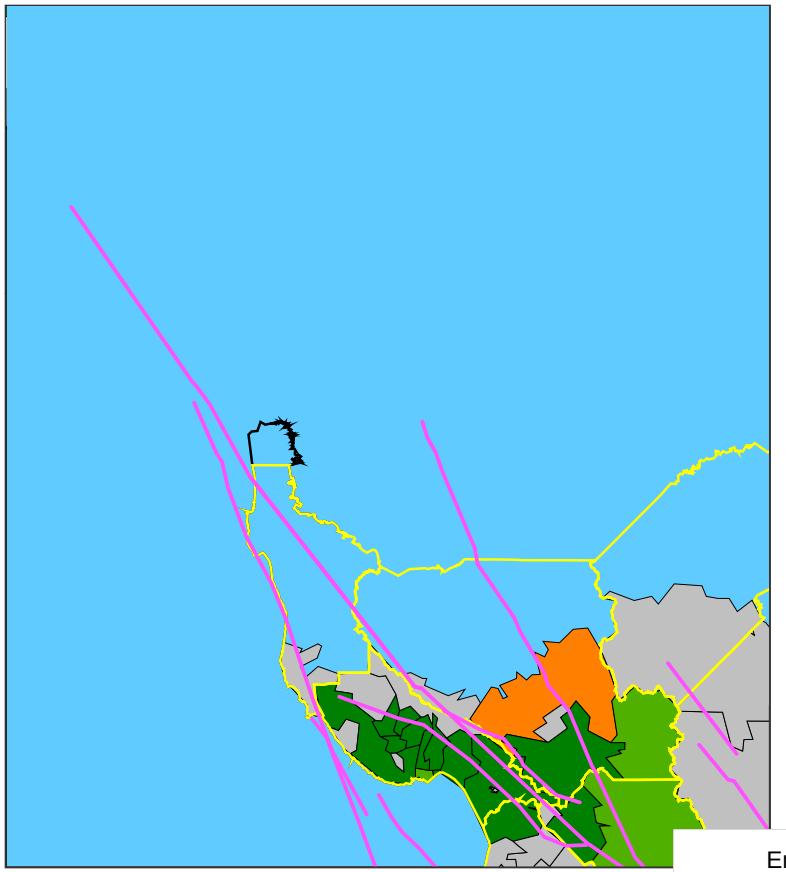
Worker Compensation Catastrophe

- Issues to Understand
  - Impact of Data Resolution – State vs County vs ZIP
  - Knowledge of Building Structure
  - Time of Event
  - Casualty Rates
  - Dollar Loss Distributions

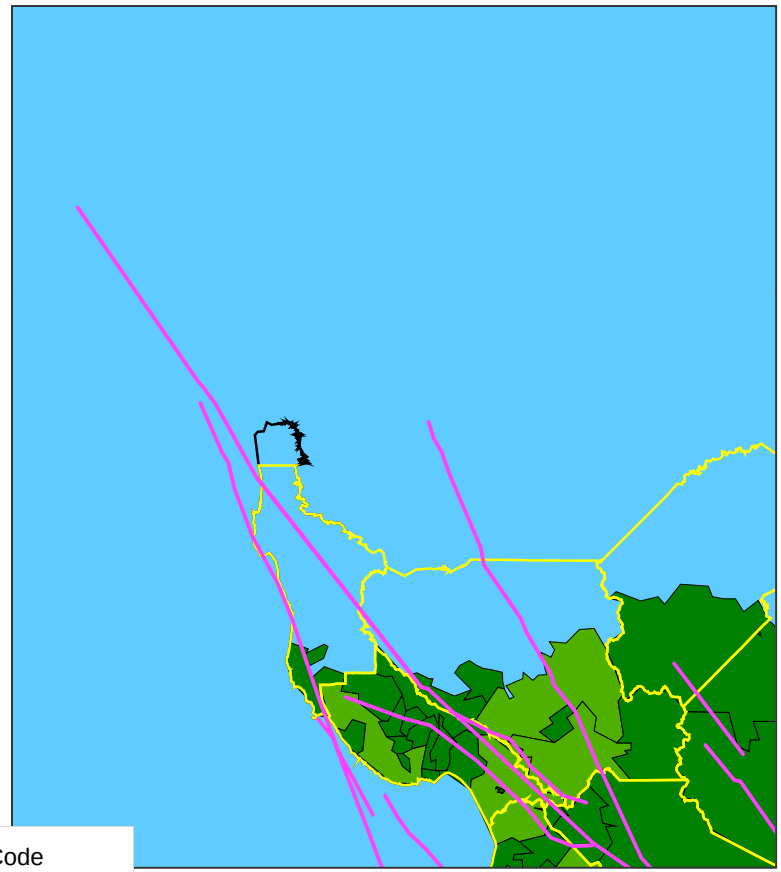


Exposure Comparison – Bay Area

ZIP Exposure



State Exposure

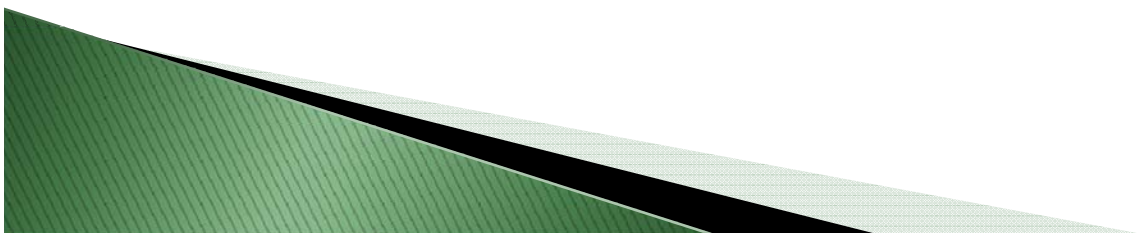


Employees by ZIP Code

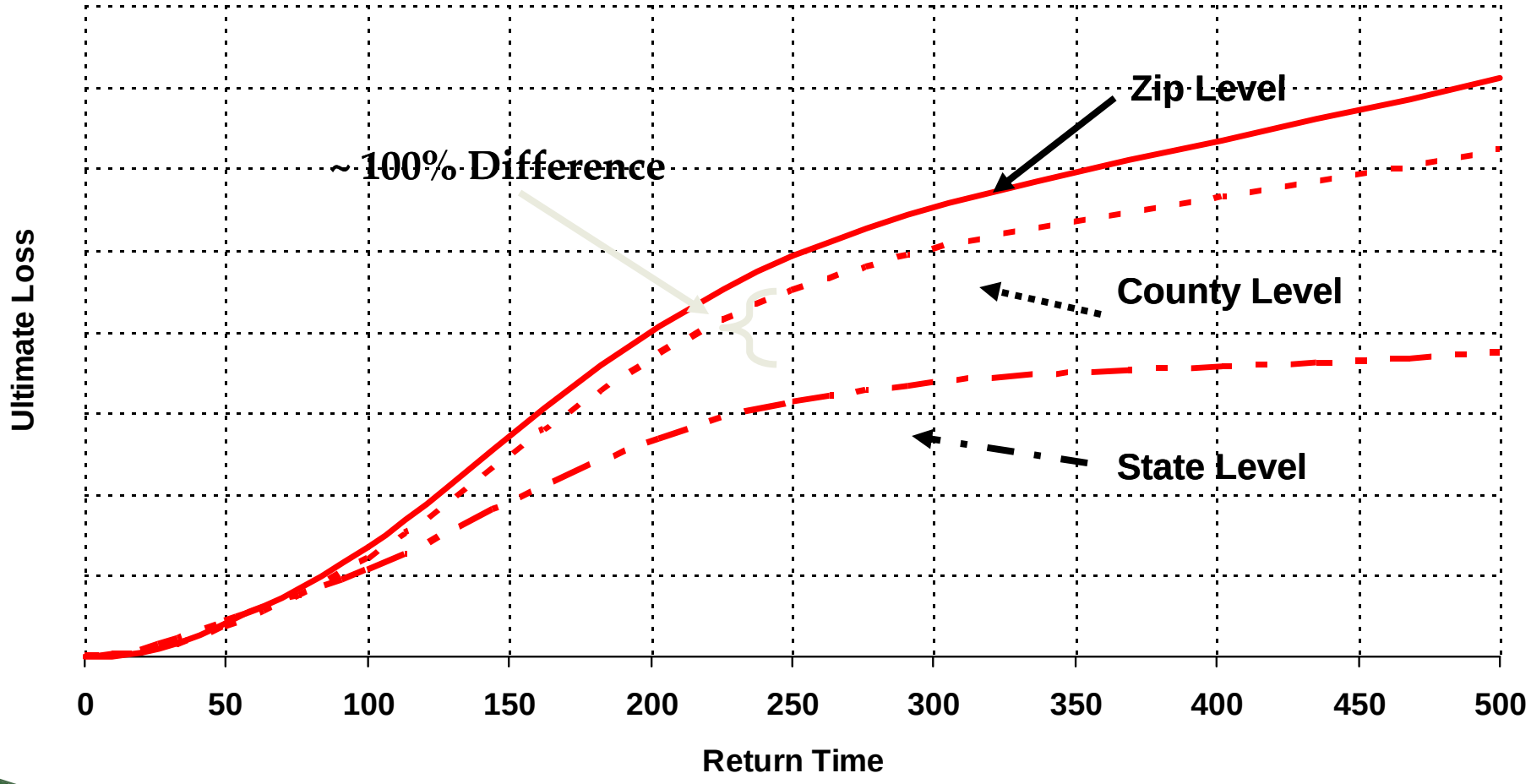
500 to	1,490		(8)
250 to	500		(5)
100 to	250		(15)
25 to	100		(124)
1 to	25		(638)

Aphorism # 1

It is always earthquake season

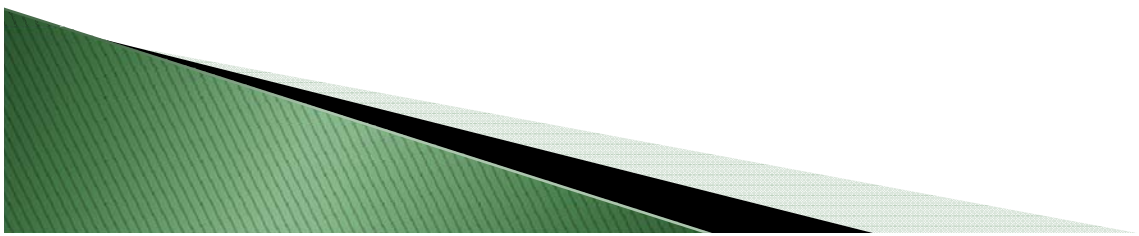


Results Peak Time at varying level of data resolution

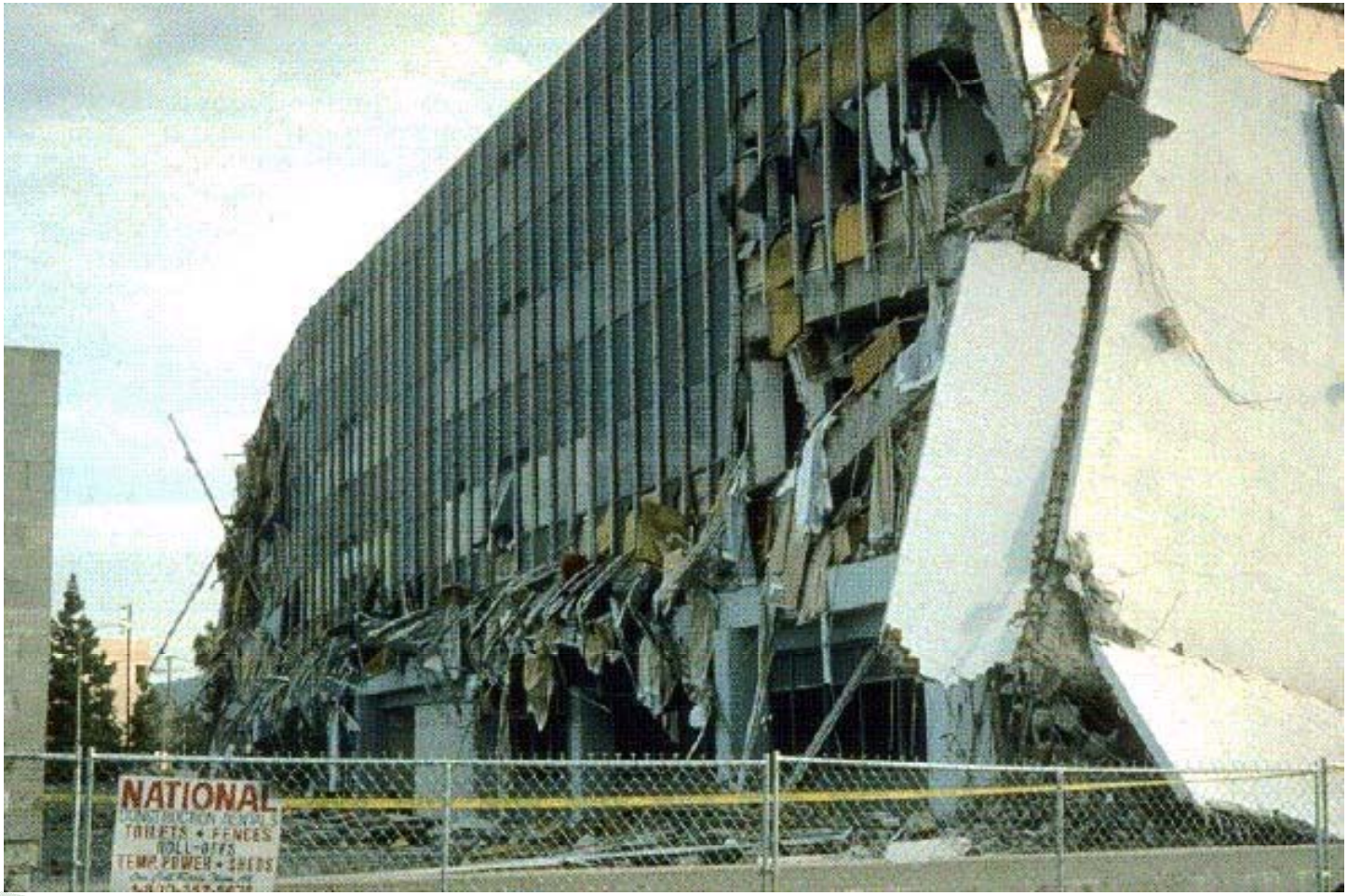


Worker Compensation Catastrophe (Building Structure)

- Building Structure Related Questions
  - building information only recently becoming available
  - will rely on the models distribution of building data by Zip Code/County/State to assign the company's insured to a certain building structure.
  - What is impact of casualty rate at different construction type assumptions

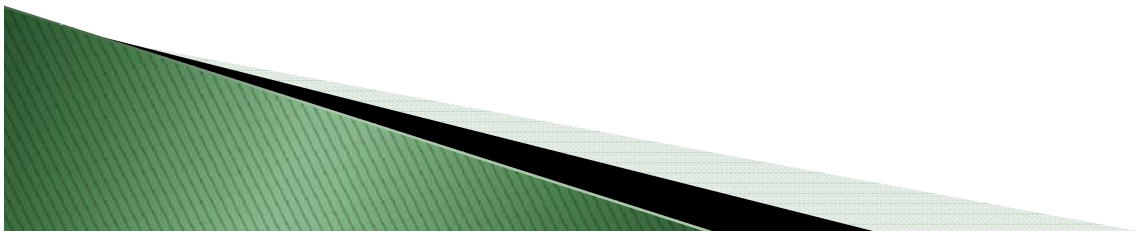


Injury and Fatality Modeling from Earthquake Partial Collapse & Pancake: Northridge

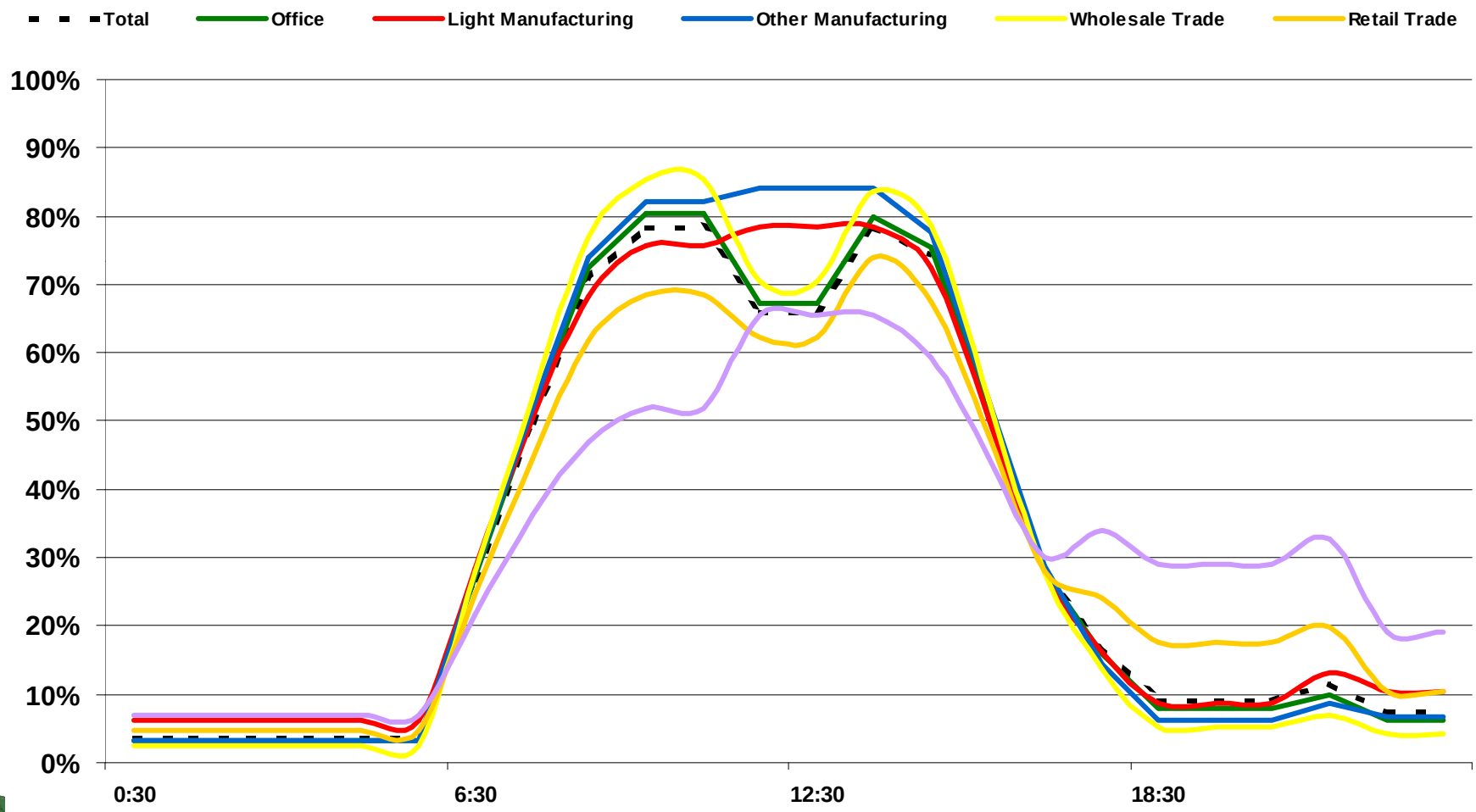


Worker Compensation Catastrophe (Peak vs Non Peak)

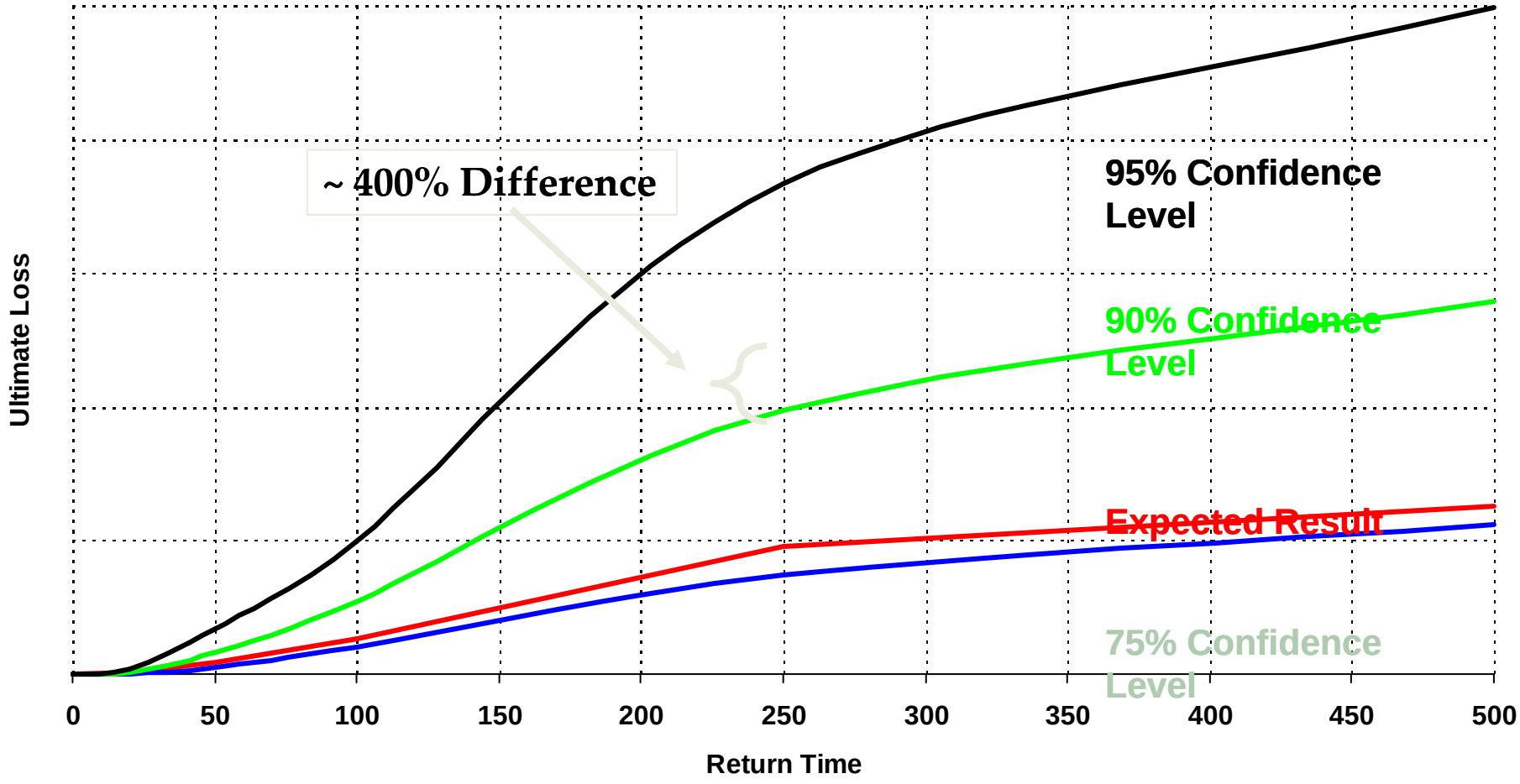
- Time of Event Related Questions
  - If the event occurs during the workday do you assume
    - Average Occupancy of the building?
  - Impact of different classes
    - Office vs restaurant workers
    - Nursing shifts
    - Mail deliveries



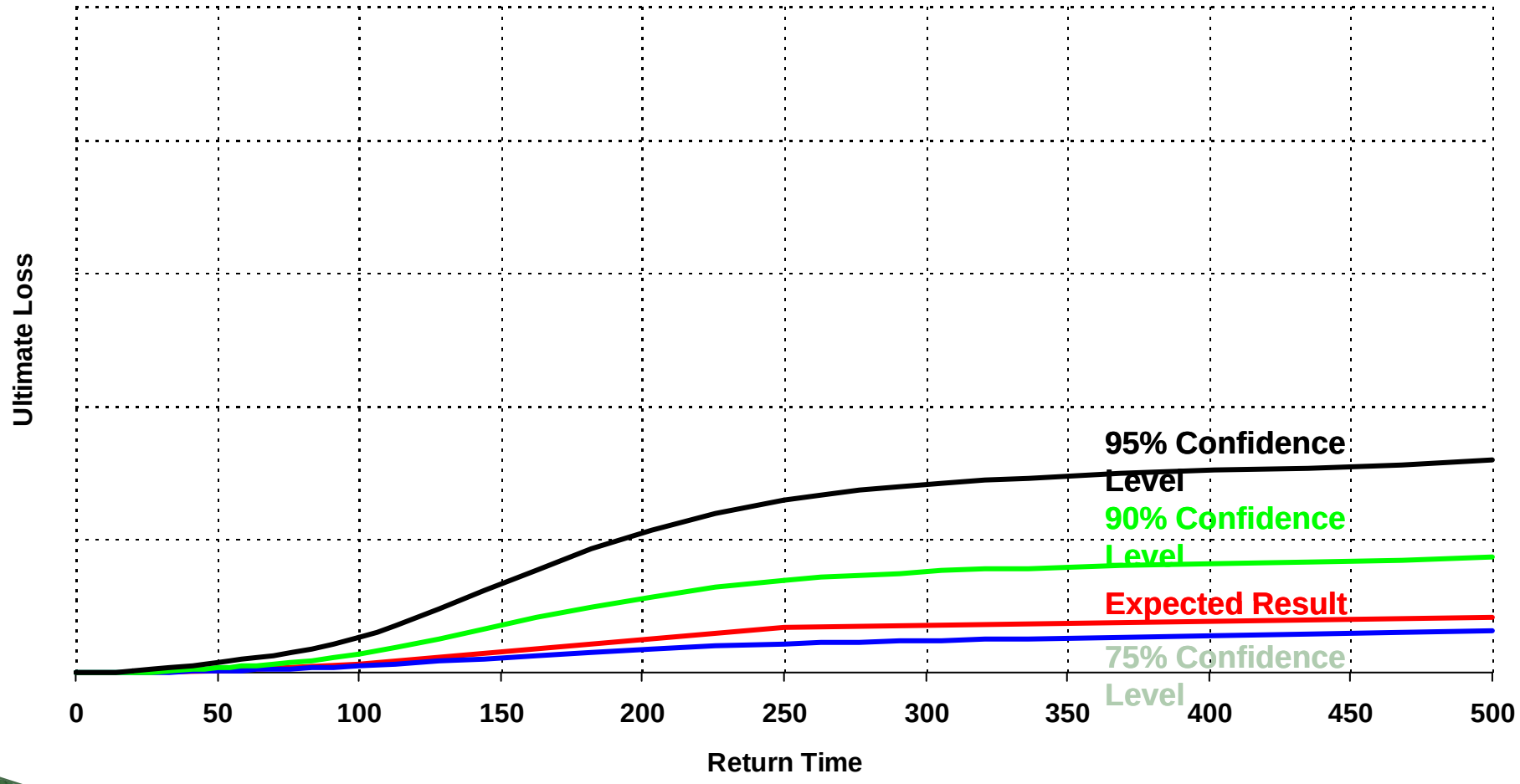
Worker Compensation Occupancy by Time of Day and Day of Week



Results – Peak Time



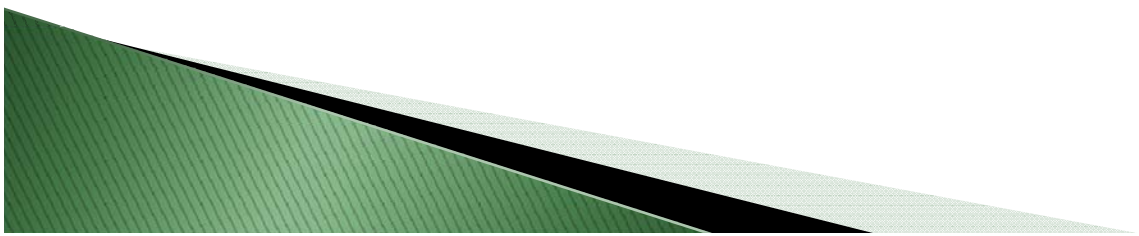
Results – Random Time



Casualty Claim Rate

Workers Compensation Classifications

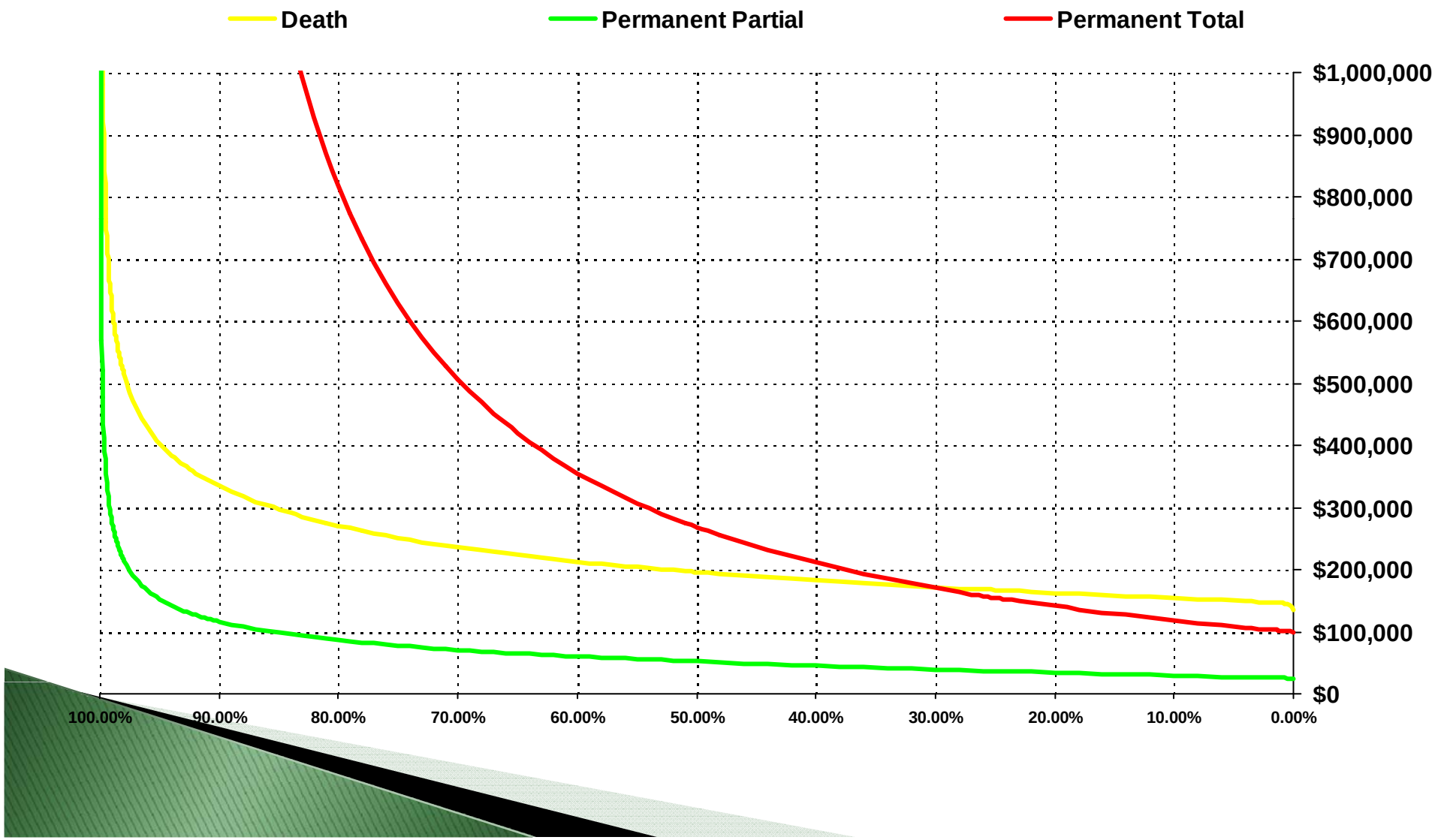
- Claim rate provide information on model results
  - Fatal
  - Permanent Total
  - Permanent Partial
  - Medical Only



Casualty Loss Dollars

- Unlike Property, Workers Compensation does not have a defined finite limit.
- The same loss (Example Permanent Total) could have a loss value range of
  - $100,000 to $25,000,000
- Though Benefits are defined by the States & limited on the Indemnity side, Medical payments are not
- Each Loss Type (Fatality, Permanent Total….) has it's own unique distribution of Loss Dollars

Worker Compensation Severity Loss Distribution



Aphorism # 2

God Created Catastrophe Modelers in order for Actuaries to look good!!