

GUY CARPENTER



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Property Exposure Rating

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Agenda

- Exposure Rating Basics
 - History
 - First-Loss Scales
- Examples/Calculations
- PSOLD Curves
- Premium Allocation Issues
- Curve Evaluation

PROPERTY Exposure Rating

- Commercial Property
- Residential Property
- Ocean Marine
- Inland Marine

■ What IS Exposure Rating??

- Pure Exposure Rating – Used by Primary Companies
 - Commonly called “Manual Rating”

Property Rating - Pure

$$\text{Premium} = \text{Rate} * \text{Insured Value}$$

Rate: Amount you charge per
\$100 of Insured Value

Insured Value: Value of building
(more or less)
Sometimes called TIV or PML

Property Rating - Pure

TIV: Total Insured Value

TSI: Total Sums Insured

Basically the value of the building or the policy limit, whichever is smaller

PML: Probable Maximum Loss

The largest loss that seems reasonable to expect (this is almost always less than TIV/TSI)

Pure Exposure Rating

- Premium = Rate * Exposure

EXAMPLE

Rate = \$0.20 per \$100 of TIV

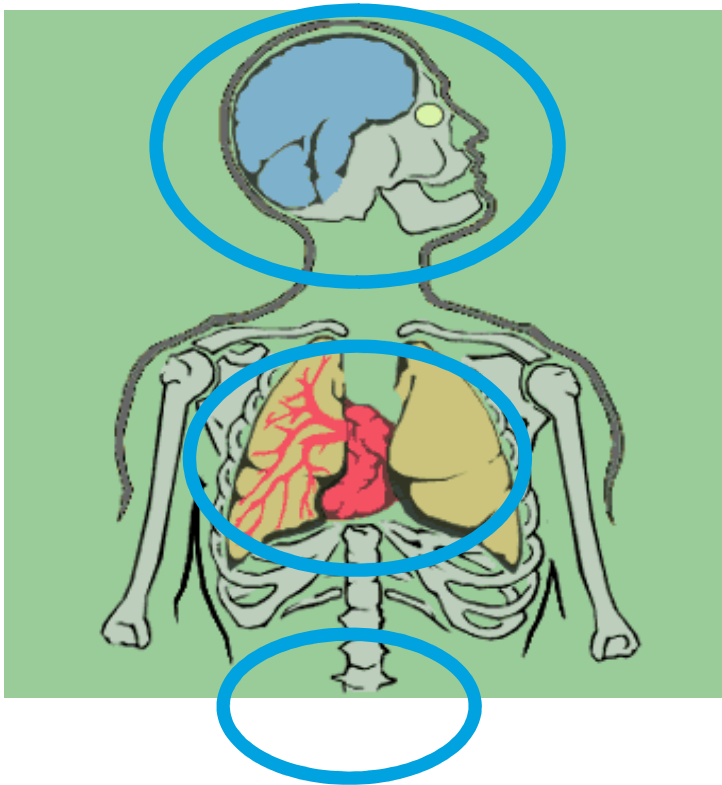
Exposure = Building Value = \$1M

$$\begin{aligned}\text{Premium} &= \text{Rate} * (\text{Exposure}/100) \\ &= \$0.20 * \$1\text{M}/100 \\ &= \$2,000\end{aligned}$$

Where does the rate come from?

Property Rating - Pure

So where does the “Rate” come from?



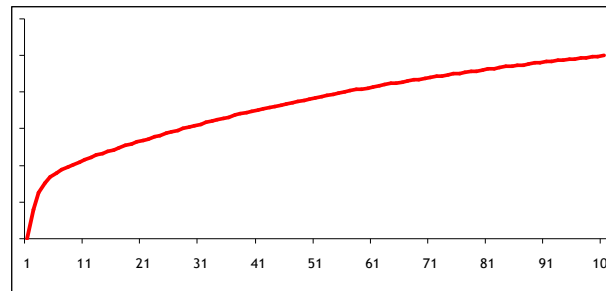


Property Rating - Pure

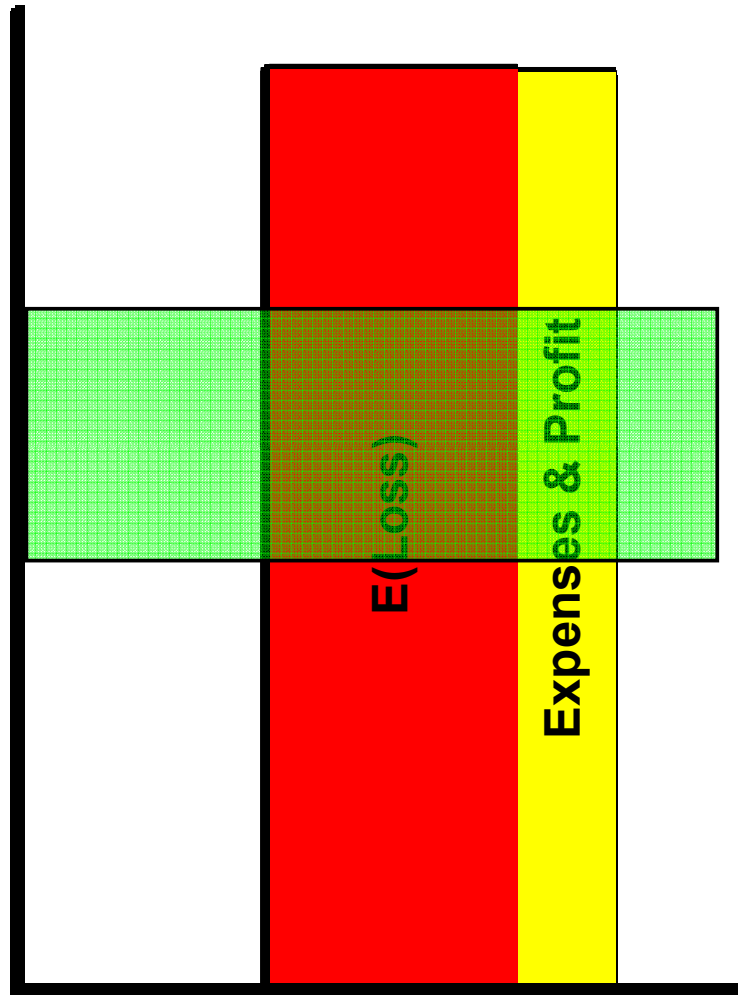
- Determined by
 - Rating agencies: ISO
 - Based on companies' reported data
 - Company Internal Analysis
- Generally subject to regulatory approval

What IS Exposure Rating??

- Reinsurance Exposure Rating
 - Allocation of Premium/Loss to Layer through use of some generated curve/equation (model of loss)
 - Based on Industry
 - Based on Company Data



Exposure Rating Overview



- We always start with the subject premium
- The loss ratio determines the expected ground-up loss
- Exposure Rating simply tells us how much of the expected loss will fall into a given layer
- Once we have expected loss to the layer, we can break it up into its component frequency and severity
- The mechanics of how we do this is different depending on the curve we use

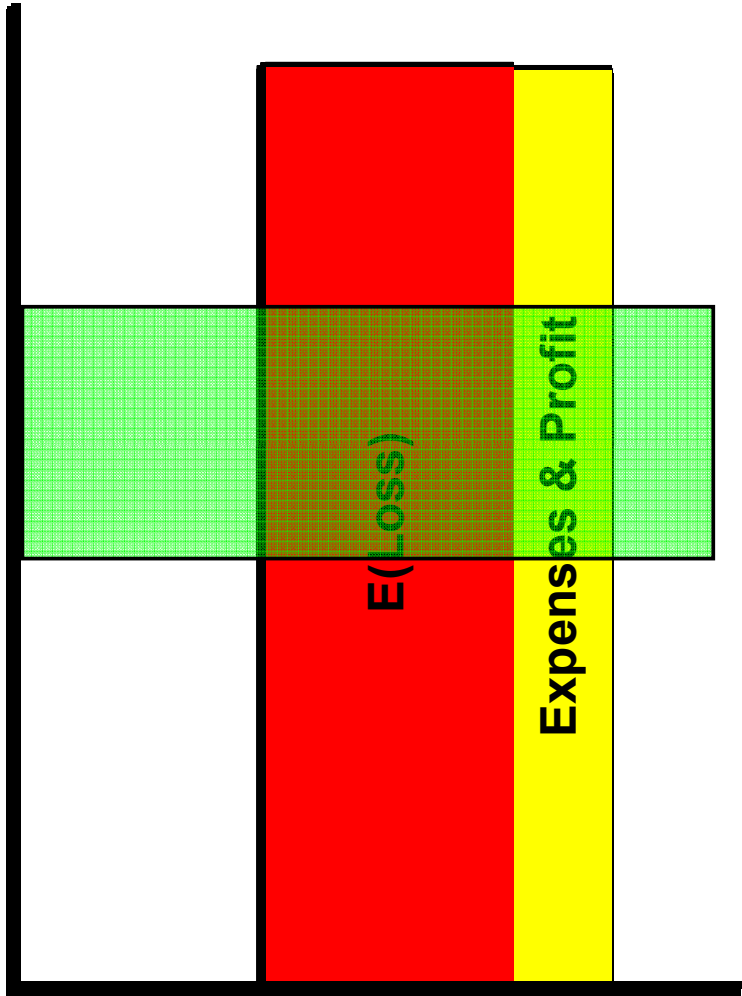
Premium

- **What we get is the Subject Premium**
 - The premium for the business that is subject to the reinsurance treaty
 - Some business not covered
 - Facultative cessions removed
- This can be a problem
 - Why?

Loss Ratios

- **We usually get the loss ratio the company supplies for the LOB**
 - Does this LR vary for subject vs non-subject business?
- **Wind vs Fire vs CAT Loss Ratios???**
 - Sometimes on a combined basis, sometimes calculate separately
 - Best to have Cat vs Non-Cat
- **Why?**
 - Exposure rate is always a **non-cat** rate
 - We let the Cat Models (AIR/RMS/EQE) calculate the cat portion of expected loss
- **Ultimately, you want a loss ratio that excludes modeled causes**

Exposure Rating Overview



WHEN Do We Exposure Rate?

When company experience:

- Is approximately like Industry
 - Or another company
- Is insufficient
 - Low volume
 - New LOB
- Is non-credible
 - Mix changes
 - Changing profiles



When DON'T We Exposure Rate?

When company:

- Experience is not like industry
- Info is not available
 - Company doesn't provide necessary info
 - No industry data is available



Property Rating – Why Use a Curve?

Using a single rate for the entire exposure leaves us in a bit of a bind....

Building Value = \$1M

Rate = 20 ¢ per \$100 in Value



How much went
for 500K x 500K
???????

Since reinsurer is getting 50% of building should he/she/it get 50% of the premium?

■ Property Rating – Why Use a Curve?

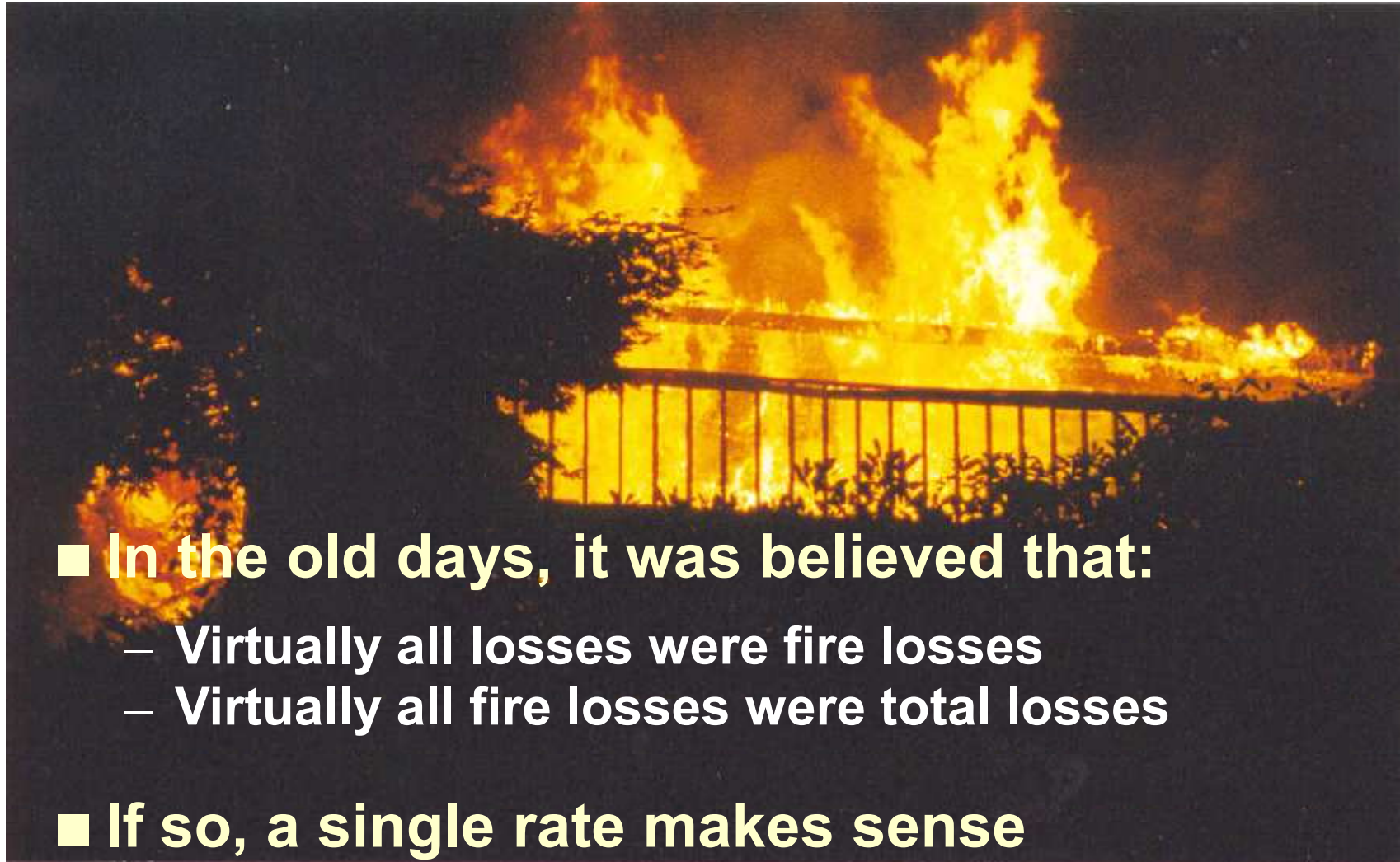
NOT

Property Rating – Why Use a Curve?

So what are we supposed to do ???

Why can't the property people use ILFs too?

Property Rating – Bit o' History



- **In the old days, it was believed that:**
 - Virtually all losses were fire losses
 - Virtually all fire losses were total losses
- **If so, a single rate makes sense**

Property Rating – Bit o' History


- These days, it is believed that:
 - For Homeowners
 - There are lots of total fire losses
 - But there are a lot of partial losses too
 - For Commercial Property
 - There are lots of ways to have losses
 - Hardly any losses are total



■ In response rating methods are different

Property Rating – Liab vs Prop

- For Liability we think in terms of dollars
 - e.g. a slip & fall costs \$2000
- For Property we think in terms of % of TIV
 - e.g. a HO claim is for 10% of the TIV
- For Liability, loss is independent of limit
For Property, loss is dependent on TIV



Some people
think E&O
behaves more
like property

Property Rating – First Loss Scales

Traditionally, Property has used something called a *First-Loss Scale*

First-Loss Scales give the distribution of loss as a percent of insured value (as opposed to the distribution of loss dollars)

This means for property we basically only do allocation of premium based on losses

Property Rating – First Loss Scales

- TIV vs PML vs Other
 - Lloyds Scales - ??????????
 - Salzmann Curves - Bldg losses for Bldg TIV
 - Ludwig Curves - All losses but Bldg TIV
 - Reinsurer Curves (Swiss Re, Munich Re, Skandia, etc) ???
 - Some curves apply to PMLs
 - Some curves are Fire-Only
 - No consistent definition of PML

Property Rating – First Loss Scales

Where do they come from?

- Lloyd’s Scales

????????????????????

- Salzmann Curves

“Rating by Layer of Insurance” – Ruth Salzmann, 1963

HO Fire losses only

1960 Accident Year Data from INA

- Ludwig Curves

“An Exposure Rating Approach to Pricing Property Excess-of-Loss Reinsurance” – Stephen Ludwig, 1991

Hartford HO AY Data, 1984-1988

Hartford Commercial Property database

Fire, Wind, Other

Retail/Wholesale, Service/Office, Apartment/Condo, Restaurant

Property Rating – First Loss Scales

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

Interpretation:

Layer 0-10% should see 25% of the total losses

Layer 0-50% should see 70% of the total losses

Property Rating – First Loss Scales

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

TIV = \$100,000

25% of losses are less than or equal to 10% of TIV. Therefore, 25% of Premium goes to pay the losses for the first 10,000 of building value.

(since $10\% * 100,000 = 10,000$)

60% of the premium goes to pay the losses for the first 40,000 of building value

(since $40\% * 100,000 = 40,000$)

Property Rating – First Loss Scales

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

TIV = \$100,000

10% (= 50% - 40%) of losses are expected to fall in the layer between \$20,000 and \$30,000

This also means that if you have a loss, there is a 30% chance more than 50% of the building will be lost.

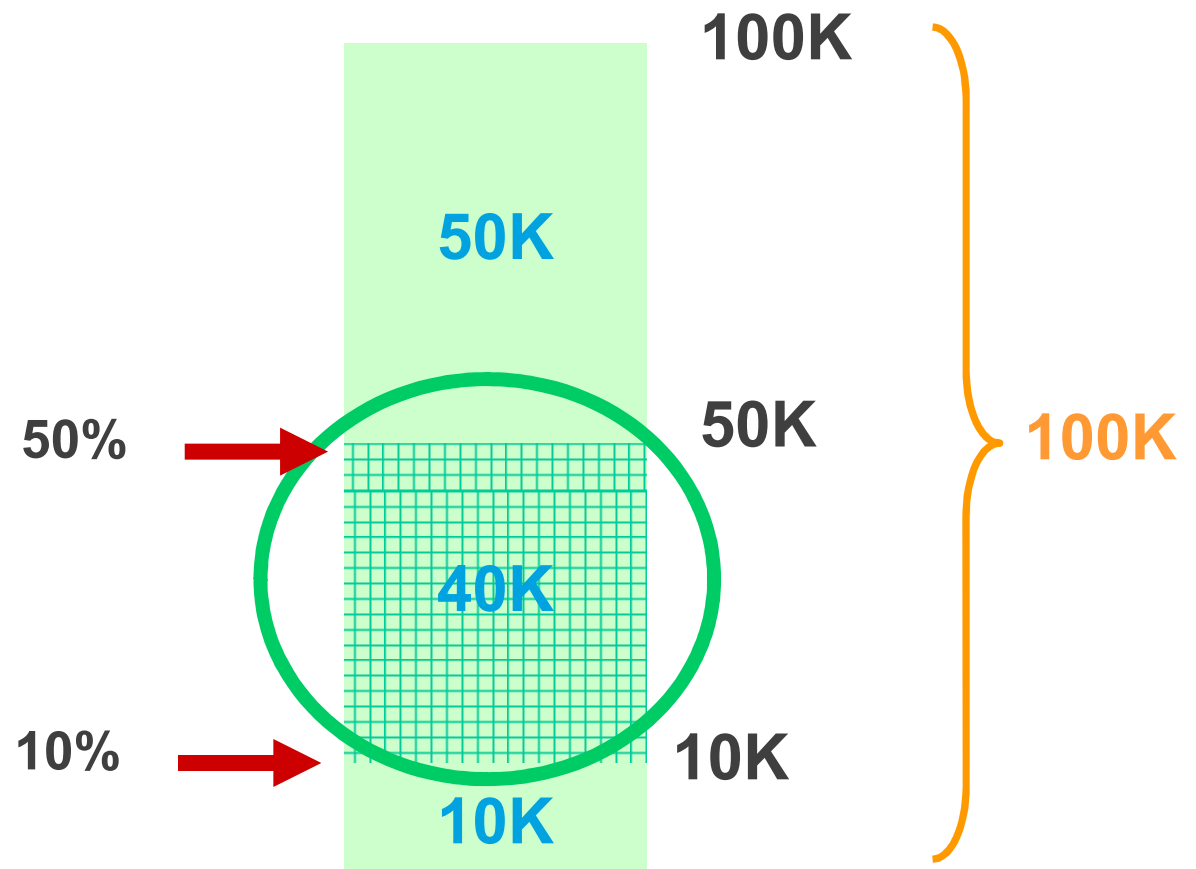
If there's a 30% chance that half of a \$1M building can get wiped out, does this also mean that there's a 30% chance that half of a \$100M building will be lost?

First Loss Scales – Example 1

What premium is needed for a 40K x 10K treaty?

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

TIV = 100K
 Prem = 1,000
 Loss Ratio = 60%
 Reins. Expenses = 20%



Step 1: We need to know what the retention and the top of the layer are as a % of TIV

First Loss Scales – Example 1

What premium is needed for a 40K x 10K treaty?

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

Prem = 1000

Loss Ratio = 60%

Reins. Expenses = 20%

Step 2: Calculate Expected Loss

$$1000 * 60\% = 600$$

Step 3: Look up Ratios on Table

10% → 25% of loss

50% → 70% of loss

Step 4: Multiply E(Loss) by Ratio Difference

$$E(\text{Loss})_{40 \times 10} = (70\% - 25\%) * 600 = 270$$

Step 5: Gross Up for Reins. Expenses

$$\text{Reins. Prem}_{40 \times 10} = 270 / (1 - 0.2) = 338$$

So insuring 40% of limit for 33.8% of premium

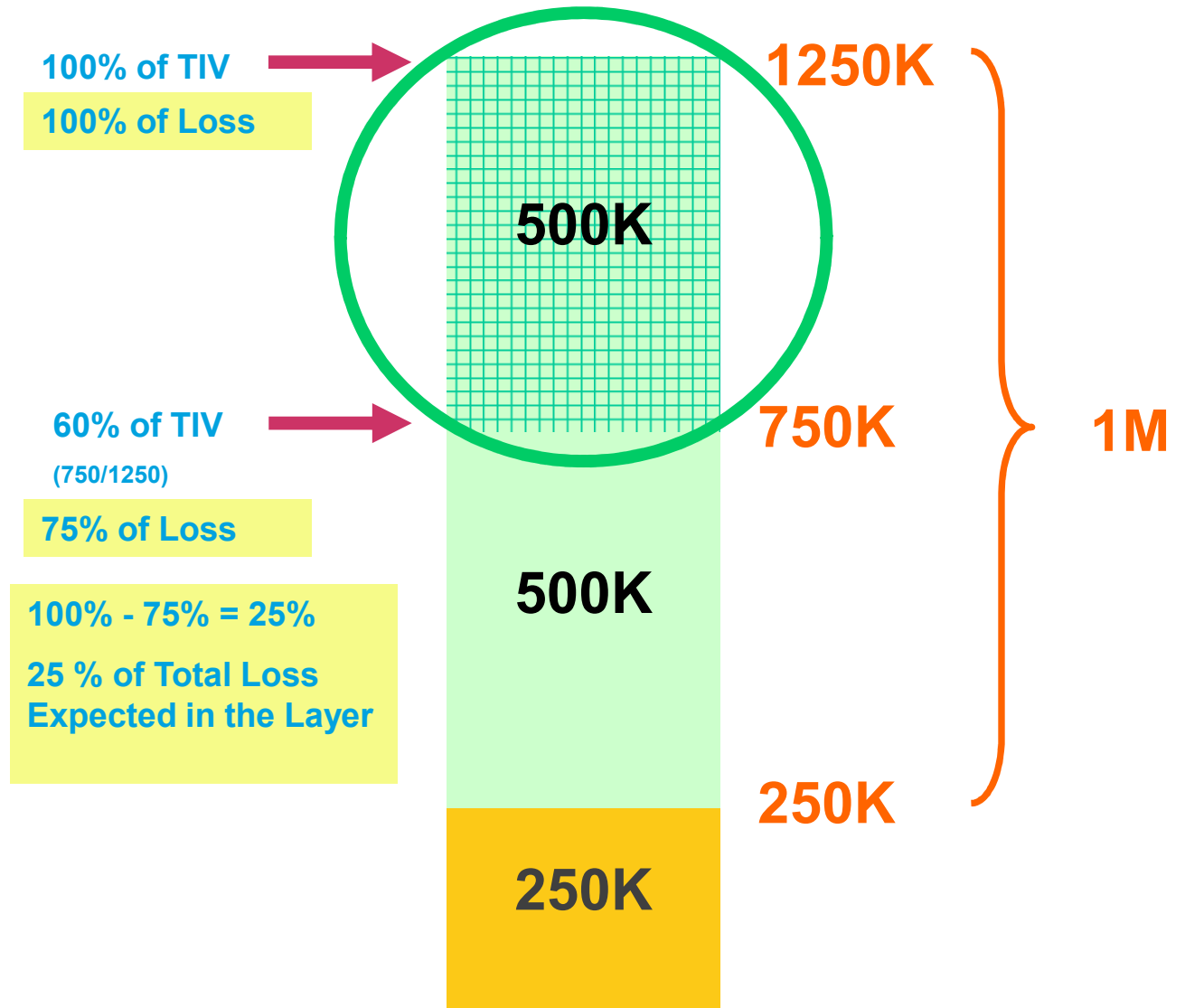
First Loss Scales – Example 2

Policy with SIR

What premium is needed for a 500K x 500K treaty?

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

Policy Limit = 1M
 SIR = 250K
 TIV = 1.25M
 Prem = 10,000
 Loss Ratio = 55%
 Reins. Expenses = 20%





First Loss Scales – Example 2

Policy with SIR

BUT WHAT IS THE TOTAL LOSS?

First Loss Scales – Example 2

Policy with SIR

Policy Limit = 1M
SIR = 250K
TIV = 1.25M
Prem = 10,000
Loss Ratio = 55%
Reins. Expenses = 20%

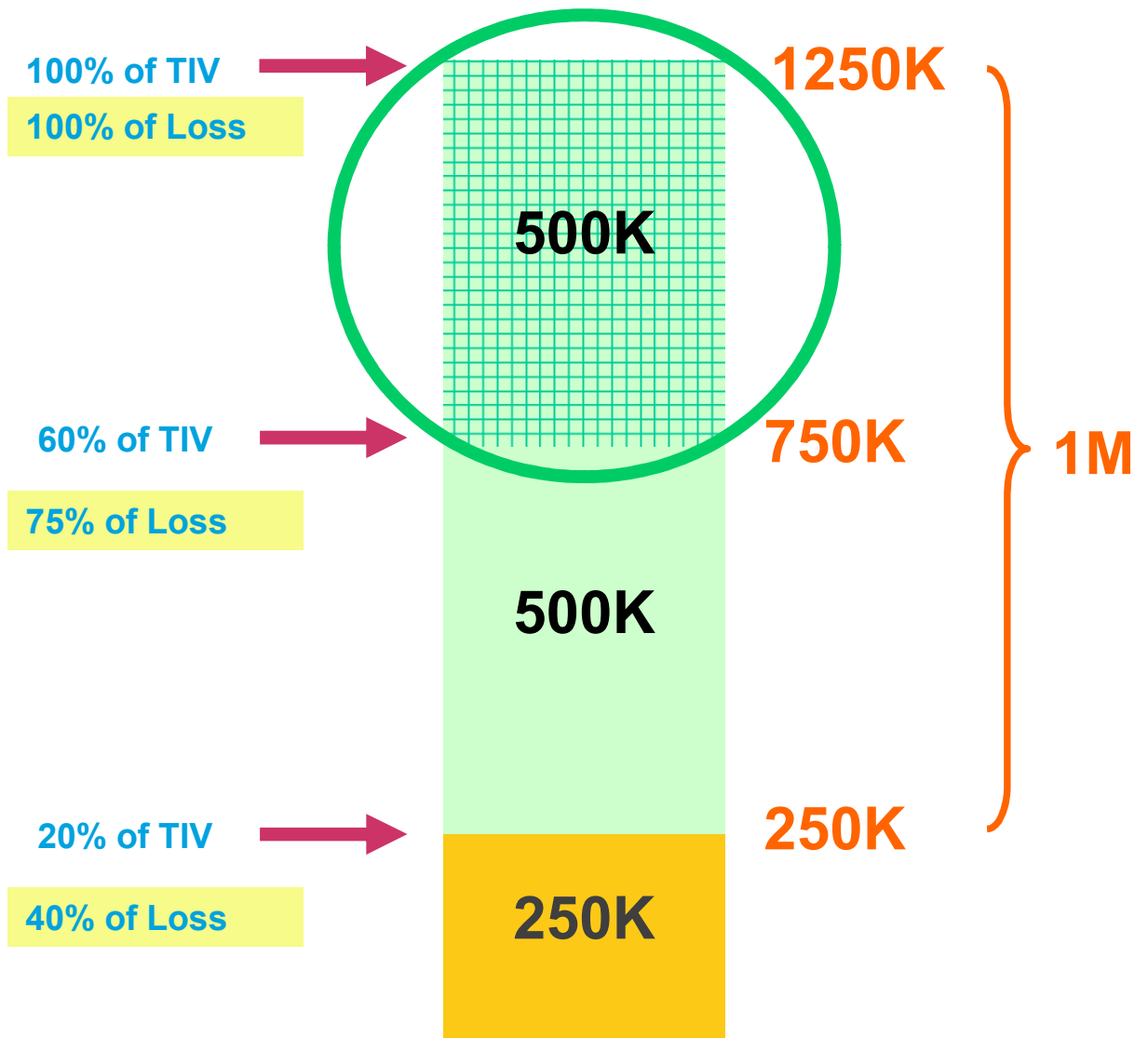
$$E(\text{Loss}) = \text{Premium} * \text{Loss Ratio} \\ = 10,000 * 0.55 = 5,500$$

**BUT THIS IS ONLY FOR
LOSSES ABOVE 250,000!**

If 40% of losses are below
250,000, then

$$5,500 = \text{Total Loss} * (1-40\%)$$

$$5,500 / (1-40\%) = 9,167$$



First Loss Scales – Example 2

Policy with SIR

What premium is needed for a 500K x 500K treaty?

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

Calculate Expected Loss in the Layer

$$9,167 * 25\% = 2,292$$

Gross-up for Reinsurer Expenses

$$2292 / (1 - 0.2) = 2,865$$

Policy Limit = 1M
SIR = 250K
TIV = 1.25M
Prem = 10,000
Loss Ratio = 55%
Reins. Expenses = 20%

So insuring 40% of limit for 28.7% of premium

First Loss Scales – Example 3

Multiple Locations

What premium is needed for a 500K x 200K treaty?

200K to 700K

BLDG	Prem	TIV	Exp Loss	Lower TIV	Upper TIV
A	100	100K	60		
B	200	400K	120	200K	400K
C	300	500K	180	200K	500K
D	400	1,000K	240	200K	700K
Tot	1,000		600		

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

Lower %	Upper %	% Loss _{Lower}	% Loss _{Upper}	Difference	E(Layer Loss)
50%	100%	70%	100%	30%	36
40%	100%	60%	100%	40%	72
20%	70%	40%	80%	40%	96

204

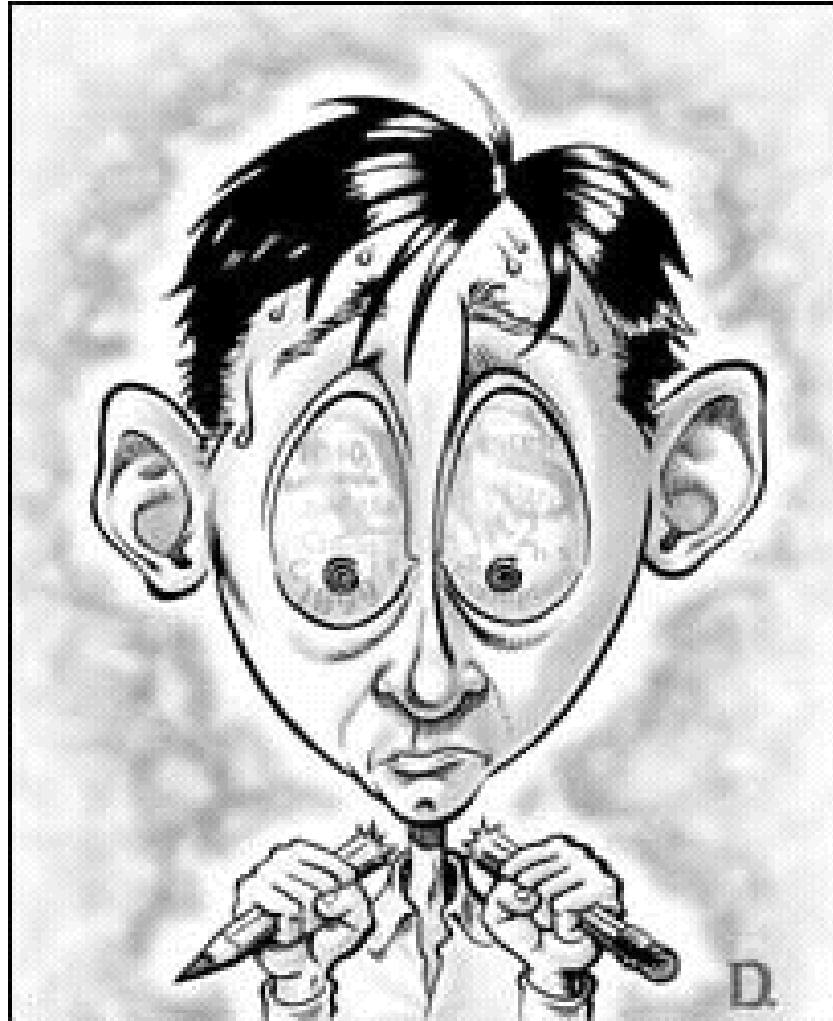
$$\frac{E(\text{Layer Loss})}{(1 - \text{Reins. Exp})} = 255$$

% of Premium = 25.5%

Loss Ratio = 60%

Reins. Expenses = 20%

First Loss Scales – Examples



First Loss Scales – Examples



First Loss Scales – Example 4

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

What premium is needed for a 300K x 200K treaty?

Layer	# Risks	Lower	Upper
A	100	0	100K
B	50	100K	200K
C	20	200K	300K
D	10	300K	500K
Tot	180		

I wish this were a trick question, but this is the kind of data we often get

First Loss Scales – Problem 3

% of TIV	% of Loss
0.0%	0.0%
10.0%	25.0%
20.0%	40.0%
30.0%	50.0%
40.0%	60.0%
50.0%	70.0%
60.0%	75.0%
70.0%	80.0%
80.0%	90.0%
90.0%	96.0%
100.0%	100.0%

What's wrong?

b) Need prem, not # of risks

Layer	# Risks	Lower	Upper
A	100	0	100K
B	50	100K	200K
C	20	200K	300K
D	10	300K	500K
Tot	180		



Wrinkles to Using First Loss Scales

- Appropriate First Loss Scale
 - Over 50 First Loss scales
 - Some are more popular with reinsurers
 - Different scales are used differently



Property Exposure Rating History

- Lloyds
- Salzmann (1960 INA Homeowners data)
- Reinsurer Curves (Swiss Re, Munich Re, Skandia, etc)
- Ludwig (1984-1988 Homeowners and Small Commercial data)
- ISO's PSOLD (Recent Commercial data)
- ISO's PSOLD+ (Recent Homeowners data)
- MBBEFD (Astin paper by Stephan Bernegger)

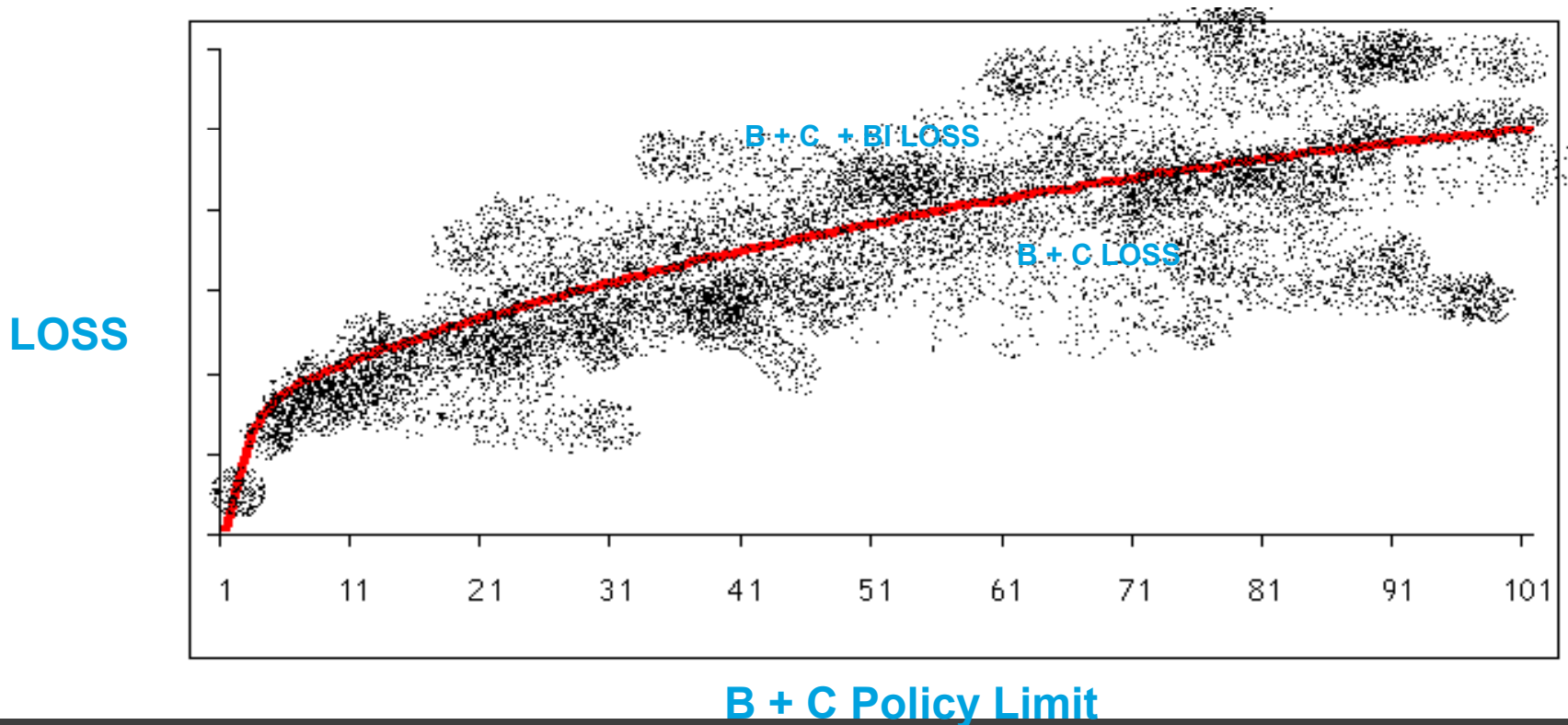
PSOLD Curves

- 1998 – PSOLD Curves Released
- Created to fix assumption of constant loss-to-value ratios across all value ranges
- Calculates average severity of loss given policy limit rather than % of value
- Separate curves for each of:
 - 60 value ranges
 - 22 commercial occupancy classes
 - Homeowners (new)
 - Building Only (discontinued in 2004)
 - Contents Only (discontinued in 2004)
 - Buildings + Contents
 - B + C + BI

PSOLD Curves – BI is an Issue!

- Buildings and Contents – not an issue
- B + C + BI - Watch your Limit Profiles!

$$CDF_ME(x; \bar{\mu}, \bar{w}) = \sum_{i=1}^8 w_i \left(1 - e^{-\frac{x}{\mu_i}} \right)$$



PSOLD Curves

- **DO NOT INCLUDE BI IN LIMITS PROFILES WHEN RATING WITH PSOLD (Most US Markets)**
 - **Overstates Severity of Loss**
- **First-Loss Scales rely on Total Limits Profile (incl. BI)**
- **If profiles are to be sent to London or Foreign markets as well as Domestic, include 2 profiles – one with BI, and one without**

PSOLD Curves – Example Calculations

Loss Amount	Cumulative Probability	Limited Average Severity
1,000	0.300911	833
5,000	0.69665	2,635
10,000	0.827319	3,765
50,000	0.957497	6,887
100,000	0.978202	8,388
500,000	0.996166	11,734
1,000,000	0.998266	13,007
1,500,000	0.998964	13,675
2,000,000	0.999301	14,101
3,000,000	0.999617	14,618
4,000,000	0.999753	14,925
5,000,000	0.999822	15,134
10,000,000	0.999932	15,676
50,000,000	0.999998	16,288
100,000,000	1	16,322
200,000,000	1	16,329
250,000,000	1	16,329

Subject Premium = \$75M

Loss Ratio = 60%

Reinsurer Expenses = 15%

What premium is needed for a \$3M xs \$2M treaty?

Expected Loss = \$75M x 0.60 = \$45M

**Portion of loss in layer = (15,134 – 14,101) / 16,329
= 0.06326**

(\$45M x 0.06326) / (1 – 0.15) = \$3,349,148



Data Issues

Policy Level Data

POL_NO	Written Premium	Number Locs	LIMIT 1	LAYER LIMIT 1	ATTACHMENT POINT 1	LIMIT 2	LAYER LIMIT 2	ATTACHMENT POINT 2	TIV
6599182	\$30,474	1	\$84,000,000	\$84,000,000	\$250,000,000	\$0	\$0	\$0	\$484,000,000
79535844	\$240,000	1	\$200,000,000	\$200,000,000	\$250,000,000	\$0	\$0	\$0	\$1,471,225,556
35786837	\$880,000	81	\$10,000,000	\$25,000,000	\$25,000,000	\$0	\$0	\$0	\$6,320,730,646
6611960	\$116,640	2	\$80,000,000	\$80,000,000	\$70,000,000	\$0	\$0	\$0	\$3,401,777,525
35860524	\$750,000	1430	\$5,000,000	\$50,000,000	\$0	\$5,000,000	\$47,500,000	\$110,000,000	\$18,027,069,919
35843371	\$900,000	406	\$5,000,000	\$50,000,000	\$0	\$1,000,000	\$50,000,000	\$50,000,000	\$8,727,379,032
6599796	\$2,282,942	71	\$100,000,000	\$200,000,000	\$0	\$0	\$0	\$0	\$2,016,541,672
35860533	\$1,012,500	8519	\$5,000,000	\$100,000,000	\$0	\$0	\$0	\$0	\$29,348,103,869
35843374	\$421,230	174	\$5,000,000	\$5,000,000	\$0	\$5,000,000	\$10,000,000	\$10,000,000	\$1,403,505,210
35843355	\$240,000	15	\$5,000,000	\$50,000,000	\$50,000,000	\$0	\$0	\$0	\$4,923,117,407
35800255	\$230,023	62	\$5,000,000	\$75,000,000	\$25,000,000	\$0	\$0	\$0	\$7,403,854,331
6607494	\$423,388	89	\$290,000,000	\$290,000,000	\$10,000,000	\$0	\$0	\$0	\$4,755,041,643
35860558	\$150,000	2962	\$3,750,000	\$3,750,000	\$0	\$3,750,000	\$125,000,000	\$125,000,000	\$12,417,484,051
35843360	\$480,000	60	\$6,000,000	\$15,000,000	\$25,000,000	\$0	\$0	\$0	\$4,409,150,884
35829556	\$50,000	1	\$100,000,000	\$100,000,000	\$740,000,000	\$0	\$0	\$0	\$6,600,408,296
6659395	\$63,750	1	\$75,000,000	\$75,000,000	\$655,000,000	\$0	\$0	\$0	\$728,564,505
35769415	\$359,040	32	\$10,000,000	\$125,000,000	\$60,000,000	\$0	\$0	\$0	\$7,803,683,906
6620216	\$305,000	0	\$100,000,000	\$100,000,000	\$1,325,000,000	\$0	\$0	\$0	\$3,164,670,759
6613493	\$16,503	5	\$16,816,068	\$16,816,068	\$1,000,000	\$0	\$0	\$0	\$17,223,039
6638205	\$80,000	1	\$100,000,000	\$250,000,000	\$1,100,000,000	\$0	\$0	\$0	\$3,121,457,630
35810724	\$7,034	0	\$5,000,000	\$5,000,000	\$5,000,000	\$0	\$0	\$0	\$6,300,000
35860556	\$335,719	54	\$5,000,000	\$5,000,000	\$5,000,000	\$0	\$0	\$0	\$734,191,122

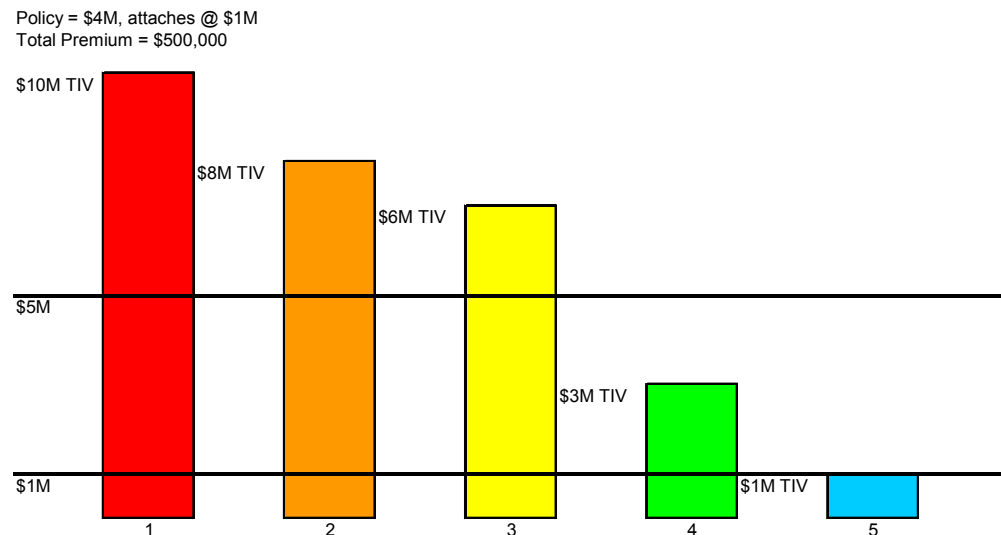
- What do you do when your data looks like this?
- Need LOCATION LEVEL data
- Does every location have the same value and represent the same amount of risk?

Why the Need to Allocate Premium

- Exposure Rating Model Inputs:
 - PREMIUM!!
 - Loss Ratios
 - Limit Profile
 - Deductible/Attachment
 - Occupancy
 - Coverage

Allocation of Premium to Individual Location

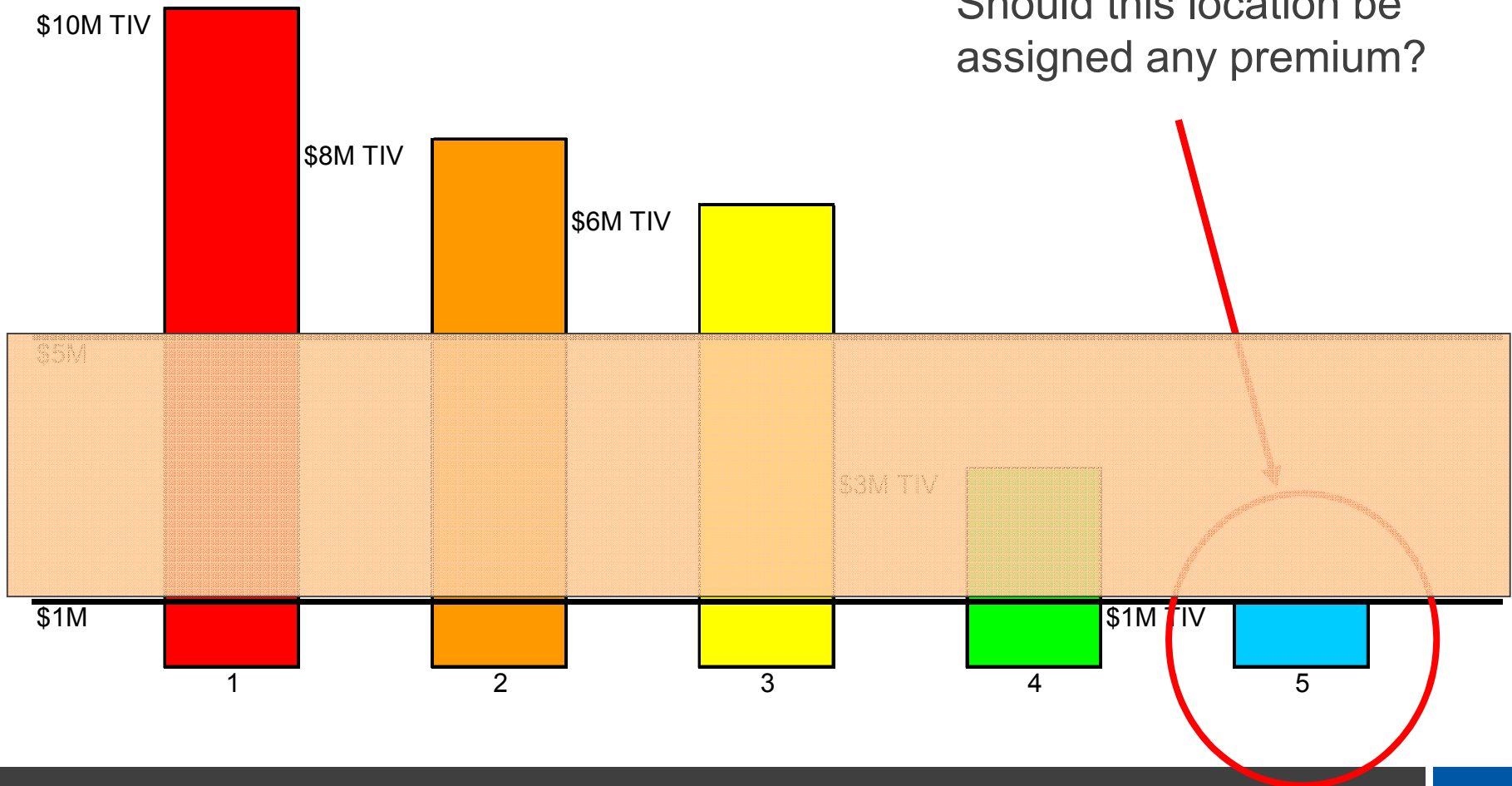
- When policies cover multiple locations, it is necessary to allocate the premium to each individual location before exposure rating techniques can be properly applied.
- Traditional Methods
 - By TIV
 - All Premium Slotted to Highest Limit
 - By Exposed TIV
- Traditional Methods are Wrong
 - Why?



Allocation of Premium to Individual Location

BY TIV???

Policy = \$4M, attaches @ \$1M
Total Premium = \$500,000



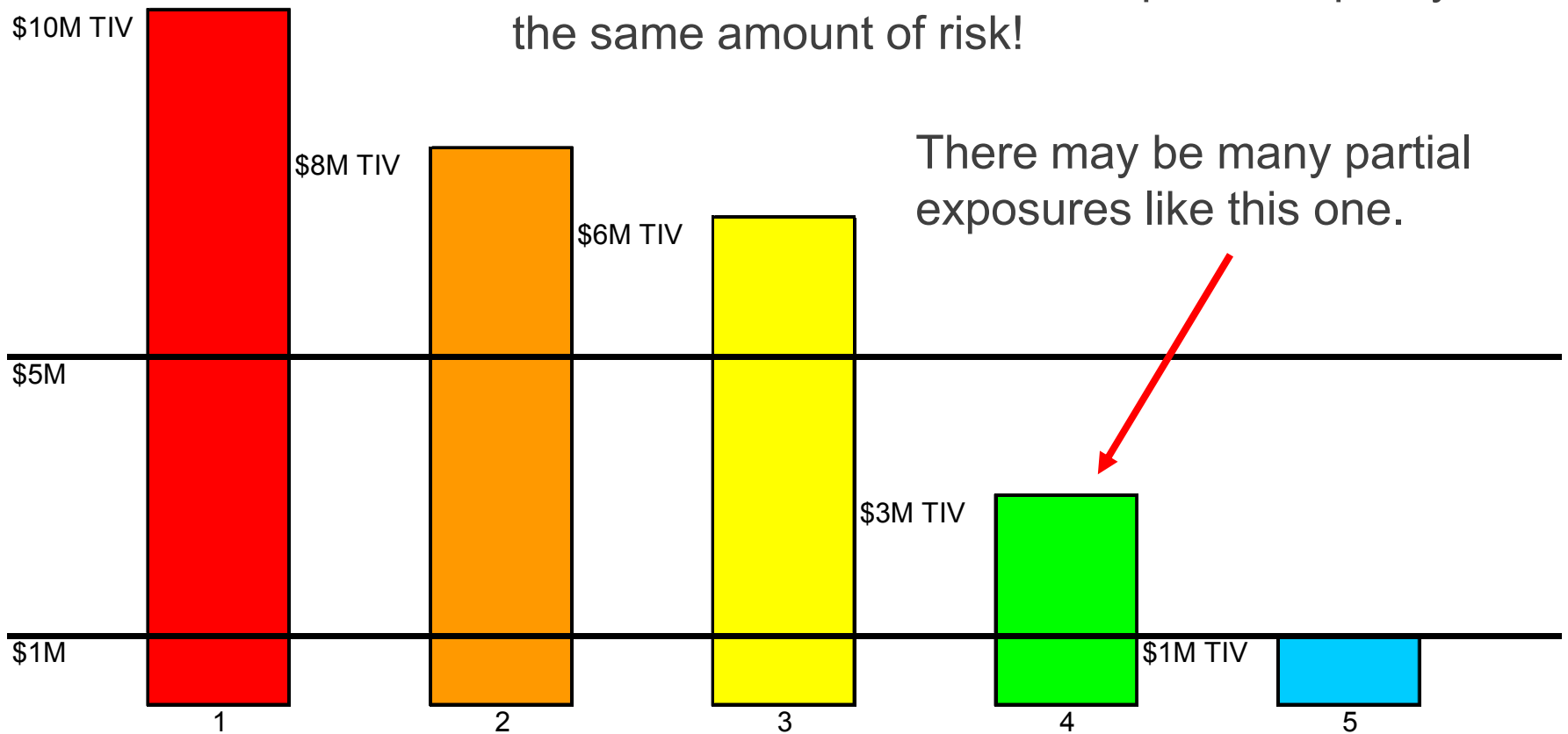
Should this location be assigned any premium?

Allocation of Premium to Individual Location

ALL PREMIUM SLOTTED TO HIGHEST LIMIT???

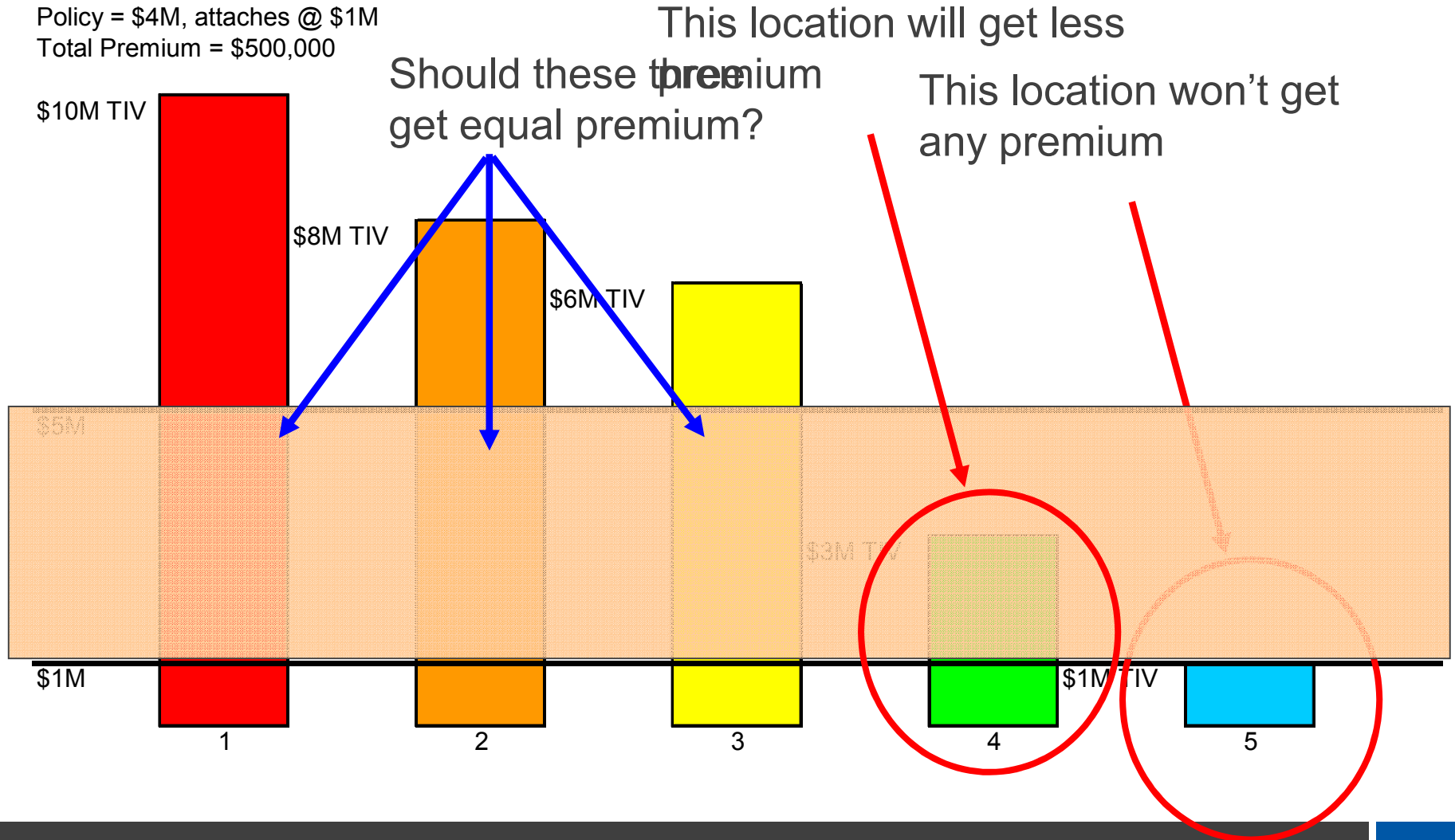
Policy = \$4M, attaches @ \$1M
Total Premium = \$500,000

Would assume all locations expose the policy to the same amount of risk!



Allocation of Premium to Individual Location

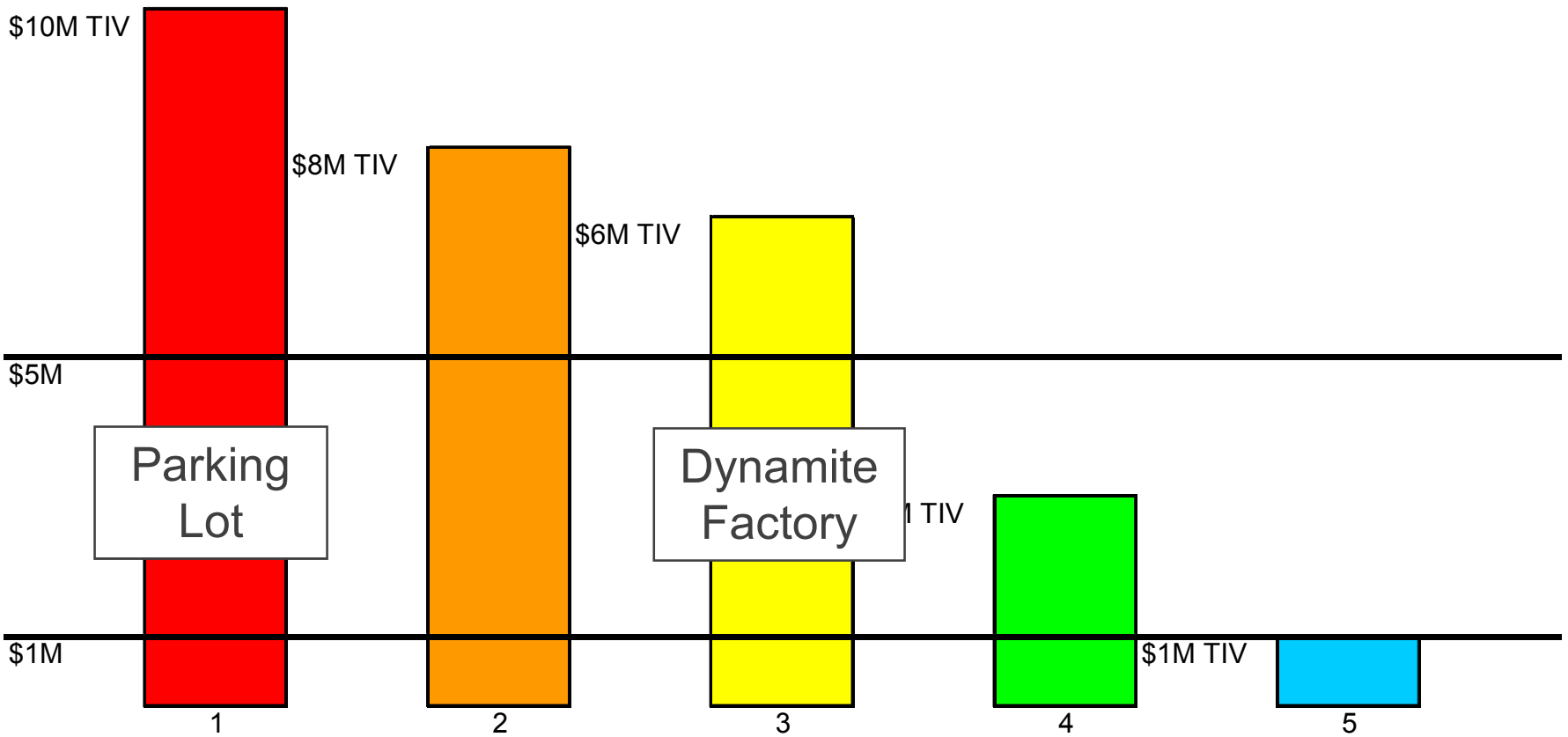
BY Exposed TIV???



Allocation of Premium to Individual Location BY Exposed TIV???

Policy = \$4M, attaches @ \$1M
Total Premium = \$500,000

Do they subject the policy to equal risk?

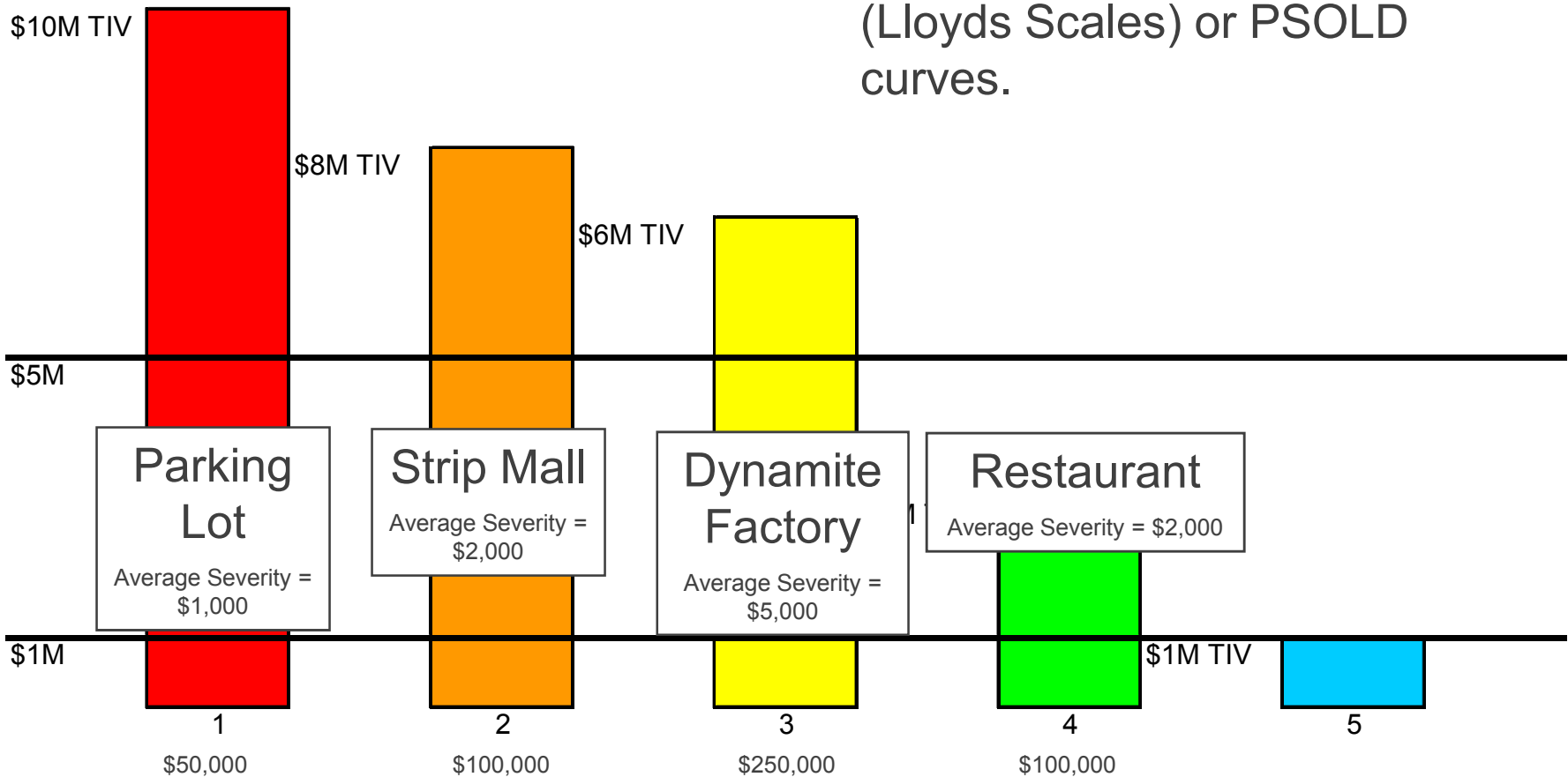


Allocate Based on Potential for Loss

SOLUTION

Policy = \$4M, attaches @ \$1M
Total Premium = \$500,000

Average Severity of loss can be based on First Loss Scales (Lloyds Scales) or PSOLD curves.





Premium Allocation

- Need the Correct Information
 - Premium, not number of risks
 - TIV or PML

The Big Question – How Do I Know Which Curve to Use?

- Compare Experience vs Exposure Frequency and Severity by band – Narrow Bands force Severity match
- One would expect to see similarity in frequency relativities at the low end where experience is credible
- Expect to see divergence at the top end when experience is less credible
- If there are several curves that match on the lower end, judgment may be required in determining which tail is more appropriate
- John Buchanan/Mike Angelina – CAS Variance: “The Hybrid Method”

Per Risk Layer		Experience Rating			Exposure Rating			Exper/Expos Relativities			Exper Freq Relativities	Expos Freq Relativities	Difference
		Projected (Undev.)		Loss	Projected		Loss	Freq	Sev	Loss Cost			
Limit	Attach	Freq	Sev	Cost	Freq	Sev	Cost	Freq	Sev	Loss Cost			
(\$000s)	(\$000s)		(\$000s)	(\$000s)		(\$000s)	(\$000s)	(%)	(%)	(%)			
		(3)	(4)	(5)	(6)	(7)	(8)	(3)/(6)	(4)/(7)	(5)/(8)			
		(9)	(10)	(11)									
150	200	25.4	112	2,839	29	117	3,341	89%	96%	85%	100.00%	100.00%	0.00%
250	250	20.7	164	3,387	24	180	4,282	87%	91%	79%	81.45%	82.97%	1.51%
500	500	9.7	340	3,305	13	347	4,414	76%	98%	75%	38.31%	44.49%	6.18%
1,000	1,000	4.2	565	2,370	6	665	4,165	67%	85%	57%	16.53%	21.90%	5.37%
1,000	2,000	1.1	774	871	3	774	2,204	40%	100%	40%	4.44%	9.96%	5.52%
1,000	3,000	0.6	680	417	2	824	1,411	36%	83%	30%	2.42%	5.99%	3.57%
1,000	4,000	0.2	1,000	205	1	857	1,000	18%	117%	20%	0.81%	4.08%	3.28%
5,000	5,000	0.2	2,579	528	1	2,895	2,483	24%	89%	21%	0.81%	3.00%	2.19%
15,000	10,000	n.a.	n.a.	n.a.	0.3	5,973	1,668	n.a.	n.a.	n.a.			
15,000	25,000	n.a.	n.a.	n.a.	0.04	8,501	346	n.a.	n.a.	n.a.			
10,000	40,000	n.a.	n.a.	n.a.	0.013	7,809	100	n.a.	n.a.	n.a.			
Unl.	50,000	n.a.	n.a.	n.a.	0.008	36,741	292	n.a.	n.a.	n.a.			



Wrap-Up

- QUESTIONS?



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