Actuarial Disclosure

I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Mathematics. I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant. Math is fun. Math should be enjoyed. All hail Math

FEBRUARY 3-5, 2021

parma
public agency risk management association
47th Virtual Conference & Expo

The WILD WEST OF RISK

You Might Be An Actuary If…

➢ You drive by looking out the rear window.

➢ You feel compelled to explain your jokes.

➢ You write memos using Microsoft Excel.

➢ You build an actuarial simulation model to make your bracket selections for March Madness.

➢ You have numerous options available when selecting the appropriate pocket protector for your presentation.

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The WILD WEST OF RISK

Why Are We Here?

- Basics
  - Ultimate Losses
  - Outstanding Liabilities
  - Projected Funding and Rates
- Loss Trends
- Discounting
- Confidence Levels
- Required Surplus
- Large Claims

The WILD WEST OF RISK

Actuarial Basics

What Does This Stuff Mean?

FEBRUARY 3-5, 2021

How Are Actuarial Reports Used?

Reserving – Outstanding Losses

How much money do you owe for old claims??

i.e. Credit Card Bill

Ratemaking – Projected Funding

How much money do you need for new claims??

i.e. Rate Forecast

Or More Specifically

Outstanding losses

Prior   17/18   18/19   19/20   20/21

June 30, 2021

21/22   22/23   23/24   24/25   …
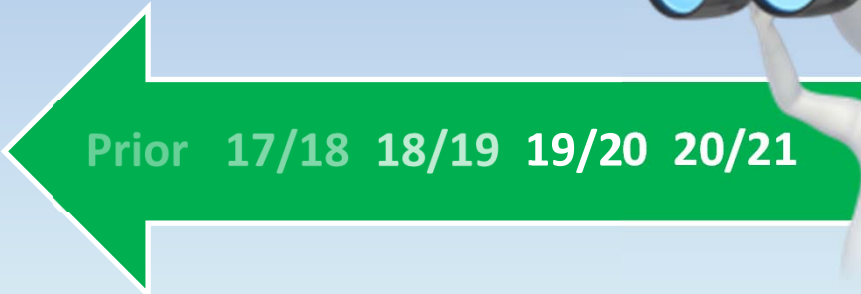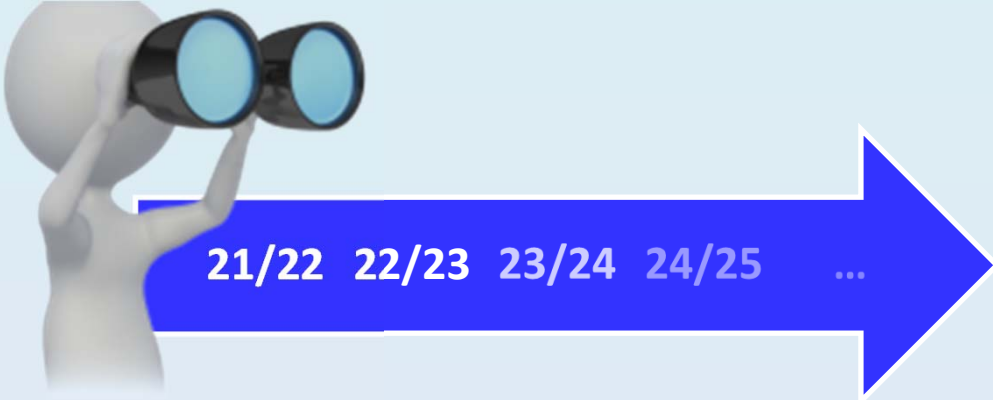
Projected funding

Ultimate Loss

➤ Ultimate Loss is the total cost of claims occurring in a given year

➤ Components of Ultimate Loss

= Paid Loss

➤ The Accountant's Number

+ Case Reserves

➤ The Adjuster's Number

+ IBNR Reserves

➤ The Actuary's Number

The WILD WEST OF RISK

A Picture Is Worth A Thousand Words
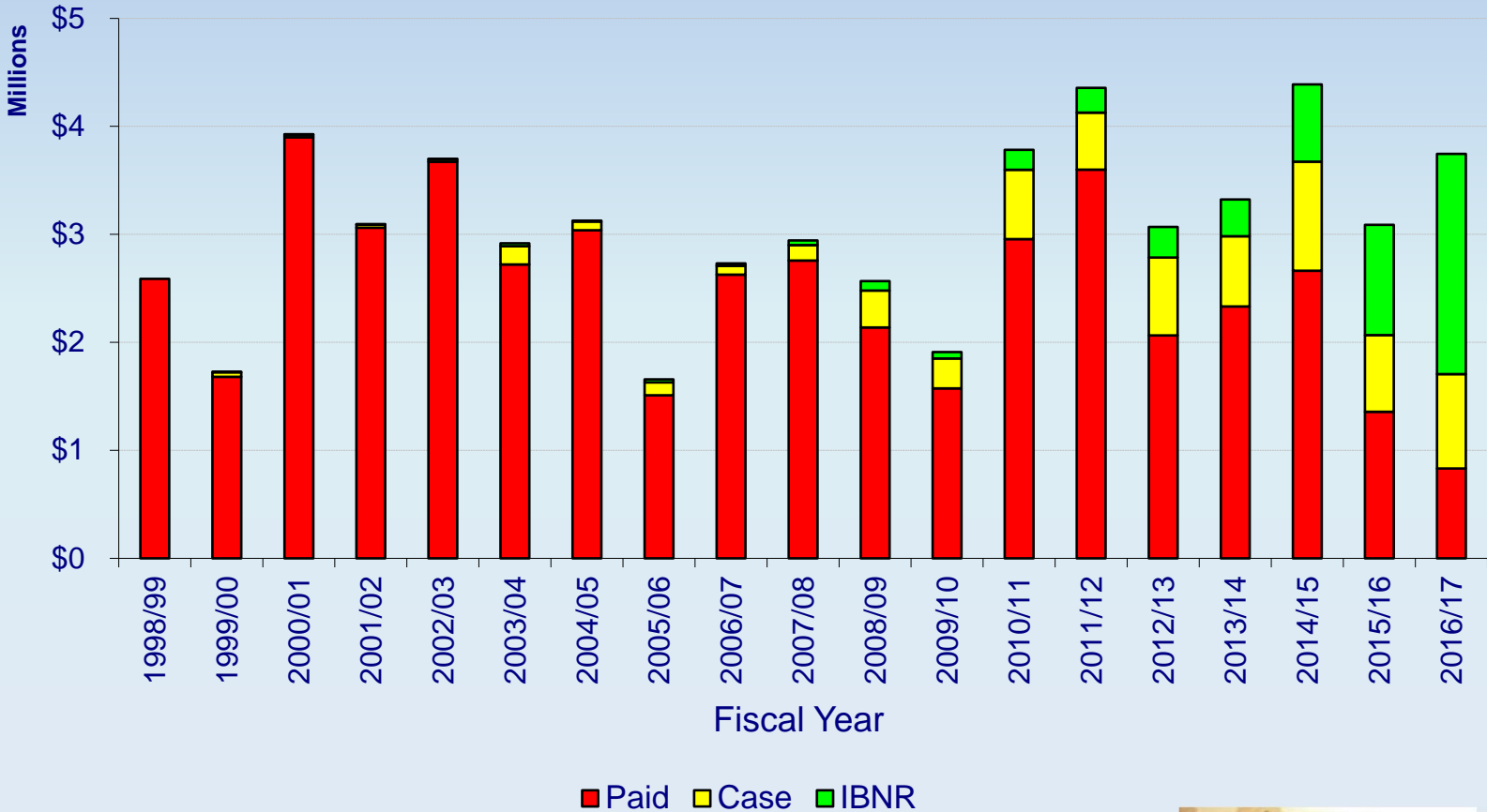
Reserve Analysis

Looking Back!

Outstanding Liabilities

➢ How much money do you owe for claims that have already happened?

➢ Credit Card Bill Analogy

➢ Case Reserves vs IBNR Reserves

➢ Good news vs Bad News

Life of a Claim

| Claim Incurred | Claim Reported | Payments & Case Reserves | Claim Closed |

- Periodic payments
- Case reserves reevaluated
- Total amount unknown until closed

Loss Development Takes Place Here!

The WILD WEST OF RISK

Loss Development

But Wait...
There's More!

Why Do Losses Develop?

➤ Claims that have occurred but have not been reported. (aka…pure IBNR)

➤ Claims that have been reported but increase (or decrease) in cost. (aka…case reserve development)

➤ These two comprise IBNR – Incurred But Not Reported.

What is Loss Development ??

Months of Development

Legend: Incremental Paid — Paid — Reported
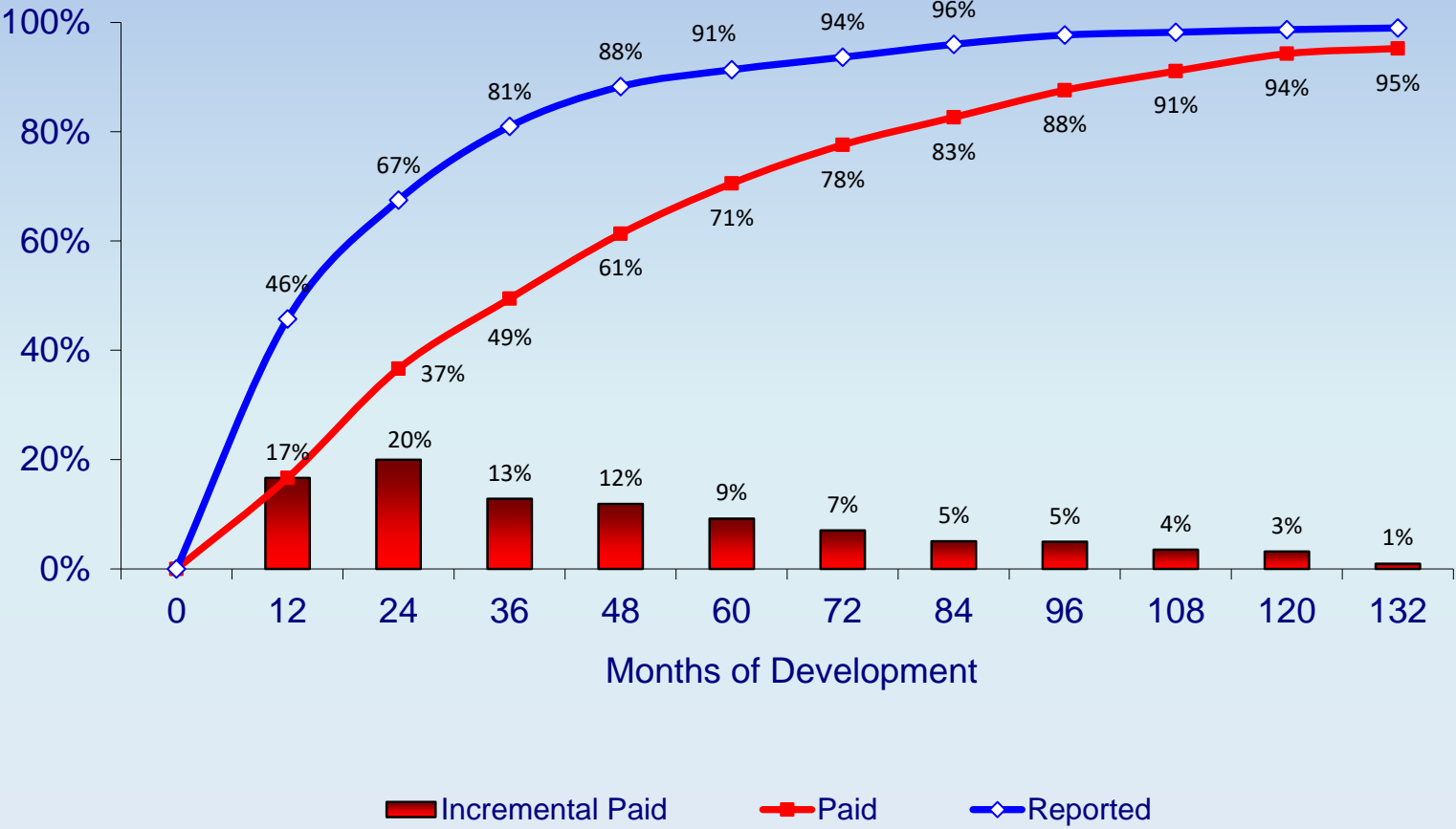
The Moral of the Story…

The longer a claim is open, the more it will cost on average!

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Rate Analysis

Looking Ahead!

Projected Losses

➢How much money do you need for claims that will happen next year?

➢Budget Analogy

➢Use history to predict future

➢Adjust for changes between history and future (e.g. inflationary trends)

Projected Program Funding

- Costs:
  - Expected Ultimate Losses
    - Discounted or full value
    - Investment income anticipated
  - Risk Margin
  - Claims Administration
  - Excess Insurance
  - Other Program Costs

- Rates:
  - Divide Costs by exposure,
    (e.g. payroll per $100 for WC)

Other Program Costs

Excess Insurance

Claims Administration

Risk Margin

Discounted Losses
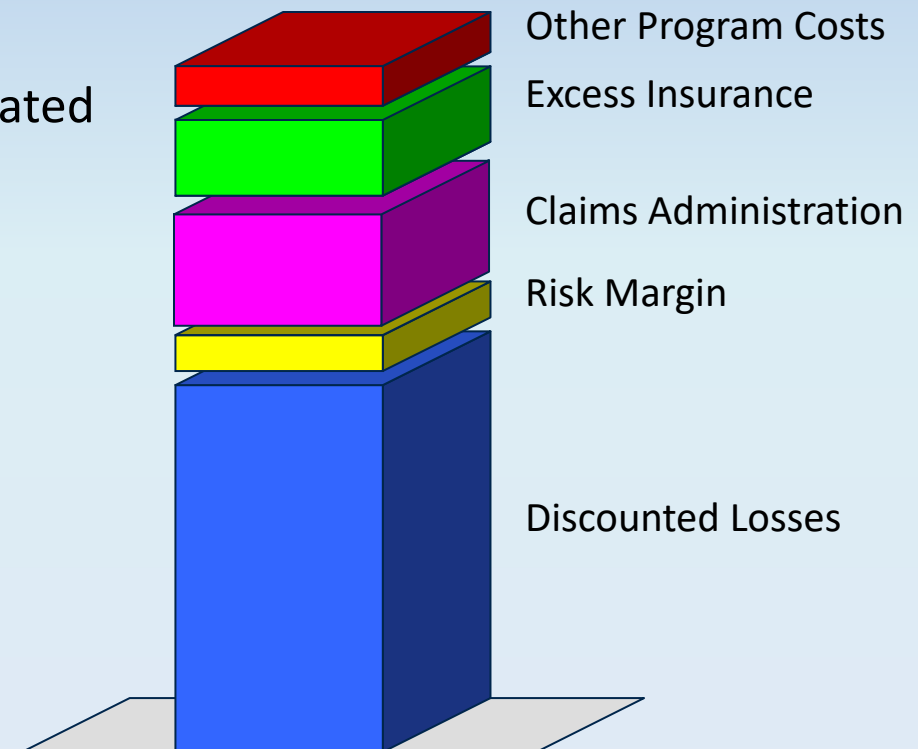
Projected Funding

As shown in actuarial report

Projected 2020			
	Loss Rate per $100	**Payroll ($M)**	**Amount ($M)**
Losses and ALAE	$3.00	$200	$6.0
Expenses			$1.0
Excess ins. premium			$0.5
Total funding			$7.5
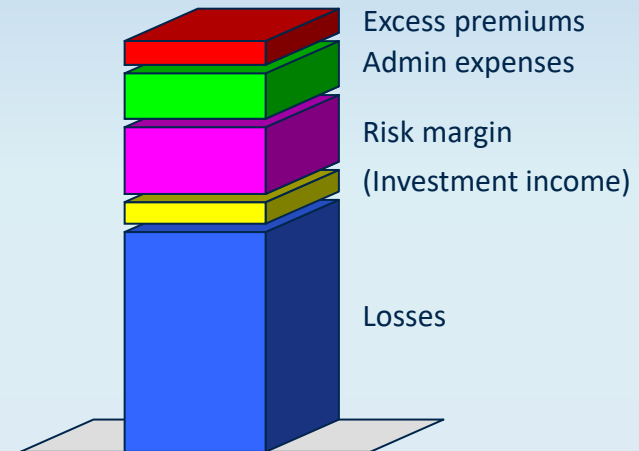
Losses can be on an accrual or pay-as-you-go basis.

- Excess premiums
- Admin expenses
- Risk margin
- (Investment income)
- Losses

Projected Funding →Income Statement

As shown in financial statement

Operating Income ($ Millions)	
Member contributions	$7.5
Excess insurance	0.5
Total operating income	$7.0

Operating Expenses ($ Millions)	
Incurred losses	$5.0
Claims administration	0.5
Overhead expenses	0.5
Total operating expenses	$6.0
Change in net position	**+$1.0**

Timeline for Funding

2-year lag between actuarial report and recording on Income Statement

Actuarial report @12/31/2018

Outstanding losses			Projected losses		
2017	2018		2019	2020	2021

12/17 **12/18** 12/19 12/20 12/21

Financial Statement @12/31/2020

Premium recorded on Income Statement

			2020	

12/17 12/18 12/19 **12/20** 12/21
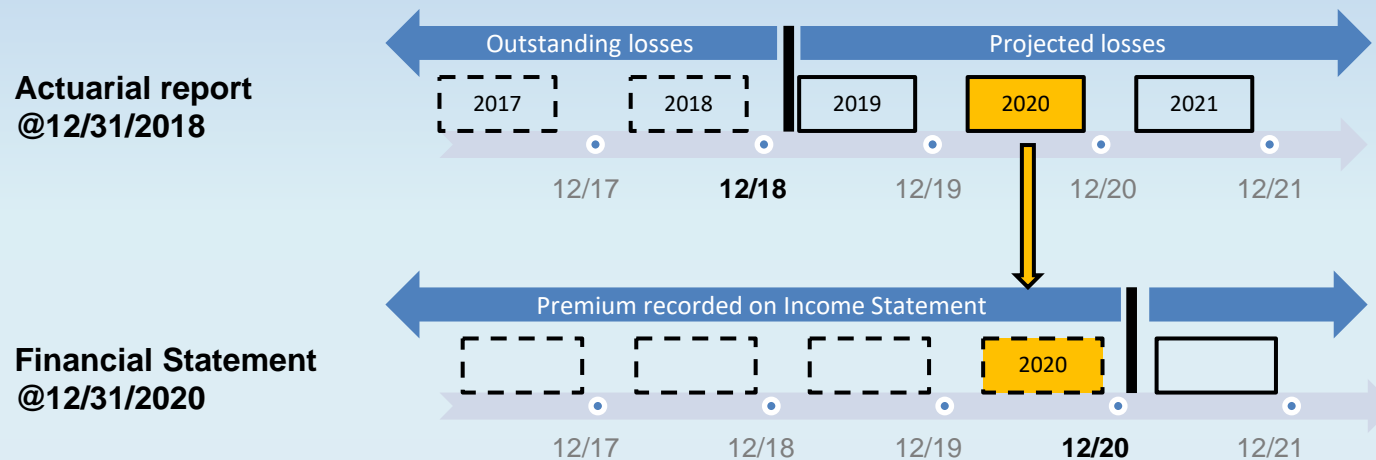
Question…

Why Are Rates Inadequate?

Rate Adequacy

- Inadequate rate
  - Reduces surplus (net assets)
    - →Rate increases, Assessments

- Adequate rate
  - Maintains surplus (net assets)
    - →Rate stabilization, Dividends

Why Are Rates Inadequate?

- Rate based on "bad" loss/exposure data

- Unanticipated trends:

  – Social inflation, Legal changes, etc.

- Unanticipated events:

  – Catastrophes (e.g., hurricane, earthquake)

- Worse than expected frequency/severity of claims

Trends

Where have we been?
&
Where are we going?

Frequency

How Many Claims Are We Having?

-6.0% Annual Trend
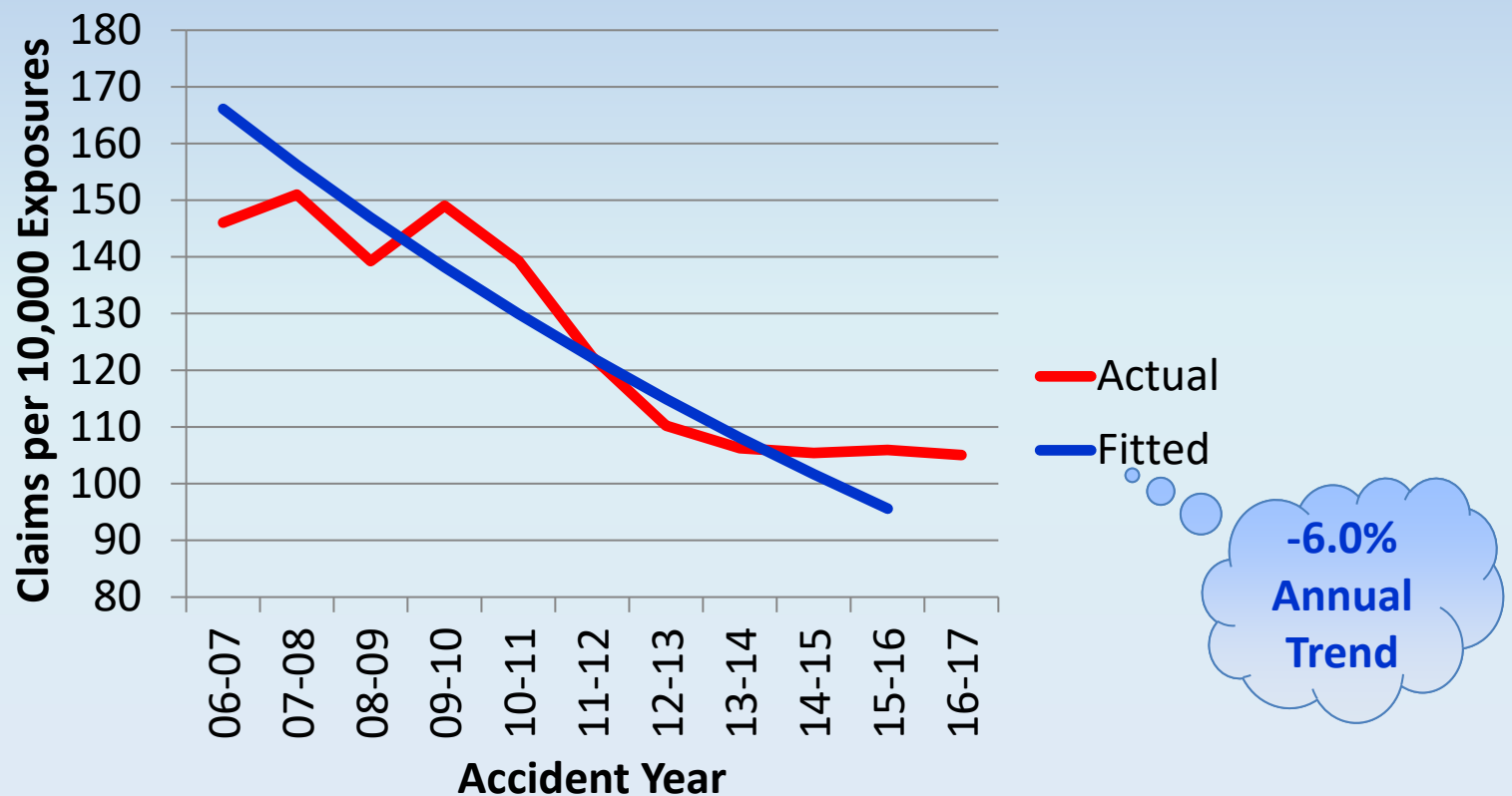
Severity

How Big is the Average Claim?

+4.5% Annual Trend

Discounting

NET PRESENT VALUE
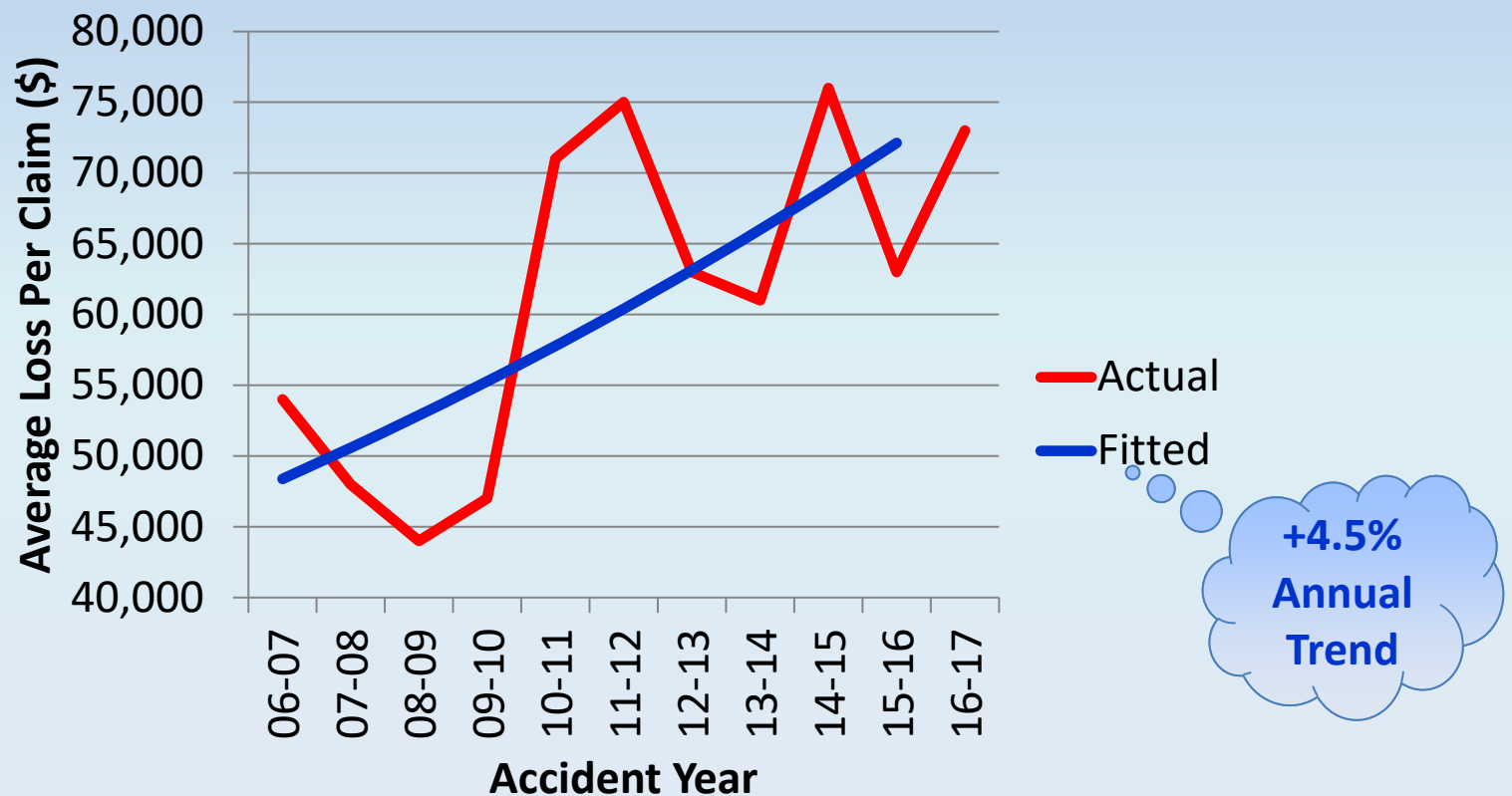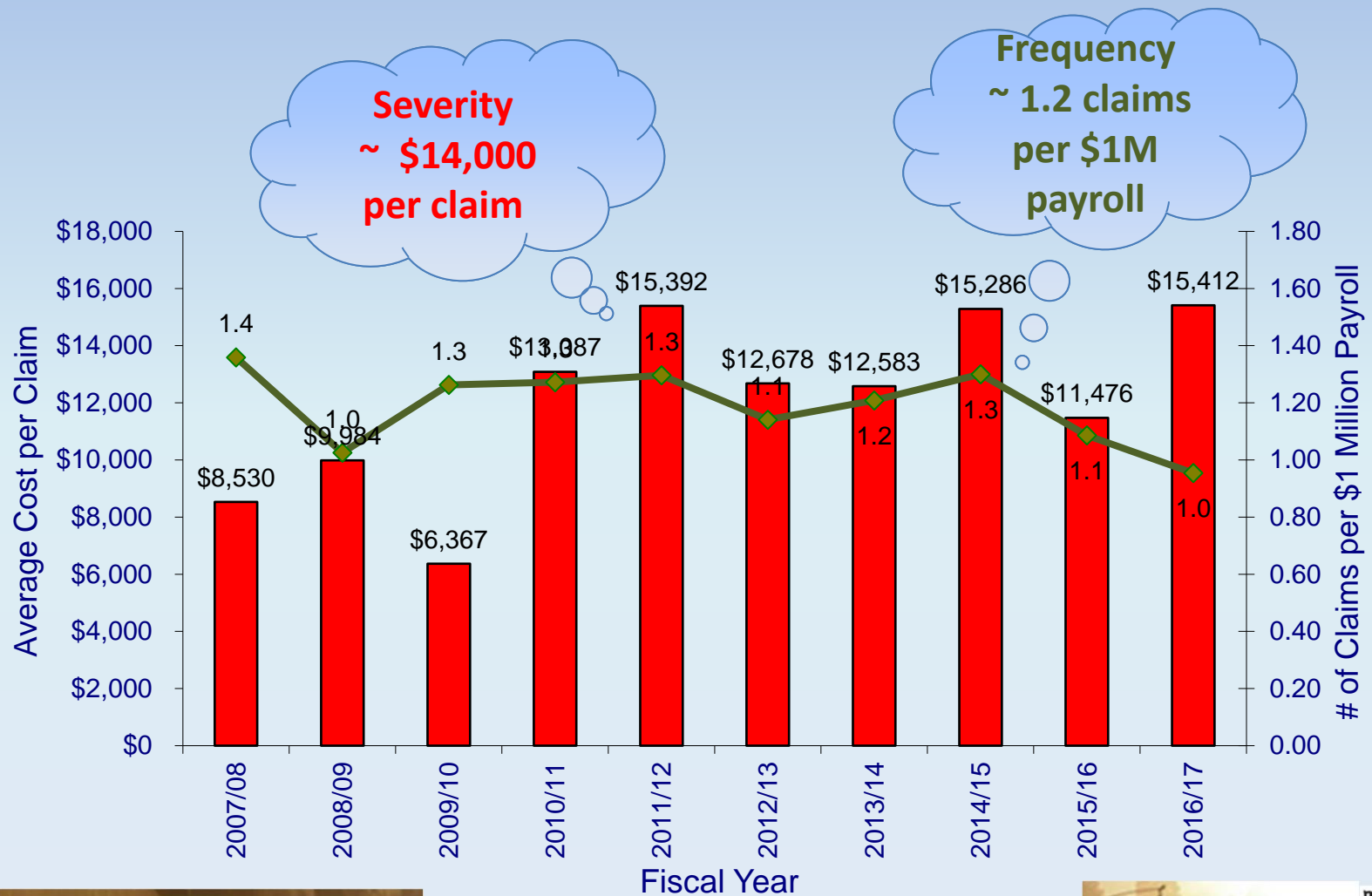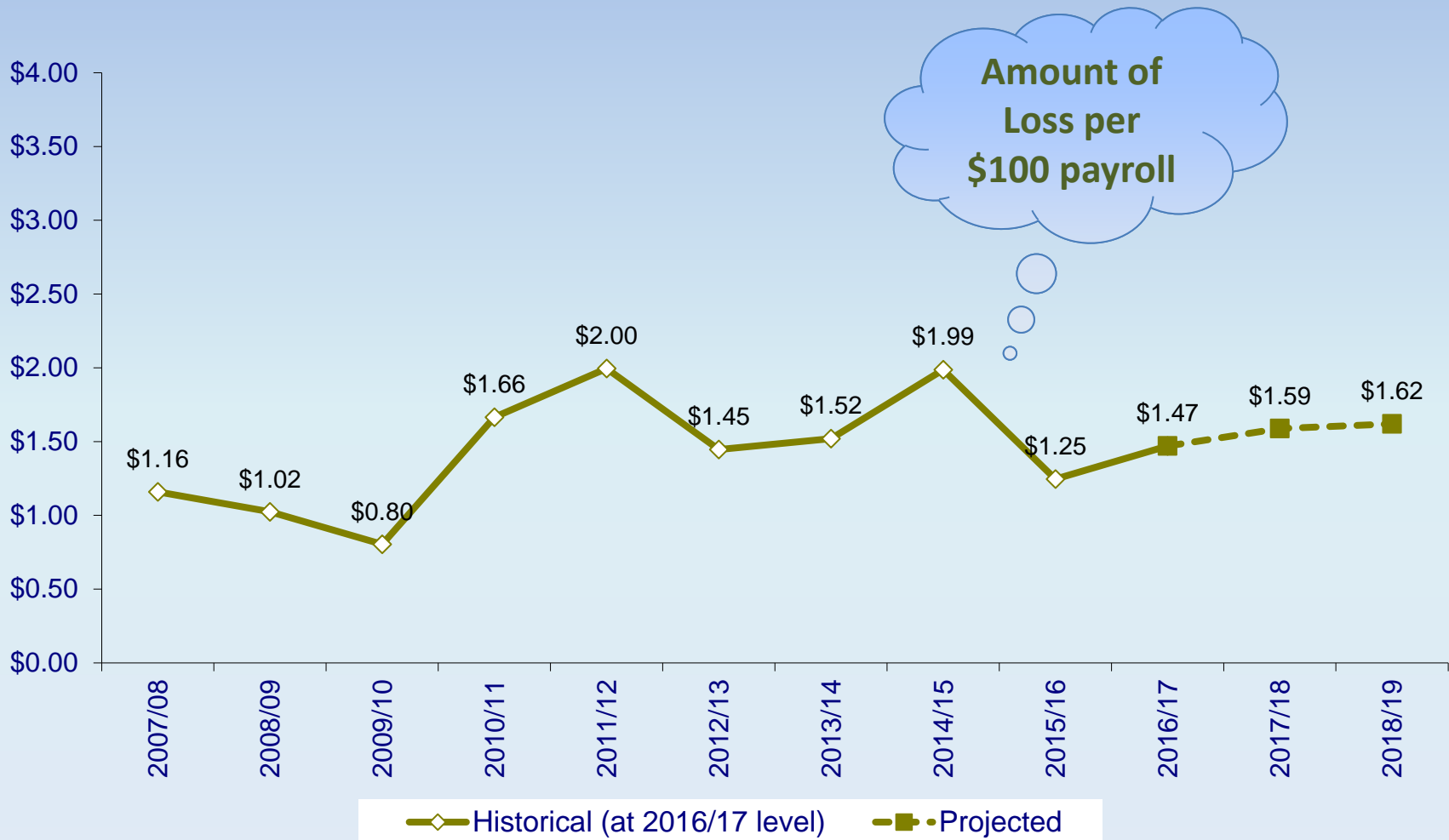
Making Investment Income Work For You!

Discounting

➢ Since losses are paid out over an extended time period, actuarial estimates may be "discounted" for expected investment income.

➢ Discounted estimates are sometimes referred to as "net present value" (NPV) estimates.

➢ Neither "mandated nor prohibited" (GASB 10)

➢ Based on payout pattern and expected yields (GASB 10)
  ➢ Large claims need separate treatment

Discounting Example

➢ You expect to pay losses of $105M in one year, and investment return is 5%.

➢ If you invest $100M today, you'll have the $105M in a year to pay the loss…

   ➢ $105M is undiscounted or full-value estimate

   ➢ $100M is discounted or NPV estimate

Question…

How Do You Select A Discount Rate?

Discount Rate

➢ Actuary is not opining on selected discount rate

➢ Still should consider if projected rate is reasonable in light of historical
  ➢ What kind of investment return have you been getting?
  ➢ What kind of investment return do you expect to get?
  ➢ Compare with market (e.g. Risk-free Treasury rate)

➢ Risk that investment income may not be fully realized

Current vs Non-Current

- Current: liabilities expected to be paid out <u>next year</u>

  - Need liquid assets available for payments

  - Asset/liability matching

  - Liquidity

- Non-current: liabilities expected to be paid out <u>later</u>

$10M Total Claim Liabilities @12/31/2018

<u>Current Liabilities</u> Projected Paid in 2019 ~ $4M	<u>Non-Current Liabilities</u> Projected Paid Subsequently ~ $6M

2019	2020	2021	2022	2023

The WILD WEST OF RISK
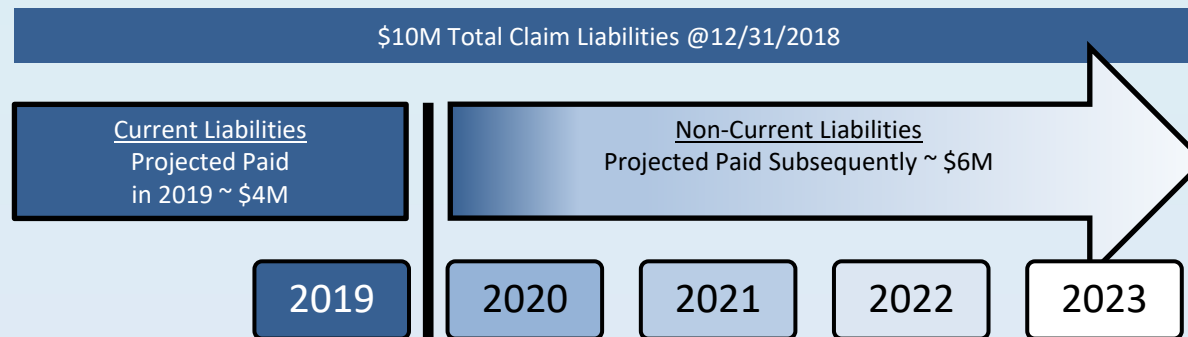
Thoughts During An Actuarial Presentation

- 🟩 What's Next on the Agenda
- 🟦 He Just Totally Made Up That Number
- 🟨 I Think I Need to Use the Restroom
- 🟪 How Can He Stand Doing This for a Living
- 🟥 This is incredibly interesting
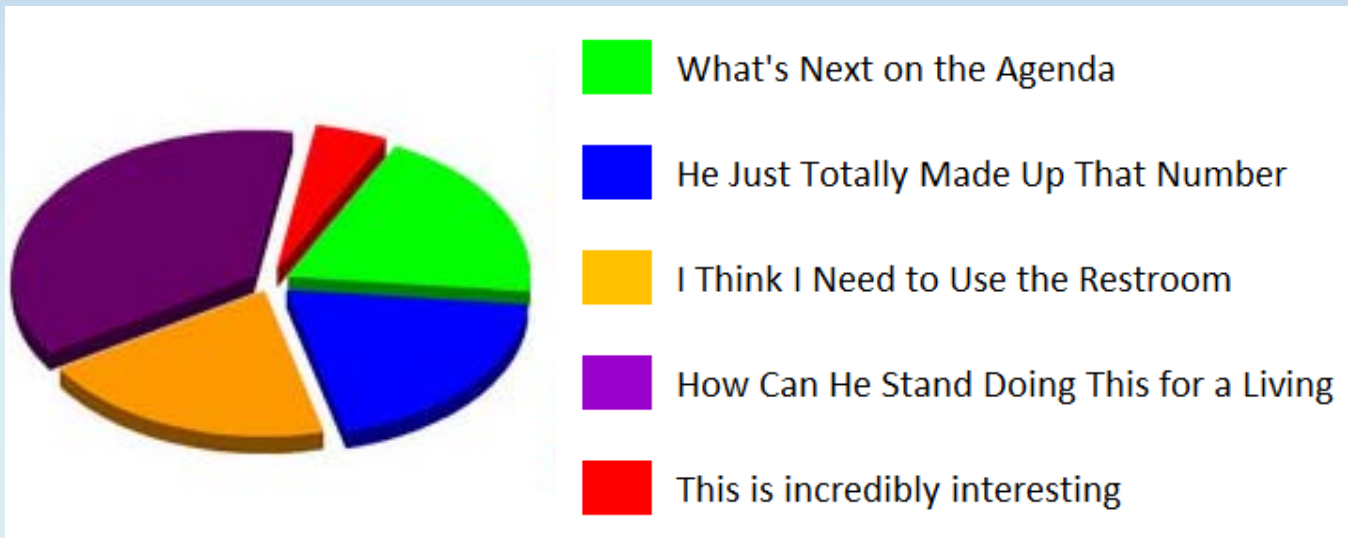
Confidence Levels

How Confident
Are You?

Confidence Levels

- Describes the degree to which funding supporting outstanding liabilities is likely to exceed the actual value of losses after all claims have been settled.

- Recognize the risk associated with a program's largest liability – loss reserves

Meaning behind a Confidence Level Estimate

Liability estimate at
85% Confidence Level

=

Actual liabilities
should be less than
this estimate 85% of
the time

And More Lingo – Confidence Levels

➤ The majority of actuarial calculations are done at the "Expected Level" (Average or Central Estimates).

➤ "Confidence Level" estimates are also provided, which provide a safety margin above the "Expected Level".

➤ Describes the probability that premiums collected will exceed the actual value of losses after all claims have been settled.

➤ "Expected Level" is approximately "55% - 60% Confidence Level"

Common Errors in Confidence Level Lingo:

- "You are funded at 120% Confidence Level, so you must release your surplus!" *(an actual quote from a State Auditor letter)*

- "Our funding is 70% of the actuarial estimate, so we are funded at 70% Confidence Level!"

The WILD WEST OF RISK

Confidence Level Example

- Outstanding Liabilities as of 12/31/16
    - » Expected = $17.2 M
    - » 70% CL = $19.9 M
    - » 75% CL = $21.3 M
    - » 80% CL = $22.9 M
    - » 85% CL = $24.9 M
    - » 90% CL = $27.6 M

Target Surplus = $7.7 M

Target

Risk Margin

50th Percentile (median)

Expected Value (average)

Black swan lives here!

Probability

50%

70%

90%

Factor of 1.15

Factor of 1.60
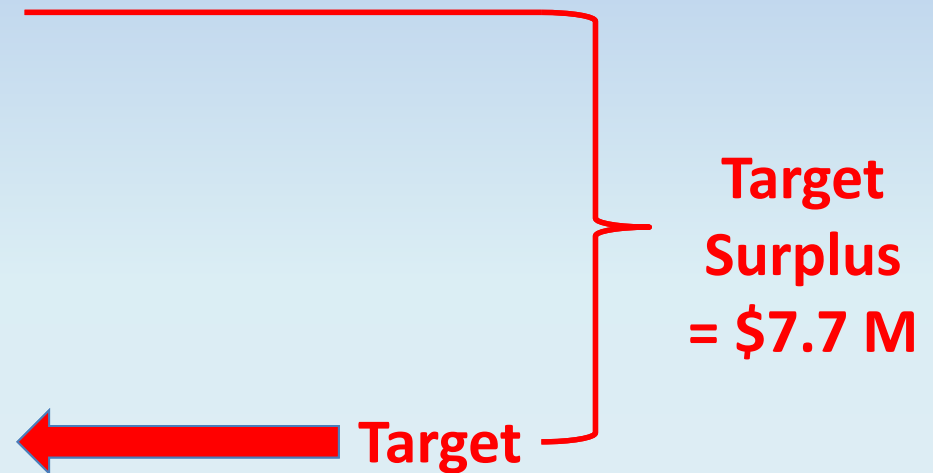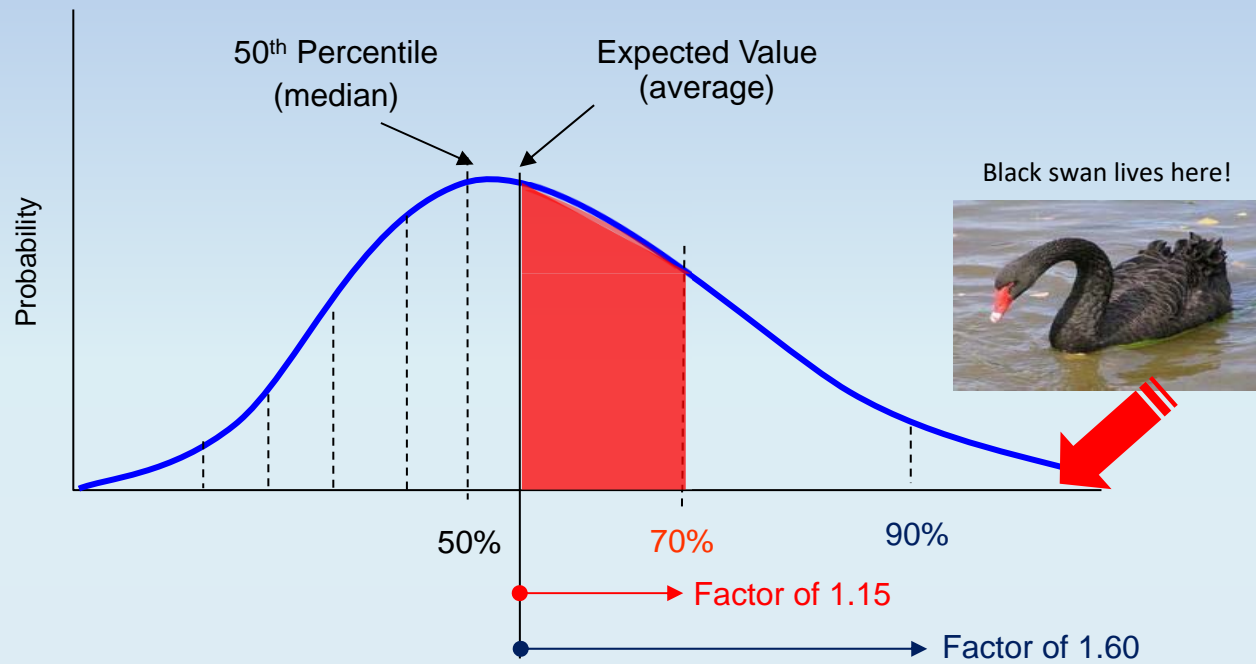
Question…

How Much Surplus Do I Need?

Balance Sheet Example

Assets ($Millions)	
Cash	$8
Stocks & bonds	11
Receivables	1
Total assets	**$20**

Liabilities & Net Position ($Millions)	
Liability for open and incurred but not reported (IBNR) claims	$10
Liability for ULAE	1
Other	1
Total liabilities	**12**
Net position (surplus)	**8**
Total liabilities and net position	**$20**

Spectrum of Surplus Targets

Backward looking ← → Forward looking

| IRIS | RBC | Scenario-Based Approach | Probabilistic Models |

Simple → Complex
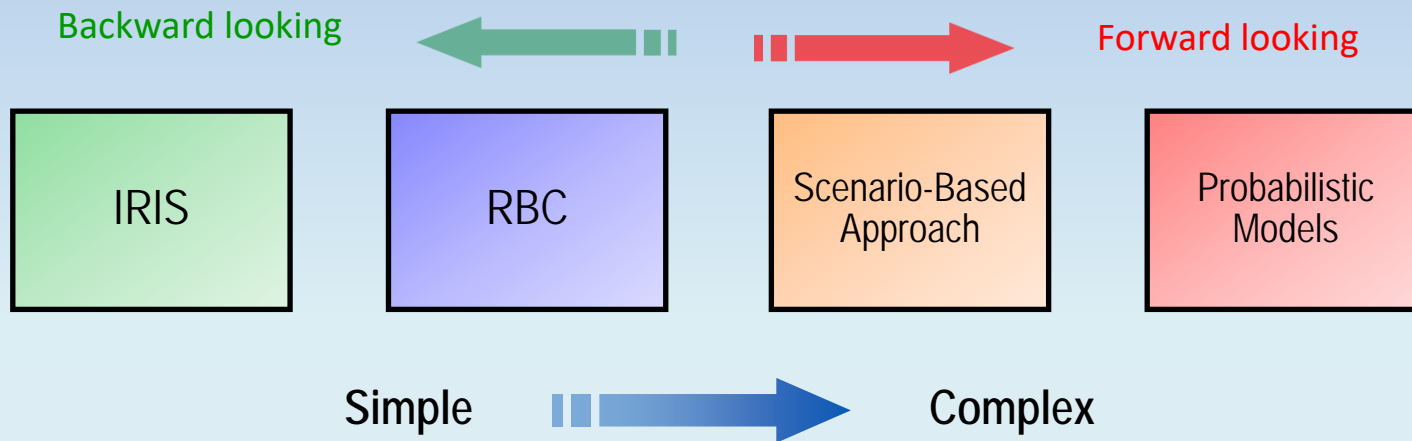
Target Surplus Ratios

- Often a surplus target is set based upon industry ratios

- These ratios relate required surplus to other measures, such as self-insured retention, outstanding liabilities, and annual losses

Surplus : SIR

- Self-Insured Retention (SIR) represents the maximum amount the pool is responsible for on any individual claim.
- Surplus must be sufficient to cover a specific number of losses at the SIR
- Very prevalent in public entities
- High ratio is better
- Typical target is > 5.0

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Surplus : SIR

Surplus = $8 million

Chart: Surplus-to SIR vs SIR

SIR	Surplus-to SIR
$250,000	32
$500,000	16
$750,000	11
$1,000,000	8
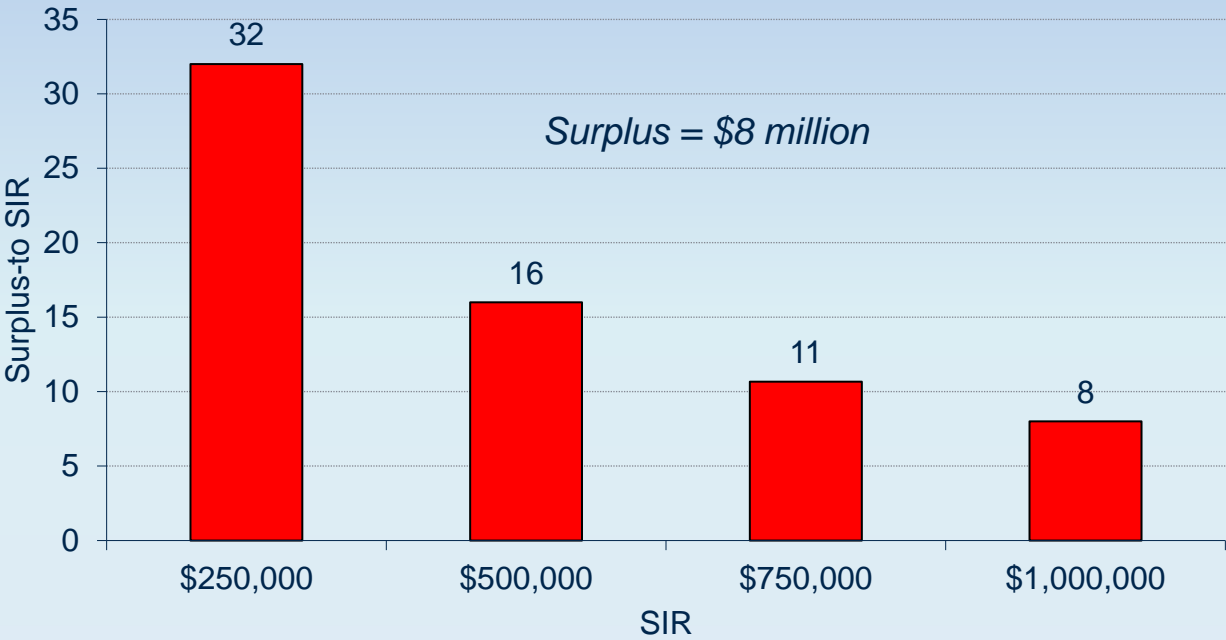
Reserves : Surplus

- Reserves, or outstanding liabilities, represent an estimate of the amount of unpaid loss on old claims, including case and IBNR

- Recognizes the uncertainty in the program's largest liability and how surplus may be impacted by adverse loss development

- Low ratio is better

- Typical target is < 1.5

Reserves : Surplus
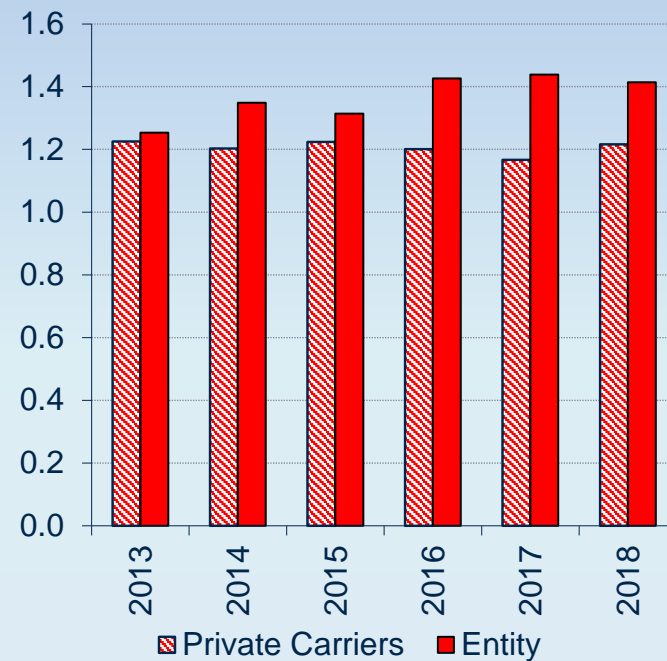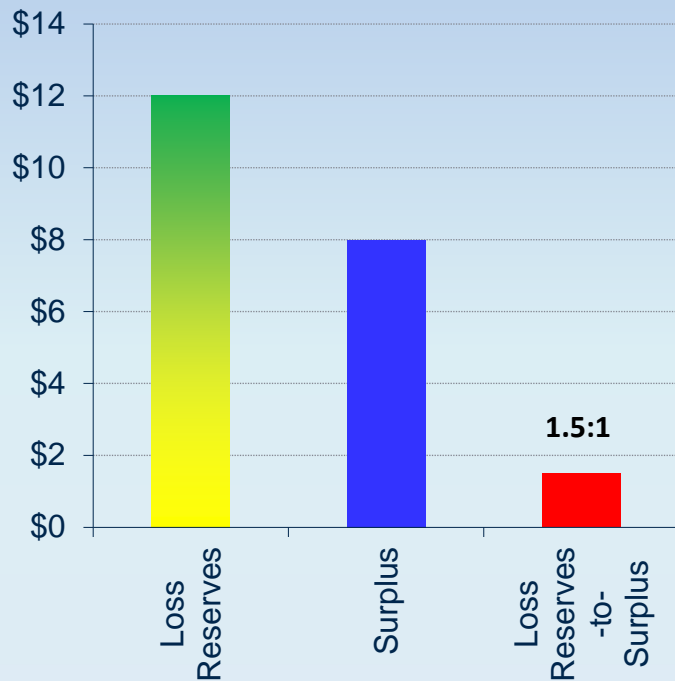
Premiums : Surplus

- Annual premiums should be less than a specific multiple of surplus

- Recognizes uncertainty of pricing estimates for the coming year and how surplus may be impacted by future adverse loss development

  - Low ratio is better

  - Typical target is < 1.0

Premiums : Surplus
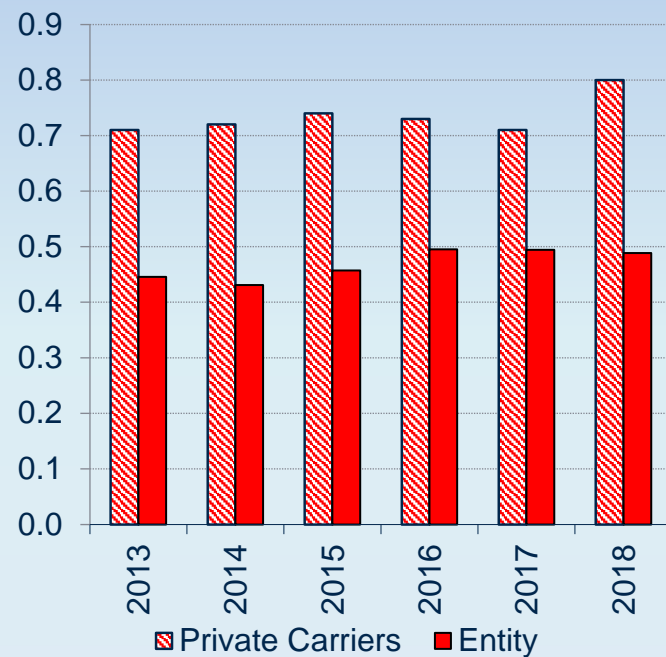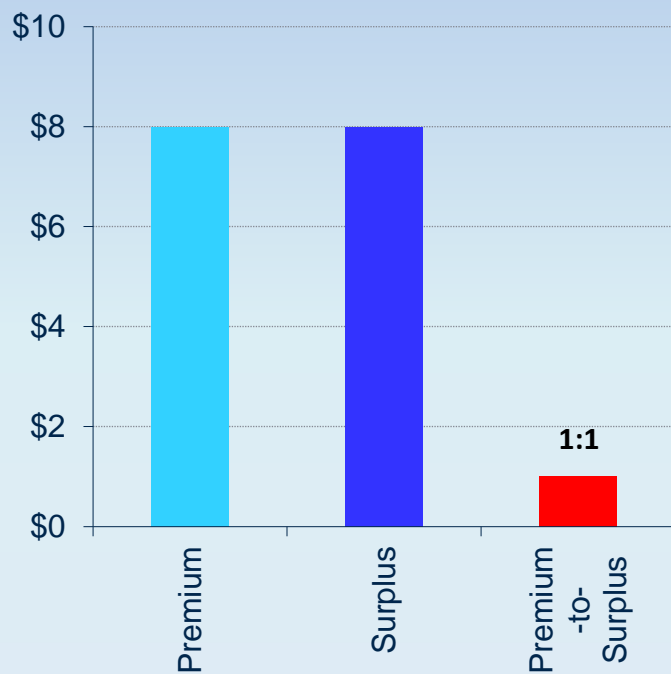
Financial Ratios Example

- SIR = $1,000,000 per occurrence
  - » Target <u>Surplus / SIR</u> Ratio > 5.0
  - » Target Surplus > 5.0 x $1.0 M = $5.0M
- Outstanding Reserves = $12,000,000
  - » Target <u>Surplus / Reserves</u> Ratio > 0.667 (i.e. R/S = 1.5)
  - » Target Surplus > 0.667 x $12.0 M = $8.0M
- Annual Premium = $8,000,000
  - » Target <u>Surplus / Premium</u> Ratio > 1.0 (i.e. L/S = 1.0)
  - » Target Surplus > 1.0 x $8.0 M = $8.0M

Surplus: Risk Based Capital (RBC)

- Risk-based capital is a method developed by the NAIC to measure the minimum surplus that an insurer needs to protect against risks from all business operations, including:
  - » Asset Risk - Investments
  - » Credit Risk – Policyholders and Reinsurers
  - » Underwriting Risk – Reserves and Premiums
    Most Important!
- High ratio is better
- Typical target is > 3.0

Risk Based Capital – Example Calculation

- **Assets Risk** –
  - Fixed Income - $100,000
  - Equity - $50,000
- **Credit** – $20,000
- **Underwriting Risk** - $2,500,000
- **Off-Balance Sheet Risk** - $25,000
- **Sub Total -** $2,995,000
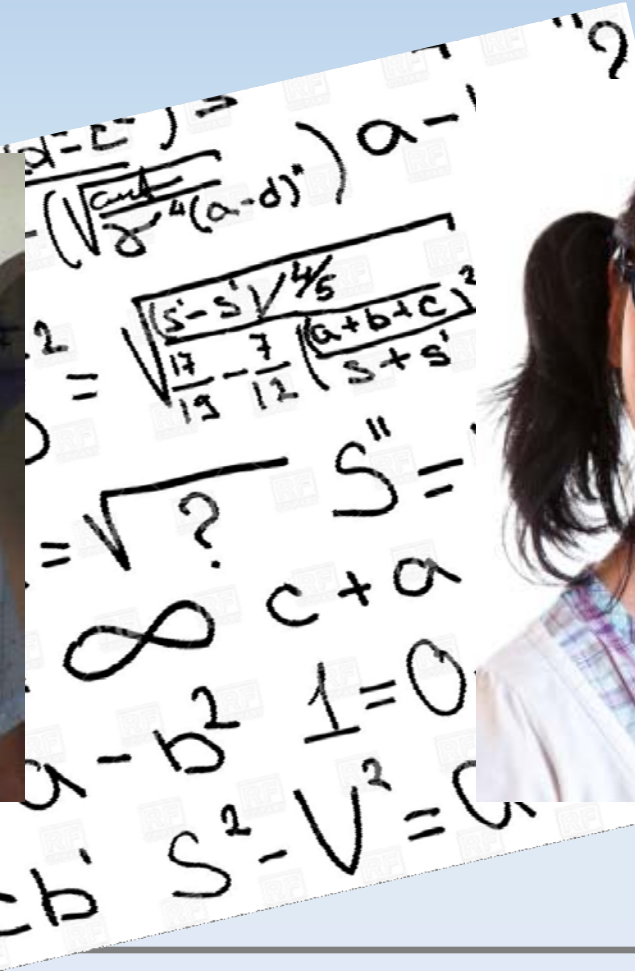- **Covariance Adjustment** – ($300,000)
- **RBC** - $2,695,000

- **Target Surplus** > 3.0 x RBC = $8,085,000

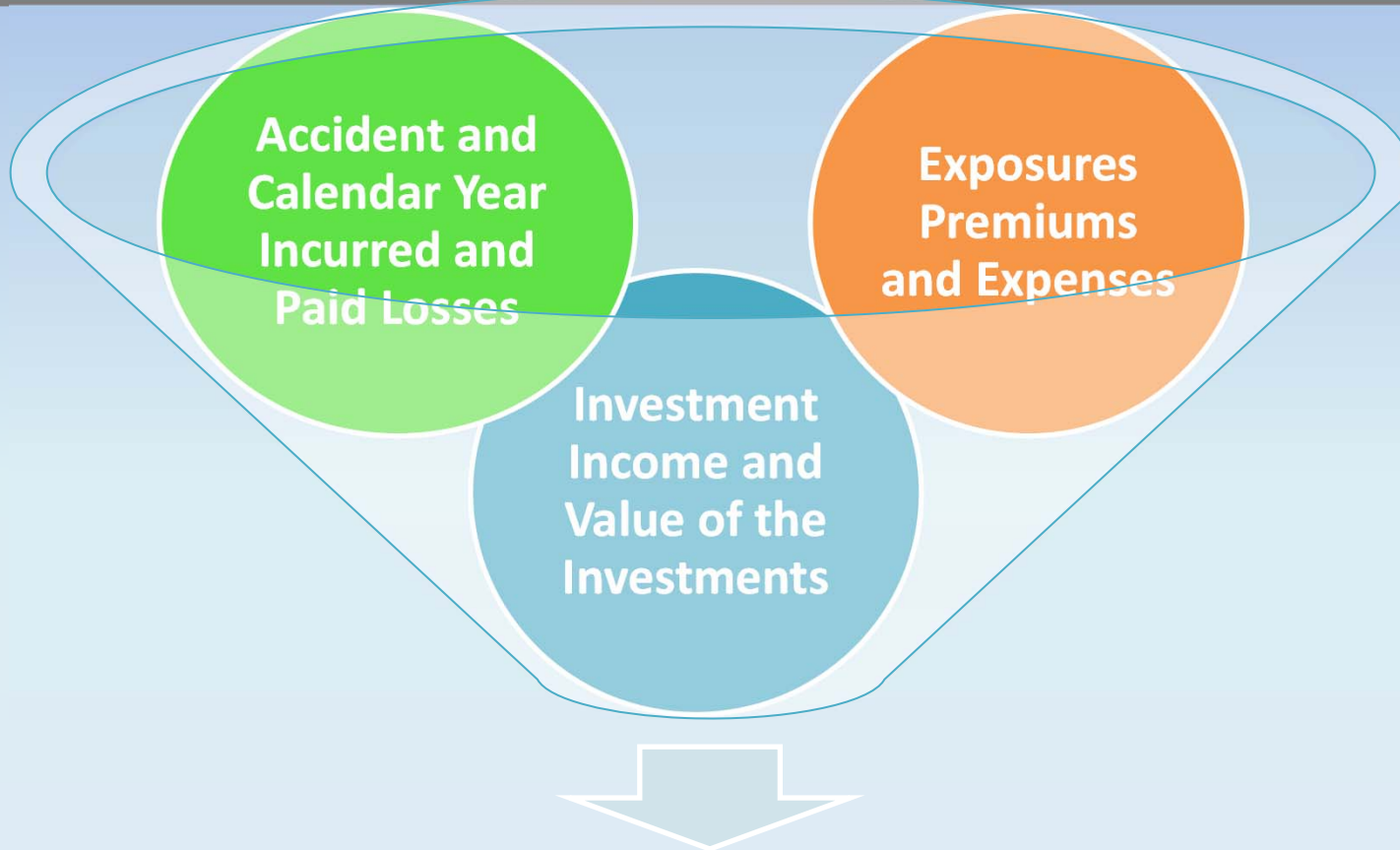# Capital Modeling

The fun never ends...

Capital Modeling – Concept

Accident and Calendar Year Incurred and Paid Losses

Exposures Premiums and Expenses

Investment Income and Value of the Investments

Change in Surplus

Capital Modeling Approach

- We are concerned with ensuring that the amount of surplus is adequate to cover most adverse outcomes → Focus is on the change in surplus over five years.

- Outcomes for each year are independent →Adverse outcomes in some years will likely be offset by favorable outcomes in other years.

- We recommend taking a five-year outlook for capital modeling results.

Rolling the Dice…

- Think of each simulation as a roll of many dice at once…

  - Die 1: Inflation
  - Die 2: Interest Rate
  - Die 3: Annual Loss Ratio
  - Die 4: Pricing Changes

- Each roll of the dice results in:
  - » Change in Assets
  - » Change in Losses
  - » Change in Surplus

One does not simply roll the dice!

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Capital Modeling Results

- Capital modeling results summarize the output of many simulations.

- For example, the multi-year loss scenarios in the model are repeated 10,000 times based upon the likely distribution of those events over time.

- The total change in surplus over five years in the simulation are sorted in descending order and each of the events is given probability of 1/10,000, or 0.001%.

- **The 250-year event is that event for which the total probability of all events exceeding it sums to 0.4%.**

Huh? Let's Do An Example...

About Those Simulations...

Sorted

1,000 Year Event

500 Year Event

Simulation	Percentile	Return	2020	2021	2022	2023	2024	5 Yr Total
5,322	0.01%		(5,182,817)	(2,128,482)	(1,894,879)	(3,201,117)	(4,752,230)	(17,159,525)
1,390	0.02%	10,000	(4,509,448)	(1,782,990)	(4,357,101)	(2,290,372)	(1,836,090)	(14,776,001)
6,476	0.03%	5,000	(5,465,440)	(1,266,616)	(2,158,438)	(2,818,438)	(2,787,274)	(14,496,206)
6,828	0.04%	3,333	(2,942,226)	(1,111,789)	(4,612,045)	(2,292,267)	(2,752,201)	(13,710,529)
1,864	0.05%	2,500	(4,785,821)	(505,594)	(2,843,916)	(4,104,147)	(1,174,813)	(13,414,291)
636	0.06%	2,000	(5,512,076)	(720,892)	(1,488,741)	(2,532,717)	(3,047,456)	(13,301,882)
7,834	0.07%	1,667	(1,761,778)	(728,667)	(2,401,946)	(3,831,574)	(4,290,437)	(13,014,401)
6,922	0.08%	1,429	(4,335,548)	(19,293)	(3,276,026)	(2,674,455)	(2,450,696)	(12,756,016)
6,613	0.09%	1,250	(3,388,510)	(789,708)	(2,949,424)	(2,097,929)	(3,236,856)	(12,462,427)
8,130	0.10%	1,111	(3,280,092)	(316,595)	(2,206,445)	(3,569,699)	(2,901,555)	(12,274,385)
9,653	0.11%	1,000	(3,877,057)	(939,806)	(3,264,246)	(2,020,330)	(2,139,242)	(12,240,680)
9,107	0.12%	909	(3,106,859)	398,763	(3,549,544)	(2,847,805)	(3,110,955)	(12,216,400)
4,613	0.13%	833	(5,105,243)	(1,304,921)	(1,492,244)	(2,126,131)	(2,076,542)	(12,105,080)
5,055	0.14%	769	(4,661,011)	(1,398,993)	(1,665,224)	(2,847,510)	(1,093,511)	(11,666,250)
1,511	0.15%	714	(3,295,194)	43,406	(2,443,935)	(3,318,263)	(2,608,962)	(11,622,946)
7,841	0.16%	667	(4,864,082)	(2,047,235)	(1,999,899)	(1,463,495)	(1,224,105)	(11,598,817)
2,275	0.17%	625	(3,839,719)	(1,400,115)	(2,937,231)	(2,041,183)	(1,332,264)	(11,550,512)
4,645	0.18%	588	(3,480,421)	(1,103,188)	(867,862)	(2,952,673)	(3,092,049)	(11,496,193)
5,046	0.19%	556	(4,589,756)	315,690	(1,657,376)	(1,557,771)	(3,844,425)	(11,333,637)
692	0.20%	526	(4,648,970)	(388,083)	(2,173,419)	(2,321,242)	(1,698,650)	(11,230,365)
9,212	0.21%	500	(4,009,156)	305,089	100,649	(3,634,500)	(3,979,156)	(11,217,099)
7,840	0.22%	476	(3,916,478)	(1,157,876)	(1,356,828)	(2,931,797)	(1,798,873)	(11,161,853)
4,326	0.23%	455	(3,717,593)	122,516	(3,955,155)	(1,616,912)	(1,848,569)	(11,015,714)

FEBRUARY 3-5, 2021

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The WILD WEST OF RISK

Results – Forecast Change in Surplus

- Results are shown in the following table:

Return Period	Percentile	2020	2021	2022	2023	2024	5 Yr Total
1,000 Years	0.1%	(5,182,892)	(1,545,448)	(3,138,366)	(3,201,208)	(3,690,953)	(12,240,680)
500 Years	0.2%	(4,862,823)	(1,314,999)	(2,778,724)	(2,922,922)	(3,153,683)	(11,217,099)
250 Years	**0.4%**	**(4,672,358)**	**(916,676)**	**(2,402,073)**	**(2,545,266)**	**(2,787,286)**	**(9,532,976)**
100 Years	1.0%	(4,268,686)	(397,116)	(1,799,255)	(2,100,333)	(2,189,524)	(7,310,402)

- As shown, the indicated 250-year event surplus requirement is $9.5M.

Multi-Level Guidelines

- Based on a review of confidence levels and multiple financial ratios
- Create a range of surplus targets
- Minimum surplus – must assess membership if surplus falls below this target
- Target surplus – Dividends are available if surplus exceeds this target
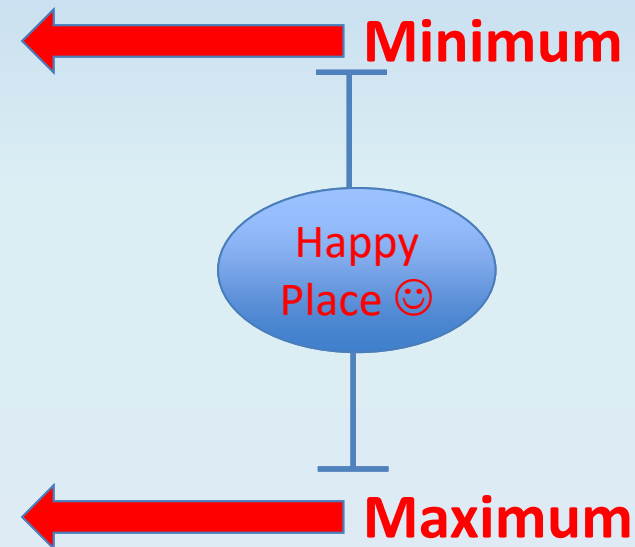- Maximum surplus – Dividends must be returned if surplus exceeds this target

Target Surplus Example

Required Surplus for Various Approaches

- 85% CL = $7.7M
- SIR Ratio = $5.0M ← **Minimum**
- Reserve Ratio = $8.0M
- Premium Ratio = $8.0M

  Happy Place ☺
- RBC = $8.1M
- CM = $9.5M ← **Maximum**

Actuarial Standard of Practice on Surplus

ASOP 55: Capital Adequacy Assessment

- New standard of practice for actuaries
- Effective November 1, 2019
- More formalized framework for reviewing capital targets and thresholds
  - Target – _preferred level_ of capital; can be a single value or range
  - Threshold – _minimum level_ of capital to operate effectively; may be based on multiple metrics

Surplus = Happiness!!

Now wasn't that cool...
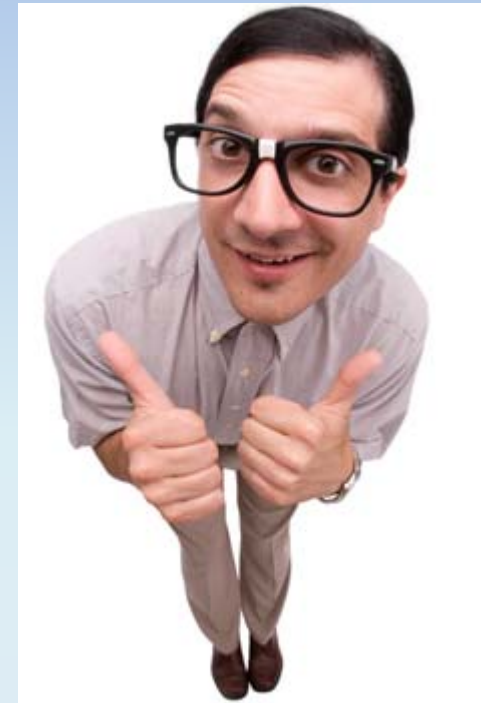
Almost Done

Take a deep breath...

...It's almost over.

Question…

How Do Large Claims Affect Results?

How Do Large Claims Affect Results?

- Large claims increase the variability of financial results
  - Large cost from single claim
  - Occur infrequently
  - Claims remain open longer
 - Take longer to pay out

How Do I Treat Large Claims?

- Reinsurance!!
  - Limits the exposure to single claims with a cap on losses
    - Self-Insured Retention (SIR)
    - e.g. $100,000 max loss per claim,
  - Limits the exposure for a single year to a dollar amount
    - Aggregate Stoploss
    - e.g. $5M max losses per year
  - Stabilizes the cost of risk
    - Fixed reinsurance cost substituted for variable large claim amounts
    - Stable budgets

How Do Large Claims Affect Results?

Unlimited CV = 0.21
Limited CV = 0.14

■ Unlimited ▨ Limited to SIR
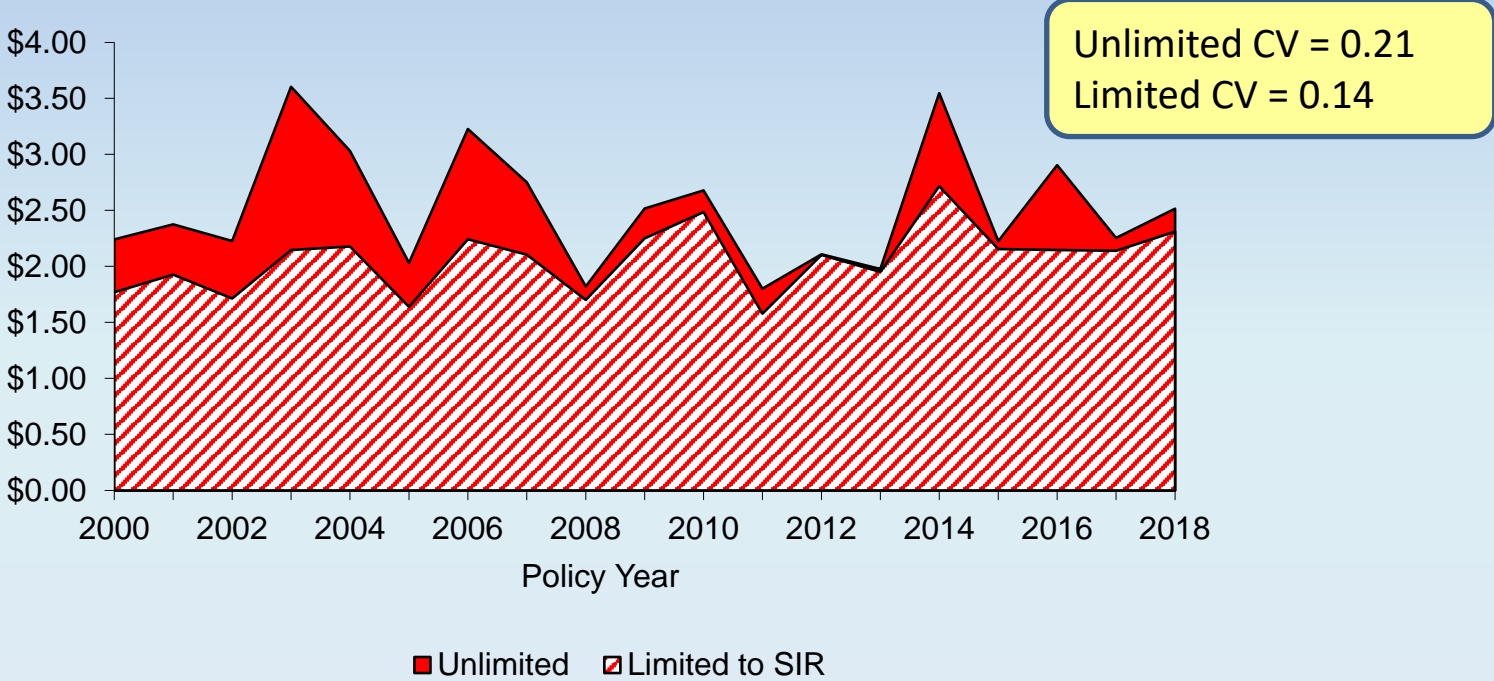
How Do Actuaries Treat Large Claims?

- Large claims can skew results of some actuarial methods.

- Reserving – Don't overdevelop large losses beyond the SIR

- Ratemaking – Use capped losses to set basic limit rates. Use ILFs to get to higher limits.

Summary

- Basics
    - Ultimate Losses
    - Outstanding Liabilities
    - Projected Funding and Rates
- Loss Trends
- Discounting
- Confidence Levels
- Required Surplus
- Large Claims

Time to Wake Up...Questions?

Ask an Actuary !

Call 1-800-[$(10x)^2 - 2x + 34$]

$\sqrt{-1}$ ♥ MATH