Actuarial Hocus Pocus

*The Magic Explained…The **Force** Behind the Numbers*

Mike Harrington
President Actuarial
Bickmore

Mujtaba Datoo
Actuarial Practice Leader
Aon

John Alltop
Chief Actuary
CSAC-EIA

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 Math

Actuarial Credentials

- What Does MAAA Stand For ?
  - Math Always Adds Anger
  - Make America Actuarial Again
  - Mathematics. Always. Anytime. Anywhere.
  - Maximum Attribute Assessment Analysis

  ✓ Member of the American Academy of Actuaries

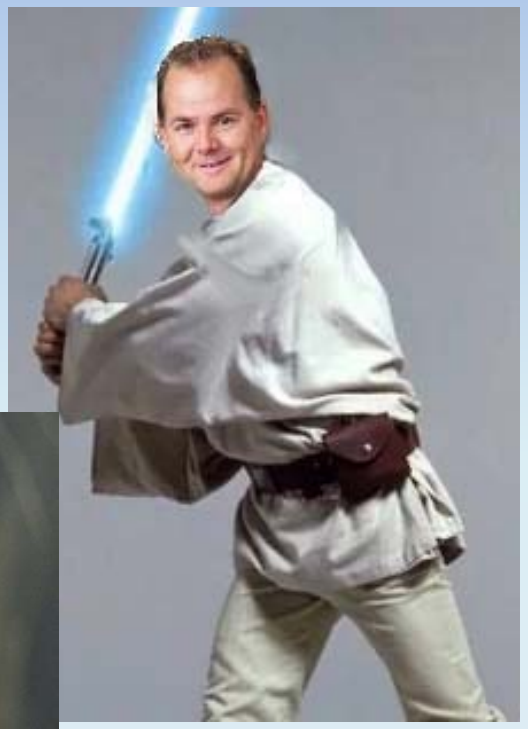
parma public agency risk management association

Why Are We Here?

- Define Terms
  - Data
  - Ultimate Losses
- Outstanding Liabilities
  - IBNR
  - Loss Development
- Projected Losses
  - Trends / Inflation
- Discounting
- Confidence Levels

parma
public agency risk management association

Questions ??



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

parma
public agency risk management association

Or More Specifically

Outstanding losses

Prior 13/14 14/15 15/16 16/17

June 30, 2017

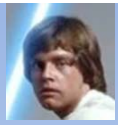
17/18 18/19 19/20 20/21 …

Projected funding

parma
public agency risk management association

Actuarial Lingo

What Does This Stuff Mean?

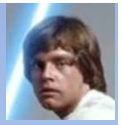


Actuaries Love "Good" Data

Data needed for an actuarial study:

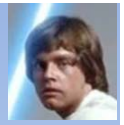
- Losses (Payments, Case Reserves...)
- Exposures (Payroll, Vehicles, SIRs,...)
- Financial Statements (Balance Sheet, Income Statement, Budget)
- Anything that may be relevant to making loss estimates

GIGO – Garbage In, Garbage Out !!



How Does The Actuary Test For "Good" Data?

- Are there large changes in the loss run?
  - Large claims
- Do loss runs tie to financial statements?
- Do I know what is reflected in the data?
  - Deductibles, SIR limits, 4850, Recoveries.
- Is exposure data consistent with prior?
  - What is included in payroll?



Question…

What Should You Tell Your Actuary Before They Start The Report?

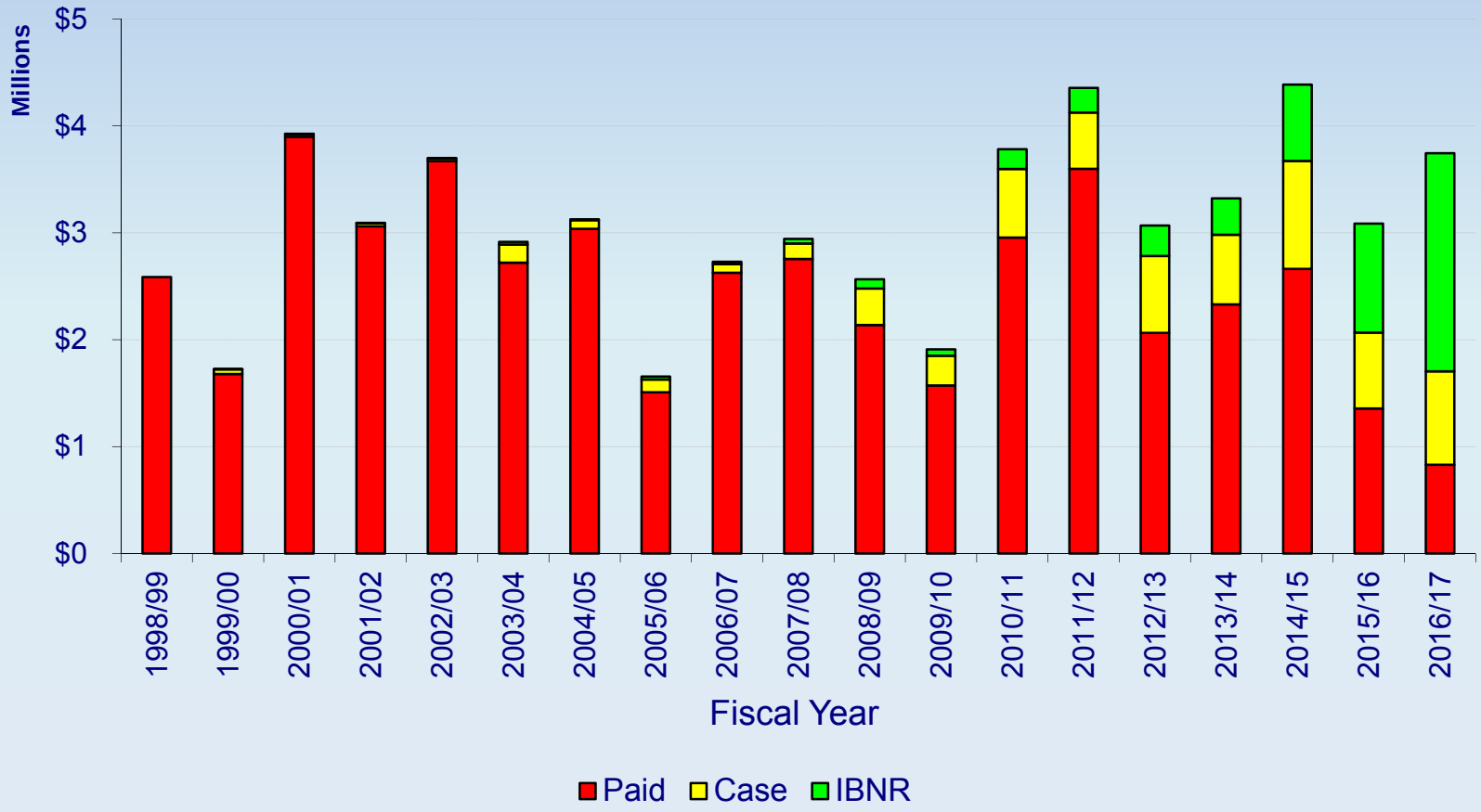
Claim Cost Components

- Loss – Settlement/Judgement Amount to Claimant
- ALAE – Allocated Loss Adjustment Expenses, which consist primarily of legal fees, usually analyzed together with loss
- ULAE – Unallocated Loss Adjustment Expenses, which consist primarily of claims administration expenses (in-house or TPA), usually analyzed separately from loss

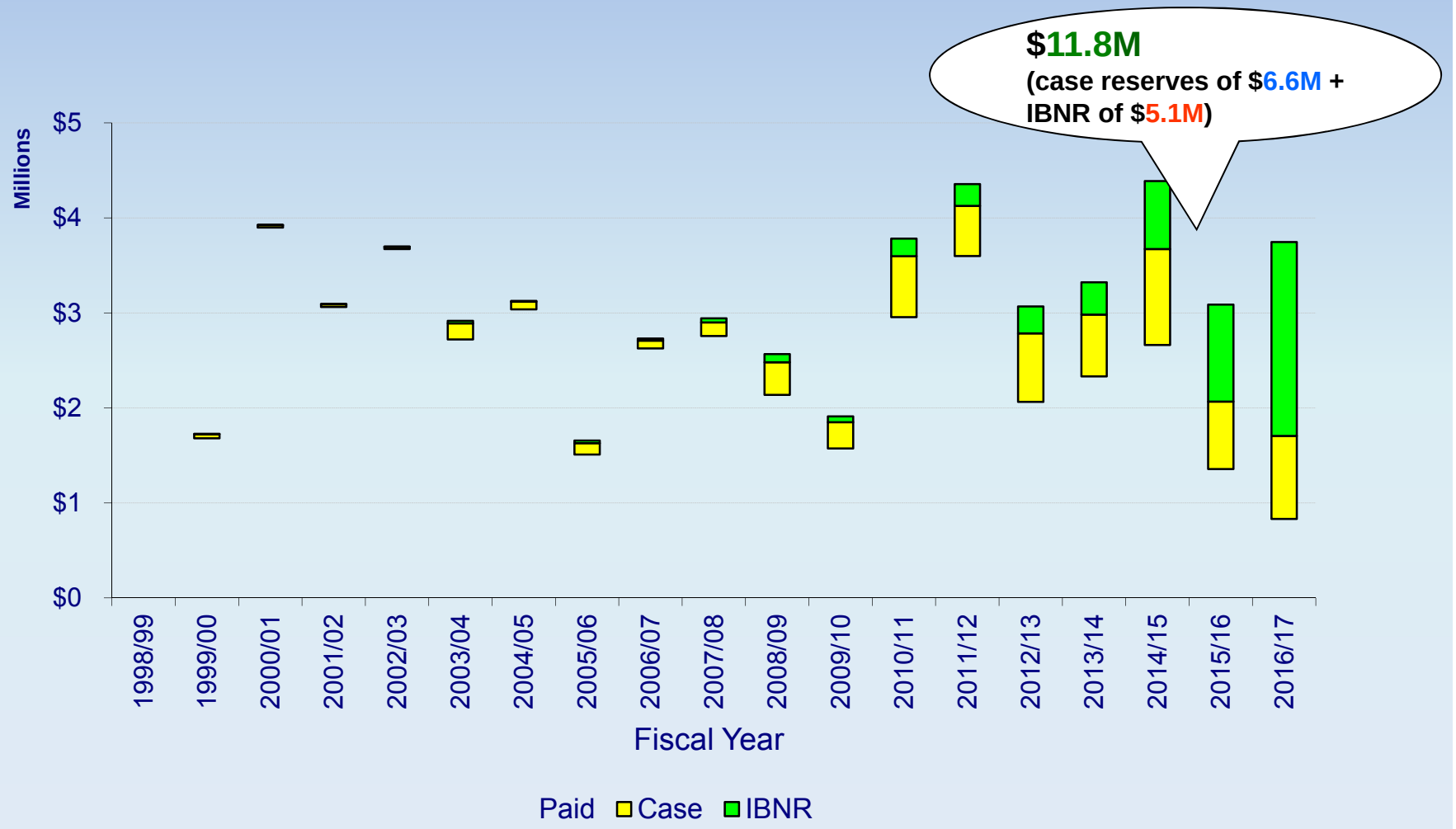
Ultimate Loss

- 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

A Picture Is Worth A Thousand Words



A Picture Is Worth A Thousand Words



parma
public agency risk management association

Reserve Analysis

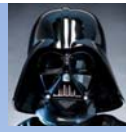
Looking Back!

Outstanding Liabilities

- How much money do you owe for claims that have already happened?
- Credit Card Bill
- Case Reserves vs IBNR Reserves
  - Good news vs Bad News

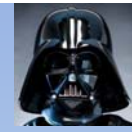
Loss Development

Favorable or Adverse?



Favorable Development

Adverse Development



Favorable Development

Adverse Development

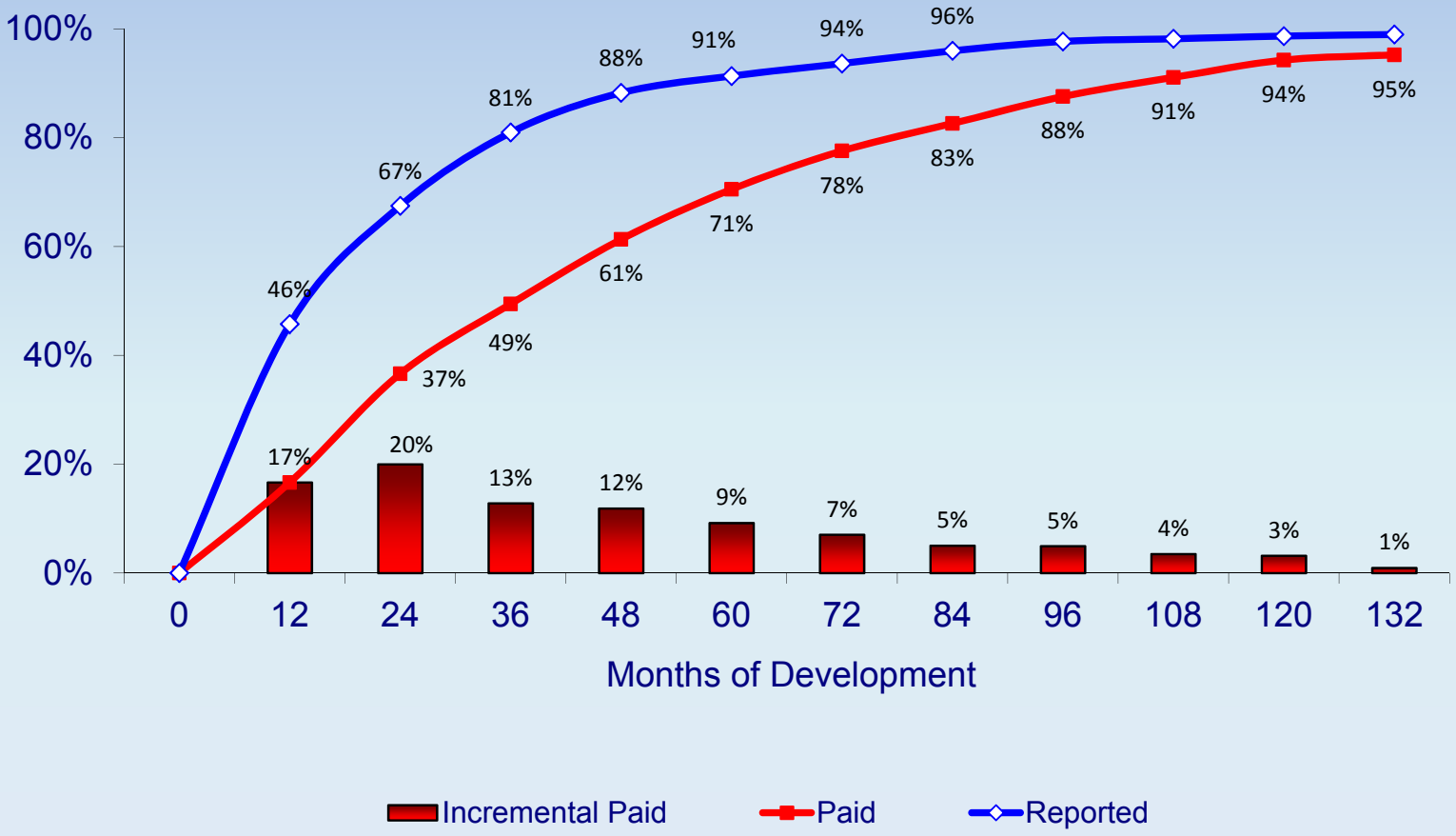
Loss Development

But Wait…
There's More!

Why Do Losses Develop?

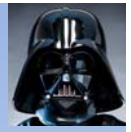
- Claims that have occurred but have not been reported. (aka…pure IBNR)
- Claims that have been reported but increase (or decrease) in cost. (aka…case reserve development)
- These two comprise IBNR – Incurred But Not Reported.

What is Loss Development ??



Loss Development

OK. LET'S DO AN EXAMPLE…



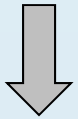
The Details

Consider 2012-13 workers' compensation claims, which have dates of loss between 7/1/12 and 6/30/13.

- At 6/30/13 (@1 year of development), there were 100 closed claims, each of which cost $5,000, total value $500,000
- At 6/30/13 (@ 1 year of development), there were 5 open claims, whose total value was $193,421
- Total Reported Losses at 6/30/09 = $500,000 + $193,421 = $693,421

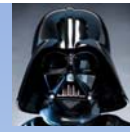
Let's Add It All Up

	6/30/2013	6/30/2014	6/30/2015	6/30/2016	6/30/2017
Closed	500,000	500,000	500,000	500,000	500,000
Claim # 1	8,421	13,309	13,309	13,309	13,309
Claim # 2	55,000	205,000	330,000	380,000	49,664
Claim # 3	40,000	5,000	216	216	216
Claim # 4	50,000	100,000	130,000	165,136	165,136
Claim # 5	40,000	40,000	40,000	40,000	400,000
Total	693,421	863,309	1,013,525	1,098,661	1,128,325



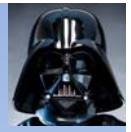
	@ 1 Year	@ 2 Years	@ 3 Years	@ 4 Years	@ 5 Years
2012-13	693,421	863,309	1,013,525	1,098,661	1,128,325

parma public agency risk management association



The Moral of the Story…

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



How Do We Build The Loss Development Triangle?

So now we can put 2012-13 into the development triangle…

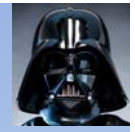
	@ 1 Year	@ 2 Years	@ 3 Years	@ 4 Years	@ 5 Years
2012-13	693,421	863,309	1,013,525	1,098,661	1,128,325
2013-14	646,534	848,899	972,838	1,038,991	
2014-15	857,642	1,159,531	1,348,536		
2015-16	725,833	963,180			
2016-17	782,778				

Other years can be derived similarly…

Ultimate Loss Estimates

Using the development triangle, we can project out ultimate losses

	@ 1 Year	@ 2 Years	@ 3 Years	@ 4 Years	@ 5 Years	Ultimate
2012-13	693,421	863,309	1,013,525	1,098,661	1,128,325	1,179,099
2013-14	646,534	848,899	972,838	1,038,991	1,064,966	1,112,890
2014-15	857,642	1,159,531	1,348,536	1,449,676	1,485,918	1,552,784
2015-16	725,833	963,180	1,117,289	1,201,086	1,231,113	1,286,513
2016-17	782,778	1,045,009	1,212,210	1,303,126	1,335,704	1,395,811



Other Ultimate Loss Estimation Methods

- Loss Development Methods
  - Paid, Incurred, Claim Count Triangles
- Exposure Based Methods
  - Bornhuetter Ferguson assumed loss rate
- Frequency-Severity Methods
  - Quantity x Average Cost
- Actual versus Expected Methods
  - More → Increases, Less → Decreases

- Just make up a number, nobody reads the actuarial report anyway!

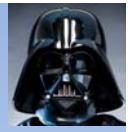
Actuarial Selections

- Sometimes we use complicated formulas involving addition, subtraction, multiplication, and division to make actuarial selections.

- For example, we may add up five different estimates and divide by five.

- This is called an …"average"!

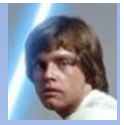
➢ Select ultimate losses based on appropriate methods and **actuarial judgment**



Reserve Estimates

Now that we have calculated ultimate losses, we can subtract paid losses to determine the reserves as of June 30, 2017…

Accident Year	Ultimate Losses	-	Paid Losses	=	Total Reserves	-	Case Reserves	=	IBNR Reserves
2012-13	1,179,099		715,461		463,638		265,513		198,125
2013-14	1,112,890		569,578		543,312		281,384		261,928
2014-15	1,552,784		723,624		829,160		400,815		428,345
2015-16	1,286,513		282,402		1,004,111		518,982		485,129
2016-17	1,395,811		234,648		1,161,163		548,130		613,033
Total	6,527,097		2,525,713		4,001,384		2,014,824		1,986,560



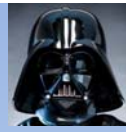
Question…

Do I Need A ULAE Reserve?

You Might Be An Actuary If…

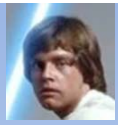
- You drive by looking out the rear window.
- You feel compelled to explain your jokes.
- You write memos using Microsoft Excel.
- You build a Monte Carlo simulation model to make your bracket selections for March Madness or to select your Fantasy Football team.
- You have numerous options available when selecting the appropriate pocket protector for your presentation.

parma
public agency risk management association



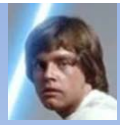
Rate Analysis

Looking Ahead!



Projected Losses

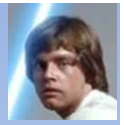
- How much money do you need for claims that will happen next year?
- Budgeting
- Use history to predict future
- Adjust for changes between history and future (e.g. inflationary trends)



Rate Analysis Quiz #1

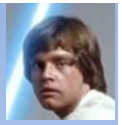
Historical Year	Last Year's Ultimate Loss Rate
2007-2008	0.987
2008-2009	0.822
2009-2010	0.793
2010-2011	0.063
2011-2012	1.002
2012-2013	1.629
2013-2014	0.520
2014-2015	0.871
2015-2016	
Averages	
Totals	0.841
07/08-14/15	0.920
11/12-14/15	1.012
Selected	.925

parma public agency risk management association



Rate Analysis Quiz #2

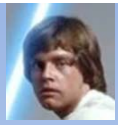
Historical Year	Last Year's Ultimate Loss Rate		This Year's Ultimate Loss Rate
2007-2008	0.987		1.060
2008-2009	0.822		0.874
2009-2010	0.793		0.830
2010-2011	0.063		0.066
2011-2012	1.002		0.934
2012-2013	1.629		1.572
2013-2014	0.520		0.136
2014-2015	0.871		0.406
2015-2016			0.715
Averages			
Totals	0.841	Totals	0.865
07/08-14/15	0.920	10/11-14/15	0.621
11/12-14/15	1.012	07/08-15/16	0.739
Selected	0.925		0.750



Historical Ultimate Losses

1. Estimate ultimate losses for each prior year.

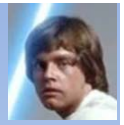
✓ Done!



Trending Losses

2. Trend prior year ultimate losses to the cost level for next year.

	Ultimate Losses	Trend Factor	Trended Losses
2012-13	1,179,099	1.402	1,653,097
2013-14	1,112,890	1.309	1,456,773
2014-15	1,552,784	1.205	1,871,105
2015-16	1,286,513	1.109	1,426,743
2016-17	1,395,811	1.047	1,461,414
Total	6,527,097		7,869,132

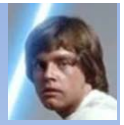


Trending Payrolls

3. Trend prior year payrolls to the wage level for next year.

	Payroll (00's)	Trend Factor	Trended Payroll
2012-13	1,154,678	1.132	1,307,095
2013-14	1,165,613	1.104	1,286,837
2014-15	1,181,679	1.077	1,272,668
2015-16	1,197,744	1.051	1,258,829
2016-17	1,247,122	1.025	1,278,300
Total	5,946,836		6,403,729

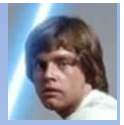
parma public agency risk management association



Trended Loss Rates

4. Calculate the ratio of trended ultimate losses to trended payroll for each prior year.

	Trended Payroll	Trended Losses	Trended Loss Rate
2012-13	1,307,095	1,653,097	1.265
2013-14	1,286,837	1,456,773	1.132
2014-15	1,272,668	1,871,105	1.470
2015-16	1,258,829	1,426,743	1.133
2016-17	1,278,300	1,461,414	1.143
Total	6,403,729	7,869,132	1.229



Projected Loss Rate

5. Based on these trended ratios, we select a projected ratio for next year.

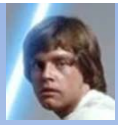
	Trended Payroll	Trended Losses	Trended Loss Rate
2012-13	1,307,095	1,653,097	1.265
2013-14	1,286,837	1,456,773	1.132
2014-15	1,272,668	1,871,105	1.470
2015-16	1,258,829	1,426,743	1.133
2016-17	1,278,300	1,461,414	1.143
Total	6,403,729	7,869,132	1.229

3-Yr Avg = 1.249

2-Yr Avg = 1.138

Selected 1.20

All Yr Avg = 1.229



Projected Ultimate Losses

6. Multiply this projected ratio times the projected payroll for next year, resulting in projected ultimate losses for next year.

   Projected Loss Rate for 2017-18 = $1.20
   Projected Payroll for 2017-18 = $1,300,000
   Projected Ultimate Losses for 2017-18 = $1,560,000

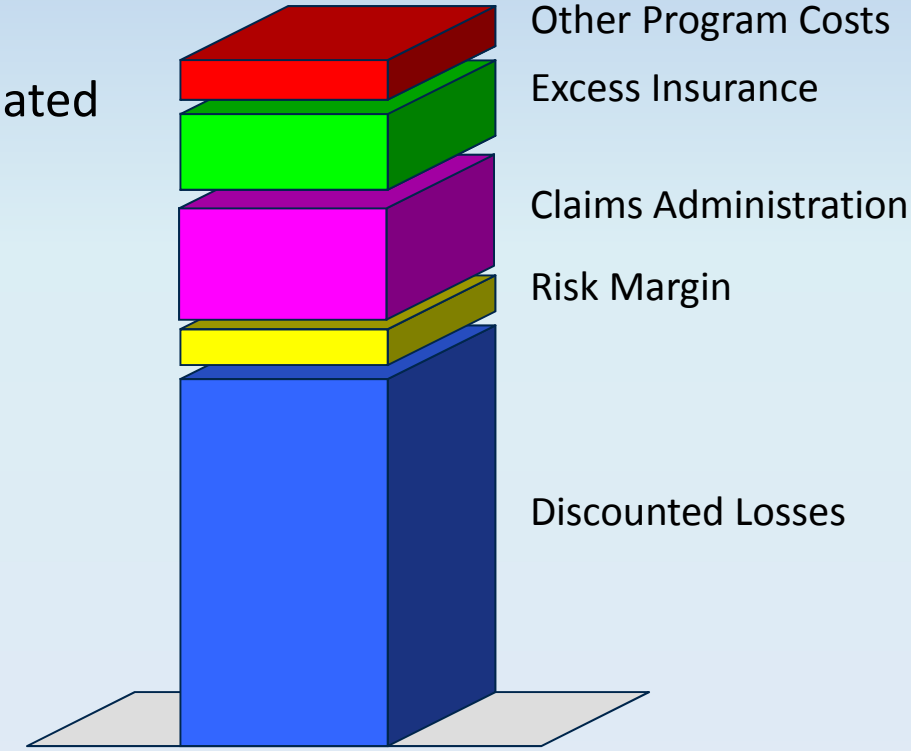
So we need to collect $1,560,000 in premiums to cover next years expected ultimate losses.

(Note: Ignores discounting, confidence levels, wind speed, NFL strike status, etc.)

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)



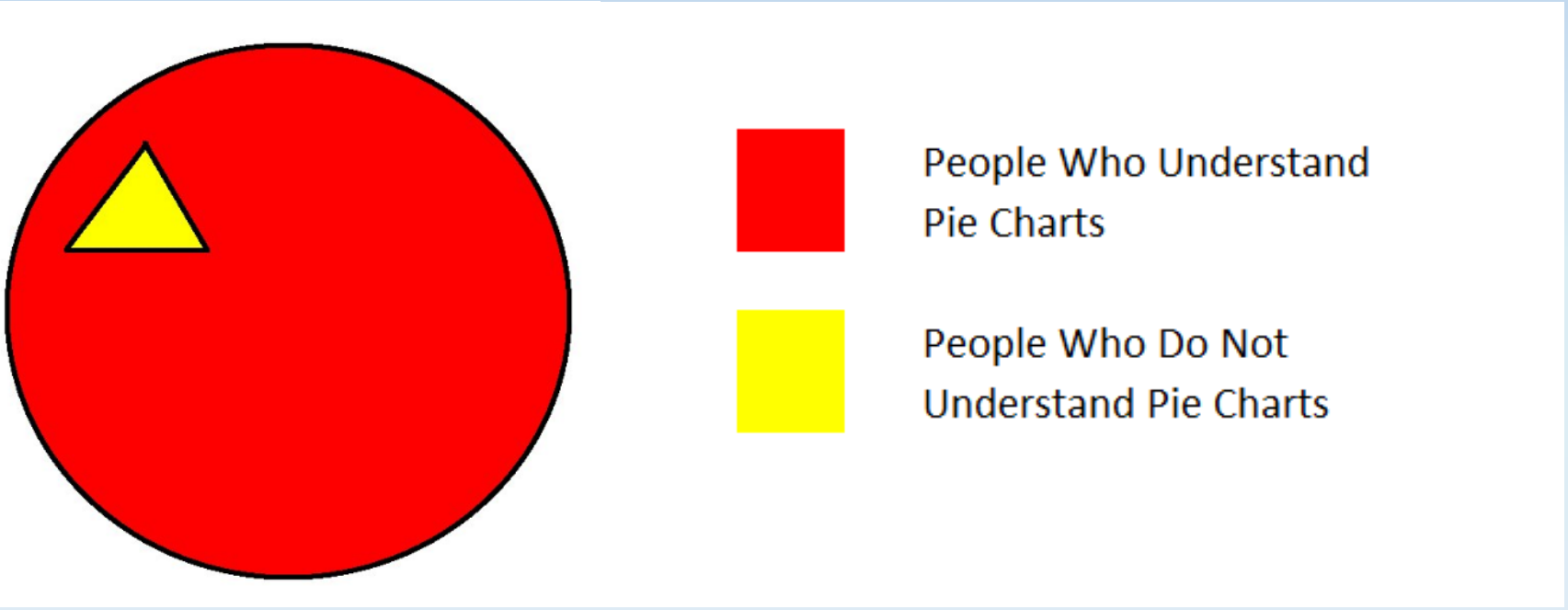
Rate Adequacy

- Inadequate rate
  - Reduces surplus (net assets)
    - →Rate increases, Assessments
- Adequate rate
  - Increases surplus (net assets)
    - →Rate stabilization, Dividends

Question…

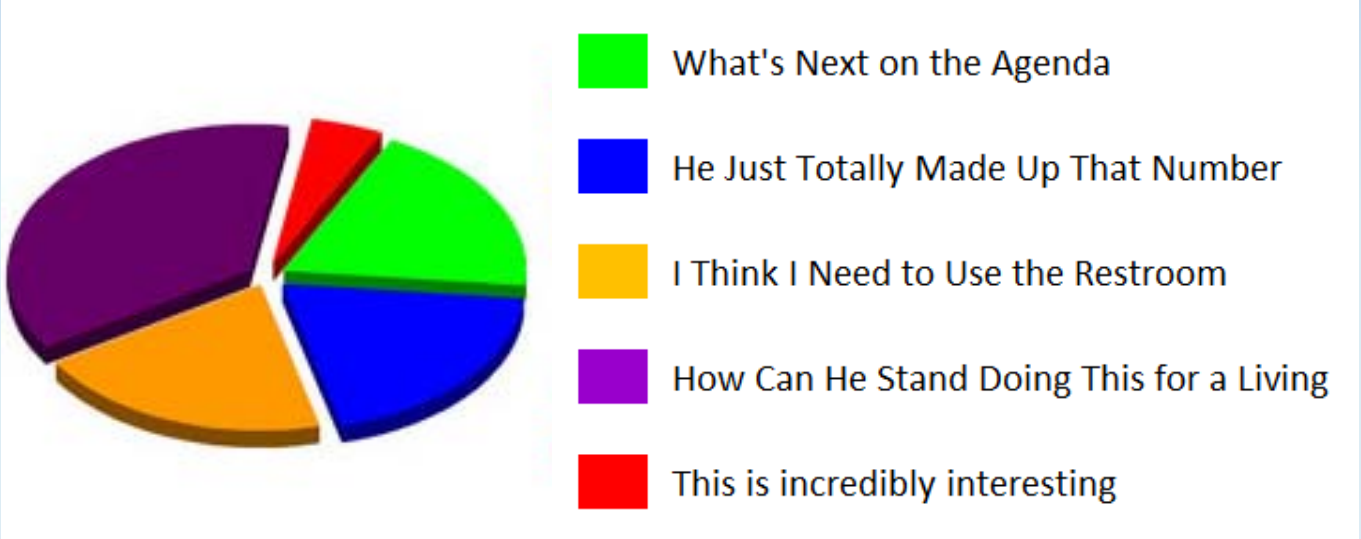
Why Are Rates Inadequate?

Pie Charts


People Who Understand Pie Charts
People Who Do Not Understand Pie Charts

Pie Charts

Thoughts During An Actuarial Presentation

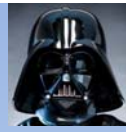


Trends

Where have we been?

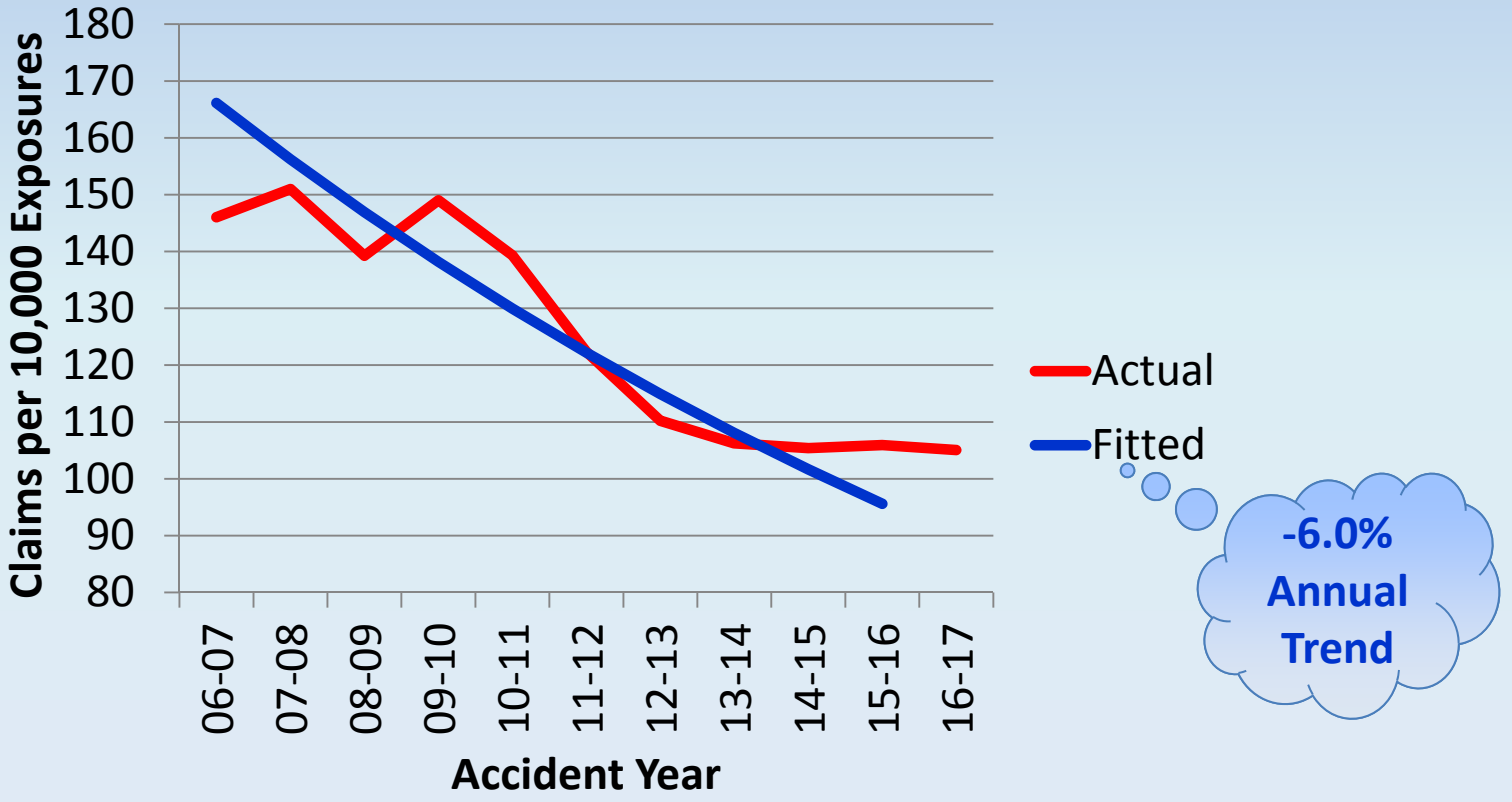
&

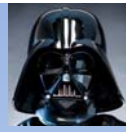
Where are we going?



Frequency

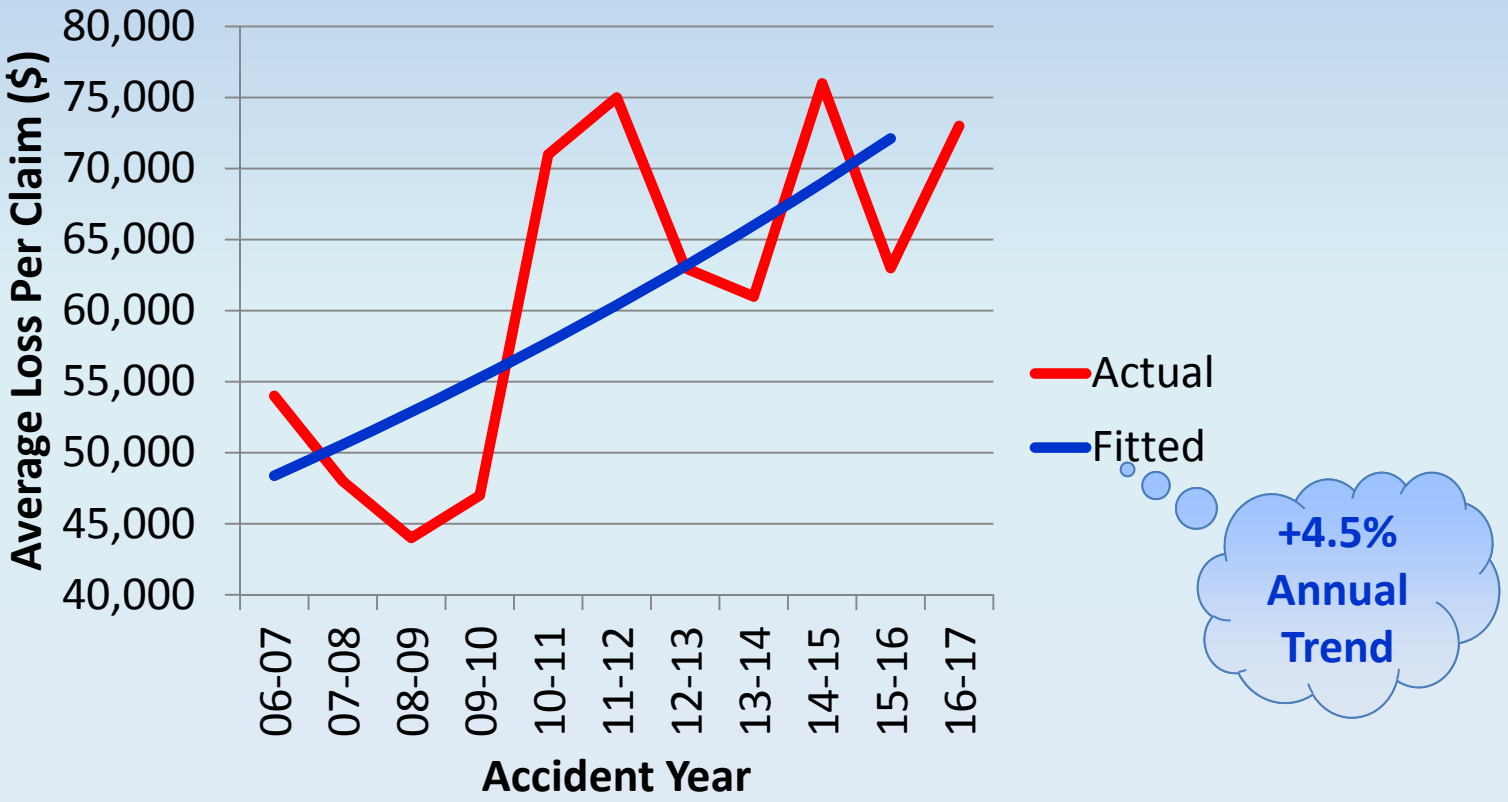
How Many Claims Are We Having?



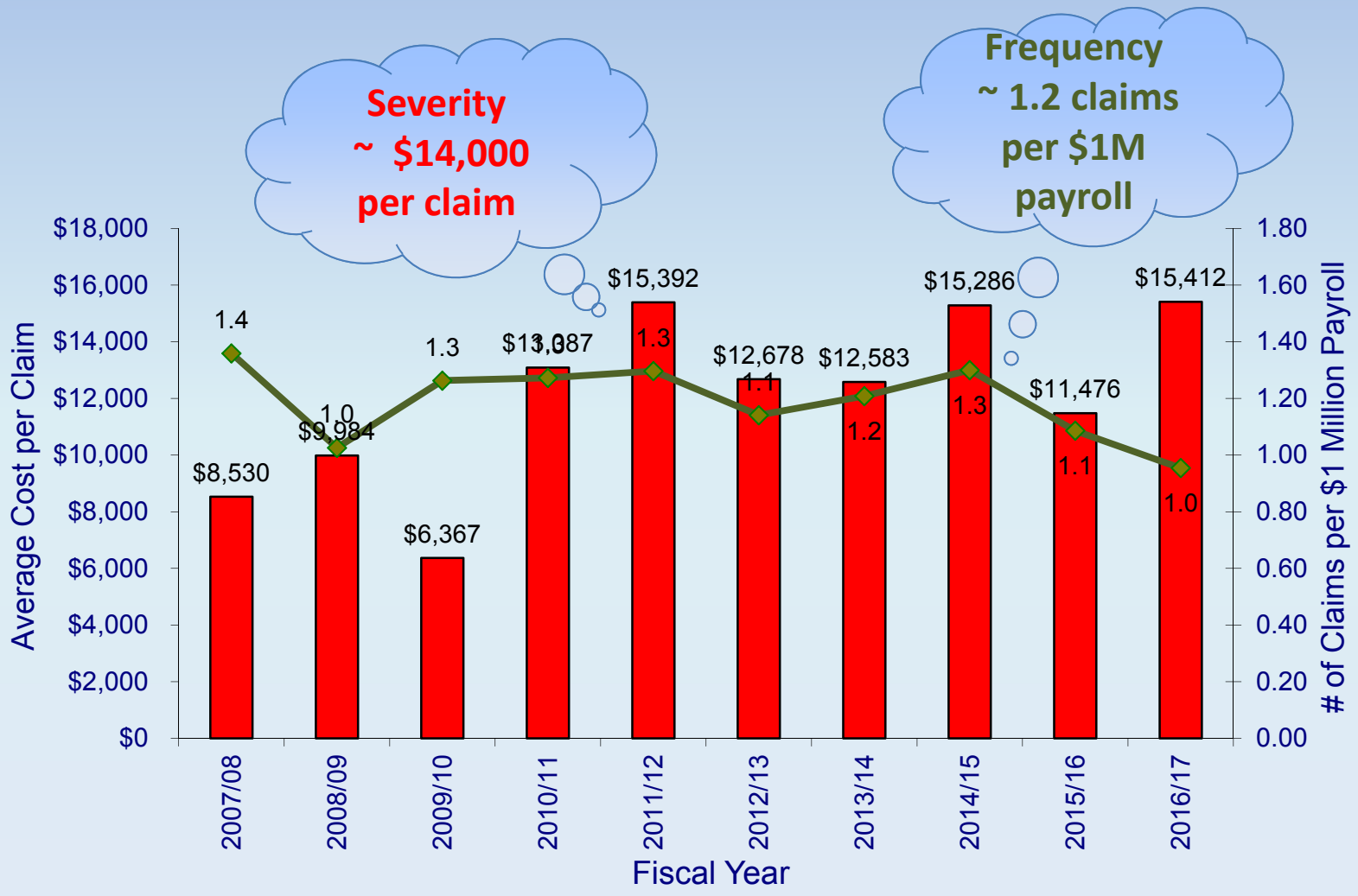


Severity

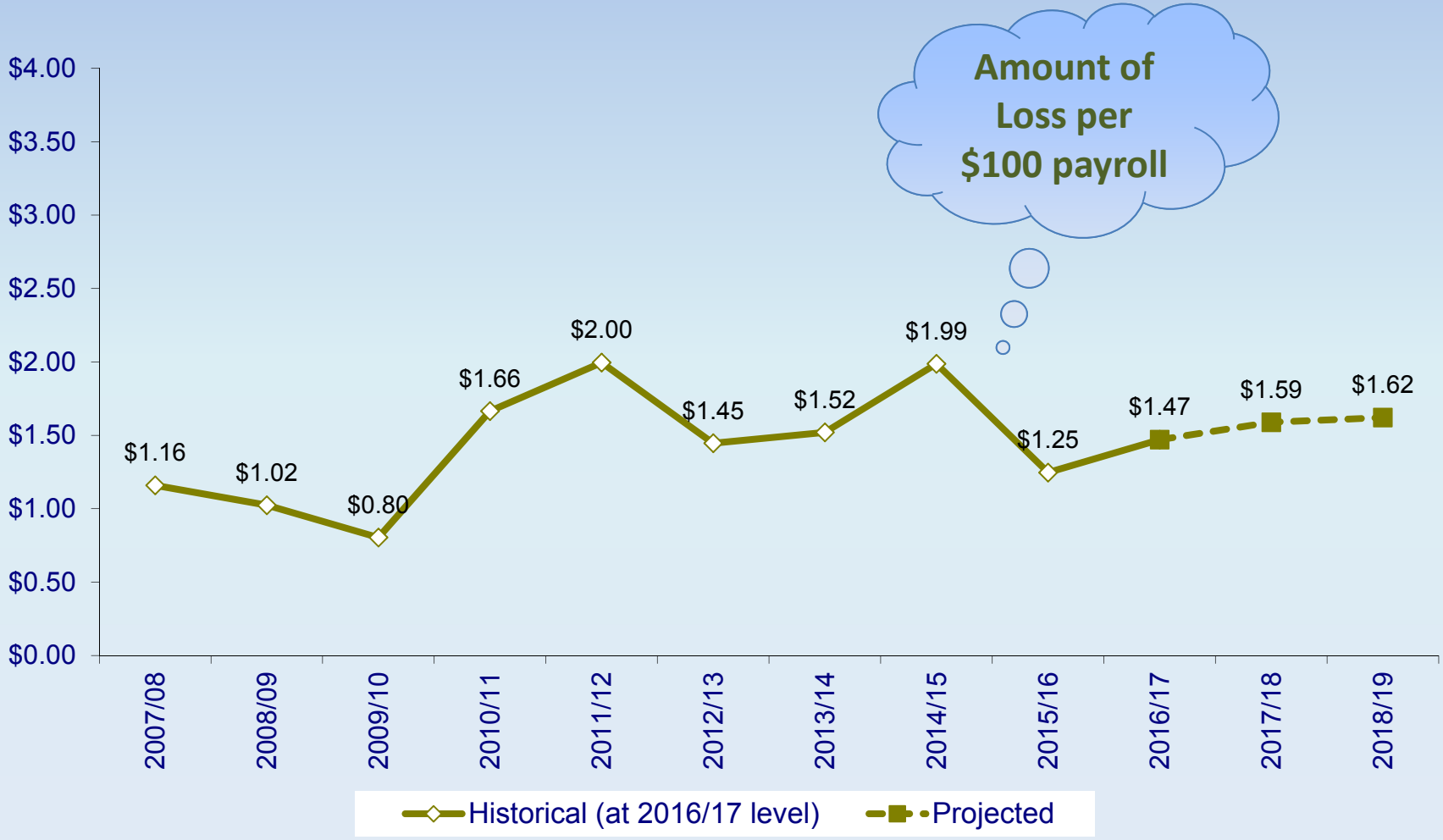
How Big is the Average Claim?



Frequency and Severity



Loss Rate


Amount of Loss per $100 payroll
$4.00
$3.50
$3.00
$2.50
$2.00
$1.50
$1.00
$0.50
$0.00
$1.16
$1.02
$0.80
$1.66
$2.00
$1.45
$1.52
$1.99
$1.25
$1.47
$1.59
$1.62
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
Historical (at 2016/17 level)
Projected


RISK
THE AGENCY STRIKES BACK
WARS

Questions ??