



SINGAPORE
ACTUARIAL
SOCIETY

Methodologies for Provision for Adverse Deviation (PAD)

SAS General Insurance conference

2015



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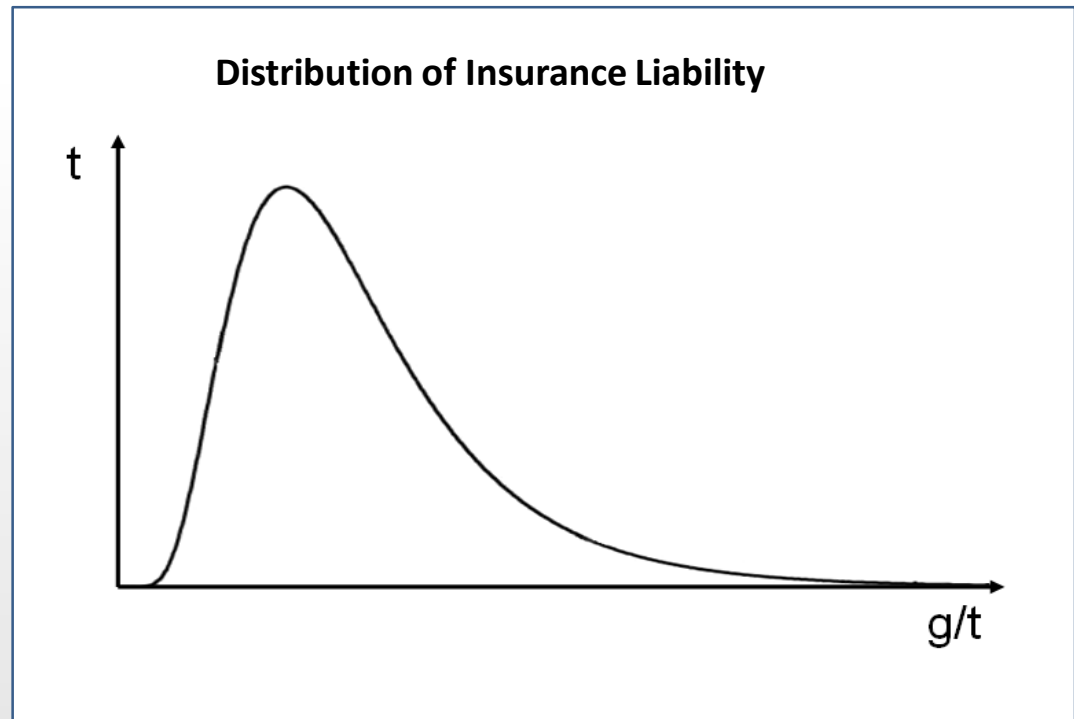


Introduction

- Required under Insurance Act (Chapter 142), Section 19: Valuation of liabilities of general business
- The Provision for Adverse Deviation (PAD) shall be determined such that the overall valuation of guaranteed liabilities secures 75% sufficiency.

Properties

- More uncertainty on the current estimate and its trend -> higher risk margin
- Low frequency and high severity -> higher risk margin





Uncertainty in Estimating Claim Liability

- **Parameter error**
 - Error in determining the values of the parameters of the claims run-off process
 - Parameter might evolve over time
- **Process error**
 - Future payments are random and unknown.
- **Model specification error**
- **Data error**
- **Future trends variability**
 - Inflation, interest rate, claims run-off patterns, claims management process, exposure, business mix, staff departure, legislation, insurance market cycle, technology etc
- **Reinsurance risk**



Methods used to derive PAD for Claim Liability

Mack Method

Bootstrapping

**Stochastic Chain
Ladder Method**

Industry Benchmark



Mack Method

- Measures the **Mean Square Error (MSE)** of the overall claims reserve, which is the sum of the MSE of individual accident year's claims reserve and the covariance of the claims reserve between accident years
- Based on chain-ladder assumptions

Pros

- Usually provide **stable results**
- Measures parameters, process and total risk

Cons

- Model provides, only, the mean and standard error of the claim distribution
- **Does not explicitly measure tail variability**
- Does not model well the situation when actuary selects factor other than weighted or simple average



Bootstrapping Method

Categorised into two types:

- Non-parametric Bootstrapping
- Parametric Bootstrapping

Pros

- **Does not need to make assumptions about underlying distribution** (i.e. Non-parametric Bootstrapping)
- Actual data “guides” the simulation
- Generates a distribution of the estimate of unpaid claims, as opposed to just a point estimate
- A powerful procedure in that it allows us to **estimate the distribution with very little data**

Cons

- Variability limited to that which is in the historical data
- **Data outlier can have a leveraged effect** on the results
- Residuals might need to be divided into similar resampling group



Stochastic Chain Ladder Method

- Development Factors assumed to be lognormal distributed
- Parameters such as mean, Standard Deviation and Coefficient of Variation are estimated and then used to generate multinomial random variables ($F_{(i,n+1-i)} + \dots + F_{(i,n)}$) through Cholesky decomposition process

Pros

- **Correlations across periods** can be accommodated
- Flexible, can incorporate the development period effect explicitly

Cons

- Requires standard statistical software for faster means of calculation.
- **Simulating with Excel is relatively slower** as this method involved simulation
- Costs more for making the model



Industry Benchmark

- Adoption of PAD loading according to Industry Benchmark by Line of Business. I.e.
 - APRA's General Insurance Risk Margin industry review report, or
 - Simple average of risk margin from different companies.

Pros

- Simple to use
- **Useful for company which lacks of claim historical data**
- Can be apply to volatile data
- Can be use as reasonableness check on the other methods

Cons

- Estimated PAD **might not be reflecting the Company's true variability** of claim liability estimated
- Mix of business is assumed to be similar with the benchmark



Comparison of Methods

Mack Method

- Provide only the mean and standard error of the claim distribution
- Does not explicitly measure tail variability
- Outliers distort results greatly

Bootstrapping Method

- Able to estimate the distribution with limited data
- Measure tail variability through resampling data
- Outliers distort results greatly

Stochastic Chain Ladder method

- Assume claims to follow lognormal distribution
- Flexible, can incorporate the development period effect explicitly
- Require statistical software for simulation

Industry Benchmark

- No distribution assumptions
- Simple to use
- Useful for companies with little claim historical data
- Can be used as reasonableness check



Premium vs Claims Liability

- PAD for Premium Liability is expected to be greater than that of Claims Liability due to the **larger degree of uncertainty** in determining the potential liabilities developing during the unexpired period of the policies, such as:
 - Greater reliance on assumptions relating to **unknown future events and experience** (e.g. changes in Claims Frequency and Average Claims Size)
 - Possible exposure to **catastrophes**
 - Potential changes in **claims procedures**
 - Uncertainty increases with **decreasing age of accident period**



Method used to derive PAD for Premium Liability

**Multiple of PAD
for
Claim Liability**

**Time Series Analysis
Of
historical ULR**



Multiple of PAD for Claim Liability

- Set PAD for Premium Liability as multiple of PAD of Claim Liability
- Rule of thumb: **1.75 for short tailed classes, 1.25 for long tailed classes** (Tillinghast – Towers Perrin, 2001)
- Multiple can also be chosen based on Coefficient of Variation (CoV) of Premium Liability

Pros

- Easy to apply and understand
- Takes into account **claims deterioration**

Cons

- Exposure might be very different for Earned portion and Unearned portion of premium (e.g. due to **exposure to event risk**)
- Multiple may need to be adjusted in an arbitrary manner to reflect changes in claims environment
- Volatility can be lower for Unexpired Risk Reserve (URR) than for Claim Liability for certain classes
- The process driving the volatility of the premium liability is largely unrelated to the process driving the volatility in the claim liability



Time Series Analysis of Historical ULR

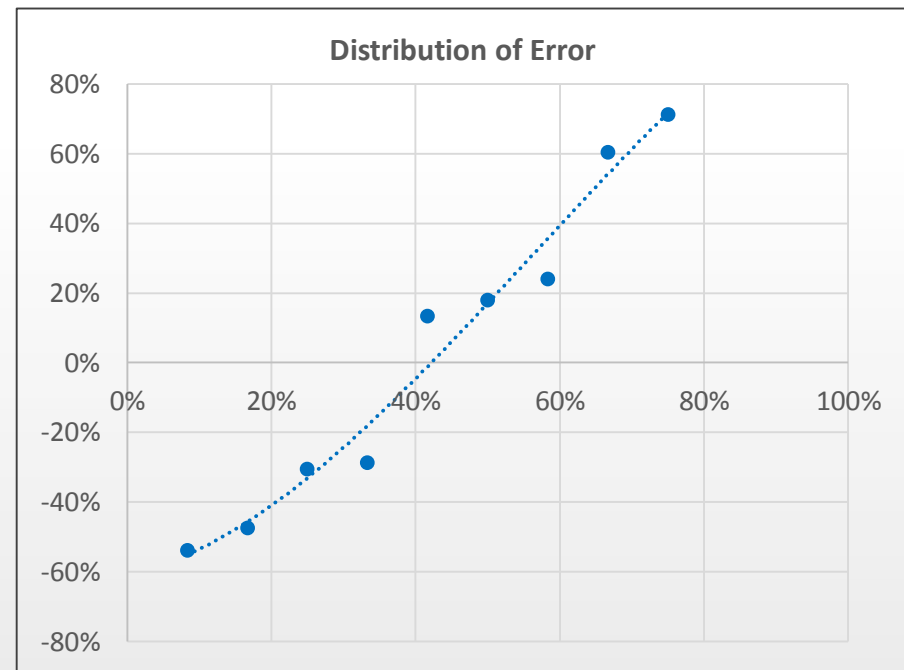
- Comparison of the historical projections of URR with the latest estimates
- Determines distribution of the standard errors and select the appropriate confidence level

Pros

- Utilises data of many prior years
- Able to determine the most appropriate method to project URR for different classes
- **Does not rely on any assumptions on distribution** of claims

Cons

- Complex and difficult to understand
- **Outliers** can distort results





Comparison of Methods

Multiple of PAD of Claim Liability

- Easy to apply and explain
- Takes into account claims deterioration
- Multiple chosen rely on assumptions
- Effective if high correlation between volatility of Claims and Premium Liability (e.g. high IBNR portion in Claims Liability, long-tailed)

Time Series Analysis of Historical ULR

- More complex
- Able to determine most appropriate method to project URR
- Suitable if claims distribution is unknown
- Suitable if nature of volatility of Claims and Premium Liability dissimilar



Conclusions

- Each method of calculating PAD has their own pros and cons
- Companies should choose the most appropriate method based on the nature of their portfolios
- The confidence level adopted by companies should reflect their risk appetite
- Calculation of PAD also helps companies gain a better understanding of their risk



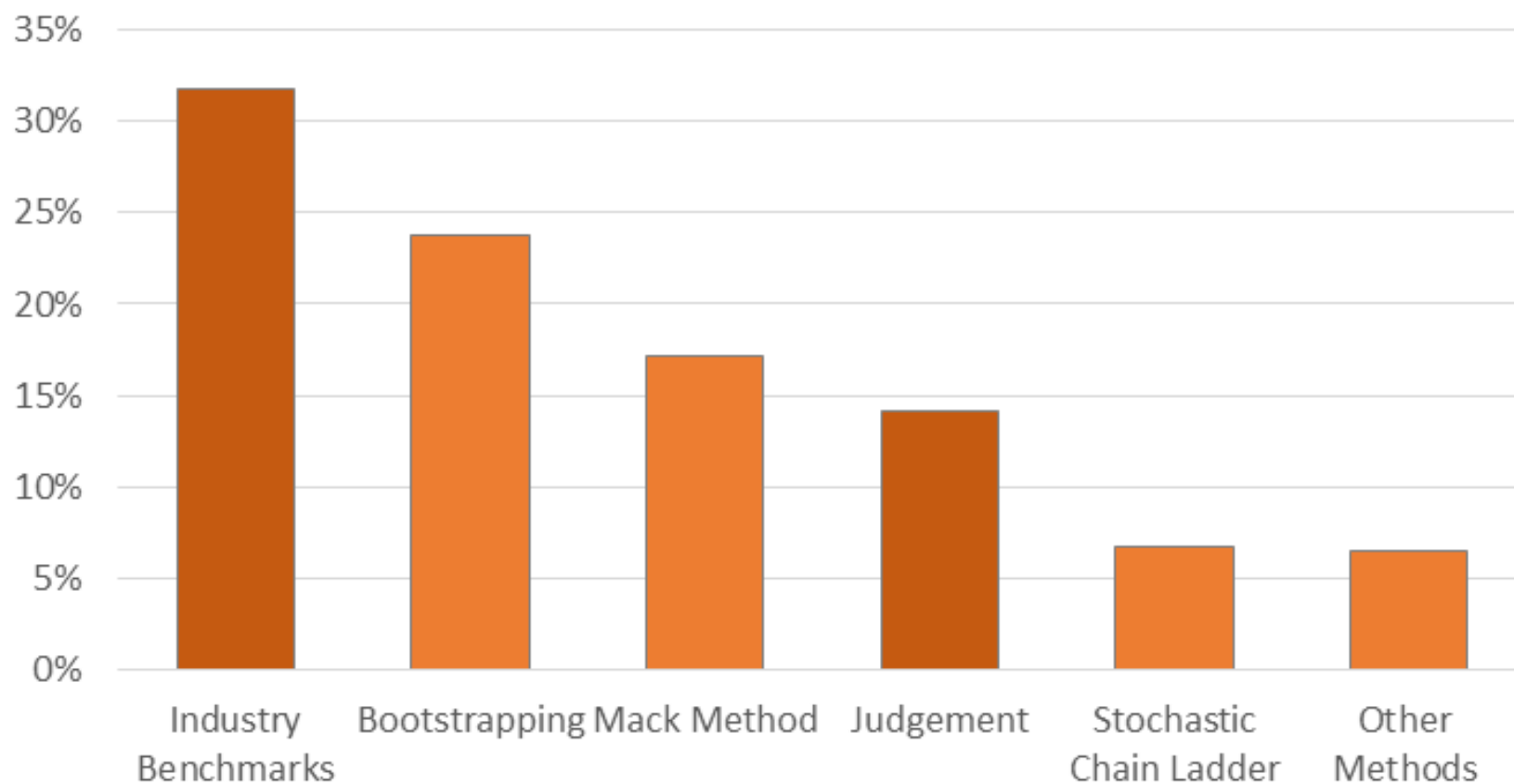
Review of Dec 2013

	Claim Liability	Premium Liability
Number of Companies	75	75
Number of Methods Used	124	77
Average Number of Methods per Company	1.65	1.03



Review of Dec 2013

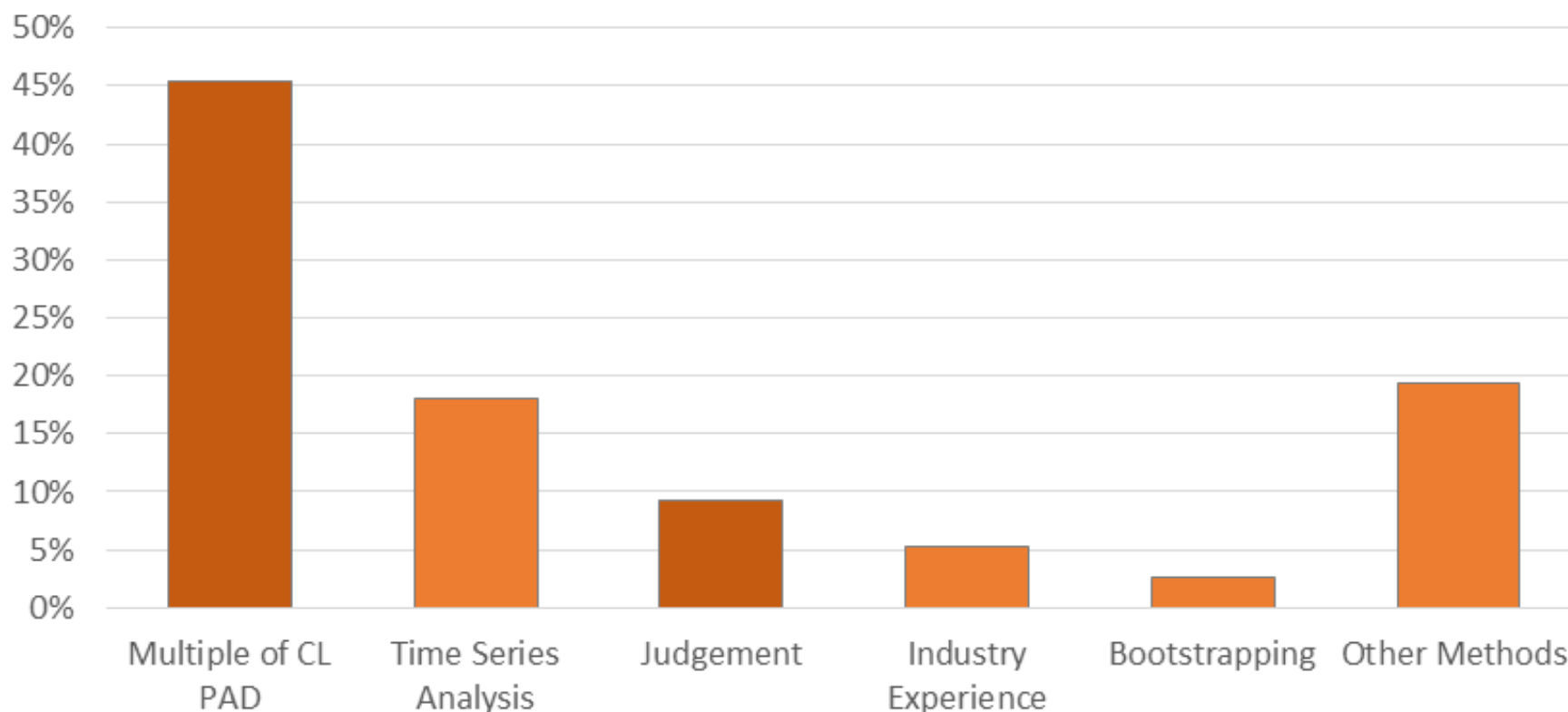
Methods Used - Claim Liabilities





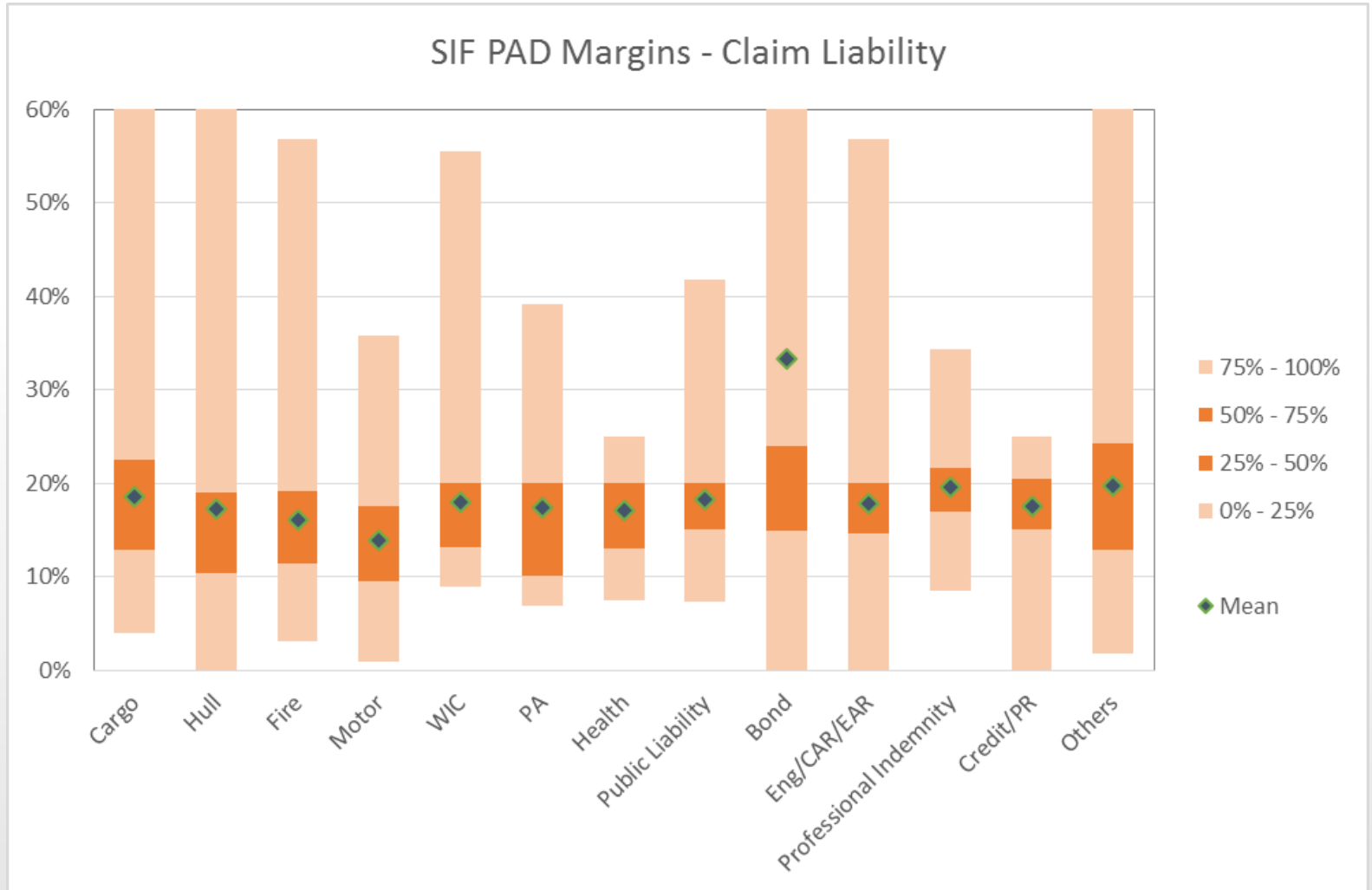
Review of Dec 2013

Methods Used - Premium Liabilities



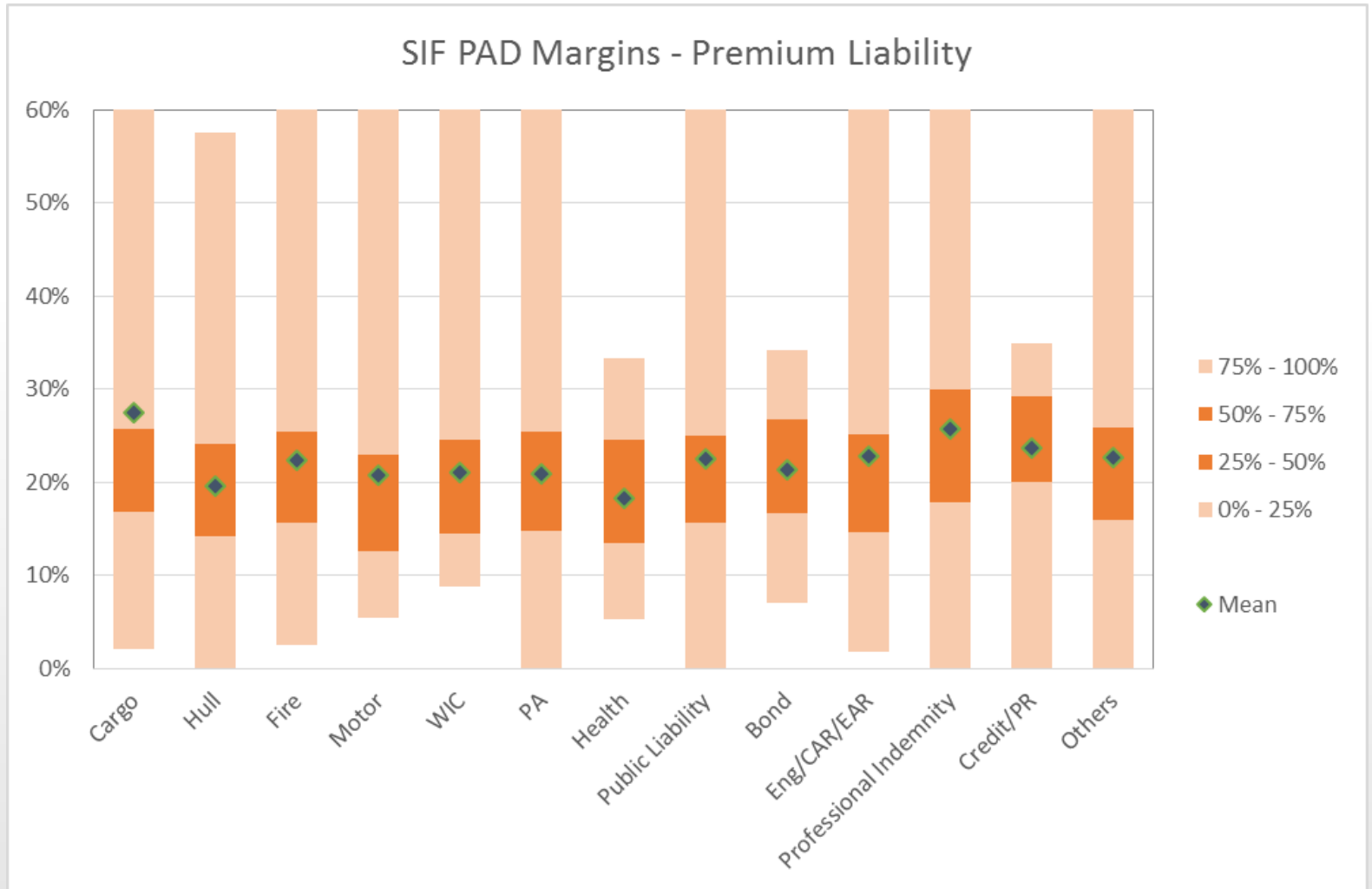


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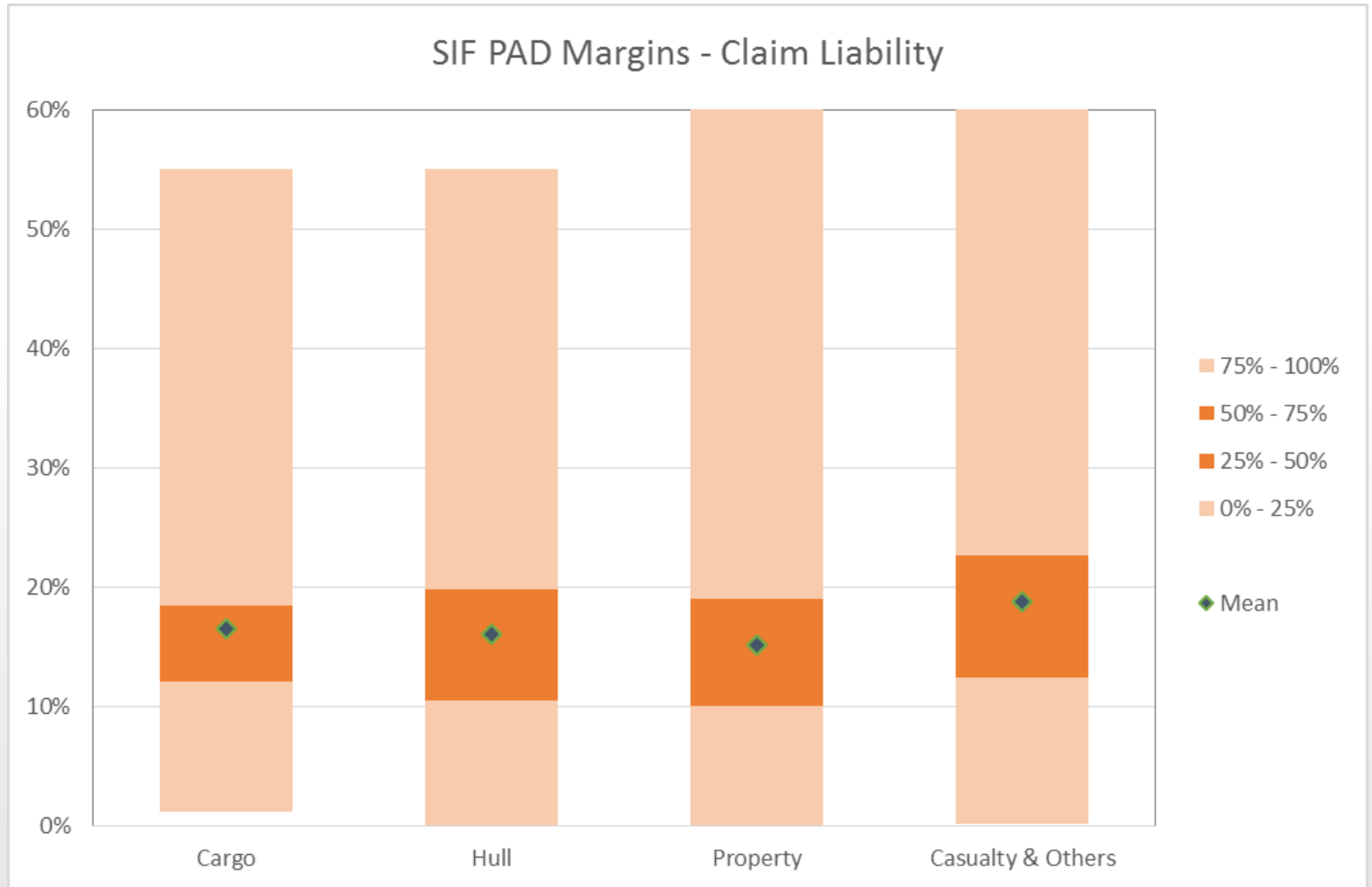


Review of Dec 2013





Review of Dec 2013





Review of Dec 2013

