2012 Casualty Loss Reserves Seminar
Call Paper:
"A Practical Way to Estimate
One-Year Reserve Risk"

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## Agenda

- Solvency II Overview
- Changes in PC Technical Provisions
- Solvency Capital Requirement
  - Risk Categories
  - Risk Margin and Capital for Unpaid Loss
- Standard Formula
- Internal Model
- One-year Reserve Risk Methods
- Proposed Method
- Conclusion and Questions

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Context
Pillars

## SOLVENCY II – OVERVIEW

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## EIOPA Solvency II – Overview

- Regulatory initiative promulgated by EIOPA
- Institutes consistent accounting rules and solvency requirements for insurance cos across Europe
- Changes approach to solvency regulation
- Utilizes principles-based regulatory accounting
- Allows use of internal models to determine capital requirements
- Very costly, non-transparent
- Implementation repeatedly delayed but inevitable
- US NAIC has stated it is taking "functional equivalence" as goal and will not be making wholesale changes in stat accounting. [See Appendix.] NAIC is undertaking SMI project and introducing ORSA

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# Three Pillars

| Pillar 1 | Pillar 2 | Pillar 3 |
|---|---|---|
| Quantitative | Qualitative | Reporting, disclosure, and market discipline |
| Balance sheet (including Technical Provisions<br>Min Capital Req'ment (MCR)<br>Solvency Capital Req'ment (SCR) | Governance, risk management and required functions<br>ORSA<br>Supervisory review process | SFCR and RSR<br>Disclosure<br>Transparency<br>Support of supervision through market mechanisms |
| Market –consistent valuation<br>Risk-based requirements | Business governance<br>Internal Control processes<br>Risk-based supervision | Disclosure<br>Transparent markets |

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## TECHNICAL PROVISIONS

Accounting Changes
Loss Provision
Risk Margin

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## Accounting Changes


- 'Market-based' Valuation
  - Mark-to-model
- Removal of prudential margins
- Explicit discounting
- Explicit Risk Margin
- Cash flow instead of accrual
  - No UEPR
- Up-front recognition - EPIFP
  - Expected Profits Included in Future Premiums
- Pre-up front = Contract boundary – date when obligation is made - different from UWY and AY

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## PC Technical Provisions

- Technical Provisions (Liability)
  - TP= BE + RM
    - BE = Best Estimate
    - RM = Risk Margin
- Premium Provision (TP2.42-2.46)
  - Premium Provision - PV of future cash flows on policies already bound and on claims occurring after valuation date
  - Future Cash Flows = Anticipated Paid Loss&LAE on future occurring claims+ Expense – Premium
  - Could be negative (reducing the liabilities)
- Loss Provision (TP2.47-2.48)
  - Covers losses that have already occurred
  - Best Estimate is Discounted Mean of Scenarios
  - Matched risk –free rates loaded with illiquidity premium

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## Risk Margin for Loss Reserves

$$Risk\ Margin = \sum r_{COC} \cdot SCR_y \cdot v(y)^{y-1}$$

- Risk Margin = discounted Cost of Capital
- r = needed additional return = 6.0%
- SCR = Solvency Capital Requirement
- Cost of capital for each year of runoff
- Reserve valuation reflects required capital

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Non-Life Risk Categories
Risk Margin for Loss Reserves

**P&C RISK**

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## Non-Life Risk Categories

- Underwriting risk
  - Premium risk
  - Reserve risk
- Lapse risk
  - A new type of P&C risk
  - Risk pre-up front profits not realized
- CAT risk

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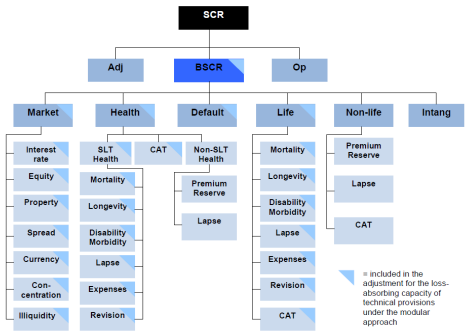


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SCR = One year 99.5% excess of mean
Example
Conceptual drivers
Standard Formula and Internal Model
SF Calibration

## RESERVE RISK

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## Solvency Capital Requirement for Unpaid Loss

- SCR = 99.5% Percentile excess above the mean
- One-year Risk
  - Retrospective look at Best Estimate

$$E[R(0)|t=1] = X(1) + E[R(1)|t=1]$$

  - R(t) = Unpaid loss at time t from start of runoff period.
  - X(y) = paid loss in year y (from runoff of Unpaid at t=0)
- Except for discounting, one-year risk would be measured by the change in estimated ultimate over one year

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## One-year reserve risk demo example

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|
| Scenario | Prob | Initial Case O/S | Initial IBNR | Initial Estimate Unpaid (3) + (4) | Yr 1 Paid | End of Yr 1 Case O/S | End of Yr 1 IBNR | End of Yr 1 Est'd Unpaid (7) + (8) | Retro Estimate Intial Unpaid (6) + (9) |
| 1 | 25% | $40 | $60 | $100 | $10 | $45 | $40 | $85 | $95 |
| 2 | 25% | $40 | $60 | $100 | $10 | $30 | $35 | $65 | $75 |
| 3 | 25% | $40 | $60 | $100 | $30 | $45 | $50 | $95 | $125 |
| 4 | 25% | $40 | $60 | $100 | $30 | $30 | $45 | $75 | $105 |
| Avg | | $40 | $60 | $100 | $20 | $38 | $43 | $80 | $100 |
| Stnd Dev | | | | | | | | | $18 |

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## One-year Risk Conceptual Drivers

- Volatility of ultimate unpaid
- Information obtained over one year
- Reserving methodology
  - Long-tail lines
    - Stable method often used over first few years
    - Implies 1 yr risk may be small for long-tail lobs over first few years.

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## Standard Formula – QIS5 and JWG

- EIOPA 12 LOBs
- Premium Risk and Reserve Risk CVs
- Lognormal distribution assumption
- Premium and Reserve correlations
- LOB Correlation matrix
- Volume measures
  - Credit for geographic diversity
- Lognormal assumption for aggregation
  - Questionable since sum of lognormals not lognormal
- Total SCR allocated using standalone LOB SCRs
- Same CVs and correlations for every year of run-off
  - Implausible as IBNR/Case OS evolve over run-off period

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## SF CVs for Premium and Reserve Risk

| SF CVs | Premium risk - gross | | Reserve risk - net | |
|---|---|---|---|---|
| Segment | QIS5 | JWG Rec | QIS5 | JWG Rec |
| Motor vehicle liability | 10.0% | 9.6% | 9.5% | 8.9% |
| Other motor | 7.0% | 8.2% | 10.0% | 8.0% |
| Marine, aviation & transport | 17.0% | 14.9% | 14.0% | 11.0% |
| Fire / property | 10.0% | 8.2% | 11.0% | 10.2% |
| General liability | 15.0% | 13.9% | 11.0% | 11.0% |
| Credit and suretyship | 21.5% | 11.7% | 19.0% | |
| Legal expenses | 6.5% | 6.5% | 9.0% | 12.3% |
| Assistance | 5.0% | 9.3% | 11.0% | |
| Miscellaneous financial loss | 13.0% | 12.8% | 15.0% | 20.0% |
| Medical expenses | 4.0% | 5.0% | 10.0% | 5.3% |
| Income protection | 8.5% | 8.5% | 14.0% | 13.9% |
| Workers' compensation | 5.5% | 8.0% | 11.0% | 11.4% |

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## LOB Reserve CV Calibration – QIS5 SF

- Heterogeneity – major differences in reserve risk within an EIOPA LOB due to limits, layers, coverages, and other factors. No one CV is right.
- Size of Risk – larger volume of homogeneous reserves should lead to lower process risk unless reserves are perfectly correlated. Same CV should not be used for all companies large and small.
- JWG
  - "… volatility factors for premium and reserve risks are typically impacted by the size of the portfolio (in the sense that with increasing size the volatility will typically decrease)"
  - "… the SCR will be too large for the larger portfolios and too small for the smaller ones".
- Rating Agencies formulas have similar issues due to use of fixed factors to derive reserve charges.

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Overview
Schedule P One Year Development and Ranges
Proposed methods

## INTERNAL MODEL FOR ONE-YEAR RESERVE RISK

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## Internal Model Overview

- Å Can be used in lieu of Standard Formula if approved by regulator
- Å Exact form or type of model not specified
  - ï Many companies using giant simulation models
- Å Requires significant amount of documentation
- Å Needs to satisfy “Use” test
- Å Ability to split business into smaller units
  - ï Better model of actual business
  - ï Reduces capital req’ment by reducing process risk depending on CVs and correlations selected

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## Use of Schedule P or Reserve Ranges

- Schedule P – One year Reserve Development Test
  - Posted reserves not “Best Estimates” -impact of cycle management
- Reserve Ranges for Ultimate Unpaid
  - Need to translate ranges into statement about distribution of unpaid loss
    - High- Low range of different types of estimates is not sufficient.
  - Going from ultimate to one-year risk.
- Application Issues
  - Assumptions needed to capture 99.5$^{th}$ percentile
  - May not be available at business unit level of detail
  - Industry data may not apply to single company

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## Methods for Modeling One-Year Reserve Risk

| Method | Author | Description |
|---|---|---|
| Variance of Chain Ladder estimates | Merz and Wutrich | Derived variance estimate of one-year claims development result assuming the distribution –free Chain Ladder algorithm is used to derive reserve estimates. Works off triangle of data. |
| Diagonal Simulation | Ohlsson and Lauzeningks | Simulate next diagonal and assume actuary-in-a- box sets reserves. Derive distribution of one- year claim development result. |
| Regression | Rehman and Klugman | Regression assuming lognormal distribution of ATA factors of estimated ultimate loss. Fitted parameters used to compute one year risk |
| Recognition Factor | ??? | Start with ultimate variability. Apply recognition factor to determine how much is recognized each year. |

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## Recognition – Variance Recognized

Å Pct of variance recognized by run-off year

| | |
|---|---|
| FV Best Estimate of Unpaid | 1,000 |
| Selected CV of Unpaid | 20.0% |
| Stnd Dev of of Unpaid | 200 |
| Variance of Unpaid | 40,000 |

| Run-off year | Initial FV Unpaid | Recognition Factor | Variance recognized | One-year Stnd Dev | One-year CV |
|---|---|---|---|---|---|
| 1 | 1,000 | 80% | 32,000 | 179 | 18% |
| 2 | 700 | 10% | 4,000 | 63 | 9% |
| 3 | 350 | 5% | 2,000 | 45 | 13% |
| 4 | 150 | 5% | 2,000 | 45 | 30% |
| Total | | 100% | 40,000 | 200 | |

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## Recognition – Trial Deviation Recognized

Å Simulation trial deviation – pct recognized by r

| | |
|---|---|
| FV Best Estimate of Unpaid | 1,000 |
| Simulation trial of Unpaid | 1,500 |
| Deviation of trial | 500 |

| Run-off year | Recognition Factor | Deviation recognized | Retro Unpaid |
|---|---|---|---|
| 1 | 80% | 400 | 1,400 |
| 2 | 10% | 50 | 1,450 |
| 3 | 5% | 25 | 1,475 |
| 4 | 5% | 25 | 1,500 |
| Total | 100% | 500 | |

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## Recognition Method Concerns

- Terminology – What is being Recognized?
  - All that can reasonably be recognized each year given incompleteness of knowledge at each evaluation
    - Change in the Best Estimate
  - Not how much management decides it will recognize of a revised estimate of ultimate loss
- Selection of Recognition Factors
  - No empirical data
    - Posted reserves (including IBNR) not Best Estimates
  - Ad hoc factors not consistent with reserve run-off?

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## PROPOSED PRACTICAL METHOD

Overview
Steps
Proposed methods

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## Proposed Practical Method Overview

Å CVs for one-year risk vary by year of run-off
Å CVs depend on mix of Case O/S vs IBNR
  ï IBNR relatively more risky than Case O/S
Å One-year risk derived from ultimate unpaid risk
Å Comparison with other proposed methods
  ï More sophisticated version of Standard Formula
  ï A form of recognition factor method with a set of systematically derived factors
  ï No regressions or simulations needed
Å Handles new, small volume, or high sev business

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## Step 1 – Split Variance into Case vs IBNR Components

- Select CV of ultimate unpaid
- Select Ratio of CV of IBNR to CV of Case O/S
- Use existing balances to decompose variance into Case O/S and IBNR variance components
- Compute CVs per unit of Case O/S and IBNR

| | | | |
|---|---|---|---|
| (1) | CY Year End | 2011 | |
| (2) | Mean FV of Ult Unpaid Loss | 9,727 | Ex 3 Tbl 1 |
| (3) | Case O/S | 3,789 | Ex 3 Tbl 5 |
| (4) | Mean IBNR | 5,938 | Ex 3 Tbl 3 |
| (5) | CV of Ultimate Unpaid Loss | 20.0% | User selection |
| (6) | k = CV of IBNR over CV of Case O/S | 150.0% | User selection |
| (7) | Stnd Dev of Ultimate Unpaid | 1,945 | (2)*(5) |
| (8) | Case OS CV Coefficient | 0.201 | $\{(7)^2/[(3)^2+((6)*(4))^2]\}^{.5}$ |
| (9) | IBNR CV Coefficient | 0.301 | (8)*(6) |

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## Step 2 – Project Reserve Variance by Run-off Year

- Project Case O/S and IBNR for each year of run-off
- Apply CV factors and square to get Case O/S and IBNR variance components
- Sum to get projected variance of unpaid by runoff year

| (1) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|
| CY | Case O/S | IBNR | Total Unpaid (3)+(4) | Stnd Dev from Case O/S $(3)*CV_{COS}$ | Stnd Dev from IBNR $(4)*CV_{IBNR}$ | Variance $(6)^2+(7)^2$ |
| 2011 | 3,789 | 5,938 | 9,727 | 762 | 1,790 | 3,784,581 |
| 2012 | 3,609 | 3,732 | 7,342 | 725 | 1,125 | 1,792,267 |
| 2013 | 3,168 | 2,057 | 5,226 | 637 | 620 | 790,176 |
| 2014 | 2,051 | 1,221 | 3,272 | 412 | 368 | 305,519 |
| 2015 | 1,001 | 704 | 1,706 | 201 | 212 | 85,608 |

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## Step 3 – Derive One-Year Variances and CVs

- Evolution of Ultimate Variance Estimates equals One-year Risk under "Strong BF" assumptions

| (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|
| CY | Ultimate Variance | One-Year Variance Δ(2) | One-Year Stnd Dev $(3)^{1/2}$ | One-Year CV (4)/E[R] |
| 2011 | 3,784,581 | 1,992,314 | 1,411 | 0.145 |
| 2012 | 1,792,267 | 1,002,092 | 1,001 | 0.136 |
| 2013 | 790,176 | 484,657 | 696 | 0.133 |

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## One –year Risk = Δ Ultimate Risk Estimates

- Evolution of Ultimate Variance Estimates equals One-year Risk under "Strong BF" assumptions


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## Step 4 – Compute Standalone SCRs for each run-off year on Full Value Reserves

Å Similar to Standard Formula only CVs vary by year of run-off

| (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|
| One-Year CV (4)/E[R] | σ | μ | Mean E[R] | Full Value 99.50th p'ctile | Full Value SCR (9) -(8) |
| 0.145 | 0.14 | 9.17 | 9,727 | 13,962 | 4,235 |
| 0.136 | 0.14 | 8.89 | 7,342 | 10,319 | 2,977 |
| 0.133 | 0.13 | 8.55 | 5,226 | 7,289 | 2,064 |
| Percentage for SCR Percentile | | | | | 99.5% |
| Standard Normal Percentile | | | | | 2.576 |
| (6) | $\sigma = [\ln(1+CV^2)]^{1/2}$ | | | | |
| (7) | $\mu = \ln(E[R]) - 1/2\ \sigma^2$ | | | | |
| (8) | Mean = $E[R] = \exp(\mu + 1/2\ \sigma^2)$ | | | | |
| (9) | 99.5th percentile = $\exp(\mu + 2.576\ \sigma)$ | | | | |

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## Step 5 – Compute PV Cost of Capital

Å Apply SCR factor to Discounted Reserves to get SCR
Å Multiply by Cost-of-Capital rate (6.0%)
Å Discount Cost-of-Capital

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|
| CY | Paid Loss from Ex 3 Table 2 | FV Unpaid Loss from Ex 3 Table 1 | PV Unpaid Loss (3) * Ex 8 Col 5 | SCR Factor from Ex 6 | SCR (5)*(4) | Cost of Capital CocRate *(6) | Discounted Cost of Capital (7) * Ex 8 Col 5 |
| 2011 | - | 9,727 | 9,199 | 43.5% | 4,005 | 240 | 238 |
| 2012 | 2,385 | 7,342 | 7,020 | 40.5% | 2,847 | 171 | 167 |
| 2013 | 2,116 | 5,226 | 5,042 | 39.5% | 1,991 | 119 | 114 |

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## Step 6 – Compute Technical Provision using Standalone Risk Margin

Å Standalone Risk Margin is sum of Discounted Cost-of Capital applied to Standalone SCR

| | | | |
|---|---|---|---|
| (1) | Mean of Full Value Ult Unpaid Loss | 9,727 | Ex 7 Col 3 |
| (2) | Mean of Discounted Unpaid Loss | 9,199 | Ex 7 Col 4 |
| (3) | Effect of Discount | (528) | (2) - (1) |
| (4) | Risk Margin | 431 | Ex 7 Col 8 |
| (5) | **Technical Provision** | **9,631** | (1) + (3) + (4) |

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## Advantages of Proposed Method

Å Conceptual
- ï Only method to make use of our knowledge of evolution of Case vs IBNR reserve mix.
- ï Can be framed as recognition factor approach with methodical selection of recognition factors
- ï Systematically relates ultimate risk to one-year views

Å Practical
- ï Computationally straightforward – only slightly more complicated than the Standard Formula
- ï Works even if no triangle is available
- ï No regressions or simulations required

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## Conclusions

Å US actuaries should be aware of Solvency II

Å One-year risk concept is founded on change in retrospective Best Estimates
- ï Some adjustment needed before using movement in posted reserves as an estimator for one-year risk

Å Internal models will lower required reserve capital

Å Other one-year risk methods available
- ï some require well-behaved data
- ï others use many assumptions

Å Proposed method is practical and worth having in the tool box

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## Appendix: US Regulator Comments

- CT Commissioner Leonardi: Aug 2011
  - "… well-intended but untested European regulatory changes, known as "Solvency II" … could weaken consumer protections …"
  - "Solvency II is a much-needed effort to modernize an …outmoded European regulatory regime, but it has been aggressively marketed by some as the 'be all and end all' of insurance regulation."
  - "…any equivalence process must respect the different legal and regulatory systems that exist around the globe."
- NAIC CEO Vaughn Nov 2011
  - " Our system is one that we're quite comfortable with… equivalence should be assessed on an outcomes basis. On that basis, we should be found equivalent."
- NAIC President McCarty Mar 2012, May 2012
  - " We're not interested in taking our system and putting it through the ..analysis undertaken by… Switzerland, Bermuda and Japan"
  - "No disrespect to the EU but …at best, they would want to make a comparison to a system [Solvency II] that isn't in place yet. It's a theoretical system … measured up against a system that's been tried and tested …. It's kind of silly to even consider that an equivalence process."

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