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 Min Capital Req'ment (MCR) Solvency Capital Req'ment (SCR)	Governance, risk management and required functions ORSA Supervisory review process	SFCR and RSR Disclosure Transparency Support of supervision through market mechanisms
Market –consistent valuation Risk-based requirements	Business governance Internal Control processes Risk-based supervision	Disclosure 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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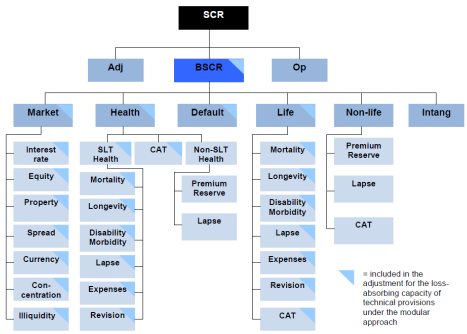

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SCR = One year 99.5% excess of mean
Example
Conceptual drivers
Standard Formula and Internal Model
SF Calibration

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 99.5th 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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