More information will be available at

CLRS – 2012

Insureware's Hospitality Suite

Sheraton Denver Downtown Hotel, Denver, CO

7:00pm-10:30pm

Wednesday September 5th

Thursday September 6th

(Also learn about the Bootstrap technique for testing validity of a model or method)

Insureware 0

Introduction and Summary / 1

- We provide our solution to the Solvency II one-year risk horizon, SCR, Technical Provisions (TP) (Fair Value Liabilities), Market Value Margins (Risk Margins) for the aggregate of long tail LOBs
- The solution is non-recursive, non-circular, tractable and satisfies all the directives (requirements)
- IFRS4 requirements in respect of fungibility and ring-fencing is discussed
- Three types of correlations between LOBs
- How do we know if two LOBs have the same economic drivers?
- Is the economic inflation a principal driver of long tail liability calendar year trends?

Insureware 1

Introduction and Summary / 2

- Which probability distributions are required to compute the various risk measures for the aggregate of multiple LOBs?
- VaRs and T-VaRs
- Process Variance versus Parameter Uncertainty
- Reserve risk, underwriting risk and the combined risk
- Risk Capital allocation by LOB and calendar year
- The ultimate year risk horizon- conceptually much simpler
- Calendar year Payment stream probability distributions
  - what are the drivers?

Insureware 2

Solvency II one-year risk horizon

- Solvency Capital Requirement (SCR)
- Market Value Margins (Risk Margins)
- Technical Provisions (Fair Value of Liabilities)

Under what (three) conditions is it necessary to compute these metrics?

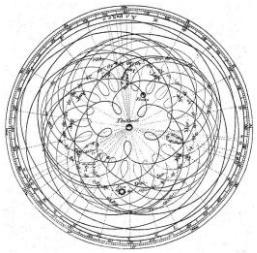
What is the cornerstone of Solvency II?

Consistency of metrics from year to year on updating?

What are the 'causes' of distress in the first year such that losses reach 99.5 percentile of the loss distribution?

Which are the LOBs that most contribute to distress?

Most solutions to SII and IFRS4 metrics for long tail liabilities are like the Ptolemaic system



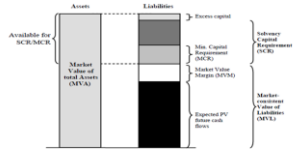
If you look at things in the right way everything becomes simpler

Copernican Solution

Example of risk diversification of SCR and Risk Margins

- SII metrics for the aggregate of real life six LOBs compared with SII metrics for the most volatile LOB to illustrate amongst other things risk diversification of SCR and (MVM (Risk Margin) component) of TP (Fair Value of Liabilities).
- Undiscounted reserves for the aggregate of six LOBs
  = (approx) Technical Provisions +Solvency Capital Requirement (SCR)
  = total in Economic Balance Sheet,
  using a risk free rate of 4% and a spread of 6%.
- No need for additional capital in this example due to risk diversification SCR and MVM.
- Conditions for consistent estimates of prior accident year ultimates and SII risk measures on updating?
- We will explain how to avoid model error "distress".

Solvency II – Economic Balance Sheet



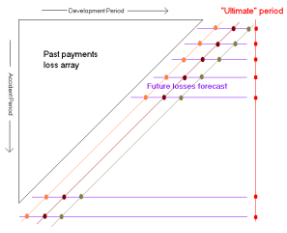
Solvency II aims to establish a solvency regime that is better matched to the true risks of an insurance company

Ann Hagen in "Solvency II : Brave new world:

"Doing the job

Under Solvency II, the way that work is carried out will change. For example, Solvency II is likely to require different actuarial techniques from the ones currently used. Technical provisions will be estimated as a probability-weighted average of expected future cash flows, taking into account the time-value of money and including a risk margin. Many of us are estimating claims reserves using traditional deterministic actuarial techniques, primarily relying on incurred claims data. Under Solvency II, not only will we need to discount these reserve estimates, requiring projected payment patterns, we will also need to demonstrate a deep understanding of the uncertainty of those reserves. We will additionally be required to apply the same approach to evaluating unexpired risk liabilities currently allowed for in the unearned premium reserves."

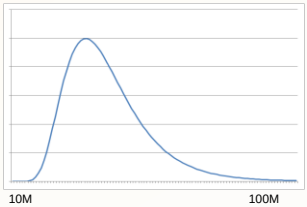
Actual payments are made by calendar year



Summing future losses along the calendar year axis produces projections of the cash-flow, and the actual calls on the reserves. This is the dimension in which solvency issues arise.

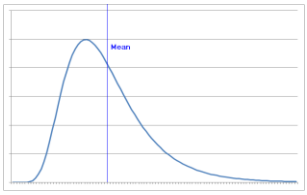
Using cell distributions and correlations we can compute the distributions for each future year's cash flow.

Risk Capital: VaRs and T-VaRs (1)



Let's look at a typical forecast paid losses distribution. We expect to see a skew to the right, and more or less heavy tails. This could the ultimate losses for a set of accident years, or the forecast losses for a single calendar year. We'll set the range as 10M-100M.

Risk Capital: VaRs and T-VaRs (2)

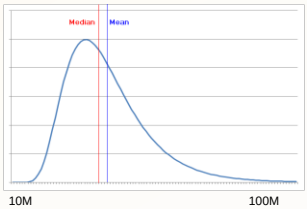


The mean is, by definition, the "probability-weighted average of future outcomes". In this example Mean = 40.0M

Solvency II: "The Best Estimate shall correspond to the probability-weighted average of future cash-flows, taking into account the value of money (expected present value of future cash-flows, using the relevant risk-free interest rate term structure.)"

To compute this we need to have the means by calendar period, as well as a projection of interest rates. Provision must be made for losses above the mean.

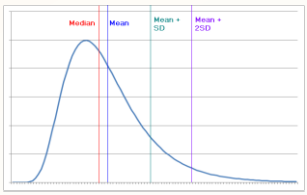
Risk Capital: VaRs and T-VaRs (3)



Mean = 40M
Median = 37M

In this example the mean is at the 59th percentile. That means that there is a 41% chance that the losses will come in above the mean. Since the right tail of the distribution is long, the loss may be much higher than the mean.

Risk Capital: VaRs and T-VaRs (4)



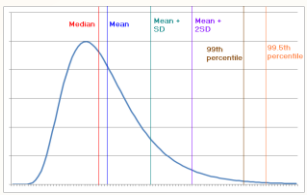
SD = 13.16M

Mean+SD = 86.5th percentile

Mean + 2SD = 95.8th percentile

A risk measure is a measure of expected variability, and this is usually taken to be the Standard Deviation. However for a skewed, non-normal distribution it is not clear what we are measuring. In this example the Mean + 2SD is exceeded more than 4% of the time. (For the Normal distribution this percentage is 2.5%.)

Risk Capital: VaRs and T-VaRs (5)

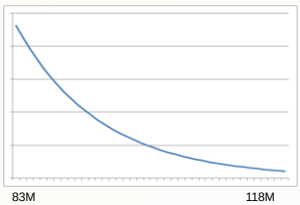


99th percentile = 82.9M

99.5th percentile = 90.1M

The percentiles of the distribution provide a measure of risk that is uniform, in that it has the same practical meaning for any distribution. The Value at Risk (VaR) codifies this concept. The VaR at 99% is the amount by which the 99th percentile exceeds the reserve (reserve = best estimate is usually equal to the mean) and corresponds to the minimum amount lost if this quantile was reached.

Risk Capital: V@Rs and T-V@Rs (6)



99th p'tile = 82.9M

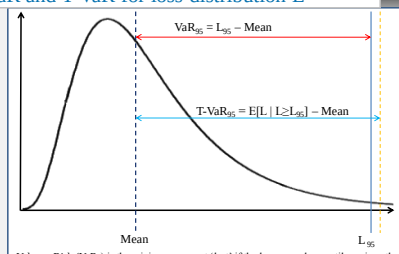
99.5th p'tile = 90.1M

$TV@R_{99\%}$ = 93.1M

$TV@R_{99.5\%}$ = 101.5M

If we are thinking about the possibility of losses exceeding a high threshold such as the 99th percentile then we need to look more closely at the tail of the distribution. Arguably we should consider the mean loss *given that the loss exceeds the 99th percentile*, this is the Tail-V@R (T-V@R).

VaR and T-VaR for loss distribution L



Value at Risk (VaR_q) is the minimum amount 'lost' if the loss exceeds quantile q given the provision (set to the mean in the diagram above). At the 95% quantile (displayed above) there is a 5% chance of losing at least VaR.

Tail-Value at Risk ($T\text{-}VaR_q$) is the average amount 'lost' if the loss exceeds quantile q.

Risk Capital: VaRs and T-VaRs (7)

The T-VaR at a given percentile is often significantly higher than the VaR at the same percentile. The "heavier the tail" the greater the difference.
The T-VaR has the desirable property for any risk measure of subadditivity:

$$T\text{-}VaR_q(A+B) \leq T\text{-}VaR_q(A) + T\text{-}VaR_q(B)$$

With equality when A and B are perfectly tail-correlated

Solvency II one-year risk horizon: satisfies three conditions - Summary of decomposing the directives- What are the basic elements?

- Risk Capital is raised at the beginning of each year and any unused capital is released at the end of the year;
- The analyses are conditional on the first (next) calendar year being in distress (99.5%);
- At the end of the first year in distress, the balance sheet can be "restored" in such away that the company has sufficient technical provisions (fair value of liabilities) to continue business or to transfer the liabilities to another risk bearing entity.

An important consideration is that **fungibility** by calendar year is only in the forward direction

One-Year Risk Horizon

- The cost of raising the risk capital, the **Market Value Margin (MVM)** or premium on the risk capital, also known as the **Risk Margin** is paid to the capital providers at the end of each year along with any unused risk capital.
- The Best Estimate of Liability (BEL) is the mean (suitably discounted)
- The **Technical Provision** or **Fair Value** = BEL +MVM.
- For calendar year k we have BEL(k) and MVM(k).

BELs and MVMs are additive.

The Concept of Risk - The SCR

As detailed in the **Insurance ERM analysis of Solvency II**:

GREAT WEB SITE- decomposes the directives.

"The fair value balance sheet is one of the cornerstones of Solvency II, and its impact is not restricted only to the calculation of fair value assets and liabilities. The concept of market value margin (MVM), and the related one-year risk approach in the calculation of the solvency capital requirement (SCR), find their origin in this fair value driven approach: re/insurance companies should have enough capital on their balance sheet to cover the risks that can emerge over a 12-month timeframe, and allow for a (theoretical) transfer of all (contractual) liabilities at the end of this balance-sheet period. This means that companies have to be able to calculate the impact of such shocks on their end-of-year balance sheets, and value these in such a way that they can be transferred to a third party."

The One-Year Risk Horizon

To satisfy Solvency II one-year risk horizon the Economic Balance Sheet at inception must have sufficient SCR and Fair Value to withstand a first (next) calendar year in distress at 99.5%, and be able to be restored to its Fair Value at the beginning of the second year.

Fair Value= BEL + Market Value Margin (Risk Margin)

It is also assumed that Risk Capital is raised from the capital providers at the beginning of each year and released if not fully used at the end of the year.

Definition of SCR

The above extracts lead to the following definition: the SCR for the one-year risk horizon is the Value-at-Risk for the first year plus the change (increase) in technical provisions (TP), equivalently, fair value, in the subsequent years (suitably discounted), **conditional** on the first year being in distress.

SCR = VaR99.5%(1) + ΔTP(2) + ΔTP(3) + ... + ΔTP(n),

where n is the limit of run-off.

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The Concept of Risk Horizon Perspective

Quantification Requirements- What do we need to compute SII metrics?

- For the calculation of the **Technical Provisions**, **Market Value Margins** and **SCR** for both the **One-year Risk Horizon** (and **Ultimate Year Risk Horizon**) for the aggregate of all long-tail LOB's and each LOB separately the following critical information is required:
  - Probability distributions of paid losses (liability stream) by **calendar year** (k =1,..,n) and their correlations, for each LOB and the **aggregate** of all LOB's
  - Probability distributions of total reserves for each LOB and the aggregate of all LOB's.
  - Probability distributions of the aggregate paid losses from calendar year k to calendar year n for each LOB and the aggregate of all LOB's. This is required for each k ranging from 1 to n, where complete run-off is achieved at the ultimate calendar year n
  - Conditional Probability distributions, conditional on the first (next) calendar year being in "distress".
- Armed with these distributions **any risk measure can be computed**, including VaR(k) for the paid losses (total loss) in calendar year k; and **Market Value Margins**, **Technical Provisions** and VaRs conditional on the first year in distress, for each LOB and the aggregate of all LOB's.

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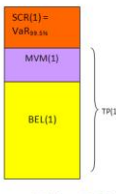
Risk Capital – One Year risk Horizon

Simplest Case: Only One Year Runoff



L_1 = projected losses for the year. This is a random variable.

$BEL(1) = {}^{E(L_1)}/_{(1+d)^{0.5}}$ Where d = interest rate. Losses are paid uniformly through year, so we discount for half a year.

$SCR(1) = VaR_{99.5\%}(L_1)$, i.e. $\Pr(L_1 \le E(L_1) + SCR(1)) = 0.995$

MVM(1) is the cost incurred in having risk fund of *SCR(1)* available for the year. It is paid to capital provider at end of year and so is discounted by a full year.

$MVM(1) = \frac{SCR(1)\times i}{(1+d)}$, if the interest on the risk fund is paid directly to capital provider, or $MVM(1) = \frac{SCR(1)\times(i+d)}{(1+d)}$, otherwise.

$TP(1) = BEL(1) + MVM(1)$. This is the Technical Provision and must be held in company own funds.

We will also let, *PV(k;d)*, or *PV(k)* be used to abbreviate the Present Value factor ${}^{1}/_{(1+d)^k}$

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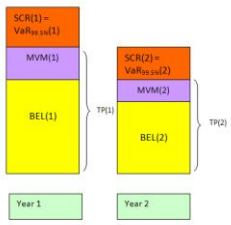
Risk Capital – One Year risk Horizon

Next Simplest Case: Two Year runoff, No correlation



$$BEL(1) = E(L_1) * PV(0.5)$$

$$BEL(2) = E(L_2) * PV(1.5)$$

$$MVM(1) = VaR_{99.5\%}(1) * s * PV(1)$$

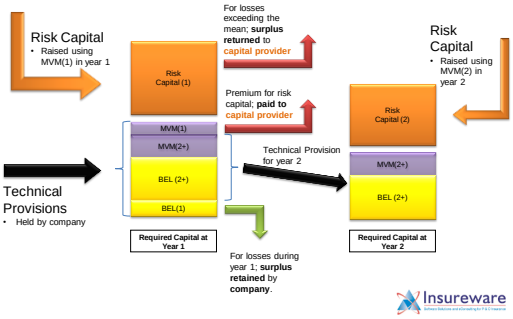
$$MVM(2) = VaR_{99.5\%}(2) * s * PV(2)$$

The Technical Provision (TP) at inception is the sum of the individual year TPs:

$$TP = TP(1) + TP(2)$$

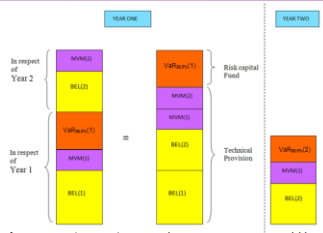
This amount needs to be available in company own funds to ensure that losses can be met up to a 99.5% or 1/200 risk level in each year. Aggregate losses up to the value of the mean are met out of *BEL* funds, excess losses are met from the *SCR* fund, access to which is financed by *MVM*.

Capital flow: Uncorrelated future calendar years



Risk Capital – One Year risk Horizon

Uncorrelated future calendar years



Two-year picture of accounts: In year 1 we require reserves to meet paid loss liabilities for years 1 and 2 and we also need to able to fund the cost of access to the risk capital funds for years 1 and 2, however we only need access to the year 1 risk fund. When year 2 begins our accounts reset, since any cost over-runs from year 1 were paid out of the risk fund and do not degrade our prepared reserves for year 2. *Provided the loss over-run is below* RC(1) = $VaR_{99.5}(L_1)$.

Risk Capital – One Year Horizon

- This is fine, except for one thing:

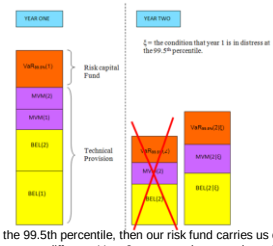
  What if the distribution for the losses in year 2 has changed conditional on the losses in year one?

- Simply put, the previous picture assumes there is no correlation between the distributions for years 1 and 2. In other words, whatever the outcome observed after year 1 we are going to remain fixed on our previous course, full steam ahead

  Typically calendar year distributions are positively correlated.

  The correlations are driven by parameter uncertainty.

Risk Capital – One Year Horizon



If year 1 is in distress at the 99.5th percentile, then our risk fund carries us over into year 2, but the conditional distributions are now different. Year 2 now must be re-evaluated in the light of conditional distributions and these increase the size of the BEL and the MVM, the cost of holding the risk fund. We need to include these adjustments in the year 1 risk fund.

Two-year runoff with first year in distress

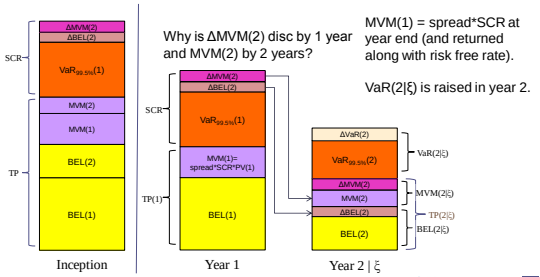
Let ξ = Year 1 in distress

VaR(1) is consumed.

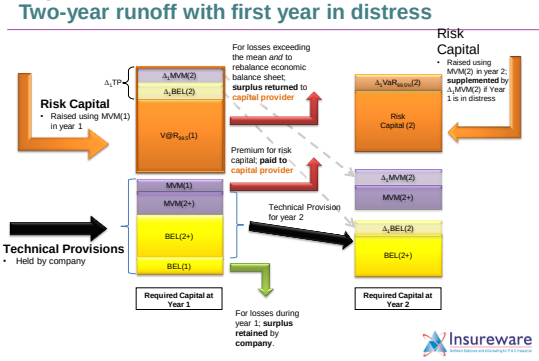
MVM(1) = spread*SCR at year end (and returned along with risk free rate).

VaR(2|ξ) is raised in year 2.

Why is ΔMVM(2) disc by 1 year and MVM(2) by 2 years?



Capital flow: Two-year runoff with first year in distress



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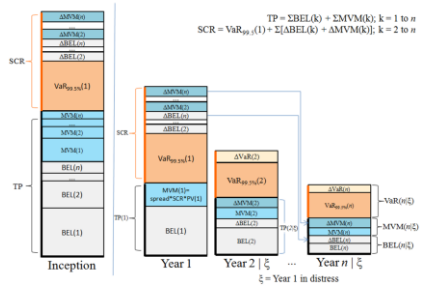
N-year run-off (Correlated)



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Two-year runoff with first year in distress

- There is sufficient risk capital SCR and Fair Value to withstand a distressed first year at 99.5% confidence and restore Fair Value at beginning of the second year.
- An important consideration is that **fungibility** by calendar year is only in the forward direction.

  Consistent metrics on updating from year to year- under what conditions?

  See also E&Y GNAIE paper (2007)

"**Market Value Margins for Insurance Liabilities in Financial Reporting and Solvency Applications , October 1, 2007**"

Full solution – see last slide.

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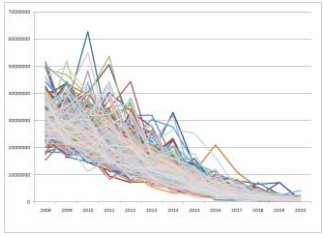
What Causes Distress in the first year?

1. "Inflation parameters" going forward. For example under the assumption 10%+_3%, a 60% trend is distress.
2. Process volatility- large values from the tail of lognormal distributions.
3. Combinations of 1. and 2.
4. Which LOBs contribute more to distress than others?

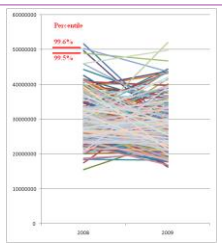
- Process volatility
- Parameter uncertainty
- "Size" of LOB

Conditional Statistics from Simulations



Begin with a large number of simulations of the entire forecast table. This provides an equal number of sample paths through all future calendar years.

Conditional Statistics from Simulations



Determine the sample paths corresponding to the distress scenario. If this is "next year at 99.5th percentile", then these paths belong in the [99.5, 99.6) order interval.

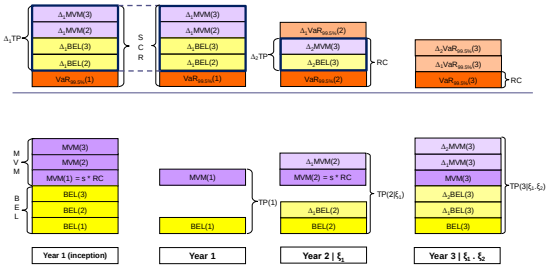
Conditional Statistics from Simulations

Restricting attention to only these sample paths we can then calculate any conditional statistic, such as BEL(k)|ξ, MVM(k)|ξ, VaR(k)|ξ etc.

Multiple distress years

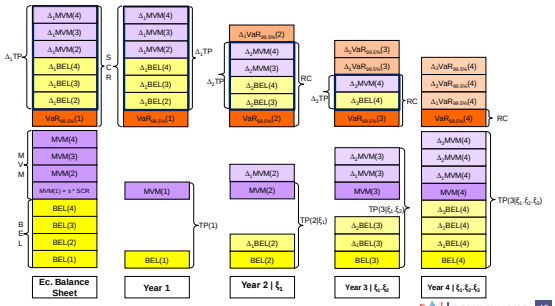
- In the previous solution, only the first year in distress is considered.
- What if receiver also subscribes to Solvency II?
- Fair value should include allowance for subsequent years also being in distress.
- One way to allow for this is to analyse subsequent years being in distress irrespective of the losses observed in previous years.

Three Year Run-off with One-Year Risk Horizon All-Inclusive, risk-free rate is 0.



Three years in run-off with One-Year Risk Horizon				
RC	ΔTP	$\Delta_1 MVM(3) = s * \Delta_1 VaR_{99.5\%}(3) * PV(2)$		
		$\Delta_1 MVM(2) = s * \Delta_1 VaR_{99.5\%}(2) * PV(1)$	$\Delta_1 VaR_{99.5}(2)$	
		$\Delta_1 BEL(3) = (E[L(3)\|\xi_1] - E[L(3)]) * PV(1.5)$	$\Delta_2 MVM(3) = s * \Delta_2 VaR_{99.5\%}(3\|\xi_2) * PV(1)$	$\Delta_2 VaR_{99.5}(3)$
		$\Delta_1 BEL(2) = (E[L(2)\|\xi_1] - E[L(2)]) * PV(0.5)$	$\Delta_2 BEL(3) = (E[L(3)\|\xi_2] - E[L(3)]) * PV(0.5)$	$\Delta_1 VaR_{99.5}(3)$
	VaR	$VaR_{99.5}(1)$	$VaR_{99.5}(2)$	$VaR_{99.5}(3)$
TP	MVM	$MVM(3) = s * VaR_{99.5}(3) * PV(3)$		$\Delta_2 MVM(3) = s * \Delta_2 VaR_{99.5\%}(3) * PV(1)$
		$MVM(2) = s * RC(2) * PV(2)$	$\Delta_1 MVM(2) = s * \Delta_1 VaR_{99.5\%}(2) * PV(1)$	$\Delta_1 MVM(3) = s * \Delta_1 VaR_{99.5\%}(3) * PV(1)$
		$MVM(1) = s * RC(1) * PV(1)$	$MVM(2) = s * RC(2) * PV(1)$	$MVM(3) = s * VaR_{99.5}(3) * PV(1)$
	BEL	$BEL(3) = E[L(3)]*PV(2.5)$		$\Delta_2 BEL(3) = (E[L(3)\|\xi_2] - E[L(3)]) * PV(0.5)$
		$BEL(2) = E[L(2)]*PV(1.5)$	$\Delta_1 BEL(2) = (E[L(2)\|\xi_1] - E[L(2)]) * PV(0.5)$	$\Delta_1 BEL(3) = (E[L(3)\|\xi_1] - E[L(3)]) * PV(0.5)$
		$BEL(1) = E[L(1)]*PV(0.5)$	$BEL(2) = E[L(2)] * PV(0.5)$	$BEL(3) = E[L(3)] * PV(0.5)$
		Inception	Year 2 | ξ_1	Year 3 | ξ_1 - ξ_2

Four Year Run-off with One-Year Risk Horizon All-Inclusive, risk-free rate is 0.



A single composite model for two long tail LOBs

- Two LOBs written by the same company rarely have the same trend structure (including in the calendar year direction) and often process (volatility) correlation is either zero or very low. Reserve distribution correlation is often zero and if significant quite low.
- No two companies are the same in respect of trend structure, and process (volatility) correlation is often zero (for the 'same' LOB).
- No company is the same as the industry, unless it is a very large proportion of the industry.

- **All the above are demonstrated with real life data**.

A single composite model for all long tail LOBs

- For each LOB the corresponding model measures the volatility in the LOB with easily interpretable parameters.
- The model has descriptors that describe the risk characteristics of the data.
- Simulated triangles (including Bootstrap triangles) are indistinguishable from the real data in respect of statistical features.
- Forecast assumptions going forward are explicit and auditable.
- A single composite model also measures the correlations between the LOBs.
- There are three types of correlations between LOBs leading to reserve distribution correlation.

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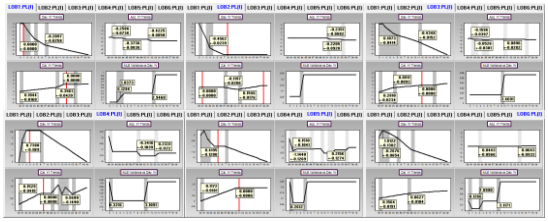
SII metrics for the aggregate of six LOBs compared with SII metrics for the most volatile LOB- risk diversification of SCR and TP

Trends and volatility are unique to each LOB

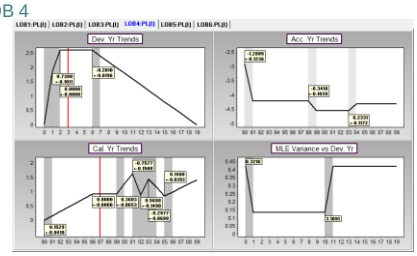
- LOB4 is the most volatile of the LOBs



Insureware 43

SII metrics for the aggregate of six LOBs compared with SII metrics for the most volatile LOB- risk diversification of SCR and TP

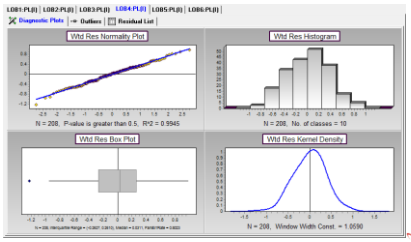
- Model for LOB 4



Insureware 44

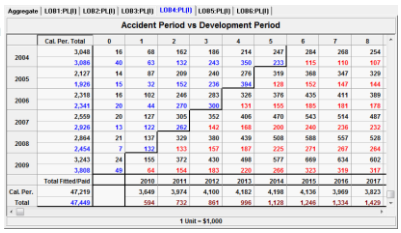
SII metrics for the aggregate of six LOBs compared with SII metrics for the most volatile LOB- risk diversification of SCR and TP

- Diagnostics for LOB4 illustrating normality satisfied. But process variance (volatility) is high



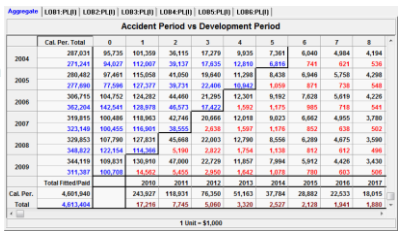
SII metrics for the aggregate of six LOBs compared with SII metrics for the most volatile LOB- risk diversification of SCR and TP

- Forecast table for LOB4- **Note there is no analytical closed form for the sum of lognormals**
- Black:
  - Fitted mean
- Blue:
  - Observed
- Red:
  - Standard Deviation (log-normal)



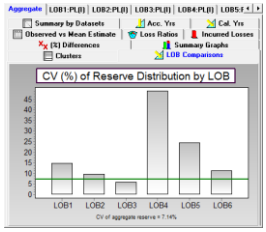
SII metrics for the aggregate of six LOBs compared with SII metrics for the most volatile LOB- risk diversification of SCR and TP

- Forecast table for the aggregate of the six LOBs
- Black:
  - Fitted mean
- Blue:
  - Observed
- Red:
  - Standard Deviation



SII metrics for the aggregate of six LOBs compared with SII metrics for the most volatile LOB- risk diversification of SCR and TP

- LOB4 is the most volatile of the six LOBs (CV=49%)
- CV of Aggregate is 7.14%
- Substantially more Solvency II risk capital required if LOB4 was written on its own. It has a CV of 49%



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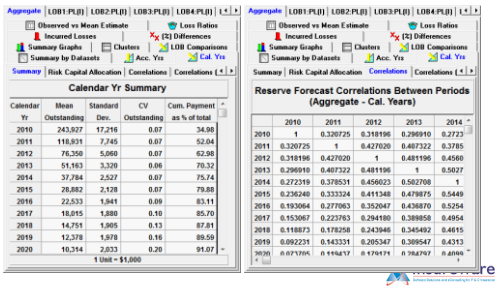
Liability stream by calendar year and calendar year correlations for the Aggregate of the six LOBs

52% of reserves paid within two years (2011).
Calendar year correlations low and reduce quickly



Calendar Yr Summary

Calendar Yr	Mean Outstanding	Standard Dev.	CV Outstanding	Cum. Payment as % of total
2010	243,927	17,216	0.07	34.98
2011	118,931	7,745	0.07	52.04
2012	76,350	5,060	0.07	62.98
2013	51,163	3,320	0.06	70.32
2014	37,784	2,527	0.07	75.74
2015	28,882	2,128	0.07	79.88
2016	22,533	1,941	0.09	83.11
2017	18,015	1,880	0.10	85.70
2018	14,751	1,905	0.13	87.81
2019	12,378	1,978	0.16	89.59
2020	10,314	2,033	0.20	91.07

1 Unit = $1,000

Reserve Forecast Correlations Between Periods (Aggregate - Cal. Years)

	2010	2011	2012	2013	2014
2010	1	0.320725	0.318196	0.296910	0.2723
2011	0.320725	1	0.427020	0.407322	0.3785
2012	0.318196	0.427020	1	0.481196	0.4560
2013	0.296910	0.407322	0.481196	1	0.5027
2014	0.272319	0.378531	0.456023	0.502708	1
2015	0.236240	0.333324	0.411348	0.479875	0.5449
2016	0.193064	0.277063	0.352047	0.436870	0.5254
2017	0.153067	0.223763	0.294180	0.389858	0.4954
2018	0.118873	0.178258	0.243946	0.345492	0.4615
2019	0.092231	0.143331	0.205347	0.309547	0.4313

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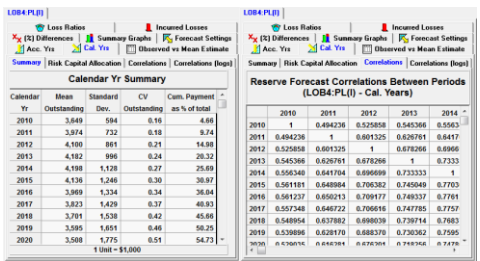
Liability stream by calendar year and calendar year correlations for LOB4- long tail with high correlations

50% of reserves not paid before 2019 (10 years hence).
Calendar year correlations high and do not dampen.



Calendar Yr Summary

Calendar Yr	Mean Outstanding	Standard Dev.	CV Outstanding	Cum. Payment as % of total
2010	3,649	594	0.16	4.66
2011	3,974	732	0.18	9.74
2012	4,100	861	0.21	14.98
2013	4,182	996	0.24	20.32
2014	4,198	1,128	0.27	25.69
2015	4,136	1,246	0.30	30.97
2016	3,969	1,334	0.34	36.04
2017	3,823	1,429	0.37	40.93
2018	3,701	1,538	0.42	45.66
2019	3,595	1,651	0.46	50.25
2020	3,508	1,775	0.51	54.73

1 Unit = $1,000

Reserve Forecast Correlations Between Periods (LOB4:PL(I) - Cal. Years)

	2010	2011	2012	2013	2014
2010	1	0.494236	0.525858	0.545366	0.5563
2011	0.494236	1	0.601325	0.626761	0.6417
2012	0.525858	0.601325	1	0.678266	0.6966
2013	0.545366	0.626761	0.678266	1	0.7333
2014	0.556348	0.641704	0.696699	0.733333	1
2015	0.561181	0.648984	0.706382	0.745049	0.7703
2016	0.561237	0.650213	0.709177	0.749337	0.7761
2017	0.557348	0.646722	0.706616	0.747785	0.7757
2018	0.548954	0.637882	0.698039	0.739714	0.7683
2019	0.539896	0.628170	0.688370	0.730362	0.7595

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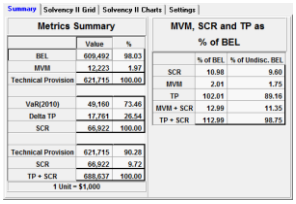
One-year risk horizon – one year in distress Aggregate of six LOBs

- Aggregate Solvency II capital required (**Technical Provisions + SCR**) is the same as undiscounted BEL
- Bulk of SCR is the VaR for next year (2010)


Summary | Solvency II Grid | Solvency II Charts | Settings

Metrics Summary

	Value	%
BEL	609,492	98.03
MVM	12,223	1.97
Technical Provision	621,715	100.00
VaR(2010)	49,160	73.46
Delta TP	17,761	26.54
SCR	66,922	100.00
Technical Provision	621,715	90.28
SCR	66,922	9.72
TP + SCR	688,637	100.00

1 Unit = $1,000

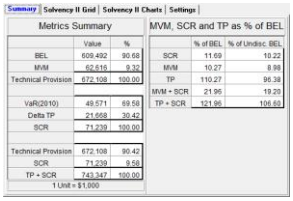
MVM, SCR and TP as % of BEL

	% of BEL	% of Undisc. BEL
SCR	10.98	9.60
MVM	2.01	1.75
TP	102.01	89.16
MVM + SCR	12.99	11.35
TP + SCR	112.99	98.75

- All calculations assume: risk free = 4% and spread = 6%

One-year risk horizon – all years in distress Aggregate of six LOBs

- Aggregate Solvency II capital required (**Technical Provisions + SCR**) is 6.6% higher than undiscounted BEL.
- Main difference MVM
- Bulk of SCR is the VaR for next year (2010)
- All calculations assume: risk free = 4% and spread = 6%


Summary | Solvency II Grid | Solvency II Charts | Settings

Metrics Summary

	Value	%
BEL	609,492	90.68
MVM	62,616	9.32
Technical Provision	672,108	100.00
VaR(2010)	49,571	69.58
Delta TP	21,668	30.42
SCR	71,239	100.00
Technical Provision	672,108	90.42
SCR	71,239	9.58
TP + SCR	743,347	100.00

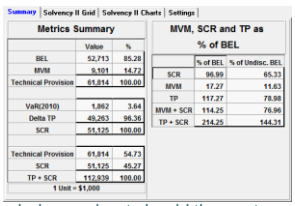
1 Unit = $1,000

MVM, SCR and TP as % of BEL

	% of BEL	% of Undisc. BEL
SCR	11.69	10.22
MVM	10.27	8.98
TP	110.27	96.38
MVM + SCR	21.96	19.20
TP + SCR	121.96	106.60

One-year risk horizon LOB4

- Solvency II capital required (**Technical Provisions + SCR**) for LOB4 is substantially higher than undiscounted BEL
- Bulk of SCR is Delta TP – capital required to restore the balance sheet should the next year be in distress


Summary | Solvency II Grid | Solvency II Charts | Settings

Metrics Summary

	Value	%
BEL	52,713	85.28
MVM	9,101	14.72
Technical Provision	61,814	100.00
VaR(2010)	1,862	3.64
Delta TP	49,263	96.36
SCR	51,125	100.00
Technical Provision	61,814	54.73
SCR	51,125	45.27
TP + SCR	112,939	100.00

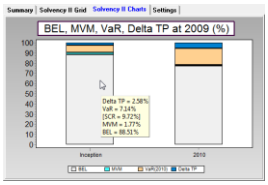
1 Unit = $1,000

MVM, SCR and TP as % of BEL

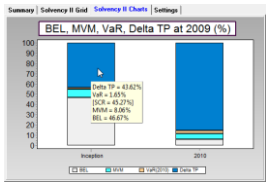
	% of BEL	% of Undisc. BEL
SCR	96.99	65.33
MVM	17.27	11.63
TP	117.27	78.98
MVM + SCR	114.25	76.96
TP + SCR	214.25	144.31

One-year risk horizon
Comparing the aggregate of six LOBs with LOB4

For the aggregate Delta TP is small, but large for LOB4 as a % of BEL

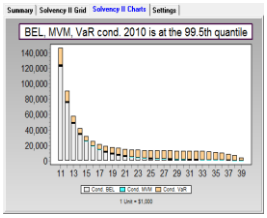


Aggregate of six LOBs

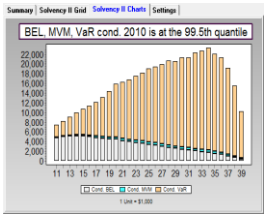


LOB4 only

One-year risk horizon
Comparing the aggregate of six LOBs with LOB4



Aggregate of six LOBs

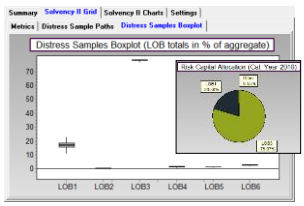


LOB4 only

One-Year risk horizon
Aggregate of six LOBs

Which LOB is in distress if the aggregate is in distress?

- **LOB3 and LOB1 are in distress if the aggregate is in distress**
- **Why? LOB3 and LOB1 have the bulk of the payments in the distress year (inset).**

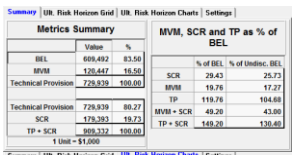


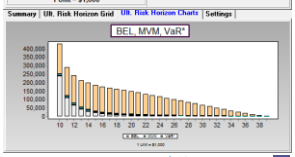
Ultimate Year Risk Horizon

- Allocation of capital in the Ultimate Year Risk Horizon framework

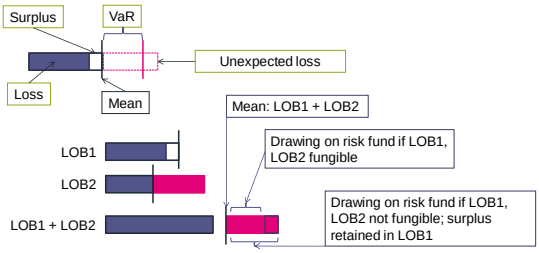
Ultimate-year risk horizon Aggregate of six LOBs

- MVM is calculated based on the VaR 'to run-off' for each calendar year
- MVM is around 10x the one-year risk horizon's MVM





Fungibility and Ring-fencing by example – drawing on the risk fund



– In the case of fungibility the risk fund is smaller since it is expected to be supplemented by surpluses from other LOBs/portfolios.

Consistent estimates of prior year ultimates and Solvency II Risk Measures on updating

- Total reserve increases from year to year (with same accident (underwriting) exposure as previous year)
- What does a calendar year trend (inflation) of 5% imply in terms of estimates of prior year ultimates, loss reserves and premiums (per unit risk)?
- AXIOM

  Calendar year trends (inflation) project (impact) both the prior and future accident (underwriting) years

  Here is a simple example that illustrates the main ideas that reserve increases do not represent under-reserving. Indeed, they are necessary in order to maintain consistent estimates of prior year ultimates as the company writes new underwriting (accident) years).

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Consistent estimates of prior accident year ultimates and reserve increases on updating

- On a logarithmic scale the data were generated as follows
- Y(w,d) = 10 -0.3*d +0.05 (w+d-1) where w is the accident year 1,...,7 and d is the development year 0,..., 5.
- The numbers down each column increase by 0.05 on a log scale (approximately 5% annual). The numbers along each row decrease by 0.25 (=-0.3+0.05) on a log scale We have assumed that the paid losses run-off after five years. Even if this is the case for 1999, this may not be the case for subsequent accident years especially if inflation is 'high'

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Consistent estimates of prior year ultimates and SII metrics updating

Reserves and ultimates as at year end 2004

Accident Period vs Development Period

Cal. Per.	Total	0	1	2	3	4	5	Reserve	Ultimate
1999		22,026	17,154	13,360	10,405	8,103	6,311	0	77,359
2000		40,310	23,156	18,034	14,045	10,938	8,519	6,634	81,325
2001		55,736	24,343	18,958	14,765	11,499	8,955	6,974	85,495
2002		68,999	25,591	19,930	15,522	12,088	9,414	7,332	89,878
2003		80,639	26,963	20,982	16,338	12,788	9,897	7,708	94,486
2004		91,085	28,283	22,026	17,154	13,360	10,405	8,103	99,331
Total Fitted/Paid				2005	2006	2007	2008	2009	Total Reserve	Total Ultimate
Cal. Per. Total		358,796		68,822	46,251	30,589	18,112	8,103	169,878	527,873

1 Unit = $1

Reserves and ultimates as at year end 2005

Accident Period vs Development Period

Cal. Per.	Total	0	1	2	3	4	5	Reserve	Ultimate
1999		22,026	17,154	13,360	10,405	8,103	6,311	0	77,359
2000		40,310	23,156	18,034	14,045	10,938	8,519	6,634	81,325
2001		55,736	24,343	18,958	14,765	11,499	8,955	6,974	85,495
2002		68,999	25,591	19,930	15,522	12,088	9,414	7,332	89,878
2003		80,639	26,963	20,982	16,338	12,788	9,897	7,708	94,486
2004		91,085	28,283	22,026	17,154	13,360	10,405	8,103	99,331
2005		95,755	29,733	23,156	18,034	14,045	10,938	8,519	104,424
Total Fitted/Paid				2006	2007	2008	2009	2010	Total Reserve	Total Ultimate
Cal. Per. Total		464,550		69,487	48,623	32,157	19,841	8,519	177,746	632,296

1 Unit = $1

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Consistent estimates of prior year ultimates on and SII metrics updating

Reserve and Ultimate as at year end 2004

Accident Year	Mean Reserve	Ultimate
1999	0	77,359
2000	6,634	81,325
2001	15,930	85,494
2002	28,835	89,878
2003	46,631	94,486
2004	71,048	99,331
Total	169,078	527,873

Reserve and Ultimate as at year end 2005

Accident Year	Mean Reserve	Ultimate
1999	0	77,359
2000	0	81,325
2001	6,974	85,495
2002	16,746	89,878
2003	30,313	94,486
2004	49,022	99,331
2005	74,691	104,424
Total	177,746	632,298

Ratio of year t ultimate to year t-1
1.051267467
1.051275745
1.051266156
1.051269499
1.051277438
1.051273016
1.051266279
Ratio of Reserves

N.B.

1. Estimtes of ultimate losses by accident year (1999- 2004) remain the same on update at end of 2005
2. The ratio of ultimate for year t to year t-1 is 1.05
3. Increase in total reserves from 2004 to 2005 is 1.05

Consistent estimates of prior year ultimates on and SII metrics updating

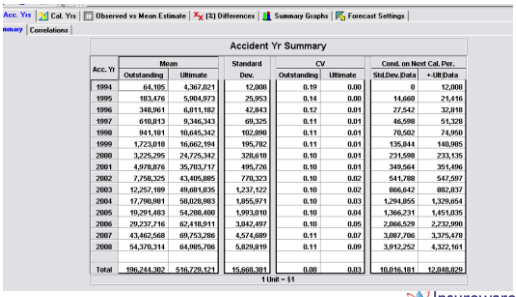
- Each year the company needs to increase its total reserves by at least 5%.
- The ultimates for prior accident years will remain consistent with each increase in total reserves.
- Each year the company needs to increase its premium (price) by at least 5%.
- Ultimates increase by at least 5% from one accident year to the next.
- These are not reserve upgrades

Consistent estimates of prior year ultimates on and SII metrics updating

- Mack and related methods give inconsistent estimates of prior year ultimates (on updating) and inaccurate liability streams by calendar year.
- Bootstrapping the wrong model does not improve the model.

This was all explained on Wednesday!

Conditional Statistics on next calendar period- volatility in ultimates on updating.

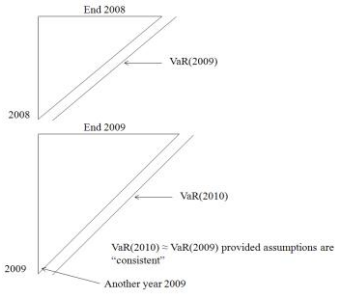


Accident Yr Summary

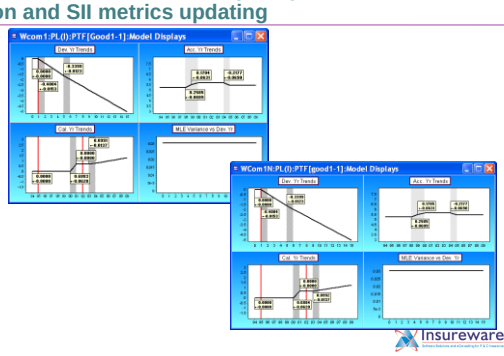
Acc. Yr	Mean		Standard	CV		Cond. on Next Cal. Per.	
	Outstanding	Ultimate	Dev.	Outstanding	Ultimate	Std.Dev.Data	+-Ult.Data
1994	64,105	4,367,821	12,008	0.19	0.00	0	12,008
1995	183,476	5,004,973	25,953	0.14	0.00	14,660	21,416
1996	348,961	6,811,182	42,843	0.12	0.01	27,542	32,818
1997	610,813	9,346,343	69,325	0.11	0.01	46,598	51,328
1998	941,101	10,645,342	102,898	0.11	0.01	70,502	74,950
1999	1,723,018	16,662,194	195,782	0.11	0.01	135,844	140,905
2000	3,225,295	24,725,342	328,619	0.10	0.01	231,598	233,135
2001	4,978,876	35,783,717	495,726	0.10	0.01	349,564	351,496
2002	7,758,325	43,405,885	770,323	0.10	0.02	541,788	547,597
2003	12,257,189	49,681,835	1,237,122	0.10	0.02	866,642	882,837
2004	17,798,981	58,028,983	1,855,971	0.10	0.03	1,294,855	1,329,654
2005	19,291,483	54,288,400	1,993,810	0.10	0.04	1,366,231	1,451,835
2006	29,237,716	62,418,911	3,042,497	0.10	0.05	2,066,529	2,232,990
2007	43,462,568	69,753,286	4,574,689	0.11	0.07	3,087,706	3,375,478
2008	54,378,314	64,085,706	5,829,819	0.11	0.09	3,912,252	4,322,161
Total	196,244,382	516,729,121	15,668,391	0.08	0.03	10,816,181	12,048,829

1 Unit = $1

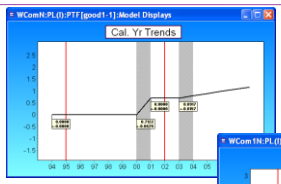
Updating and monitoring

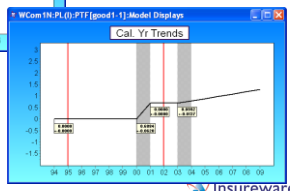


Consistent estimates of prior year ultimates on and SII metrics updating



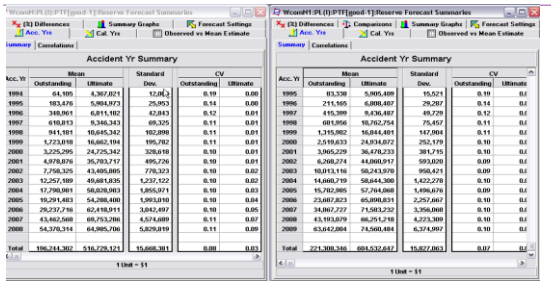
Consistent estimates of prior year ultimates on and SII metrics updating





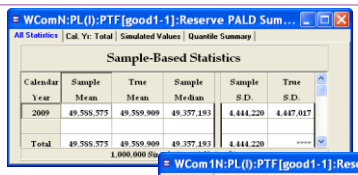
Calendar year trend has not changed statistically on updating

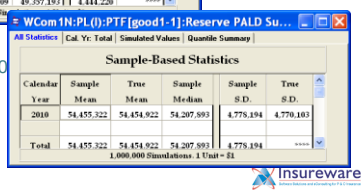
Consistent Estimates of prior year ultimates on updating



At end 2008, ultimate 2008=64.9+_5.8, at end 2009 66.2+_4.22

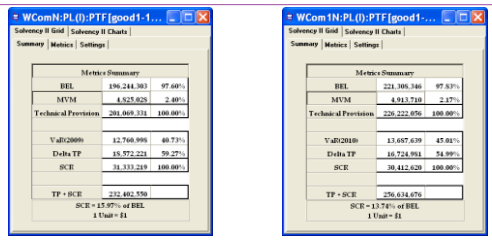
Consistent estimates of prior year ultimates on and SII metrics updating





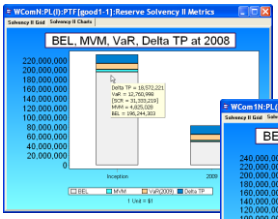
Mean Reserve for Calendar Year 2010 is approximately 10% higher than Mean reserve for 2009.

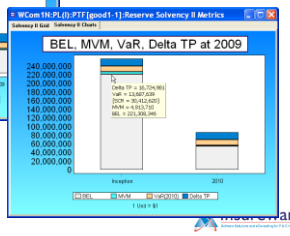
Consistent SII metrics on updating



Solvency II calculations with no discounting: MVM for 2010 is almost the same as for 2009, and so is SCR.

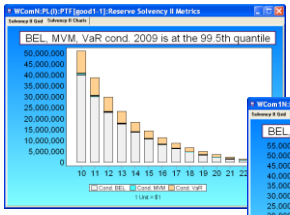
Consistent SII metrics on updating

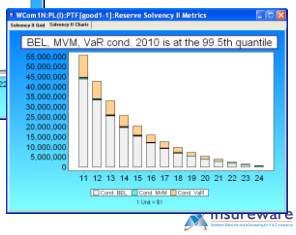




Reduction in TP offsets increase in VaR to produce slightly lower SCR.

Consistent SII metrics on updating

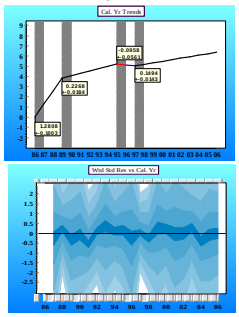




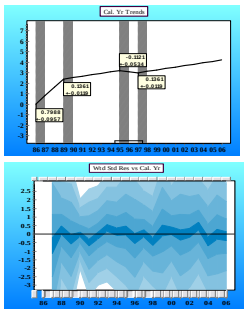
Break-down by future calendar year, shows same pattern but scaled up. Metrics based on the first year being at the 99.5th percentile.

Two LOBs with common drivers- Example 1- same calendar year trend structure and high process correlation of 0.85

LOB A

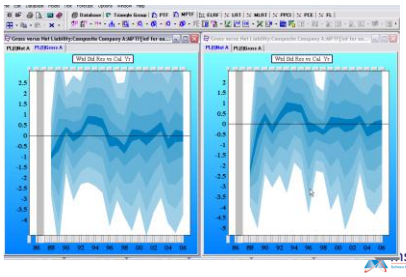


LOB B

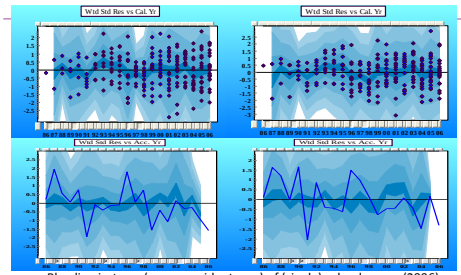


Two LOBs with common drivers- Example 1- same calendar year trend structure and high process correlation of 0.85

Process correlation adjusted for the average calendar year trend for each LOB
= sum of trend correlation + process (volatility) correlation



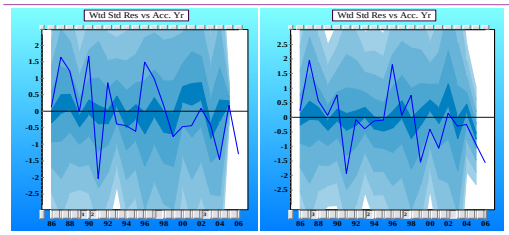
Residual plots by calendar year LOB A (left) LOB B (right)



Blue line is trace (versus accident year) of (single) calendar year (2006)

Process Correlation = 0.85

When do two LOBs (LOB A & LOB B) have common drivers?



- Two LOBs have "same" trend structure and high process correlation
- Visible in trace of calendar year 2006 versus accident years.
- Note high process correlation (of 0.85).

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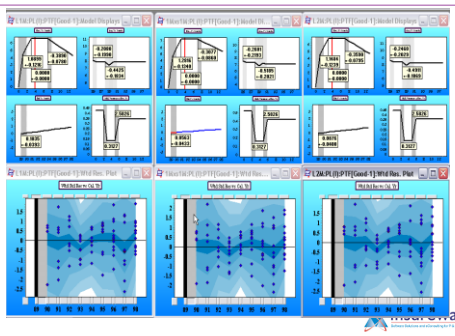
Three LOBs with common drivers- Example 2
Identical trend structure and high process correlation exceeding 0.9!



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Process correlation, trend (parameter) correlation, same trend structure and reserve distribution correlation

- The above two examples are not different LOBs!
- The first is E&O D&O gross and net of reinsurance
- The second example involves three layers of a medical malpractice LOB; Lim 1Million, Lim 2Million and 1Mxs1M. The triangles are additive.
- Two LOBs written by the same company rarely have the same calendar year trend structure and often process correlation is either zero or very low. Reserve distribution correlation is much lower.
- No two companies are the same and process correlation often zero (for the 'same' LOB)
- No company is the same as the industry

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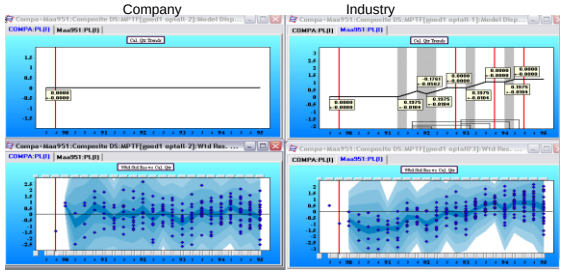
Small company (exposure) versus industry auto BI New South Wales Australia

Company Industry



Calendar year trend for company is zero, whereas industry it is huge!
(Company also has much higher process volatility)

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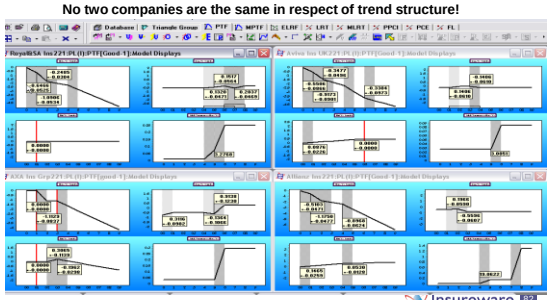
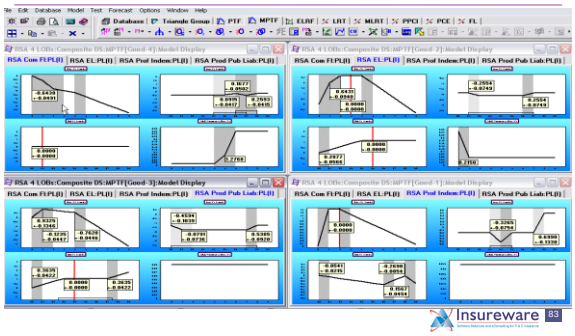
S&P Syn Thesis 2010- RSA vs Allianz vs AXA vs Aviva Commercial:Fleets- each normalized by number claims reported in dev period zero

No two companies are the same in respect of trend structure!



Insureware 82

S&P Syn Thesis 2010- RSA: Commercial Fleet vs Employers Liability vs Professional Indemnity vs Product and Public Liability- no relationships!



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There are four types of correlations between LOBs

:

1. Process (volatility) Correlation (that is, correlation between two sets of residuals)

2. Parameter Correlations
3. Same trend structure (especially along the calendar years)
4. Reserve distribution correlations

#1 induces #2. However, #3 is the 'worst' kind of relationship you can have between two LOBs as it results in very little, if any, risk diversification. It means that in terms of future calendar year trends the two LOBs move together, that is, a trend change in one LOB means a trend change in the other LOB, and is tantamount to the two LOBs having the same drivers. If two LOBs satisfy #3, then #1 and #2 are close to 1.

Fortunately, #3 we have only observed between layers of the same LOB, between segments of the same LOB, and between net of reinsurance and gross data (of the same LOB). #1, #2, #3 induce #4. #4 is typically much less than #1 in the absence of #3.

It is important to recognize that you cannot measure the relationship between two LOBs unless you first identify the trend structure and process variability in each LOB. It is only in the Probabilistic Trend Family (PTF) modelling framework that you can identify a parsimonious model that separates the trend structure in the three directions from the process variability.

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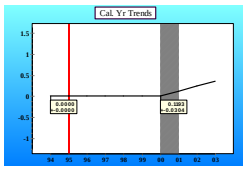
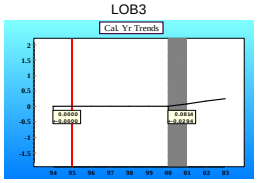
Two LOBs: LOB1 and LOB3
Actually same LOB different territories

LOB1



LOB3



Both LOBs have a calendar year trend change in 2000

That should be regarded as a concern!

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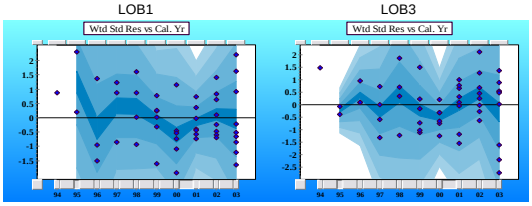
Two LOBs: LOB1 and LOB3
Actually same LOB different territories

Process correlation=0.35

LOB1



LOB3

Note 98-00 slight negative trend, 00-02 slight positive trend and 02-03 zero trend LOB1 and slight negative trend LOB3.

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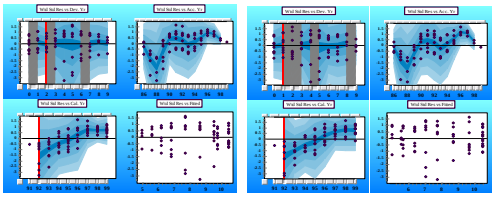
Two segments of WC

Each segment only adjusted for development year trends

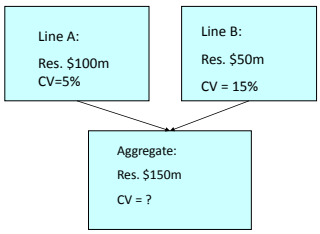
Accident year parameter correlations equal 1 after modelling accident years- major implications also for future underwriting years, where correlation in distributions of ultimates exceed 0.99



Reserve distribution correlations between two distinct LOBs- a very different story

- Highest process correlation observed between two different LOBs is about 0.6 (in our experience)
- But Reserve distribution correlation is typically lower.
- Trend structures for two LOBs typically different
- Parameter correlations low or zero
- See Private Passenger Automobile (PPA) versus Commercial Auto Liability (CAL)for Berkshire Hathawy below, for example

Risk Capital Allocation



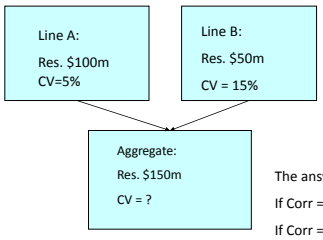
Assume Risk Capital at 98th percentile = 2 Standard Deviations

Risk Capital for Line A = $10m

Risk Capital for Line B = $15m

Aggregate Risk Capital (ARC) = $25m ?

Risk Capital Allocation



Assume Risk Capital at 98th percentile = 2 Standard Deviations

Risk Capital for Line A = $10m

Risk Capital for Line B = $15m

Aggregate Risk Capital (ARC) = $25m ?

The answer depends on the correlation.

If Corr = +1.0, ARC = $25m

If Corr = 0.0 ARC = $18m

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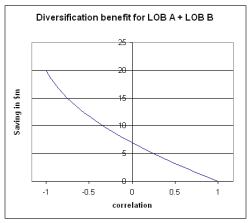
Risk Capital Allocation: Diversification benefit



Benefit =

Sum of individual risk capital assessments – aggregate risk capital assessment from *joint distribution* of the two (correlated) lines.

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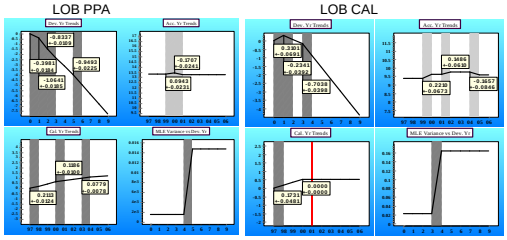
Berkshire Hathaway Schedule P 2006

No LOBs have the "same" tend structure and most LOBs have zero process correlation. Consider Private Passenger Automobile and Commercial Auto Liability

LOB PPA

LOB CAL



Note LOBs have very different trend structure and process variance

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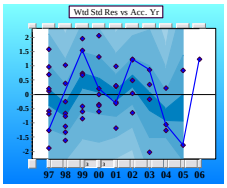
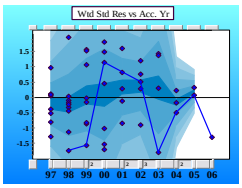
Berkshire Hathaway Schedule P 2006

LOB PPA



LOB CAL



Note zero process correlation. Blue lines represent trace of calendar year 2006

Forecast lognormal distributions (and their correlations) for each future cell for each LOB based on an explicit forecast scenario

2003	3,202,436	1,525,975	1,107,844	413,244	194,092	104,193	56,317	2
	3,225,785	1,514,680	1,022,987	416,588	200,477	4,986	7,268	
2004	3,443,730	1,649,599	1,197,652	446,766	239,812	128,758	69,606	3
	3,362,493	1,663,027	1,139,227	428,201	11,242	7,137	9,282	
2005	3,714,166	1,783,347	1,294,820	552,022	296,359	159,145	86,048	4
	3,734,136	1,840,895	1,207,194	26,731	16,318	10,359	11,954	
2006	4,011,063	1,928,056	1,599,904	682,204	366,309	196,740	106,393	5
	4,008,908	2,020,277	79,001	38,777	23,877	14,966	15,494	
	Total Fitted/Paid		2007	2008	2009	2010	2011	
Cal. Per.	25,980,855		2,571,638	1,199,857	639,334	337,281	173,651	8
Total	25,966,538		97,713	55,991	37,506	25,695	19,419	1

1 Unit = $1,000

Blue is observed, black is mean of lognormal and red is standard deviation of lognormal

Berkshire Hathaway Schedule P 2006
One Year Time Horizon- "Change" in Ultimates conditional on next year's paid losses?

Related Question:

When do estimates of prior year ultimates stay consistent on updating (next valuation period) ?

No need for simulations! Why?

Risk Capital Allocation | Correlations | Correlations (logs)

Accident Yr Summary

Acc. Yr	Mean		Standard	CV		Cond. on Next Cal. Per.	
	Outstanding	Ultimate	Dev.	Outstanding	Ultimate	Std.Dev.|Data	+-Ult|Data
1999	404,928	7,341,745	96,942	0.24	0.01	54,108	80,437
2000	694,421	7,694,760	138,848	0.20	0.02	81,066	112,725
2001	1,169,064	8,854,561	187,454	0.16	0.02	113,677	149,051
2002	1,726,108	8,062,073	239,837	0.14	0.03	180,697	157,704
2003	2,012,700	7,324,906	245,950	0.12	0.03	190,312	155,797
2004	2,967,607	6,370,560	311,555	0.10	0.04	240,509	198,045
2005	4,895,219	10,343,879	509,057	0.10	0.05	336,132	382,302
2006	9,616,003	11,863,381	1,374,676	0.14	0.12	711,682	1,176,113
Total	23,898,022	80,529,585	2,040,345	0.09	0.03	1,172,221	1,670,001

1 Unit = $1,000

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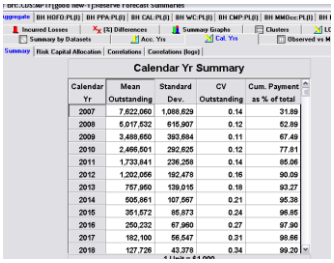
Which risk characteristics of the data do calendar year payment stream distributions depend on?

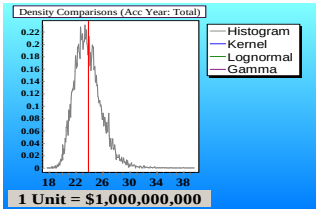
1. Base development period trends, and
2. Calendar year trend assumptions for the future



Calendar Yr Summary

Calendar Yr	Mean Outstanding	Standard Dev.	CV Outstanding	Cum. Payment as % of total
2007	7,822,060	1,088,629	0.14	31.89
2008	5,017,532	615,907	0.12	52.89
2009	3,488,660	393,684	0.11	67.49
2010	2,496,501	292,625	0.12	77.51
2011	1,733,841	236,259	0.14	85.06
2012	1,202,056	192,478	0.16	90.09
2013	757,960	139,015	0.18	93.27
2014	505,861	107,567	0.21	95.38
2015	351,572	85,873	0.24	96.85
2016	250,232	67,960	0.27	97.90
2017	182,100	56,547	0.31	98.66
2018	127,726	43,378	0.34	99.20

Distribution of Aggregate Reserves=Sum of all lognormals for each future cell for each LOB



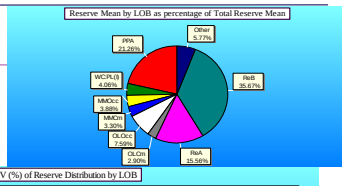
Note skewness (even) of aggregate distribution. Mean=23.9B, VaR at 95%=3.6B and T-VaR at 95%=5B

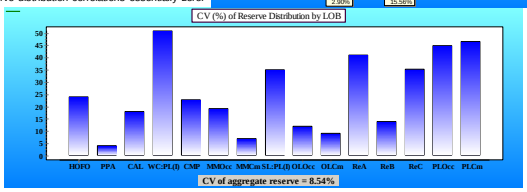
Mean Reserve as a % of Total Reserve, and Reserve CV of aggregate versus CV for each LOB.

WC has largest CV but is not smallest LOB by Mean Reserve

ReA has large CV and is not so large proportion of total business.

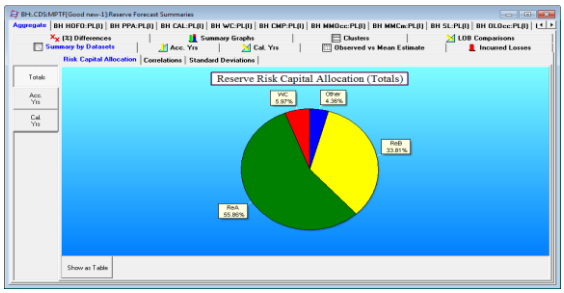
Reserve distribution correlations essentially zero!

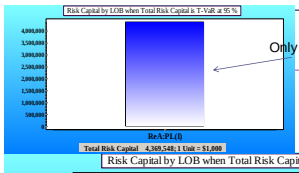




CV of aggregate less than most CVs

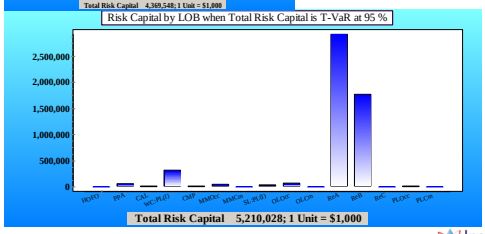
Risk allocation based on a variance/covariance formula



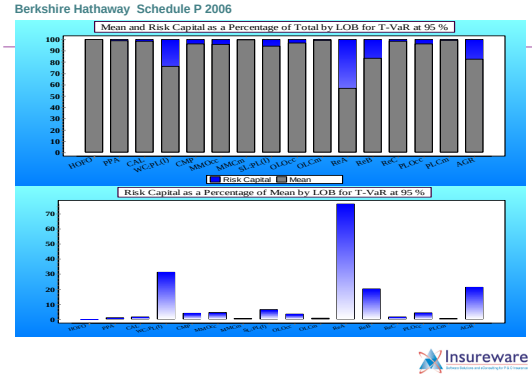


Only LOB ReA

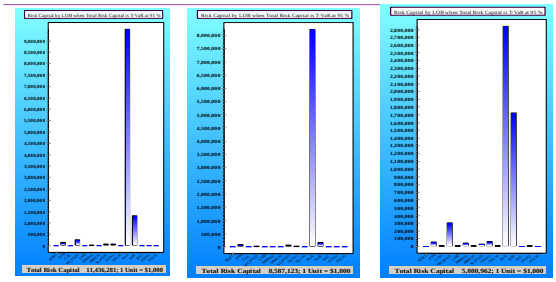
Risk capital for ReA if this is the only line written is not much less than risk capital for aggregate of all 15 LOBs! Much credit for risk diversification by writing the other LOBs that are essentially uncorrelated



Berkshire Hathaway Schedule P 2006



Combined risk charge < underwriting risk charge + reserve risk charge, for any T-VaR . Why?



Combined | Underwriting | Reserve

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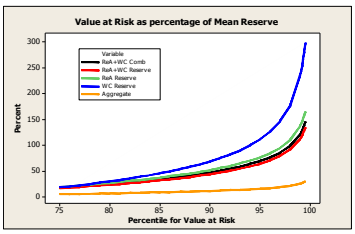
Berkshire Hathaway – Diversification Effects

This graph compares risk capital, calculated as Value at Risk and expressed as a percentage of the Forecast Mean Reserve. Only WC and ReA, two of the high CV lines are shown.

Blue = WC and **Green** = ReA **Red** = WC+ReA

Black = WC+ReA including next underwriting year.

Orange = Aggregate of all BH lines.



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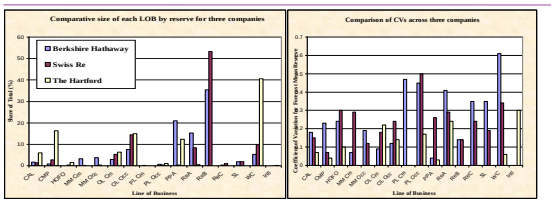
Berkshire Hathaway, Swiss Re and The Hartford, comparison by Line of Business



Higher Mean does not necessarily mean lower CV

For PPA , BH Mean>HF Mean, and CV BH> CV HF
For OLOcc,Mean Hart> Mean Swiss Re > Mean BH & CV Hart>CV Swiss Re >CV BH

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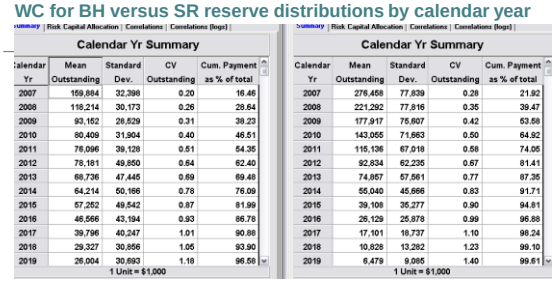
WC for BH versus SR reserve distributions by calendar year



Calendar Yr Summary

Calendar Yr	Mean Outstanding	Standard Dev.	CV Outstanding	Cum. Payment as % of total
2007	159,884	32,398	0.20	16.46
2008	118,214	30,173	0.26	28.64
2009	93,152	28,529	0.31	38.23
2010	80,409	31,904	0.40	46.51
2011	76,096	39,128	0.51	54.35
2012	78,181	49,850	0.64	62.40
2013	68,736	47,445	0.69	69.46
2014	64,214	50,166	0.78	76.09
2015	57,252	49,542	0.87	81.99
2016	46,566	43,194	0.93	86.78
2017	39,796	40,247	1.01	90.88
2018	29,327	30,856	1.05	93.90
2019	26,004	30,693	1.18	96.58

1 Unit = $1,000

Calendar Yr Summary

Calendar Yr	Mean Outstanding	Standard Dev.	CV Outstanding	Cum. Payment as % of total
2007	276,458	77,839	0.28	21.92
2008	221,292	77,816	0.35	39.47
2009	177,917	75,607	0.42	53.56
2010	143,055	71,663	0.50	64.92
2011	115,136	67,018	0.58	74.06
2012	92,834	62,235	0.67	81.41
2013	74,857	57,561	0.77	87.35
2014	55,040	45,666	0.83	91.71
2015	39,108	35,277	0.90	94.81
2016	25,129	25,878	0.99	96.88
2017	17,101	18,737	1.10	98.24
2018	10,828	13,282	1.23	99.10
2019	6,479	9,085	1.40	99.61

1 Unit = $1,000

Distributions of payment streams by calendar year are different

These depend on the base development period trends and the assumed forecast scenario calendar year trends.

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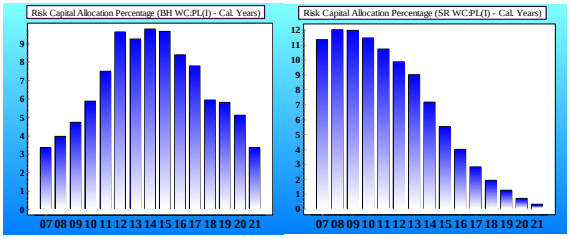
Risk capital allocation (%) by calendar year for WC, BH versus SR



% allocation very different. It is based on a variance/covariance formula that is a function of three factors. 1. The future calendar year trend (mean and standard deviation thereof) assumption, 2. Development period trends and 3. process variance.

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Summary

•All companies are different and no company is the same as the industry.

•Consistent estimates of prior year ultimates on updating can only be maintained within a sound modelling framework that incorporates calendar year parameters and assumptions about the future are explicit and auditable. The assumptions can easily be monitored on updating.

•Reserve distribution correlation is usually considerably less than process correlation.

•Segments of the same LOB such as 1. net of reinsurance and gross, 2. indemnity versus medical, 3. layers, for example, limited to 500K and limited to 1M; have common drivers and are highly correlated.

•Different LOBs very often do not have common drivers. That is, the trend structure (especially along calendar years) is not the same and process correlation is zero.

• A sound measurement of volatility and correlations (from the data) is essential to calculate risk capital allocation by LOB and calendar year, irrespective of capital risk measure.

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Summary

- Combined reserve and underwriting risk charge < reserve risk charge + underwriting risk
- Mack and related methods can give answers that are wildly too low or too high and cannot capture the volatility in the data.
- The identified Probabilistic Trend Family (PTF) model measures the trends in the three directions and the distributions about the trend structure.
- In order to measure the process (volatility) correlation between two LOBs you need to first identify the PTF model for each LOB.

More information will be available at

CLRS – 2012

Insureware's Hospitality Suite

Sheraton Denver Downtown Hotel, Denver, CO

7:00pm-10:30pm

Wednesday September 5th

Thursday September 6th

(Also learn about the Bootstrap technique for testing validity of a model or method)