A re-reserving algorithm to derive the 1-year reserve risk view

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The application in a nutshell …

At the moment it is a (heavy) mod of the glmReserve.R library (by Zhang) of the Chain Ladder R package, not yet compiled in the main package

It's currently available to public at the following web address:
http://code.google.com/p/chainladder/source/browse/branches/alessandro/R/StochasticReserving.R

TWO MAIN PURPOSES

- ✓ Improves the **MODEL ERROR** understanding for the Reserve Risk, in a Solvency 2 framework

- ✓ It provides an estimation of the **1 year Reserve Risk view** through a **re-reserving approach**, useful for internal models

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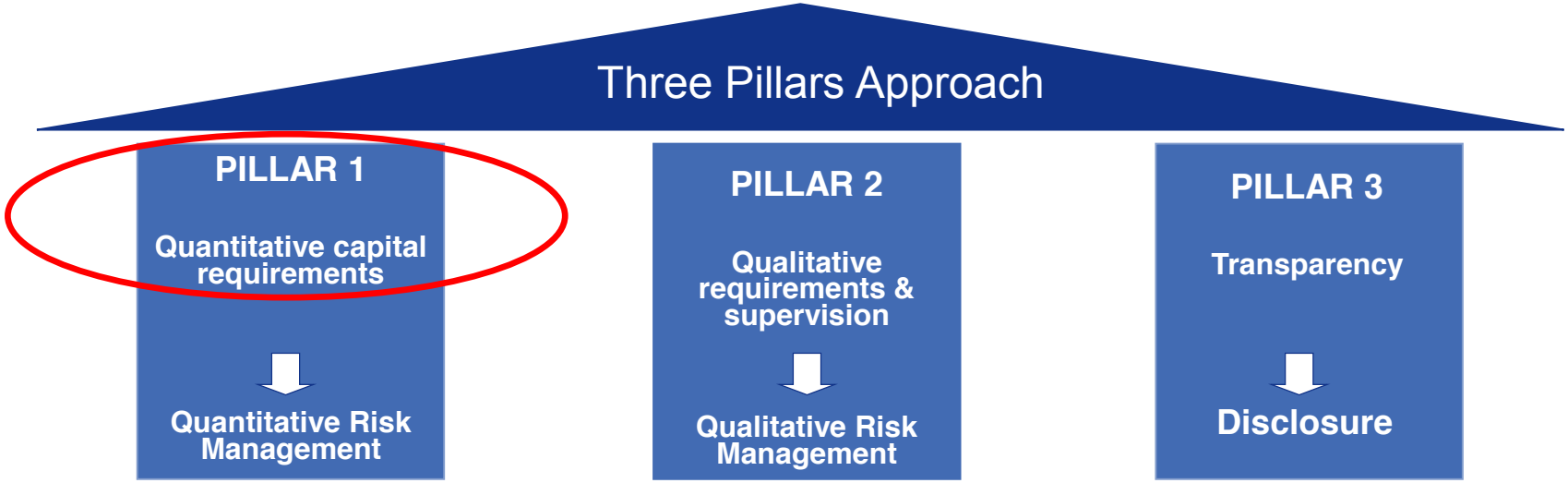
Solvency II: a Three-Pillar Structure



Three Pillars Approach is applied both at Company and at Group level

- Assets and Liabilities Valuation
- Risk quantification
  - •Minimum capital requirement (MCR)
  - •Solvency capital requirement (SCR)
- Market value based own funds

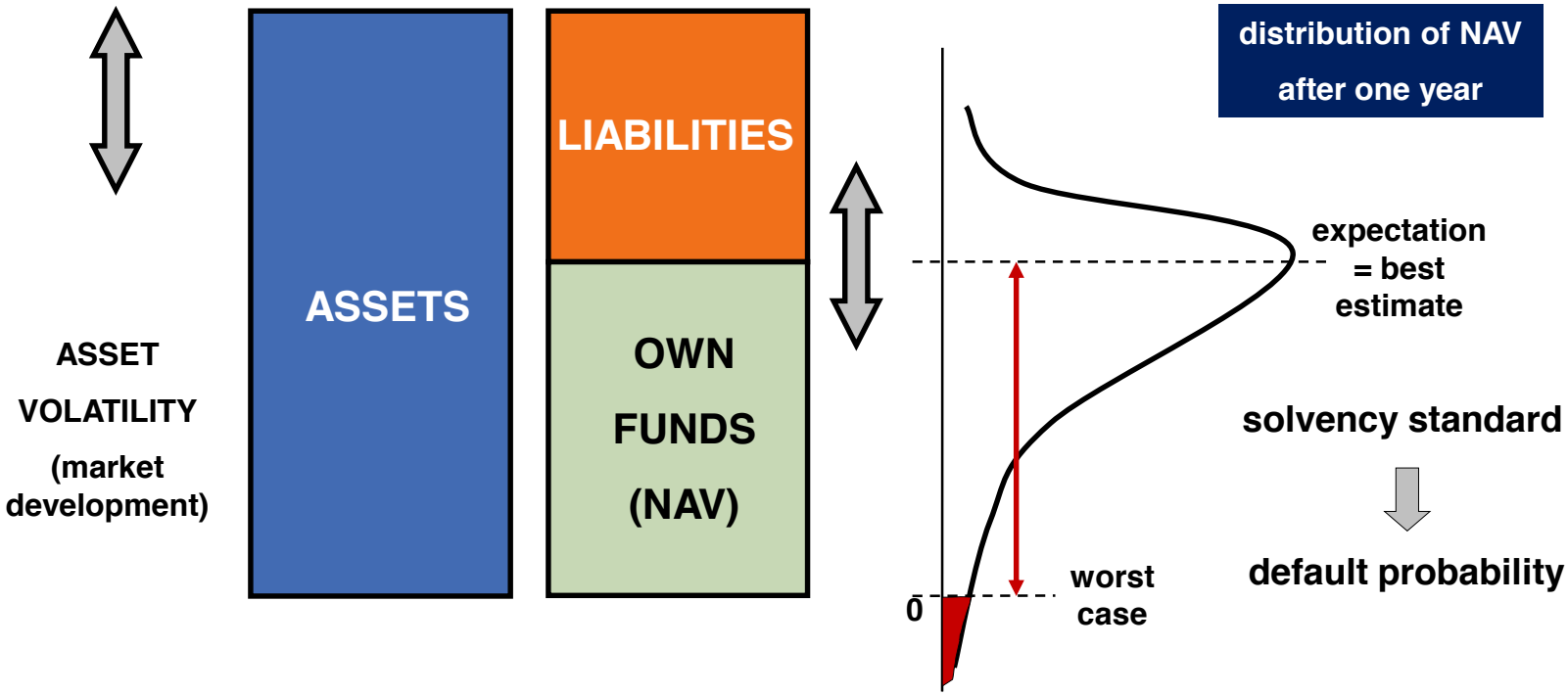
- Governance System
  - •Organisational structure
  - •Risk Management
  - •Actuarial function
- Internal control system
- ORSA
- Use Test

- Market information
  - •Business overview and performances
  - •Governance
  - •Evaluation criteria
  - •Risk and Capital Management
- Supervisory reporting

There are a lot of interdependencies between the different tasks within the different pillars

Risk Capital

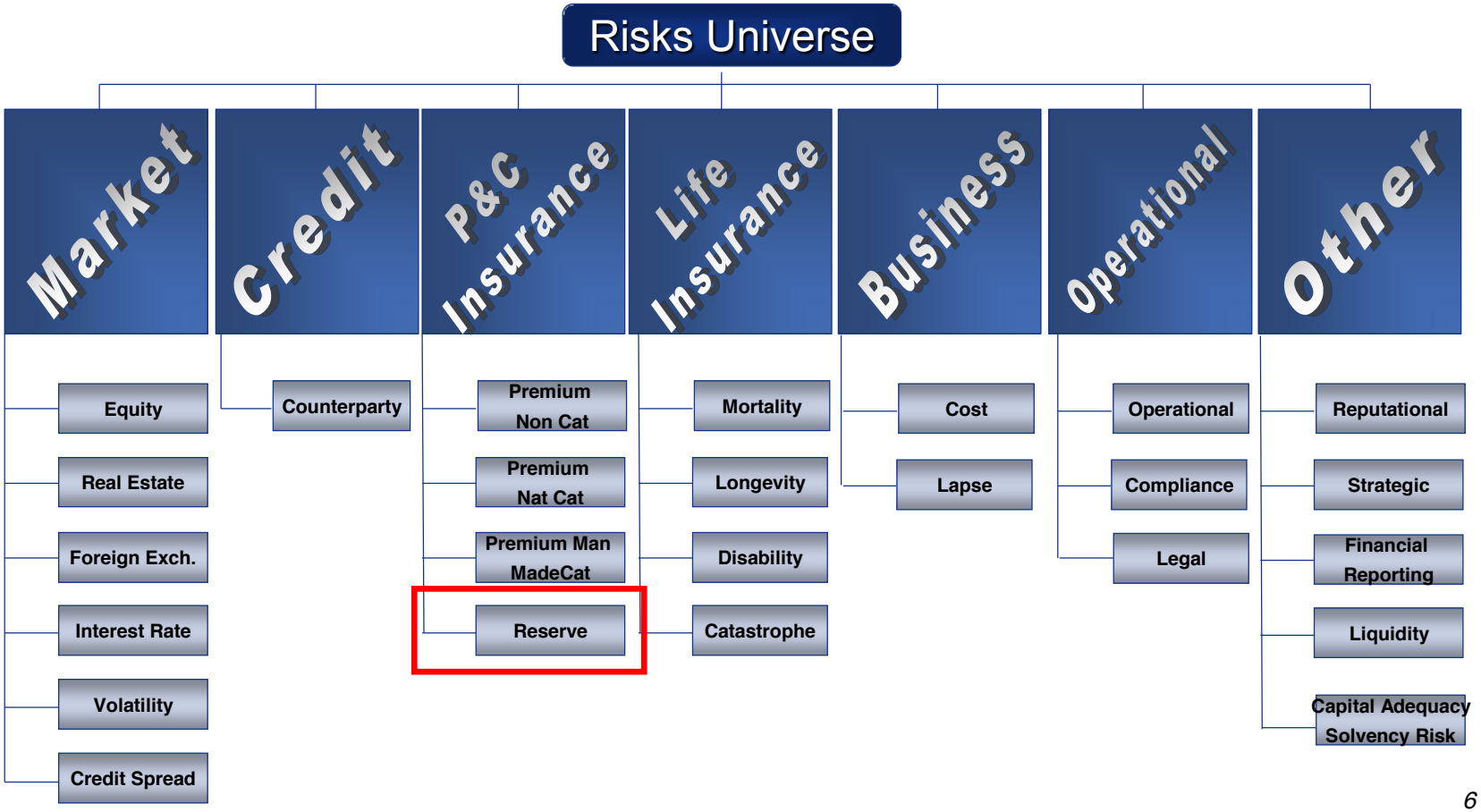
*SCR.1.9 The SCR (Solvency Capital Requirement) should correspond to the **Value-at-Risk** of the **basic own funds** of an insurance undertaking subject to a confidence level of **99.5%** over a **one-year period***



So, everything that affects the own funds in the next 12 months should be considered as a **risk**

Risk Capital

Being the risk represented by the uncertainty of the future NAV development, this can be split into **several categories**, corresponding to the **events** giving place to the **possible NAV variations**



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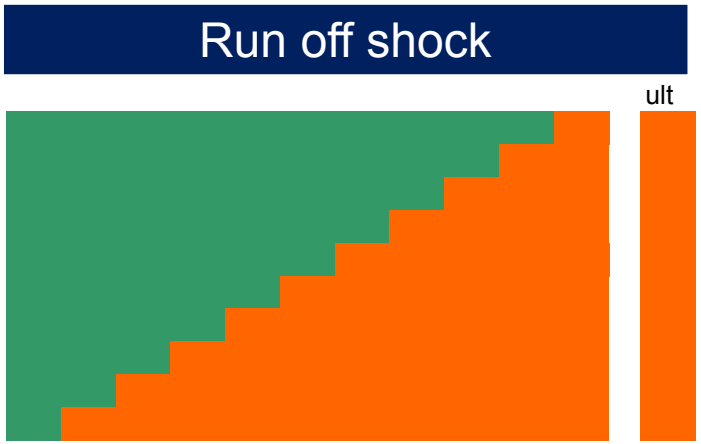
Reserve Risk

*SCR.9.11 Reserve risk results from **fluctuations** in the **timing** and **amount** of **claim settlement***



$$CDR_{\infty} = R_0 - \sum_{\text{future CY } t} P(t)$$

$$VAR\left(CDR_{\infty}\right) = VAR\left(\sum_{\text{future CY } t} P(t)\right)$$

In order words, it's like if we simulate the fact we are at the end of the reserve run-off and we observe how wrong we were at the instant of evaluation

Risk Capital

Step 1: Assessment of nature, scale and complexity of risks

*SCR.1.19 The insurer should assess the **nature**, **scale** and **complexity** of the risks […]*

This includes **parameter**, **process** and **model** errors …

Step 2: Assessment of the model error

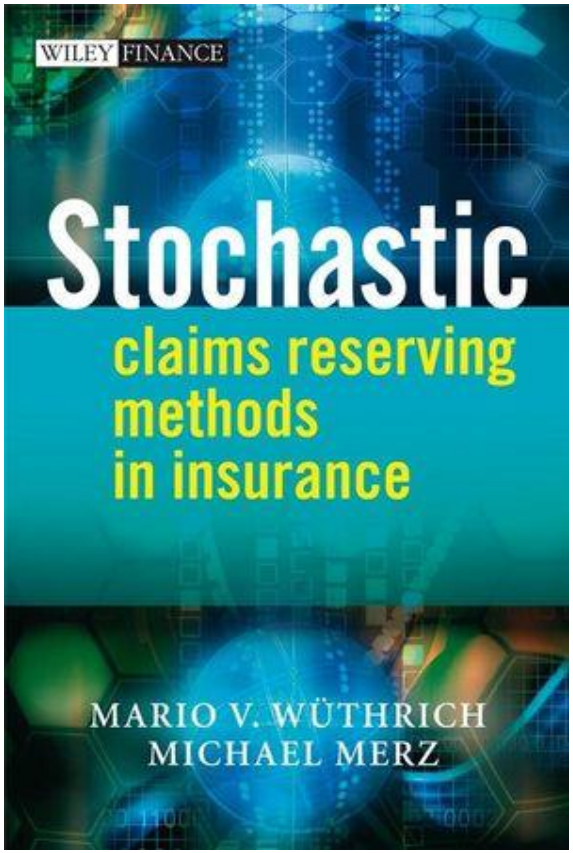
*SCR.1.21 Where simplified approaches are used to calculate the SCR, this could introduce **additional estimation uncertainty** (or **model error**) […]*

*SCR.1.23 Undertaking **are not required to quantify** the degree of **model error** in **quantitative terms** […] Instead, it is sufficient **if there is reasonable assurance that the model error included in the simplifications is immaterial***

… but if **model error** is “immaterial”, we aren’t required to quantify it …

Reserve Risk

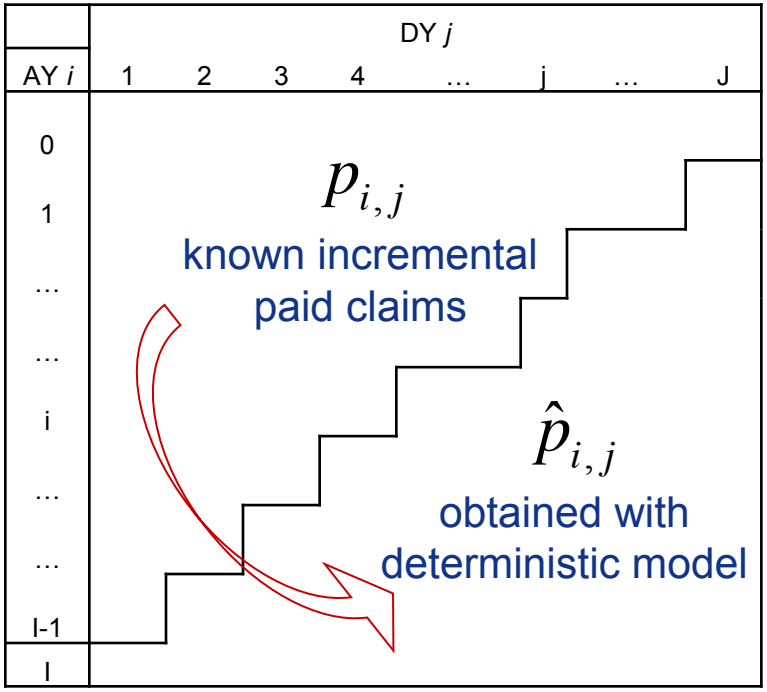
- Tons of studies in actuarial literature regarding the Stochastic Loss Reserving

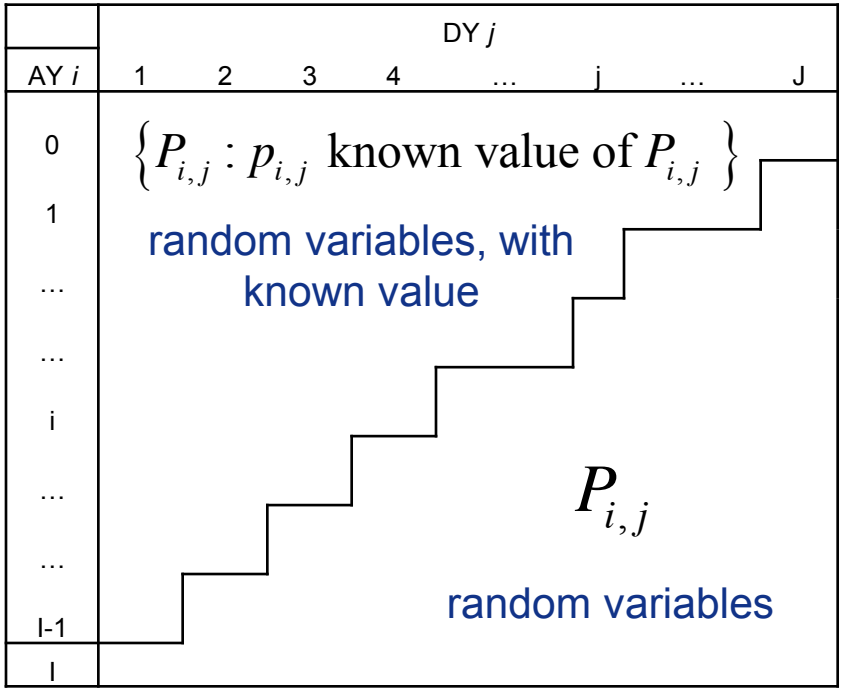


Reserve Risk – The underlying models

There is a “change of perspective” compared with the past

DETERMINISTIC MODELS ⇒ **STOCHASTIC MODELS**





Reserve Risk – The underlying models

In order to use stochastic model, you need to fix stochastic assumptions

Assumptions		Example
▪ PARAMETRIC	Give the parametric distribution family of $P_{i,j}$	GLM
▪ SEMIPARAMETRIC	Give only some assumptions on some moments	MACK

Usually the market is now considering **mainly** two stochastic models (ODP & Mack model), that have the **Chain Ladder** as underlying BE …

But if the Chain Ladder isn't working … what about the **model error**?

Please note that – actually – stochastic models based on DFM selection **don't have** a proper stochastic underlying model

Reserve Risk – Assessing the Model Error

Idea: give as much flexibility as possible!!

Other than **Tweedie(power) family** and **link function** …

design.type (*)	• Possibility to change the GLM design matrix, considering Origin Year (OY), Development Year (DY) and Calendar Year (CY) e.g. ODP has a Y ~ as.factor(OY) + as.factor(DY) • Possibility to model *as.factor* or *as.number*
bootstrap (param error)	• Parametric bootstrap (*rtweedie* generation of pseudodata) • Semi-parametric bootstrap (i.e. residual resampling)
proc.error	• Derive process error through a proper *rtweedie* random number generation, coherent with specified model
p.optim	• Find the max likelihood estimate of the Tweedie's *p* parameter
boot.adj	• Change the adj made in case of negative generated pseudo-data

(*) See Gigante, Sigalotti (2005) – Model Risk in Claims Reserving with GLM [Journal of Istituto Italiano degli Attuari, Vol. LXVIII, pp.55-87]

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Reserve Risk - Where are the problems?

Let's give a look again to the definition of SCR

*SCR.1.9 The SCR (Solvency Capital Requirement) should correspond to the **Value-at-Risk** of the **basic own funds** of an insurance undertaking subject to a confidence level of 99.5% over a **one-year period***

So, in 2008, the IAIS(*) published the following interpretation:

" […]

- ***Shock period**: the period over which a shock is applied to a risk;*
- ***Effect horizon**: the period over which the shock that is applied to a risk will impact the insurer*

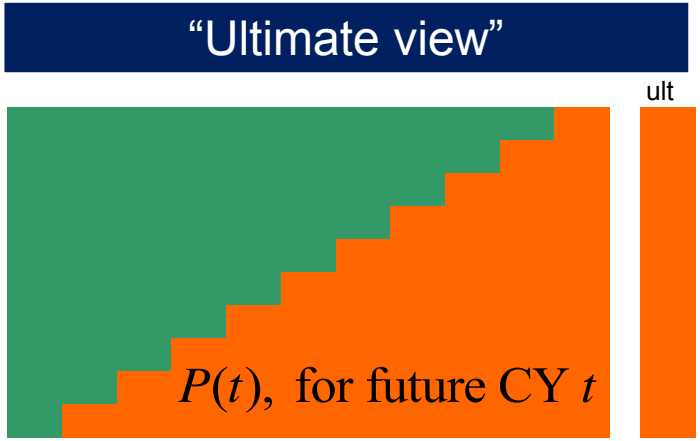
*In essence, at the end of the shock period, capital has to be sufficient so that assets cover the technical provision (…) **re-determined at the end of the shock period**. The re-determination of the technical provisions would allow for the impact of the shock on the technical provisions over the full time horizon of the policy obligations"*

(*) International Association of International Supervisors

Guidance paper No. 2.1.1 on the structure of regulatory capital requirements (October 2008), Art. 55

http://www.iaisweb.org/view/element_href.cfm?src=1/5778.pdf

All the models seen until now consider a “shock” until the full reserve run-off (the so called “**Ultimate View**”)



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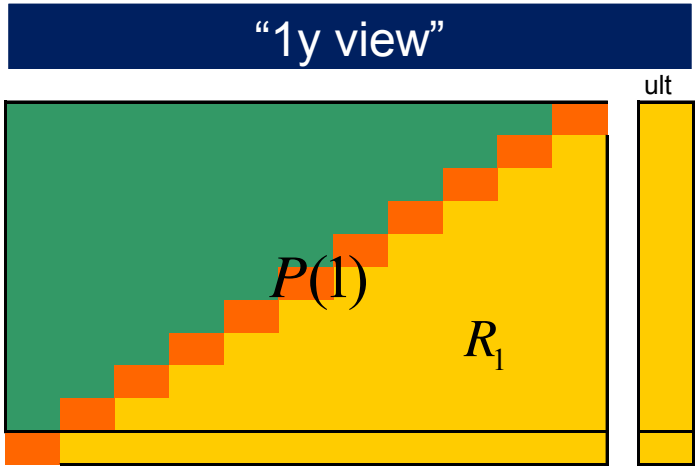


$$CDR_1 = R_0 - P(1) - R_1$$

$$VAR\left(CDR_1\right) = VAR\left(P(1) + R_1\right)$$

The “1-yr view” concept was born!!

Reserve Risk - The “1yr View”

From 2008, mainly **two** papers have been published on the topic

Merz, Wuthrich (June 2008) - Modelling the Claims Development Result for Solvency Purposes (ASTIN)

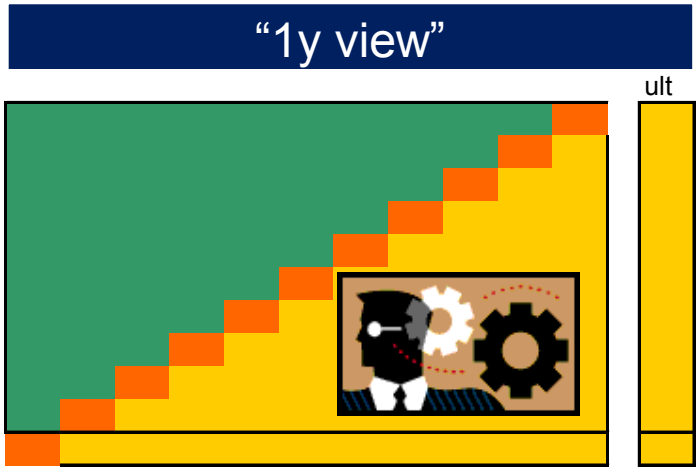
- Based on Mack (1993) assumptions + additional assumptions (martingale process)
- No tails considered
- Closed form for MSEP calculation (no information on the tails)
- Consider both a “perspective” and retrospective view

Starting from QIS5 it has been officially recognized for the calculation of the USP (Undertaking Specific Parameters), to be used thru a credibility approach with the market parameters

Reserve Risk - The “1yr View”

Ohlsson, Esbjorn, Lauzeningks (2008) - The one-year non-life insurance risk

- Gives only the general idea on how the one-year view should be evaluated (i.e. implementing the **re-reserving algorithm** – the so called “actuary in the box”)
- If we consider as re-reserving algorithm only the CL, we get the previous Merz-Wuthrich approach



This approach is particular interesting for the internal model implementation; anyway, in these last years, not many studies in actuarial literature have been done: **there are still a lot of open issues to be deepen**

Reserve Risk – The “1yr View”

My idea is: “If I have an actuary that has parameterised the *Ultimate View* somehow in *t*=0, likely after 1-yr he will keep the same GLM parameterisation, but updating the state of information in *t*=1 with the next year simulated diagonal”

In other words:
For every diagonal simulated in the previous step, run again the GLM as parameterized in t=0

New function arguments	
`rereserving`	• If `TRUE`, the model find the new ultimates after 1yr, simply running the same GLM parameterised in the *Ultimate View*, but adding the *simulated* diagonal related to the next year

The final slide ☺

FINAL CONSIDERATIONS

- I tested the function several times, and it seems to don't have critical issues
- The are still minor tweaks to be done (e.g. extrapolation of future CY factors for particular design matrix specifications)
- .. other than I have further ideas to implement!

Feel free to use it .. I'll look forward to your feedback ☺

Q&A … and … Thank you for your attention

Main References

[1] EIOPA (2012) Technical Specifications for the Solvency II valuation and Solvency Capital Requirements calculations [SCR 1.23, p. 119]

[2] Gigante, Sigalotti (2005) Model Risk In Claims Reserving with GLM [Giornale Istituto Italiano degli Attuari LXVIII, n. 1-2, pp. 55-87, 0390-5780]

[3] Merz, Wüthrich (2008), “Modelling CDR for Solvency purposes” [CAS E-Forum, Fall 2008, 542-568]

[4] Ohlsson et al. (2008), “The one-year non life insurance risk” [ASTIN Colloquia 2008]

[5] Wüthrich, Merz (2008), “Stochastic Claims Reserving Methods in Insurance” [The Wiley Finance Series]