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Software Solutions and eConsulting for P & C Insurance

Excess Risk Capital based on a composite model and associated forecast scenario for multiple LOBs via ICRFS-Plus™ COM

The impact of the first future (next) calendar year being in distress is an important question in the context of Solvency II regulation.

The basic idea here is to examine the impact on future calendar years' paid losses (reserve) means, given the first (next) calendar year falls into a particular percentile - e.g.: 99.5%. That is, conditional on the first calendar year being in a distress situation.

Excess risk capital (ERC) is defined as the Value at Risk in the first calendar year (VaR(1)) plus the difference in expected losses minus the mean (unconditional) losses in subsequent calendar years, conditional on the first calendar being in distress,

$$\begin{aligned} \text{ERC} &= \text{VaR}(1) + \sum \{E(L_k - M_k \mid L_1 \in \text{quantile [99.5\% : 99.6\%]})\}, k > 1 \\ &= \text{VaR}(1) + \sum \{E(L_k \mid L_1 \in \text{quantile [99.5\% : 99.6\%]}) - M_k \}, k > 1 \end{aligned}$$

where,

k - future calendar period,

L_k – random variable representing total paid loss in the future calendar period k,

M_k – mean paid loss for future calendar period k.

The conditional term $L_1 \in \text{quantile [99.5\% : 99.6\%]}$ expresses the fact that the first calendar year is in a “distress” situation.

ERC represents the risk capital requirement for the first calendar year in distress plus the excess mean capital above the (unconditional) mean for subsequent years. That is, the first calendar year's contribution is risk capital and the subsequent years contributions are the additional mean reserves (conditional on the first calendar year being in distress).

If we replace VaR by T-VaR then:

$$\text{ERC} = \text{VaR}(1) + \sum \{E(L_k \mid L_1 \in \text{quantile [99.5\% : 100\%]}) - M_k \}, k > 1$$

A single composite model forecasts lognormal distributions and their correlations for each cell for each LOB. By simulating from the correlated lognormals, we can extract information about the samples for which the first calendar year values are in distress. For example, they lie in the 99.5-99.6 percentile.



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The Excel macro that estimates ERC uses the identified composite model for multiple LOBs with the associated forecast scenarios.

The COM script performs the following operations:

- runs the identified composite model with the associated forecasting scenario that predicts lognormal distributions for each cell and their correlations for each LOB;
- uses the PALD module to simulate from the predicted lognormals to obtain samples of the aggregates by calendar year for each LOB and the aggregate of all LOBs;
- selects the distress simulation paths that fall into the specified VaR or T-VaR quantile for the first future calendar period;
- the selected simulations paths are used to calculate the ERC using the above mentioned formulae.

The macro also produces $E(L_k - M_k | L_1 \text{ in distress})$ for each $k=1, \dots, n$.

Due to Excel limitations, maximum of 65,000 simulations can be processed (100,000 for newer version of Excel). Hence, there are only 65 sample paths that belong to the [99.5% : 99.6%] interval and 325 sample paths that belong to [99.5% : 100%] interval. It might be a good idea to run the macro repeatedly for more confident inference.

The first calendar year being in distress could be due to parameter uncertainty, process variability, or both. For the former, the realized parameter is significantly higher than its expected value resulting in all observations being significantly higher than their expected; in the case of process variability only one or two observations would be significantly higher than expected.

The differences between ERC, the VaR for the aggregate reserve distribution $VaR(\text{aggregate})$, and $VaR(1)$ the VaR for the first calendar year is driven by the relationship between parameter uncertainty and process variability.

We have $VaR(1) \leq ERC \leq VaR(\text{aggregate})$ (1)

If parameter uncertainty is high relative to process variability, then calendar year paid losses distributions are highly correlated (first year in distress implies other years are also in distress) and ERC tends to $VaR(\text{aggregate})$. On the other hand, if parameter uncertainty is zero, the calendar year paid loss distributions are uncorrelated (first year in distress has no impact on the losses in subsequent years) resulting in ERC equal to $VaR(1)$.



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The table below illustrates those facts

	Both parameter uncertainty and process variance	No parameters uncertainties	No process variance
Total Mean Loss	\$1,473M	\$1,462M	\$1,254M
Std Dev of Reserve (or Loss) Distribution	\$169M	\$110M	\$107M
VaR_{99.5%}(1)	\$120M	\$111M	\$26M
ERC	\$176M	\$111M	\$270M
VaR_{99.5%}(aggregate)	\$496M	\$325M	\$311M

Thus, in *No parameters uncertainties* forecast scenario the ERC \$111M is equal to VaR(1) \$111M; in *No process variance* forecast scenario the ERC \$270M is close to VaR(aggregate) \$311M.

If ERC is based on a T-VaR than equation (1) also applies to T-VaRs.