Financial position and performance in IFRS 17

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Background

- General principles for determining financial performance:
  - Revenue earned as goods are delivered or services provided
  - Expenses made up of costs associated with the earned revenue
- Current practices in the insurance industry vary in different jurisdictions, and are often not aligned with these general principles
- IFRS 17 is a new International Financial Reporting Standard for insurance contracts:
  - Consistent framework for insurance industry regardless of jurisdiction
  - Aligning insurance industry with general accounting principles

Main principles in IFRS 17

- Risk-based valuation of insurance contracts, consistent with observable market prices
- Contracts divided into groups based on product line, issuing year and level of profitability
- Profits earned over time, as services are provided
- Losses recognised immediately

Contractual service margin and loss component

- Contractual service margin (CSM) measures unearned future profits
  - Added to the risk-based liability value in the balance sheet
  - Ensures that there is no initial gain for a profitable group of contracts
  - Released into profit or loss as services are provided
  - Provides a buffer for some changes in the risk-based liability value
- Loss component (LC) is the loss taken immediately if a group of contracts is unprofitable
  - Part of the risk-based liability value
  - Needs to be tracked over time to determine if a CSM arises at a future date
  - All changes in the risk-based liability value will directly affect profit or loss, until the loss component is fully reversed.

Algorithm for profit and loss

Definition (Profit or loss)

Profit or loss determined at time t for reporting period t and group g of contracts is given by

$$\mathrm{P\&L}_t^{(g)} := L^{(t-1,g)} + \mathrm{CSM}^{(t-1,g)} + P^{(t,g)} - (L^{(t,g)} + \mathrm{CSM}^{(t,g)}) - I_t^{(g)}.$$

For a group of contracts initially recognised at time t_0, where all claims are paid by time $t_0 + \tau$, under the assumption that

- $L^{(t_0-1,g)} = L^{(t_0+\tau,g)} = 0$
- $\mathrm{CSM}^{(t_0-1,g)} = \mathrm{CSM}^{(t_0+\tau,g)} = 0$

the total profit or loss for the group over its lifetime is given by

$$\sum_{t=t_0}^{t_0+\tau} \mathrm{P\&L}_t^{(g)} = \sum_{t=t_0}^{t_0+\tau} P^{(t,g)} - \sum_{t=t_0}^{t_0+\tau} I_t^{(g)}$$

Definition (Algorithm for calculating CSM and LC)

Consider a sequence of groups $(\mathrm{Gr}_t)_{t\in\mathcal{T}}$ and sequences $(W_t^{(g)})_{t\in\mathcal{T}}$ and $(U_t^{(g)})_{t\in\mathcal{T}}$, where $W_t^{(g)}$ is $[0,1]$-valued and $W_t^{(g)}=0$ for $g\notin \mathrm{Gr}_t$. Fix $(t,g)\in\mathcal{T}_+\times\cup_{s\in\mathcal{T}}\mathrm{Gr}_s$.
If $g\notin\mathrm{Gr}_{t-1}$, then set $\mathrm{CSM}^{(t-1,g)}:=0$ and $\mathrm{LC}^{(t-1,g)}:=0$.
If $g\in\mathrm{Gr}_{t-1}\cup\mathrm{Gr}_t$, $\mathrm{CSM}^{(t-1,g)}\geq 0$ and $\mathrm{LC}^{(t-1,g)}=0$, then set

$$\Delta_1 := \frac{d_{t_0,t-1}}{d_{t_0,t}}\,\mathrm{CSM}^{(t-1,g)} + \frac{d_{t_0,t-1}}{d_{t_0,t}} L^{(t-1,g)}_{\mathrm{FS},t_0} - L^{(t,g)}_{\mathrm{RC},t_0} + P^{(t,g)} \tag{1}$$

and set $\mathrm{CSM}^{(t,g)}:=W_t^{(g)}\Delta_1^+$ and $\mathrm{LC}^{(t,g)}:=\Delta_1^-$.
If $g\in\mathrm{Gr}_{t-1}\cup\mathrm{Gr}_t$, $\mathrm{CSM}^{(t-1,g)}=0$ and $\mathrm{LC}^{(t-1,g)}>0$, then set

$$\Delta_2 := -\,\mathrm{LC}^{(t-1,g)} - U_t^{(g)}\Big(L^{(t,g)}_{\mathrm{RC}} - L^{(t-1,g)}_{\mathrm{RC}} + \frac{d_{t_0,t-1}}{d_{t_0,t}} L^{(t-1,g)}_{\mathrm{FS},t_0} - L^{(t,g)}_{\mathrm{RC},t_0}\Big), \tag{2}$$

$$\Delta_3 := -\Delta_2^- + \frac{d_{t_0,t-1}}{d_{t_0,t}} L^{(t-1,g)}_{\mathrm{FS},t_0} - L^{(t,g)}_{\mathrm{RC},t_0} + P^{(t,g)} \tag{3}$$

and set $\mathrm{CSM}^{(t,g)}:=W_t^{(g)}\Delta_3^+$ and $\mathrm{LC}^{(t,g)}:=\Delta_3^-$.

- Assumption: liability cash flows are independent from financial asset values

Building blocks for measuring financial performance in IFRS 17

- Stochastic model for aggregate cash flows
- Valuation method
- Allocation method
- Algorithm for profit and loss

Valuation method

Risk-based valuation of liability cash flows, consistent with observable market prices

- Broad requirements in IFRS 17, hence many different valuation methods are possible
- Valuation of aggregate liability cash flows, to reflect diversification between groups of contracts
- We use a multi-period cost-of-capital approach, as developed in Engsner et al. (2017), inspired by Möhr (2011).

Valuation method

One-period valuation

- The **one-period** value L_0 is given by

$$L_0 := \varphi_0(X_1),$$

where X_1 is the aggregate liability cash flow in the period, and φ_0 is a valuation operator.

- **Example:** Standard deviation principle

$$\varphi_0(X_1) = \mathbb{E}[X_1] + c\,\mathrm{Var}(X_1)^{1/2}$$

for some constant $c \geq 0$.

Valuation method

Multi-period valuation

The multi-period value L is given by

$$L := L_0, \quad L_t = \varphi_t(X_{t+1} + L_{t+1}), \quad L_\tau = 0,$$

- $X = (X_t)_{t=1}^{\tau}$ are the aggregate liability cash flows in run-off,
- τ is the time point at which all contracts are terminated,
- φ_t denotes a valuation conditional on the information $\mathcal{H}_t$ at time t.

Valuation method

Multi-period cost-of-capital approach

- Hypothetical transfer of the liability to a subsidiary at time 0, together with an amount of capital equal to the liability value.
- Liability value at time 0 is $\varphi_0(Y)$, where $Y = X_1 + L_1$.
- Because of capital requirements, the owner has to supply the capital $\rho_0(Y) - \varphi_0(Y)$ at time 0, where ρ_0 is a risk measure.
- At time 1, X_1 is paid to the policyholders, and the remaining capital is $\rho_0(Y) - X_1$.
- If $\rho_0(Y) - X_1 > L_1$, the owner can collect the excess capital as compensation for providing capital at time 0.
- If $\rho_0(Y) - X_1 \leq L_1$, the owner is not required to supply more capital at time 1 (limited liability).
- Hence, the owner can collect $(\rho_0(Y) - Y)^+$ at time 1.
- The owner will only supply capital at time 0 if the expected return on the provided capital is $\eta_0 \geq 0$. Putting this altogether:

$$\mathbb{E}[(\rho_0(Y) - Y)^+] = (1 + \eta_0)(\rho_0(Y) - \varphi_0(Y))$$

Valuation method

Multi-period cost-of-capital approach

- Cost-of-capital approach:

$$\varphi_t(Y) = \rho_t(Y) - \frac{1}{1+\eta_t}\mathbb{E}[(\rho_t(Y) - Y)^+ \mid \mathcal{H}_t]$$

where ρ_t is a conditional risk measure, and (η_t) are the cost-of-capital rates, i.e. the required rate of return above that of a money market account on capital invested in the company.

Example Solvency II: $\rho_t = \mathrm{VaR}_{0.995,t}$, $\eta_t = 0.06$.

Valuation method

Multi-period cost-of-capital approach

- Cost-of-capital approach:

$$\varphi_t(Y) = \rho_t(Y) - \frac{1}{1+\eta_t}\mathbb{E}[(\rho_t(Y) - Y)^+ \mid \mathcal{H}_t]$$

  where ρ_t is a conditional risk measure, and (η_t) are the cost-of-capital rates, i.e. the required rate of return above that of a money market account on capital invested in the company.

  Example Solvency II: $\rho_t = \mathrm{VaR}_{0.995,t}$, $\eta_t = 0.06$.

- Under the assumption that all variables are jointly Gaussian

$$\varphi_t(Y) = \mathbb{E}[Y \mid \mathcal{H}_t] + c_t \operatorname{Var}(Y \mid \mathcal{H}_t)^{1/2}$$

  where c_t depends on ρ_t and η_t.

Valuation method

Multi-period cost-of-capital approach

- Explicit formula for L in terms of conditional variances of the remaining cash flows if all variables jointly Gaussian

$$
\begin{aligned}
L &= \mathbb{E}[R] &+& \sum_{t=0}^{\tau-1} c_t \Big(\mathrm{Var}(R \mid \mathcal{H}_t) - \mathrm{Var}(R \mid \mathcal{H}_{t+1}) \Big)^{1/2} \\
\text{FCF} &= \text{PVFCF} &+& \text{RA}
\end{aligned}
$$

where $R = \sum_{t=1}^{\tau} X_t$.

- IFRS 17 terminology:
  - FCF $=$ Fulfilment cash flows
  - PVFCF $=$ Present value of future cash flows
  - RA $=$ Risk adjustment

Allocation method

- CSM and profit or loss measured at contract group level
- Value of aggregate liability cash flows needs to be allocated to each contract group
- Economically sound requirements (see e.g. Kalkbrener (2005))
  - Aggregate value is fully allocated to contract groups
  - The value allocated to each group does not exceed the corresponding stand-alone value
- We obtain an explicit Euler allocation of the aggregate liability value

Allocation method

Liability value allocated to group k of contracts:

$$L^{(k)} = \mathbb{E}[R_k] + \sum_{t=0}^{\tau-1} c_t \frac{\mathrm{Cov}(R_k, R \mid \mathcal{H}_t) - \mathrm{Cov}(R_k, R \mid \mathcal{H}_{t+1})}{\Big(\mathrm{Var}(R \mid \mathcal{H}_t) - \mathrm{Var}(R \mid \mathcal{H}_{t+1})\Big)^{1/2}}$$

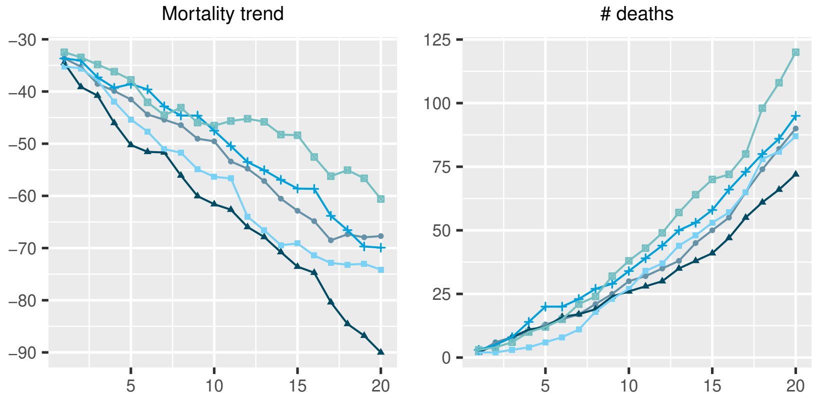
where $R_k = \sum_t X_t^{(k)}$, and $R = \sum_k R_k$.

Numerical example I: Dynamic CSM and $\mathrm{P\&L}$

- Portfolio of survival benefits
- All policyholders 50 years old at $t = 0$
- Single premium P paid at $t = 0$, with $nP = (1 + m)L^{(0)}$, where n is the number of policyholders, and $m \in \{-0.1, 0, 0.1\}$ is the margin added to the liability value
- Benefit paid out if policyholder survives until age 70
- Poisson log-bilinear stochastic mortality model (Brouhns et al. 2002)
- Deaths each year according to five simulated trajectories of stochastic mortality model, from time $t = 0$ until $t = 20$.
- Calculating liability value, CSM, LC, and $\mathrm{P\&L}$ at the end of each year, until all contracts are terminated
- Simulated value of mortality trend at the end of each year used as starting value for trend in the stochastic mortality model in the valuation

Numerical example I: Dynamic CSM and P&L

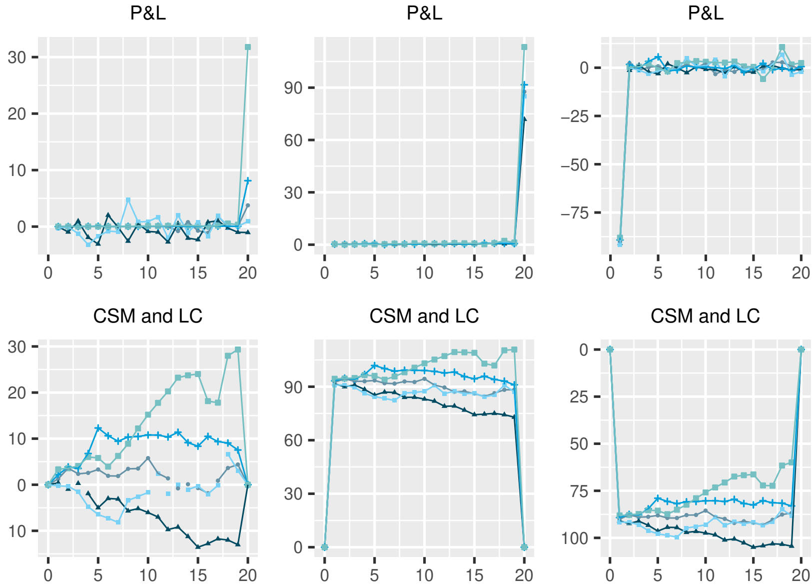
Simulated mortality trend and accumulated number of deaths



The left figure shows the trajectories for the mortality trend. The right figure shows the trajectories for the accumulated number of deaths in the portfolio consisting of 1000 contracts.

Numerical example I: Dynamic CSM and $\mathrm{P\&L}$

$\mathrm{P\&L}$ (top), CSM and LC (bottom), with margin 0 (left), 10% (middle), and -10% (right)



Numerical example I: Dynamic CSM and $\mathrm{P\&L}$

Conclusions

- The size of the total premium compared to the initial liability value can have a large effect on the pattern for $\mathrm{P\&L}$.
- If $\mathrm{CSM} > 0$, it can absorb certain changes in the liability value $\implies$ $\mathrm{P\&L}$ more stable.
- If $\mathrm{LC} > 0$, all changes in the liability value will directly affect $\mathrm{P\&L}$ $\implies$ $\mathrm{P\&L}$ more unpredictable.
- Losses are recognised immediately, profits are earned over time[1]

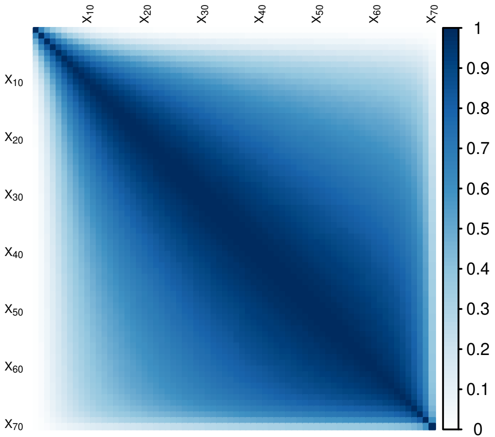
[1] Note that $\mathrm{P\&L}$ in the middle column on the previous slide is only valid for a homogeneous portfolio of survival benefits with no other costs than payments to policyholders.

Numerical example II: Initial valuation and allocation

- Portfolio of life annuities
- Empty company at $t = -19$
- Contracts issued to policyholders aged 30-64 years
- Benefit paid out at the end of each year to a policyholder aged 65-100 years, as long as the policyholder is still alive
- Policyholder arrivals according to a marked Poisson process, where marks determine the age of the arriving policyholders
- Groups of contracts determined according to the issuing year
- Poisson log-bilinear stochastic mortality model (Brouhns et al. 2002)
- At $t = 0$, valuation of the portfolio, and allocation of this value to 20 groups of contracts

Numerical example II: Initial valuation and allocation

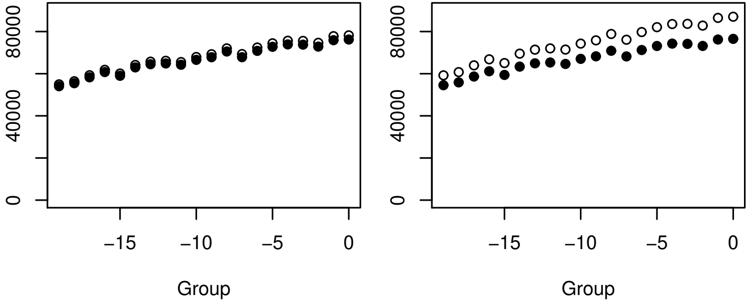
Valuation



Correlation matrix for aggregate liability cash flows

Numerical example II: Initial valuation and allocation

Allocation



Allocation of the liability value (empty circles) and the expected value of the outstanding liability cash flows (filled circles) at time $t = 0$ to the 20 groups of contracts. The left figure corresponds to a 10% cost-of-capital rate, and volatility parameter for the stochastic mortality model estimated from data. The right figure corresponds to a 20% cost-of-capital rate, and a higher volatility in the stochastic mortality model.

Main references

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