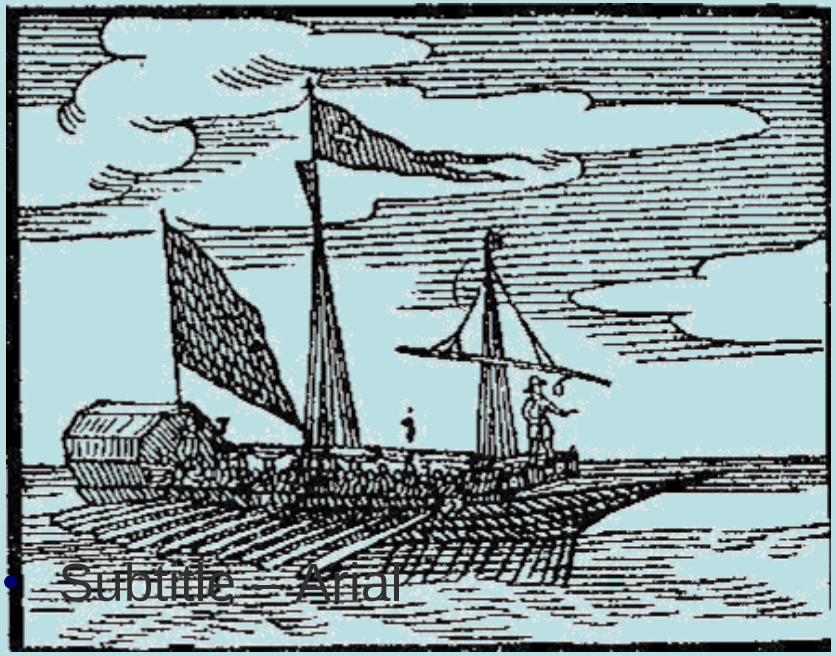
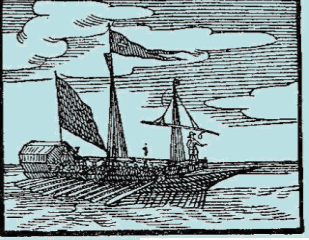
Pojistný matematik a Solventnost II
Pojistný matematik v praxi

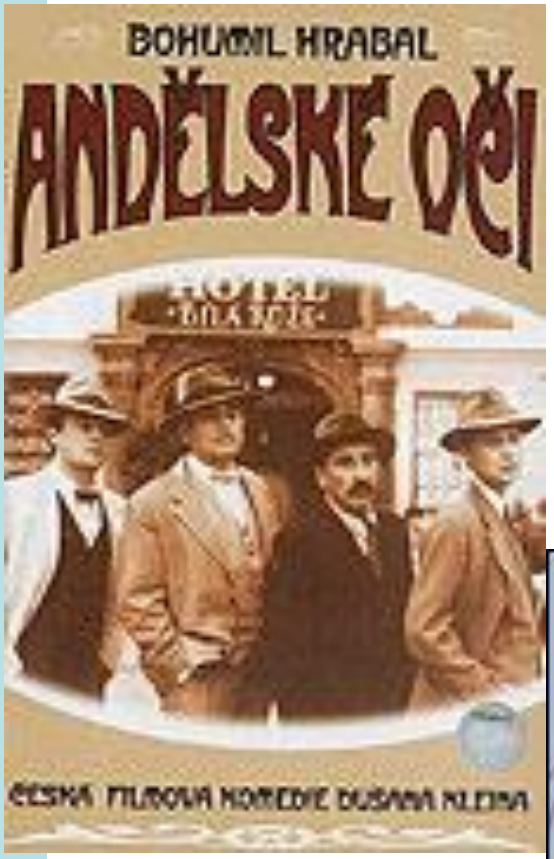


- Subtitle – Arial

Dana Bohatová Chládková
Seminář z aktuárských věd

28. března 2014




BOHUMIL HRABAL
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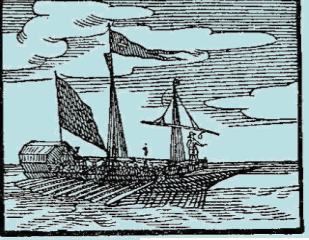
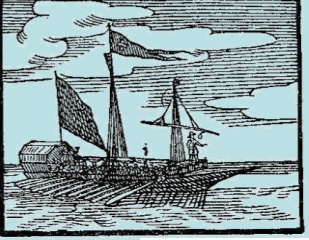


Obsah

- Základy Solvency II
- Technické rezervy
- Standardní vzorec
- Příklady

Základy Solvency II



Co je Solvency II?

...is a project which was initiated by the European Commission in 2001

...establishes capital requirements and risk management standards that will apply across the EU

...affects all areas of an insurer's operations

...aims to move away from the idea that "one approach fits all"

...encourages companies to manage risk in a way which is appropriate to the size and nature of their business

...aims to provide protection to policyholders by reducing the risk of insolvency to insurers

...will come into effect on Jan 1, 2016

Origin

Target

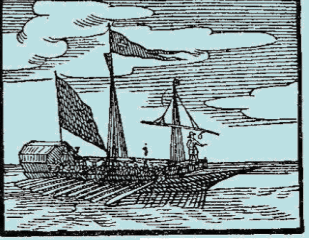
Scope

Comparison

Consequence

Aim

Timing



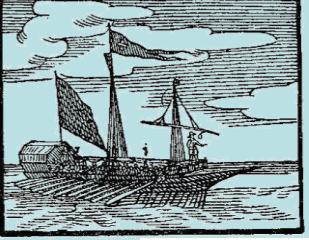
Co se mění?

Solvency I

- ‘One size fits all’ rather than risk based approach to solvency capital requirements
- Punishes prudent behaviour
- Uneven playing field
- Limited reporting requirements
- Many different requirements for different countries

Solvency II

- Replaces Solvency I across Europe: promises a (more) level playing field
- Encourages and rewards companies for managing risks
- Requires insurers to look at their risks more closely
- Requires a completely different set of financial information for reporting
- Requires increased integration of systems and processes, including IT systems
- Requires detailed documentation
- Allows for application of internal risk models for capital calculations



Proč?

A solvency capital requirement has the following purposes:

To reduce the risk that an insurer would be unable to meet claims.

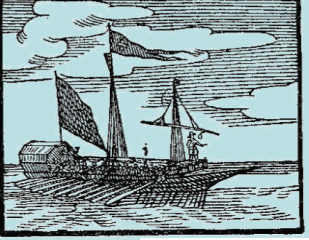
To reduce the losses suffered by policyholders in the event that a firm is unable to meet all claims fully.

To provide supervisors early warning so that they can intervene promptly if capital falls below the required level.

To promote confidence in the financial stability of the insurance sector.

Position European Commission

The objective of the Solvency II regulation is to ensure that insurance companies are financially sound and able to cope with adverse events, to protect policyholders and the financial system in general.

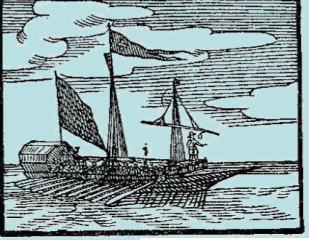


Struktura Solvency II

SOLVENCY II

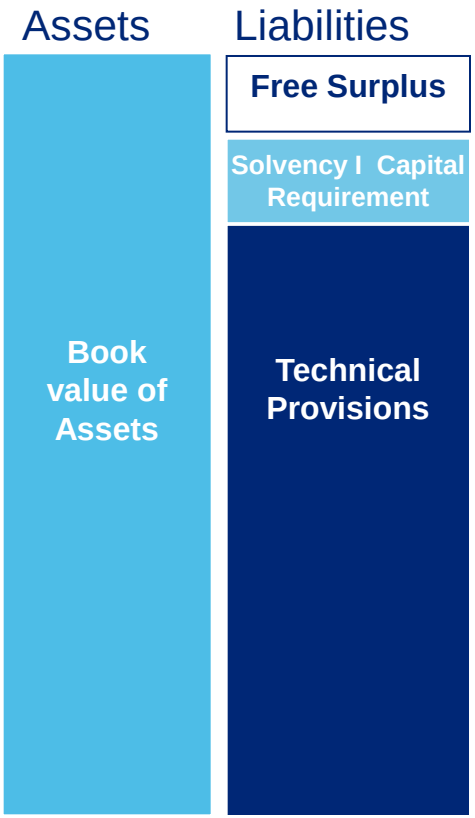
Pillar 1	Pillar 2	Pillar 3
Quantitative Requirements	**Qualitative Requirements & Rules on Supervision**	**Supervisory Reporting and Public Disclosure**
Minimum capital Requirement	Own Risk and Solvency Assessment (ORSA)	Transparency
Solvency Capital Requirement (SCR)	Capabilities and powers of regulators, areas of activity	Disclosure Requirements
Technical Provisions		Competition Related Elements
Investment Rules		
Own funds		
Quantification	**Governance**	**Disclosure**

Note: there is no reference to pillars in the Solvency II Directive or other official documents

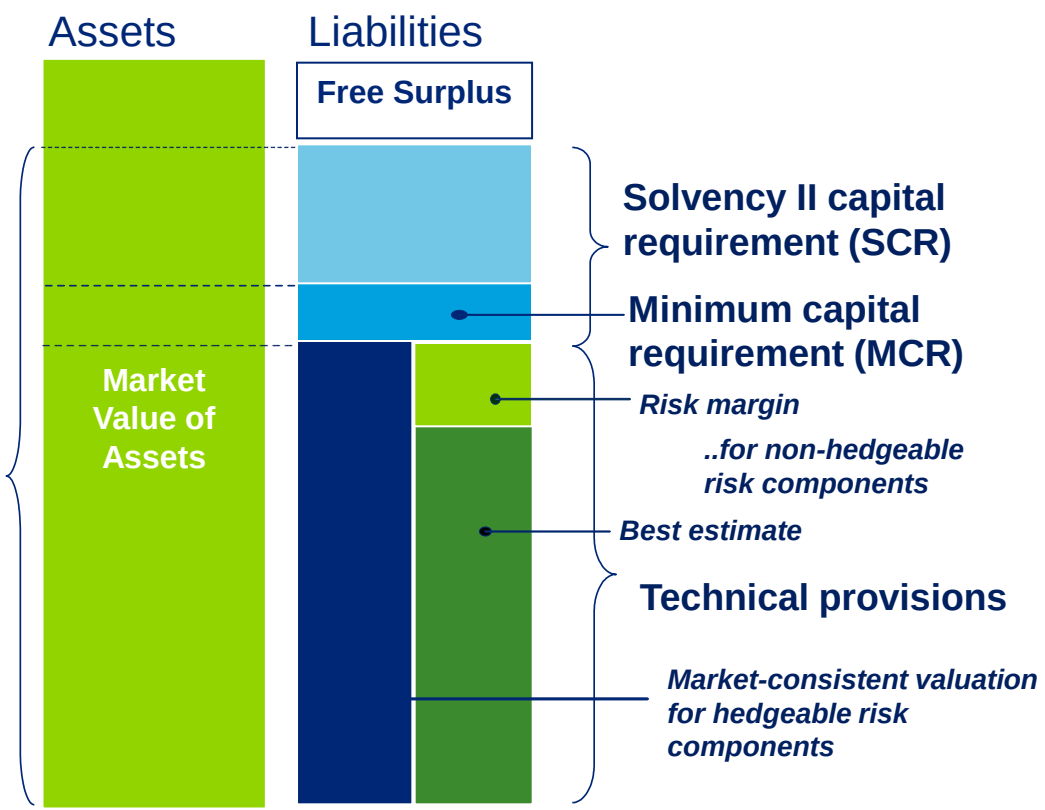


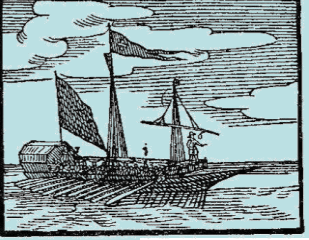
Od Solvency I k Solvency II

Solvency I

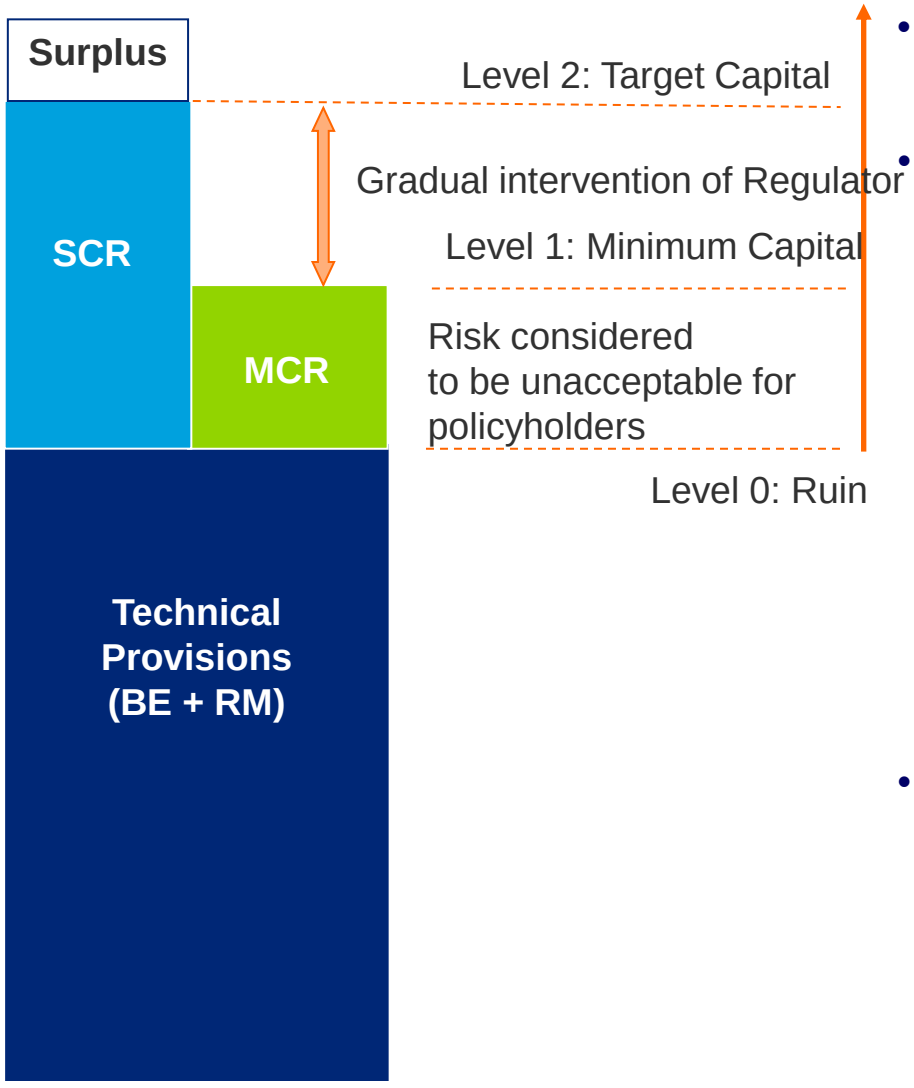


Solvency II



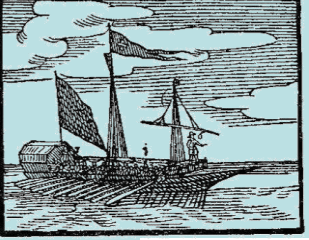


Pilíř 1: kapitálové požadavky

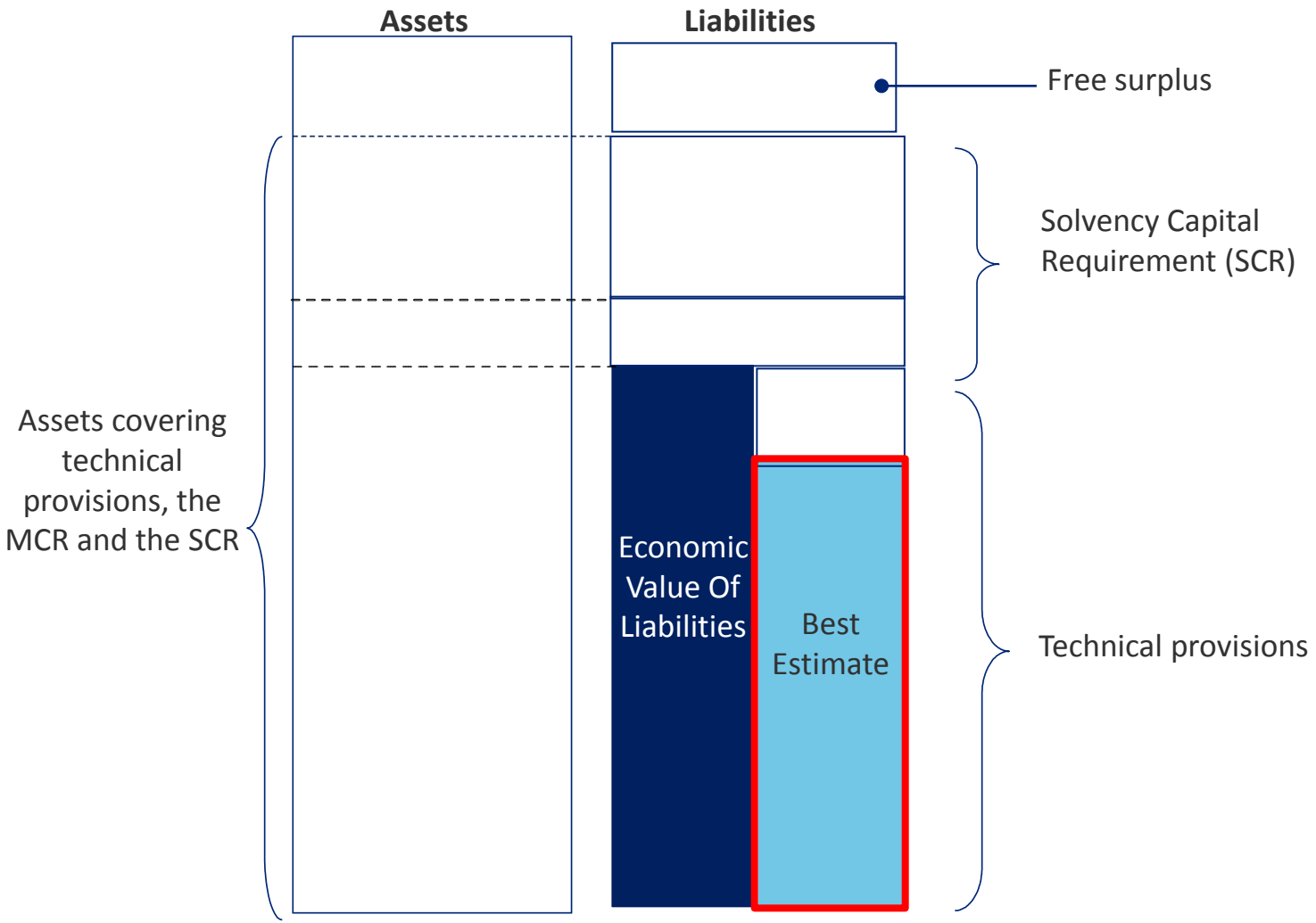


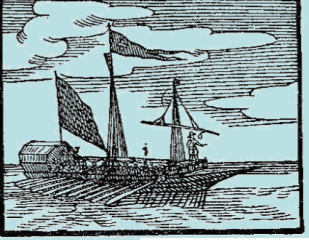
- Solvency II foresees two levels of capital requirements:
- **Solvency Capital Requirements (SCR)**
  - Level of capital to enable firm to absorb significant unforeseen losses
  - Gives reasonable assurance to policyholders and beneficiaries
  - Calibrated at 99.5% confidence over 1 year
  - Can use standard formula or own Internal Model
- **Minimum Capital Requirements (MCR)**
  - Threshold that could trigger the ultimate supervisory action if breached
  - Unacceptable risk to policyholder

Technické rezervy



Technické rezervy - Best Estimate



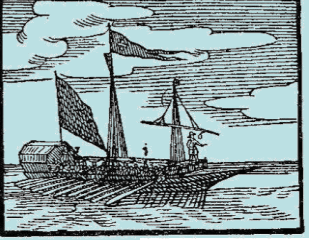


Best estimate výpočet

Definition

- **Probability weighted average** of all future cash in- and out-flows required to settle the obligations over the lifetime thereof, taking into account the time value of money, using the relevant risk free interest rate term structure

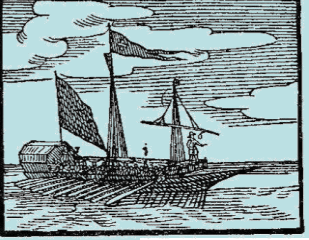
"…should be carried out by a person who has knowledge of actuarial and financial mathematics, commensurate with the nature, scale and complexity of the risks… and who are able to demonstrate their relevant experience….."



Best estimate výpočetní proces

Calculation Process

Gathering and analysing data	Determination Assumptions	Selecting and running model	Validation and documentation
• Quality of internal and external data • Data criteria • Expert judgement	• Adequate reflection of the uncertainty of the underlying cash-flows	• Appropriate valuation method • Explore key drivers	• Relevance of method and data • Comparison against experience • Documentation and communication



Best estimate předpoklady o datech

Data

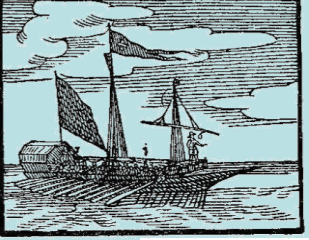
- All relevant available data whether external or internal data -> to arrive at the assumption which best reflects the characteristics of the underlying insurance portfolio.
- **All information needed** to carry out a valuation of technical provisions
- **Assumptions** are **not regarded as data**, although the use of data is an important basis to develop actuarial assumptions

Criteria to assess data quality

- **Appropriateness**: suitable for the intended purpose and relevant to the portfolio of risks being analysed?
- **Completeness**: Recognition of all of the main homogeneous risk groups? Sufficient historical information?
- **Accuracy**: free from material mistakes, errors and omissions (e.g. due to human error or IT failures)? Adequate recording, timely and consistent over time?

Data deficiencies

- E.g. due to changes in legal environment
- **Adjustments** could be made to the data, based on or complemented with **expert opinion**. Those should be justified and documented and not overwrite the raw data
- **Simplifications** could be used to calculate the technical provisions
- In no case the use of simplifications should be seen as an alternative to implementing appropriate systems and processes for collecting material relevant information and building historical databases



Best Estimate – segmentace

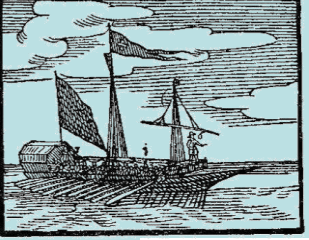
- Obligations should be segmented into **homogenous risk groups** when calculating technical provisions
- Unbundling
- As a **minimum** segmentation should be performed by **lines of business**

Life

1. Health insurance
2. Insurance with profit participation
3. Index-linked and unit-linked insurance
4. Other life insurance
5. Annuities stemming from non-life insurance contracts and relating to health insurance obligations
6. Annuities stemming from non-life insurance contracts and relating to insurance obligations other than health insurance obligations

Non-life

1. **Medical Expenses**
2. **Income protection**
3. **Workers' compensation**
4. **Motor vehicle liability**
5. **Motor, other classes**
6. **Marine, aviation and transport**
7. **Fire and other damage**
8. **General liability/third party liability**
9. **Credit and suretyship**
10. **Legal expenses**
11. **Assistance**
12. **Miscellaneous non-life insurance**



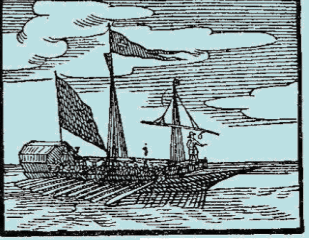
Best estimate - nejistota v cash flow projekcích

Uncertainty of cash flows

- The following uncertainties should be taken into account when cash flows are projected:
  - Policyholders' behaviour
  - Timing, frequency and severity
  - Claims amounts
  - Expected future developments

Expected future developments

- Future developments (demographic, legal, medical, technological, social, environmental and economical) which create uncertainties shall be taken into account



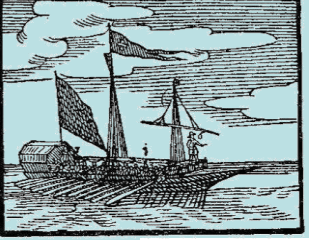
Best estimate
chování pojistníka a akce managementu

Policyholders' behaviour

- Assumptions about **contractual option exercise rates** e.g. surrender rates, paid-up rates and annuity take-up rates
- Policyholders' behaviour should **not be assumed independent** from **financial markets**, an undertaking's **treatment of customers** or publicly available information **unless proper evidence** to support the assumption can be observed

Management actions

- Investment strategy e.g. asset allocation, reinvestment horizon
- Profit sharing
- Changes in expense charge unit-linked



Best estimate projekce cash flow

Gross cash in-flows

- Future premiums
- Receivables for salvage and subrogation
- No investment returns

Gross cash out-flows

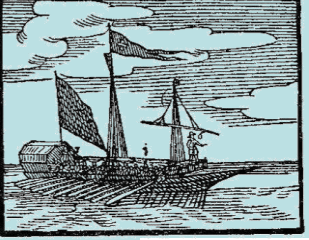
- Benefits
- Expenses
- Other e.g. taxation payments which are charged to the policyholder

Benefits

- Claims payments
- Maturity, Death, Disability benefits
- Surrender benefits
- Annuity payments
- Profit sharing

Investments

- Projection of investments is necessary for cash flows of obligations derived from assets
- Example: management fee of 0.5% of fund value
- Investment should be projected consistently with liabilities (“risk free rate”)



Best estimate
cash flow projekce – budoucí pojistné

Which cash-flows?

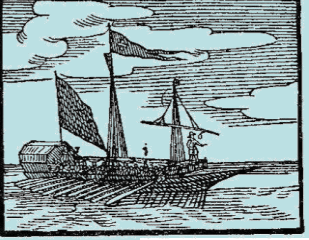
- The cash-flow projection used in the calculation of the best estimate shall take account of **all the cash in- and out-flows** required to **settle** the insurance and reinsurance **obligations** over the lifetime thereof
- Only the cash-flows relating to **existing obligations** should be recognized in the solvency balance sheet

Recognition of existing contracts

- Undertaking becomes a **party** of the contract
- Usually when the contract with the policyholder is **legally formalized**
- **Might be earlier than inception** of the insurance cover
- **Tacit renewals** where the cancellation period has already expired

Boundaries of existing contracts

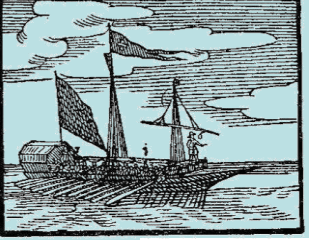
- **All future cash-flows** specified in the terms and conditions should be taken into account in the valuation of the liability
- If a **loss** is expected from **contractual options** (e.g. extension of period, coverage, guaranteed annuities) which the insurer cannot reject or amend, related future premiums (and losses) are to be taken into account with realistic option exercise rates.



Best Estimate
cash flow projekce - hranice závazků

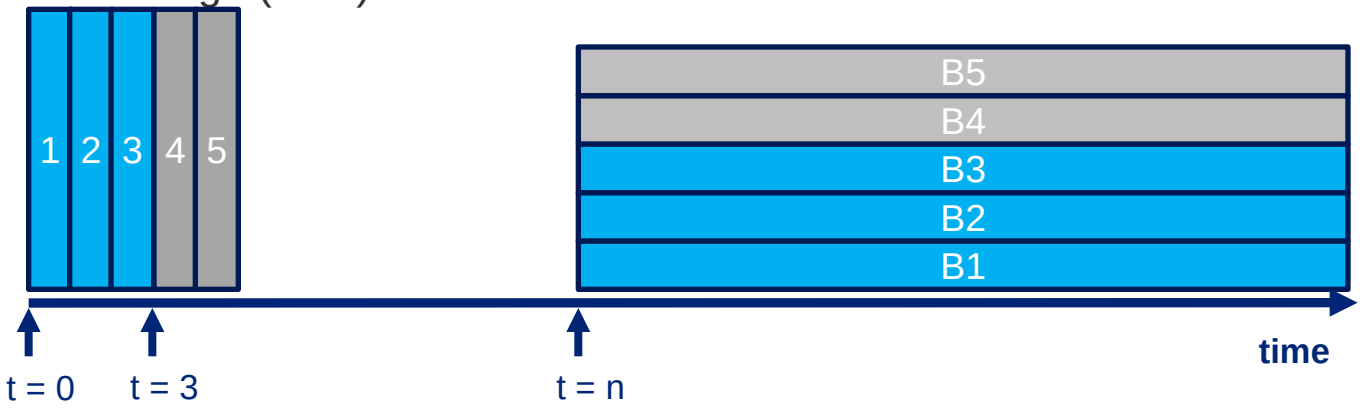
- The contract boundaries have to be properly reflected within the calculation
- Premiums after the contract boundary as well as obligations arising from that premiums should be excluded from the technical provisions
- Boundaries of the contract defined by the unilateral right of a company to
  - Terminate the contract
  - Reject premiums payable under the contract
  - Amend premiums in a way that they fully reflect the risks

- In the Czech market, the current proposal impacts mainly premium from riders
  - Premiums after the renewal (i.e. typically after the first year of projection) should not be considered
  - Negative impact on the BEL (as riders are usually profitable)

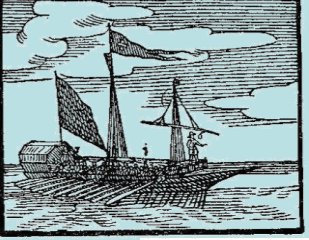


Best estimate
cash flow projekce - hranice závazků - příklad

- Consider a group pension contract.
  - The term of the contract is strictly limited to 3 years, after which a renewal can be negotiated.
  - If the contract ends, the policyholder may surrender the contract or the contract can be made paid-up.
- Each annual premium leads to a series of benefit cash-flows to be paid from the pensionable age (t = n) onwards.



- Premiums 1, 2 and 3 and the corresponding benefits B1, B2 and B3 (blue) are part of the contract and included in the calculation of the technical provisions. Reasonable assumptions should be used for the possible surrender.
- Premiums 4, and 5 and the corresponding benefits B4 and B5 (gray) are not part of the contract and not included in calculation of technical provision,
  even though they might be expected from a business perspective.



Best estimate typy opcí a garancí

Contractual options

- **Right** to change the benefits (or reduce premium) on the deliberate decision **of the (policy)holder**
- Examples: surrender value option, paid-up policy option, annuity conversion option, policy conversion option, extended coverage option

Financial guarantees

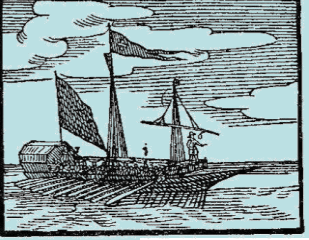
- **Possibility** to **pass losses** to the insurer or **receive additional benefits** (or reduce future premiums)
- Examples: guaranteed invested capital, guaranteed minimum investment return, profit sharing

Non-financial guarantees

- Benefits driven by the **evolution of non-financial variables**
- Examples: reinstatement premiums in reinsurance, experience adjustments

Methodologies

- **Stochastic approach** (both closed form and stochastic simulation)
- Series of deterministic **projections with attributed probabilities**
- **Deterministic valuation**



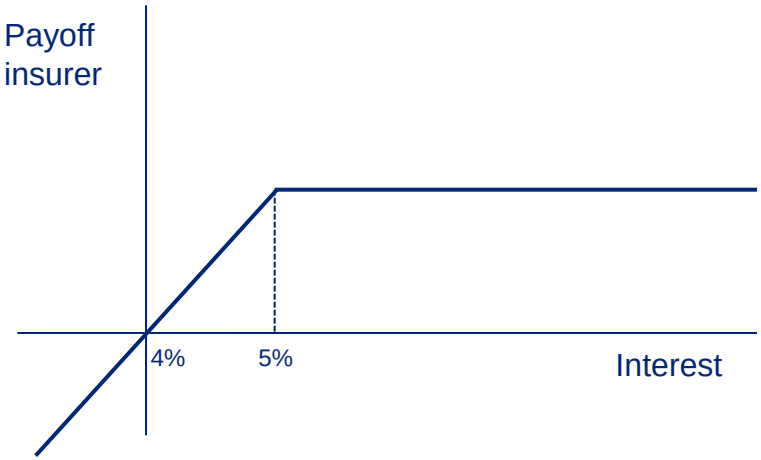
Best estimate ocenění opcí a garancí

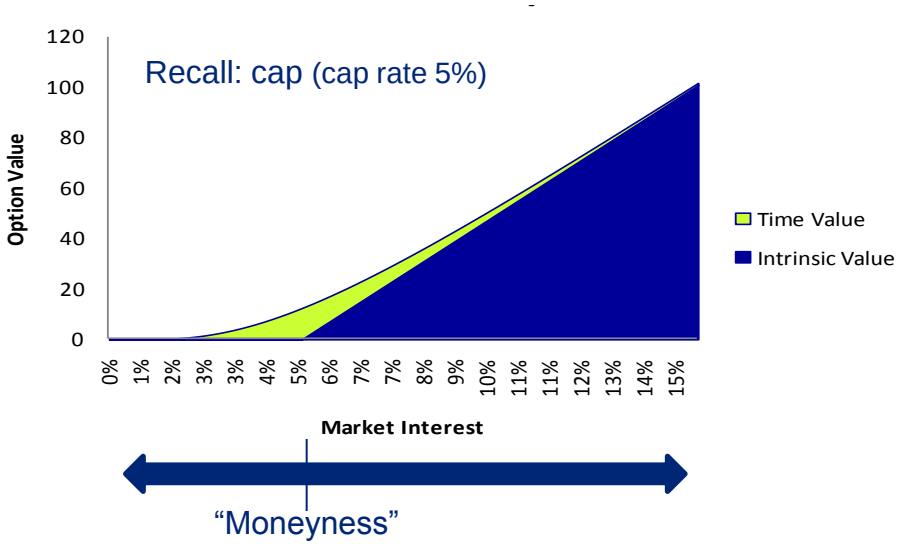
Example: profit sharing

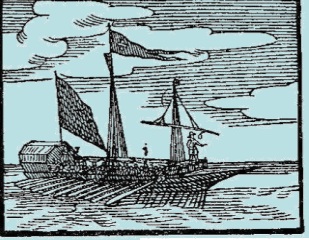
- Consider the following profit sharing rule:

  x% * (y% * Return – z% * Guaranteed Interest – Margin)

- For simplicity assume x%=y%=z%=100% and Margin = 1%, for a contract with a guaranteed interest rate of 4% we get the following payoff function:







Best estimate předpoklady

Consistency

- Consistent with information provided by financial markets
- Consistent with available data on insurance and reinsurance technical risks

Determination

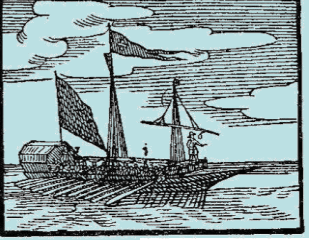
- Set in realistic manner
- Based on credible data
- Derived consistently from year to year without arbitrary changes; the changes and their impact should be quantified , traced, explained and documented

Assumptions consistent with financial markets

- Risk free interest rate
- Exchange rates
- Market inflation rates (consumer price index or sector inflation)
- Economic scenario files (i.e. set of scenarios of correlated market variables)

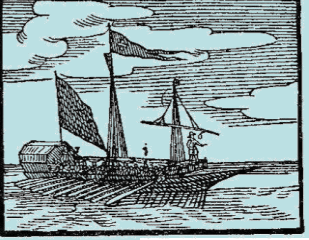
Undertaking and portfolio specific data

- Assumptions consistent with generally available data on (re)insurance technical risks should be based on characteristics of the portfolio, where possible regardless of undertaking holding portfolio.
- Undertaking specific data (e.g. regarding claims management) to be used only if it better reflects the characteristics of the portfolio.



Best estimate předpoklady - biometrické

- Underwriting risk related to human life conditions:
  - Longevity / Mortality
  - Disability / Morbidity
- Mortality vs. Longevity risk :
  - Mortality: risk that the number of deaths > expected
  - Longevity: risk that the number of deaths < expected
  - Best estimate common practice is deterministic, with stochastic approach for reserving of the-value of options and guarantees
  - Underlying assumption is choice of a base mortality table
- Best estimate assumptions should take into account
  - Current observed experience (best estimate at valuation date)
  - Expected change in the future (best estimate of future trend)



Best estimate
předpoklad o nákladech

Which expenses?

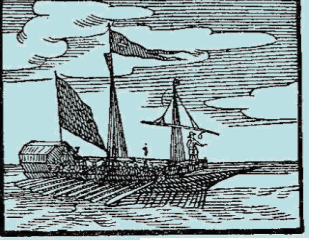
- Incurred in servicing all **obligations related to existing (re)insurance contracts** over the lifetime thereof
- **Allocated expenses** directly assignable to individual claims, policies or transactions
- **Unallocated (overhead) expenses**: all other expenses which the insurer incurs in settling its obligations assuming that the undertaking continues to write further new business.

Types of expenses

- Administrative expenses
- Investment management expenses
- Claims management expenses / handling expenses
- Acquisition expenses including commissions which are expected to be incurred in the future

Determination expense assumptions

- Non-life: allocation between premium and claims provisions
- Based on own analysis and relevant market data. Allowance for inflation should be consistent with economic assumptions. Allowance for expected future cost increase



Best estimate životní závazky

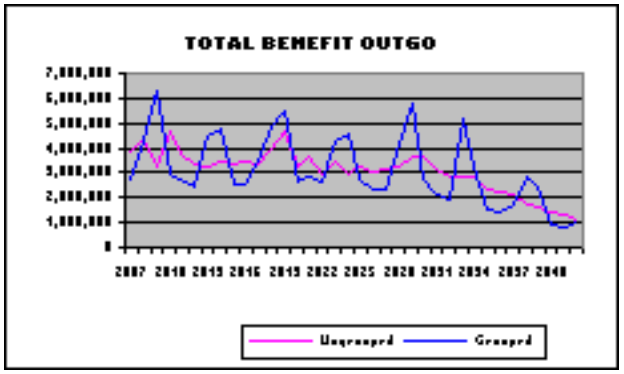
Valuation

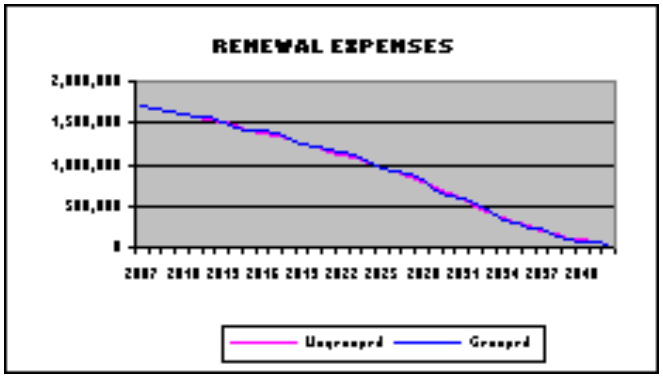
- Cash-flow projection should be based on a **policy-by-policy approach**, but reasonable actuarial methods and approximations may be used
- **Negative best estimates** are allowed and **no surrender floor** assumed

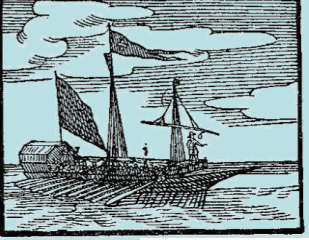
Conditions for the use of model points

- No significant differences in the nature, scale and complexity of the risks underlying the policies that belong to the same group;
- Grouping does not misrepresent the risk underlying the policies and does not misstate their expenses;
- Grouping likely to give approximately the same results, in particular in relation to financial guarantees and contractual options.

Example output







Best estimate neživotní závazky

Split of valuation of best estimate

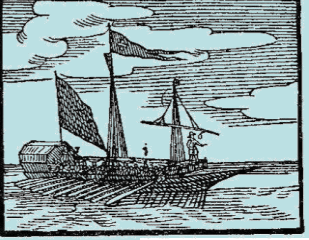
- Separate valuation of provisions for **claims outstanding** and **premium provisions**

Premium provisions

- Related to future claim events after the valuation date and during the remaining coverage period of the policies held
- Cash-flow projections: all future claim payments and claims administration expenses, cash flows arising from ongoing administration of the in-force policies and expected future premiums from existing policies
- Negative best estimate must not be set to zero
- Future policyholder behaviour should be taken into account such as the likelihood of policy lapse during the remaining period

Claims outstanding

- Cash-flow projection of claims events before or at valuation date
- Whether the claims have been **reported or not**
- All future claim payments as well as **benefits, expensed and premiums relating to those events.**



Best estimate výběr modelu

Life insurance

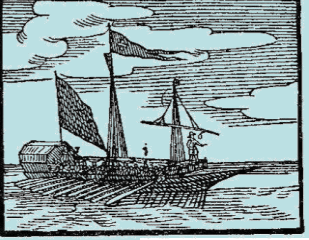
- As **simulation** (monte carlo) may lead to a more appropriate and robust valuation for participating contracts or other contracts with embedded options and guarantees, simulation techniques would normally be required in such circumstances

Non-life insurance

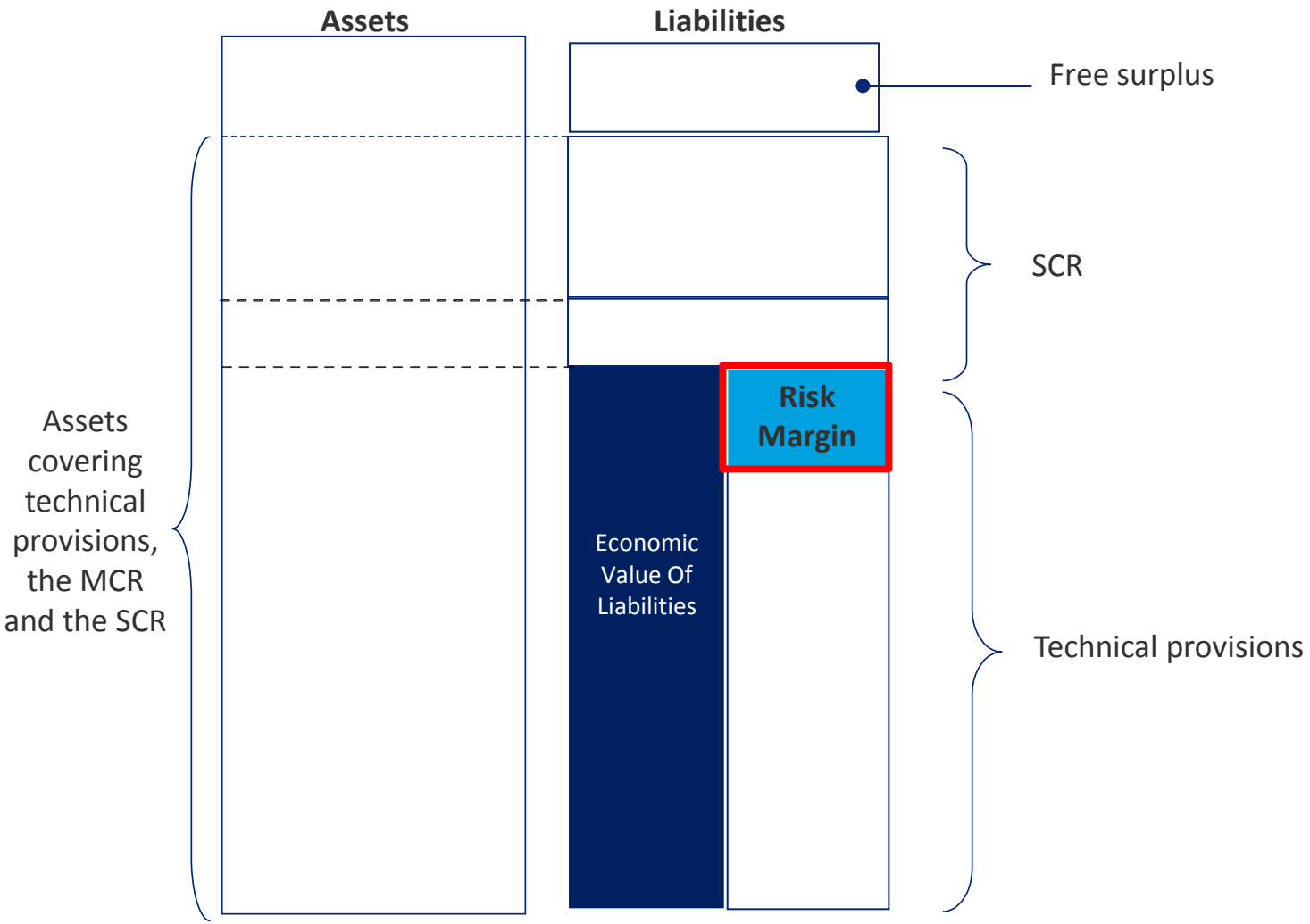
- For non-life insurance and life insurance not covered above, **deterministic** (e.g. chain ladder, Bornhuetter Ferguson, average cost per claims, outliers via case-by-case reserving, stress and scenario testing) and **analytical** techniques (e.g. Black & Scholes, Mack method) might be more appropriate
- Reason:
  - Deterministic results are often used to calibrate simulation methods
  - Both stochastic and deterministic methods are based on historical data so the resulting mean will be the trend in past data
  - Stochastic error
  - Non-life stochastic reserving methods are not mature and have a lot of limitations

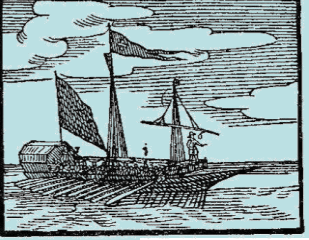
Importance of judgement

- Regardless of the technique, **judgement** is necessary to make additions or adjustments to allow for circumstances not included in the history



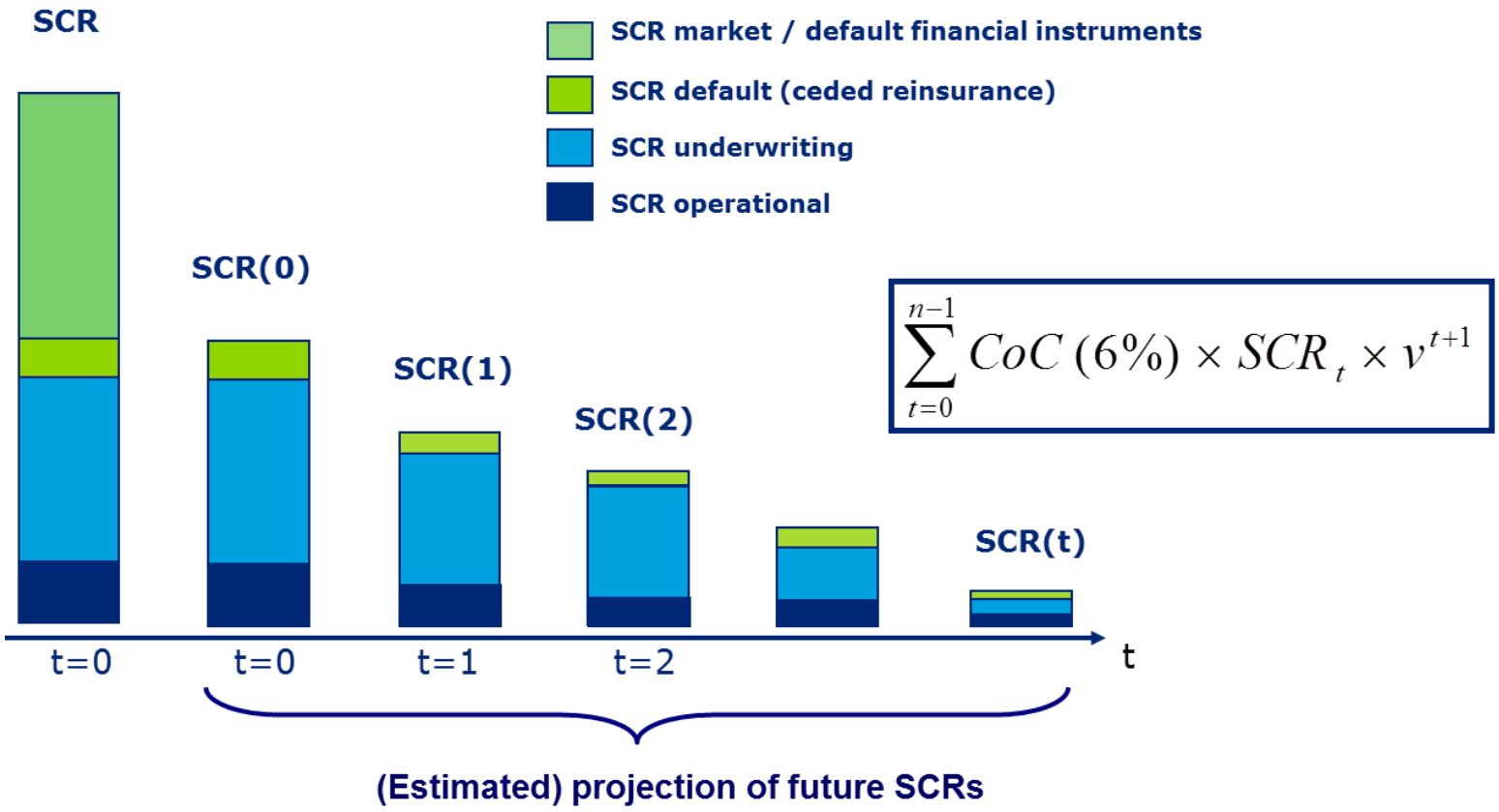
Technické rezervy - Riziková přirážka



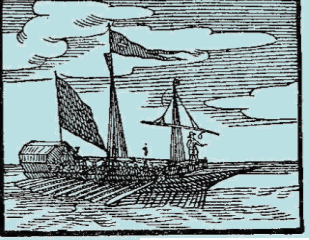


Technické rezervy
Riziková přirážka

- Risk margin should ensure that the amount of technical reserves is equal to the amount, which should be given to another insurance company for taking over the liabilities from the insurance contracts



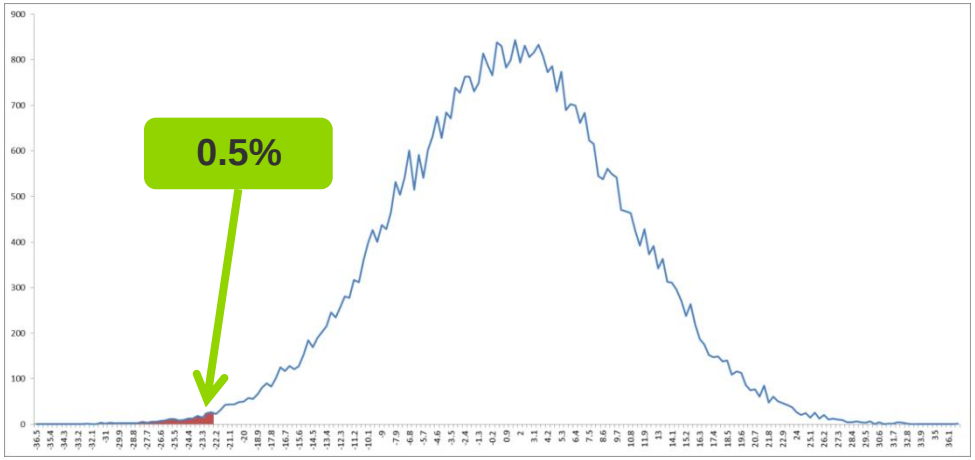
Solventnostní kapitálový požadavek (SCR)



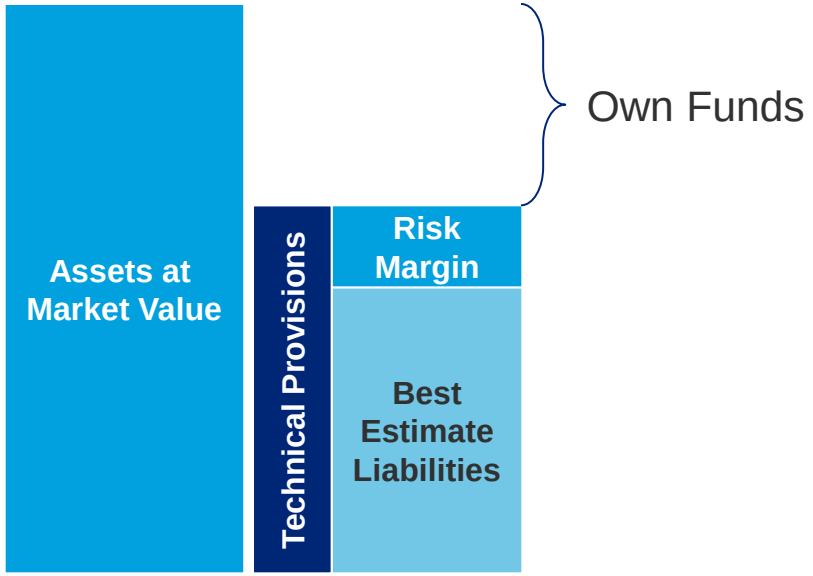
SCR Definice

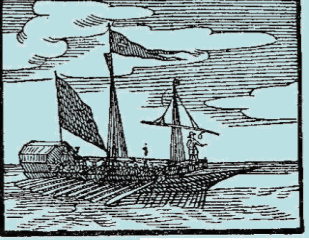
- Solvency II Directive on SCR:

Solvency Capital Requirement shall correspond to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99,5 % over a one-year period.

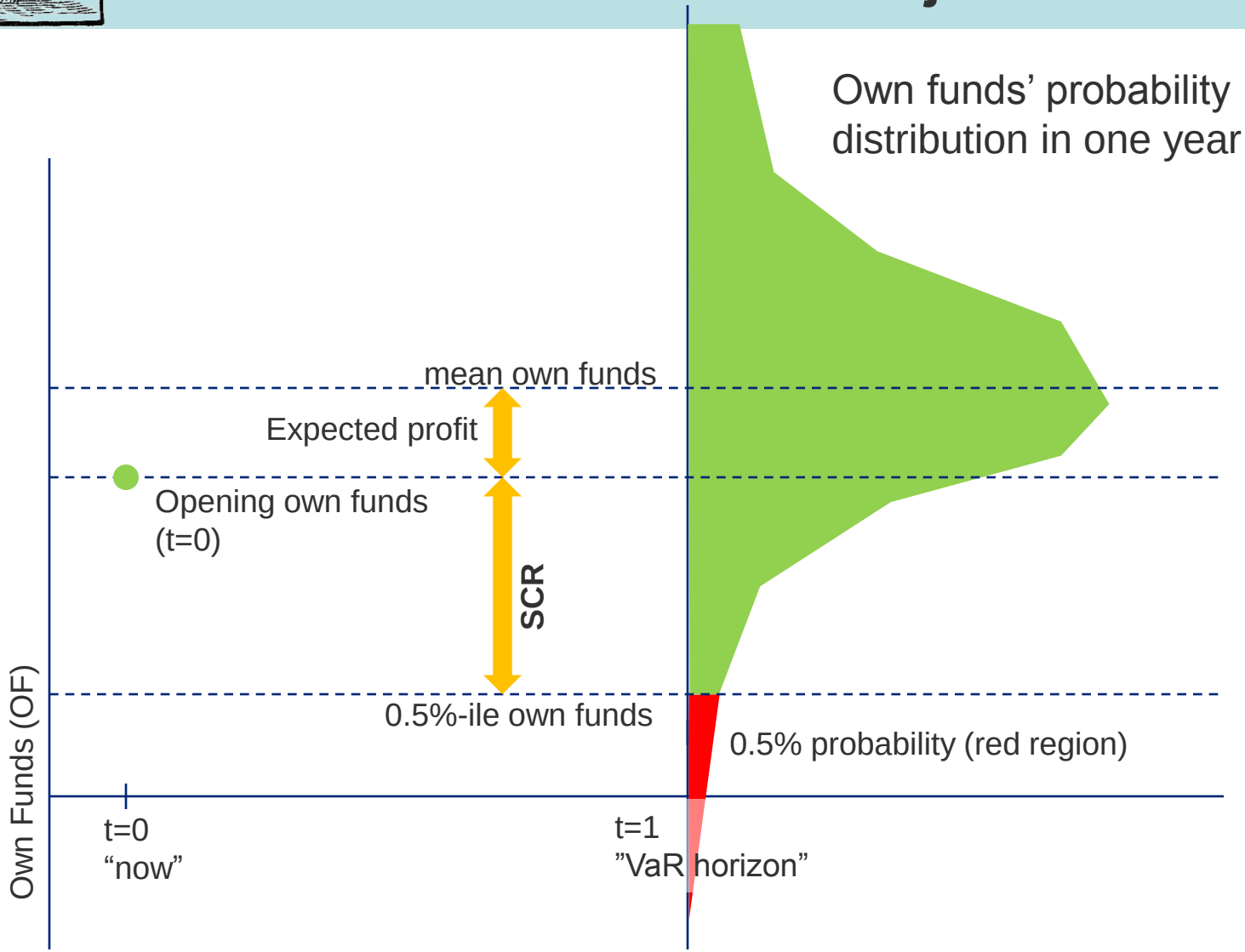


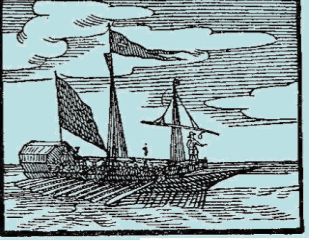
- Basic own funds: excess of assets over liabilities (market consistent valuation)





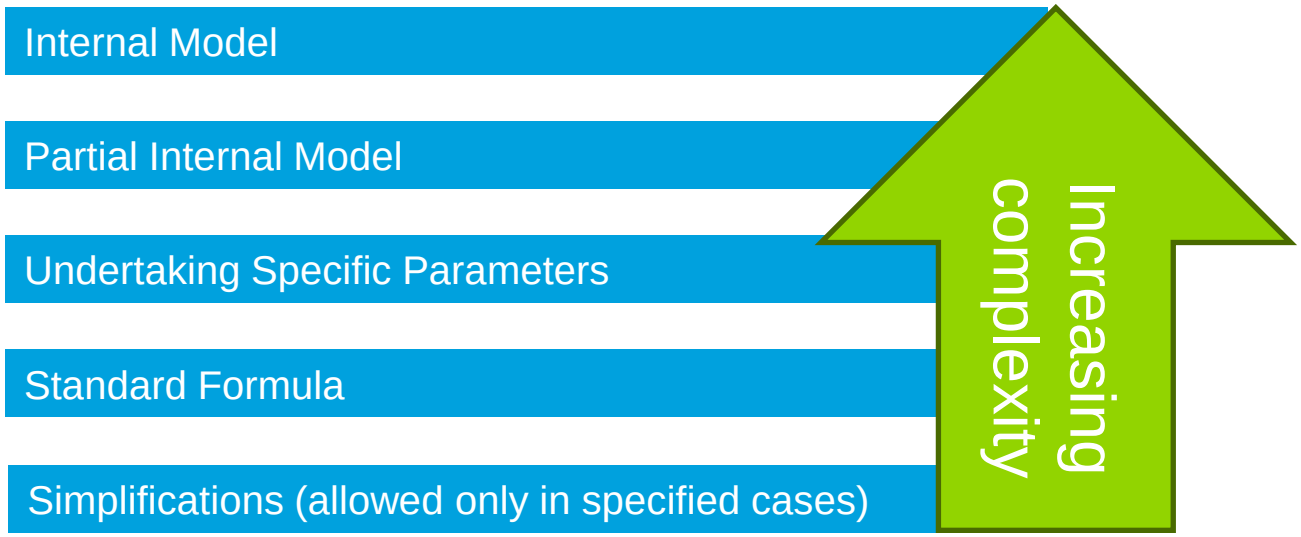
SCR
jednoroční horizont



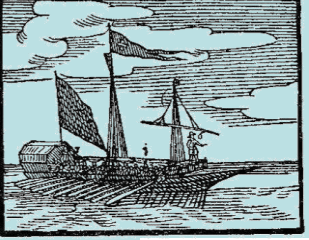


SCR
výběr metod

- The principle of proportionality is intended to support the consistent application of the principles-based solvency requirements to all insurers. Based on the nature, scale and complexity of the risks, the following methods can be used to calculate the SCR:



- The undertaking should be able to explain which methods are used and why the specific methods are selected



SCR
porovnání metod

Requires calculation of capital requirement estimated to be sufficient to cover liabilities following a 1 in 200 year event

Options for calculation of SCR

Standard Formula

Generic factor based formula that calculates 1 in 200 capital

Internal Model

Firm specific methodology for calculating 1 in 200 capital, which must receive prior supervisory approval

Partial Internal Model

Hybrid approach which uses both standard formula and internal modelling to calculate 1 in 200 capital with prior supervisory approval

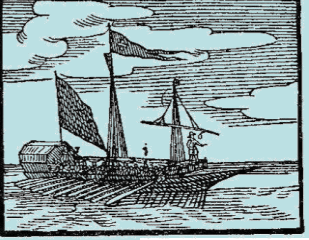
Simplified Standard Formula

Less complicated standard formula calculation for insurers with a lower risk business and a risk profile that is relatively less complex

Undertaking Specific Parameters

Use of an insurer's own data for the following risk sub-modules: non-life premium and reserve; life revision; and related health modules

Standardní vzorec



Standardní vzorec moduly

- Correlation
- Loss absorbing capacity of Technical Provisions and deferred taxes

SCR

Risk modules

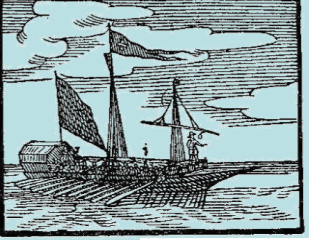
- Market
- Default
- Life
- Non life
- Health
- Operational Risk

Formulas or stress tests

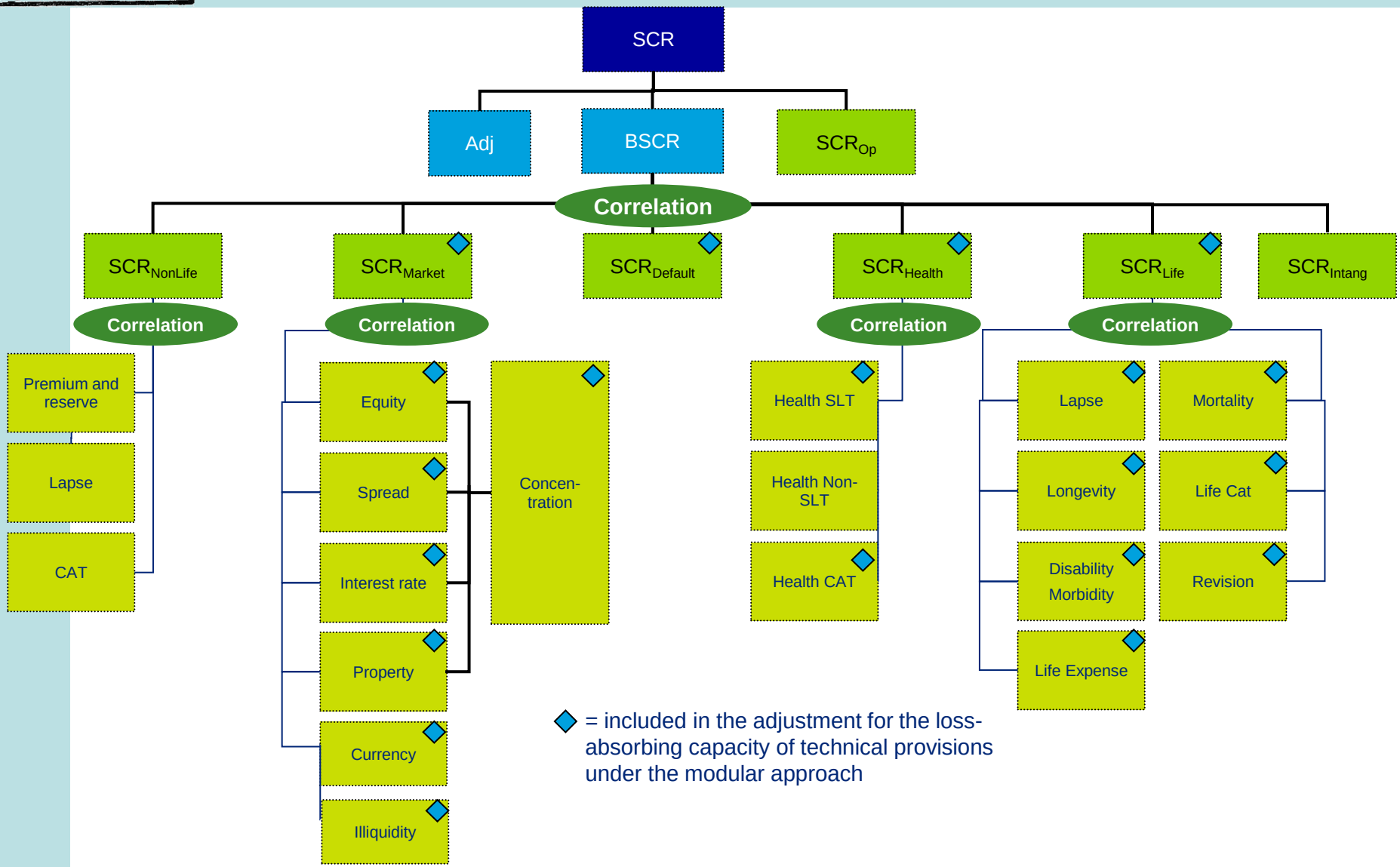
- Lapse
- Disability
- Life Expense
- Revision
- Longevity
- Life Cat
- Mortality

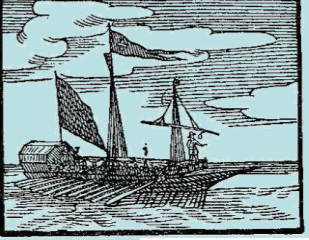
15% increase of mortality rates

20% decrease of mortality rates



Standardní vzorec SCR typologie rizik





SCR – šoky - příklad 1

Step 1

- Calculate base free surplus:

$$\{\text{free surplus}\}_{base} = \{\text{asset value}\}_{base} - \{\text{technical provision}\}_{base}$$

$$10 = 100 - 90$$

Step 2

- Example: assume that 1 in 200 year event in respect of equity values is a stock market crash of 50%
- Apply this shock to the asset value and the technical provision
- This gives a new (lower) free surplus:

$$\{\text{free surplus}\}_{equity} = \{\text{asset value}\}_{equity} - \{\text{technical provision}\}_{equity}$$

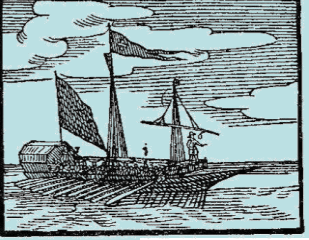
$$7 = 97 - 90$$

Step 3

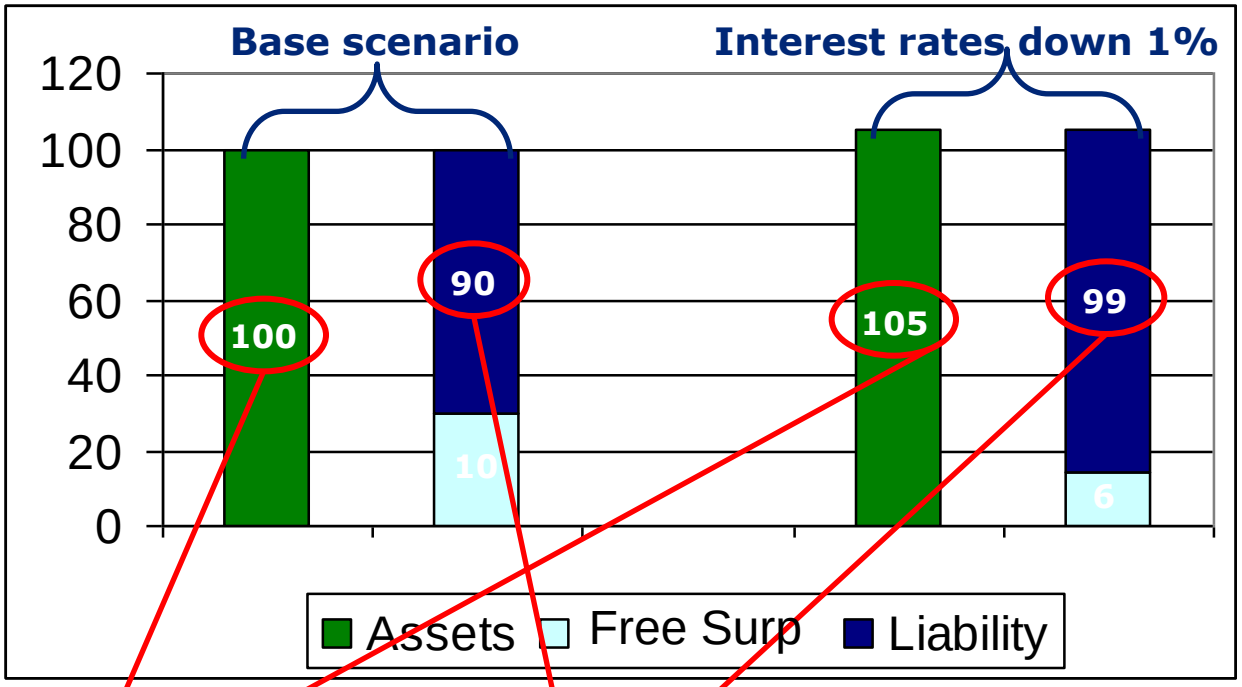
- $\mathbf{SCR}_{equity} = \{\text{free surplus}\}_{base} - \{\text{free surplus}\}_{equity} = 10 - 7 = 3$

Step 4

- Repeat for each stress test, add up (but some diversification allowed)



SCR – šoky - příklad 2



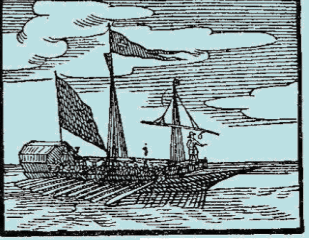
Asset duration = short
Current MV = 100
Stressed MV = 105

Liab duration = long
Current MV = 90
Stressed MV = 99

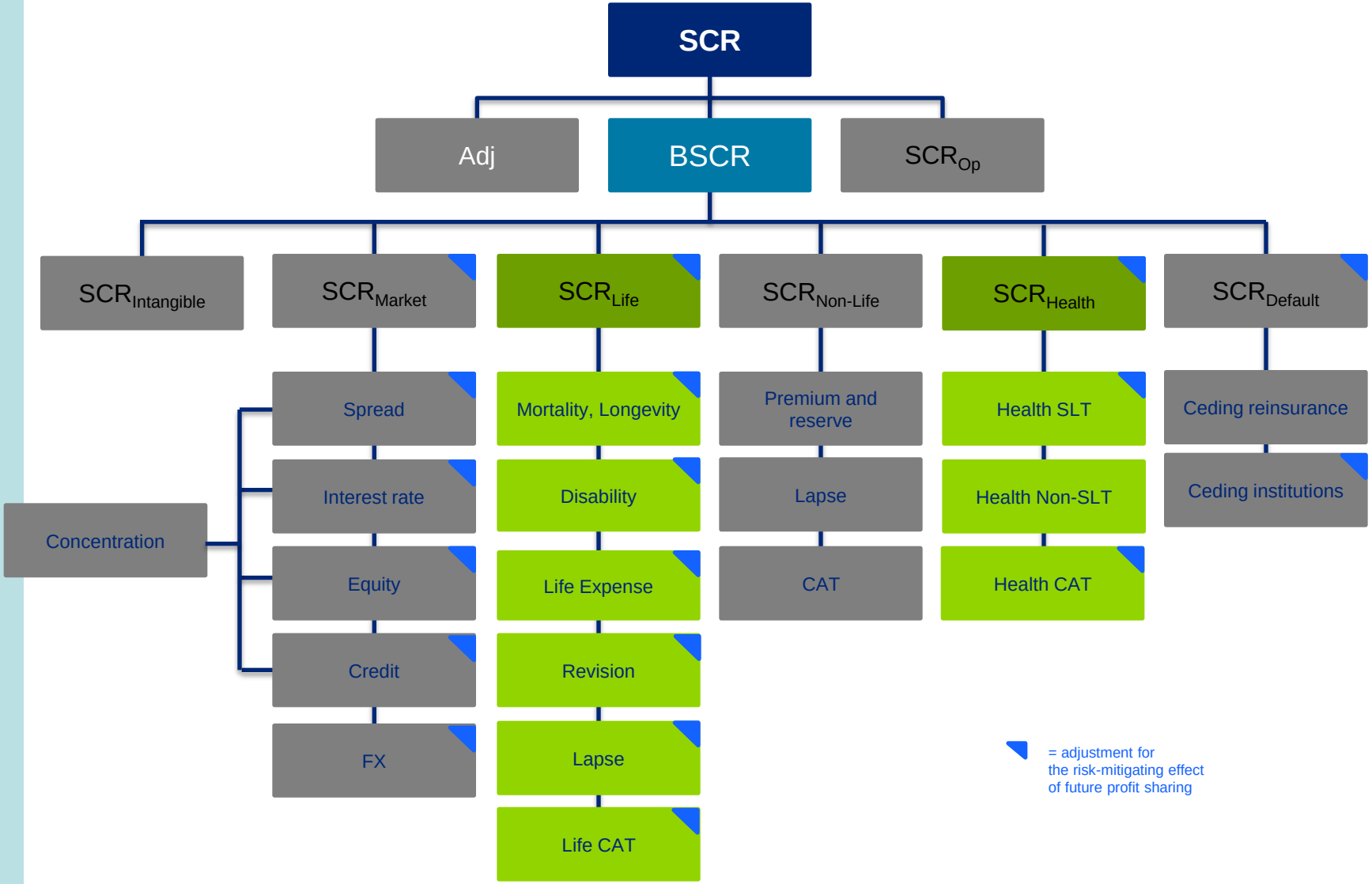
Asset increase = 5
Liab increase = 9

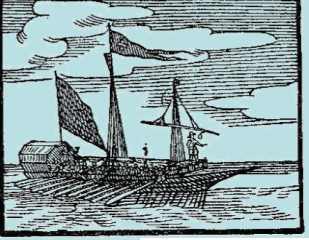
Free surplus decrease by 4

SCR (interest rate fall) =4

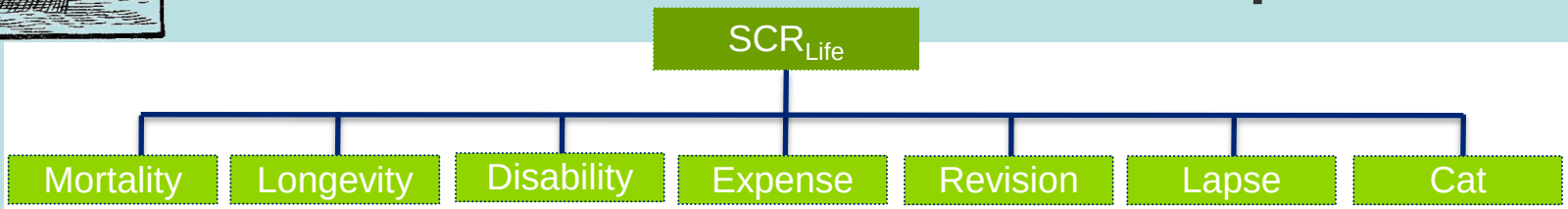


Standardní vzorec
životní a zdravotní upisovací riziko





Standardní vzorec životní upisovací riziko



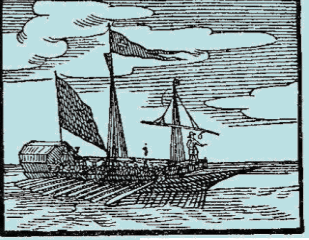
SCR for life underwriting risk (standard formula)

- The capital charge for each life underwriting risk is first calculated and then a correlation matrix is used to determine the overall SCR_{life}

$$Life_{UL/C} = \sqrt{\sum_{rxc} CorrLife_{r,c} \bullet Life_r \bullet Life_c}$$

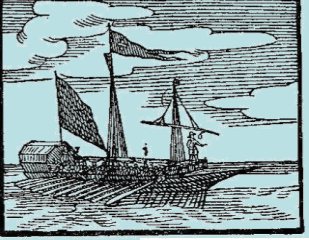
$Life_{UL/C}$	=	Capital charge for life risk
$CorrLife_{r,c}$	=	the cells of the correlation matrix *CorrLife*
$Life_r$, $Life_c$	=	Capital charges for individual life sub-risks according to the rows and columns of correlation matrix *CorrLife*

	Mortality	Longevity	Disability	Lapse	Expense	Revision	Cat
Mortality	1						
Longevity	-0.25	1					
Disability	0.25	0	1				
Lapse	0	0.25	0	1			
Expense	0.25	0.25	0.5	0.5	1		
Revision	0	0.25	0	0	0.5	1	
Cat	0.25	0	0.25	0.25	0.25	0	1



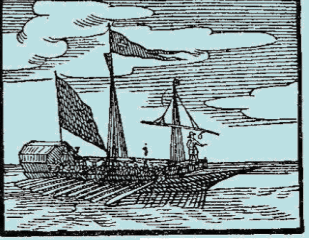
Standardní vzorec
životní a zdravotní upisovací riziko

Risk	Scope	Applicable stress
Mortality	• Applicable to obligations contingent on mortality risk i.e. where the amount currently payable on death exceeds the technical provisions.	• A permanent **15%** increase in mortality rates for mortality risk
Longevity	• Applicable to obligations contingent on longevity risk i.e. there is no death benefit or where the amount currently payable on death is less than the technical provisions.	• A permanent **20%** decrease in mortality rates for mortality risk
Disability	• Applicable for obligations contingent on a definition of disability (compensation of losses or medical expenses due to illness, accident or disability / where morbidity acts as an acceleration of payments or obligations which fall due on death). • Is likely to be applied only in cases where it is not appropriate to unbundle contracts (otherwise in health module instead of life module).	• A **35%** increase in disability **inception rates** and a **25%** increase for **subsequent years**. • Where applicable, a permanent **decrease of 20% in recovery rates**
Life Cat.	• Applicable to obligations which are contingent on mortality i.e. an increase in mortality increases technical provisions.	• **Absolute** increase in the rate of policyholders dying of **1.5 per mille over the following year**.



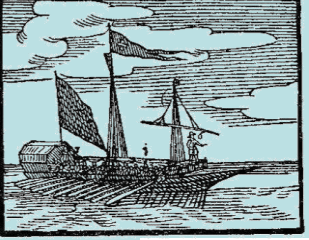
Standardní vzorec
životní a zdravotní upisovací riziko

Risk	Scope	Applicable stress
Expense	• Covers risk arising from change in expenses incurred in servicing (re)insurance contracts. • Captured by increasing expected future expenses by fixed proportion and increasing future expense inflation.	• Increase of **10% in future expenses** compared to best estimate anticipations • Increase by **1% per annum of the inflation** rate compared to anticipations.
Revison	• Only to be applied on annuities (or benefits that can be approximated by annuity) arising from non-life claims (excluding health SLT) where the amount of the annuity may be revised during the next year.	• Increase of **3%** in the annual amount payable for annuities exposed to revision risk. • **Undertaking-specific parameters** allowed for this module.
Lapse	• This sub-module covers the risk **of adverse changes in option take up behaviour of policyholders**. • **All legal and contractual policyholder options** which can significantly change the value of future cash-flows should be taken into account (fully or partially terminate, decrease, restrict or suspend as well as the full or partial establishment, renewal, increase, extension or resumption of the insurance cover)	• Shock up and down of **50%** of lapse rates (but limited to a maximum change). • Lapse mass shock of **30% of surrender strains** for retail business and **70%** for non-retail business.

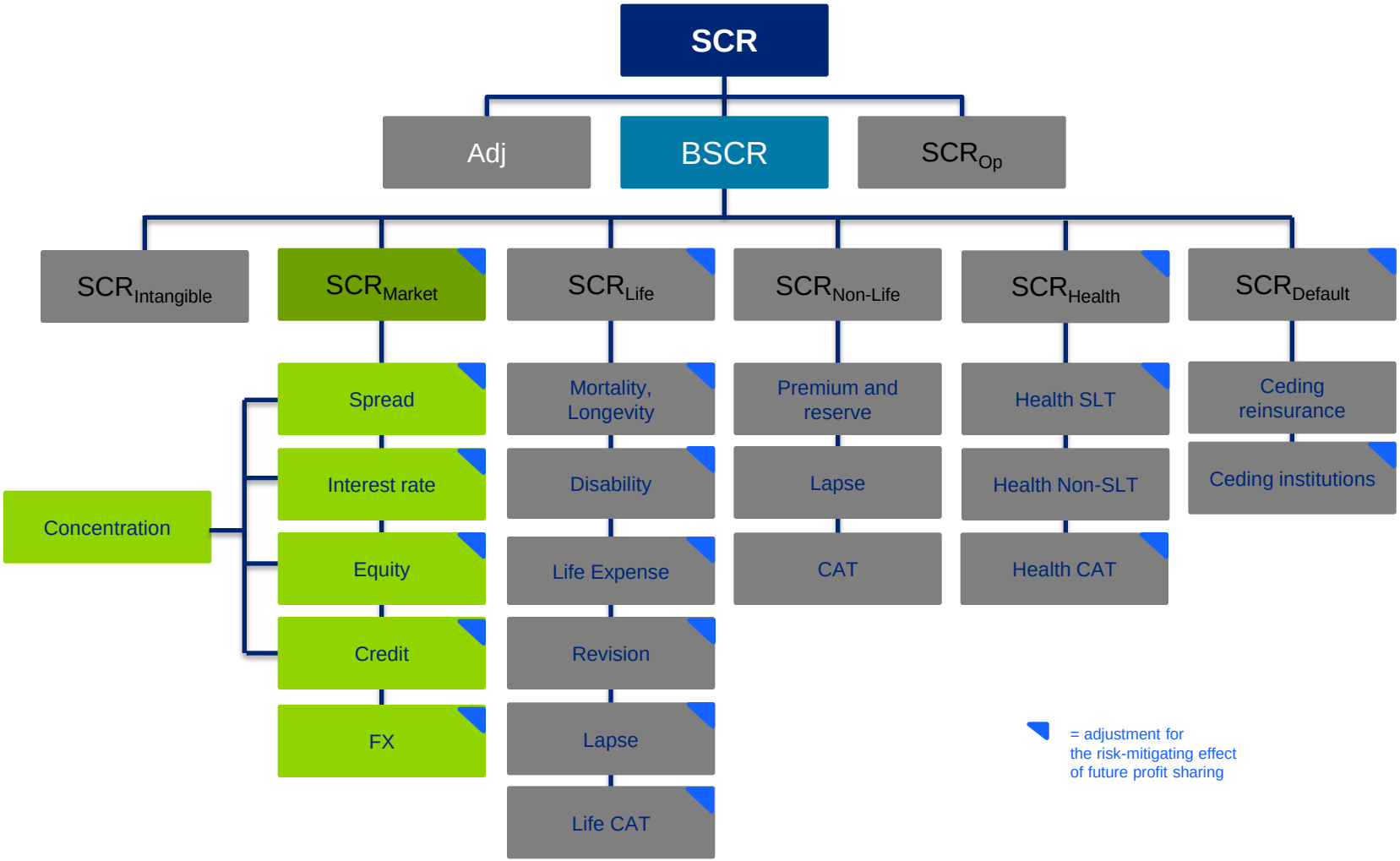


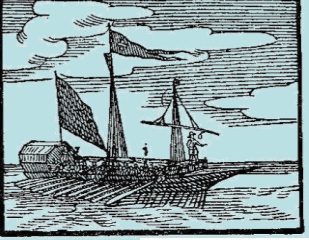
Standardní vzorec
životní a zdravotní upisovací riziko

Risk	Scope	Applicable stress
Health Disability	The sum of the capital requirement for medical expense disability risk and the capital requirement for income protection disability risk.	Medical expense • an instantaneous **increase/decrease of 5%** in the amount of medical payments and an **increase/decrease by 1 percentage** point in the inflation rate of medical payments. Income protection disability-morbidity risk • Instantaneous **increase** in disability rates **by 35% over the following year** and **by 25%** for all months **after the first year**.



Standardní vzorec tržní riziko





Solvency Capital Requirements Market Risk

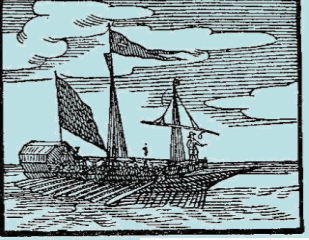
SCR for market risk

- The capital charge for each market risk is first calculated – usually via calculating NAV in a scenario with specified increase or decrease in the respective rates

$$SCR_{market} = \sqrt{\sum_{i,j} Corr_{i,j}\ SCR_i\ SCR_j}$$

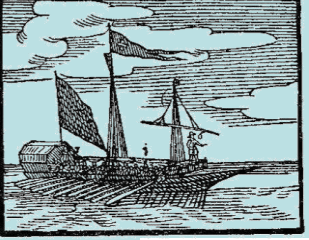
	Interest rate	Equity	Property	Spread	Concentration	FX
Interest rate	1					
Equity	A*	1				
Property	A*	0.75	1			
Spread	A*	0.75	0.5	1		
Concentration	0	0	0	0	1	
FX	0.25	0.25	0.25	0.25	0	1

* 0 if the capital requirement for interest rate results from increase of interest rates, o.w. 0.5

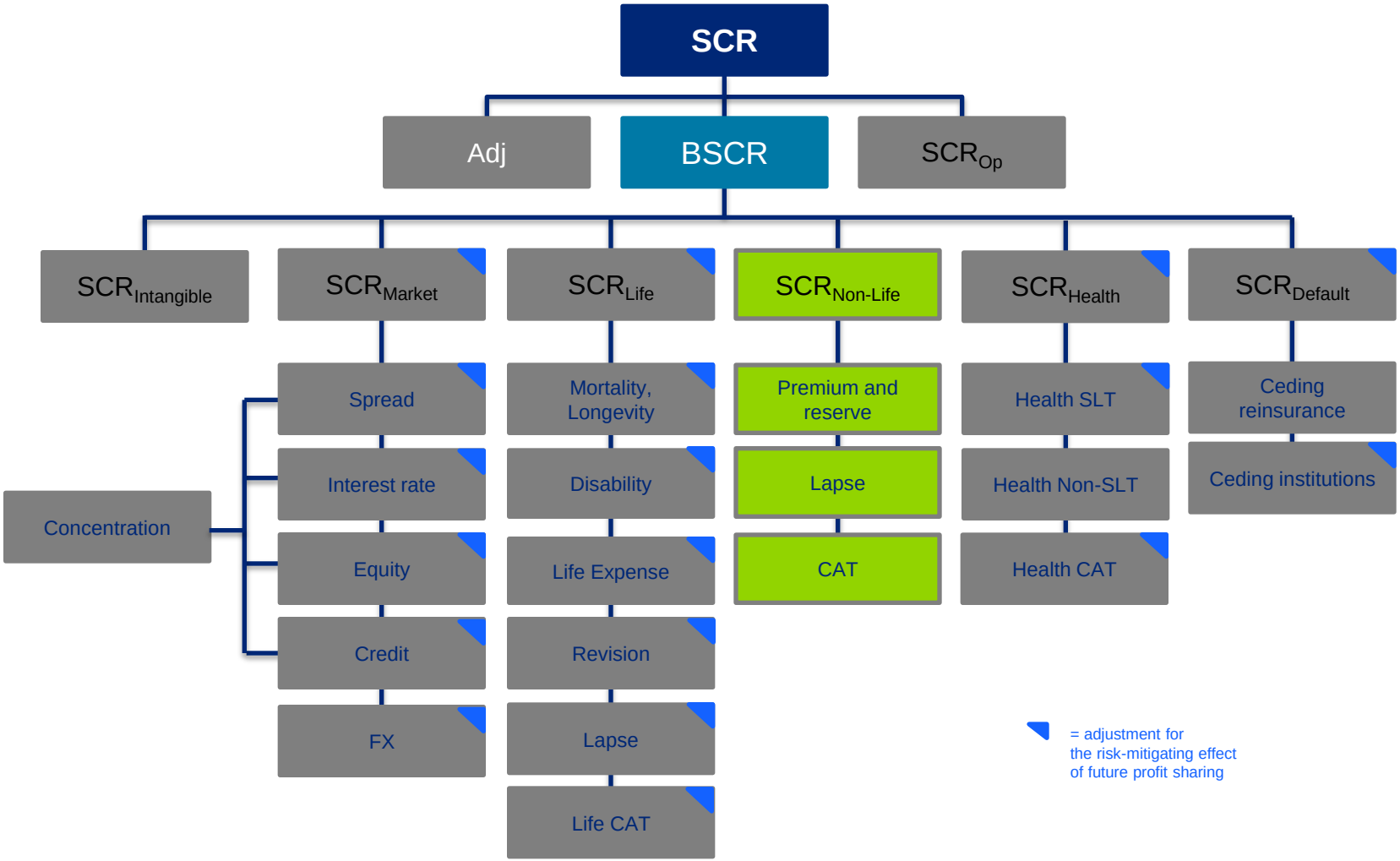


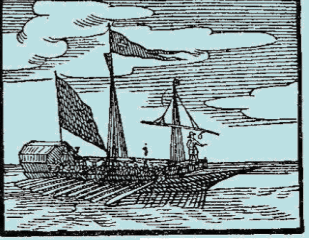
Standardní vzorec tržní riziko

Risk	Level 2 Implementing Measures
Interest rate	Increase and decrease in the risk-free interest rates. The percentage change is different for different maturities.
Equity	Instantaneous **decrease of 39% + SA** (symmetric adjustment) in the value of type 1 equity investments and **decrease of 49% + SA** type 2 equity investments, where type 2 equities comprise of equities listed in countries which are **not members of the EEA or the OECD** and $SA = \max\{min\left\{0.5 \times \left(\frac{CI-AI}{AI} - 8\%\right), 10\%\right\}, -10\%\}$, where *CI* current level of appropriate equity index and *AI* is the weighted daily average of that index over the past 36 months.
Property	Instantaneous **decrease of 25%** in the value of real estate investments.
Spread	Instantaneous **decrease in value of the given financial instrument.** The percentage decrease is determined based on duration and credit quality of the given financial instrument.
Market concentration	Instantaneous decrease in the value of assets corresponding to a single name exposure by $\max\left\{0, \left(\frac{E}{Assets} - CT\right) \times g\right\}$. Where *E* is the value of the given asset, *CT* is a threshold based on the credit rating of the asset and *g* is a risk factor based on credit rating of the asset.
Currency	Instantaneous **increase and decrease of 25%** in the value of the foreign currency against the local currency.



Standardní vzorec neživotní riziko





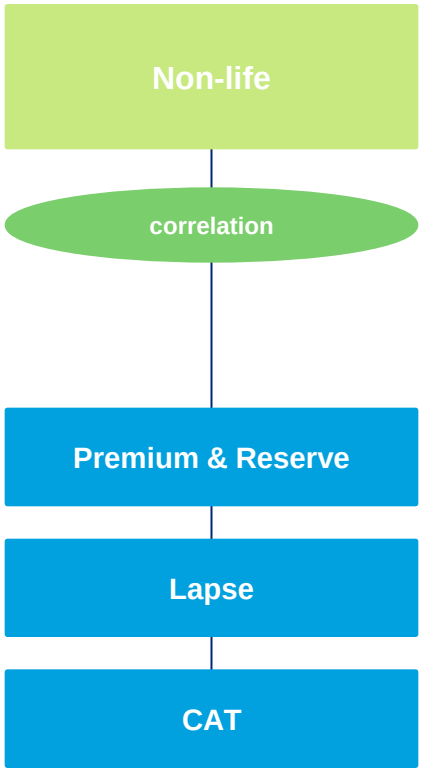
Standardní vzorec neživotní riziko

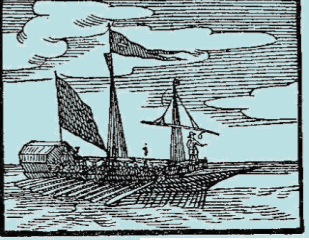
SCR pro neživotní riziko

The capital charge for non-life underwriting risk is derived by combining the capital charges for the non-life sub-risks using a correlation matrix as follows (SCR):

$$SCR = \sqrt{\sum Corr_{r,c} * SCR_r * SCR_c}.$$

	SCR_{pr}	SCR_{lapse}	SCR_{CAT}
SCR_{pr}	1		
SCR_{lapse}	0	1	
SCR_{CAT}	0.25	0	1





Standardní vzorec neživotní riziko

Level 2 on non-life underwriting risk

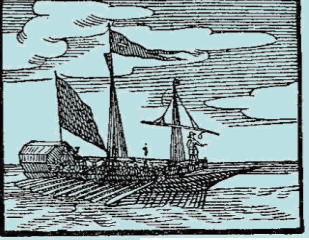
1.Premium and reserve risk

- Premium risk
  - relates to policies to be written (including renewals) during the period, and to unexpired risks on existing contracts.
  - includes the risk that premium provisions turn out to be insufficient to compensate claims or need to be increased.
  - also includes the risk resulting from the volatility of expense payments.
  - Expense risk can be quite material -> to be fully reflected in the module calculations; implicitly included as part of the premium risk.
- Reserve risk
  - results from fluctuations in the timing and amount of claim settlements.

2.Lapse

This module is applicable for contracts where the policyholder can terminate a contract before the end of a previously agreed insurance period and options to renew contracts according to previously agreed conditions.

3.Catastrophe risk



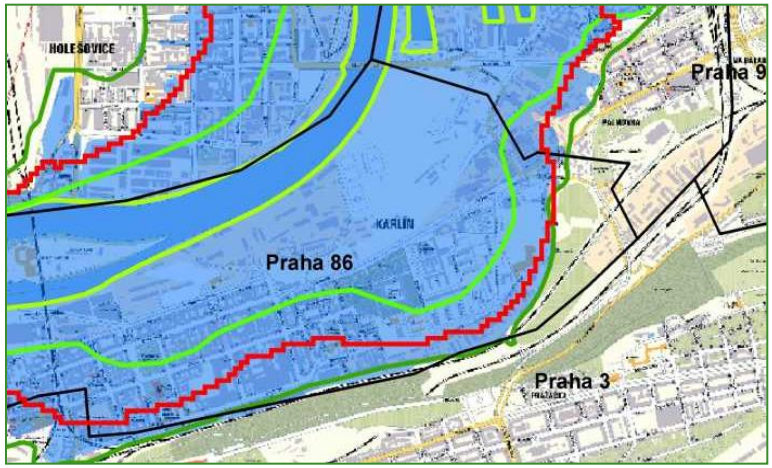
Standardní vzorec
neživotní riziko – katastrofické riziko

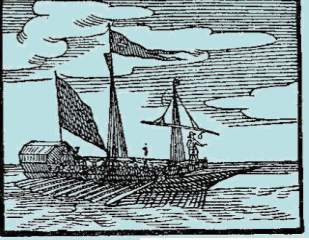
"the risk of loss, or of adverse change in the value of insurance liabilities, resulting from significant uncertainty of pricing and provisioning assumptions related to extreme or exceptional events."

- CAT risks stem from extreme or irregular events that are not sufficiently captured by the charges for premium and reserve risk.
- The catastrophe risk charge has to be calibrated at the 99.5% VaR (annual view)

- The Level 2 delegated acts state the following CAT risk sub-module:

1. natural catastrophes
2. non-proportional property reinsurance
3. man made catastrophes
4. other non-life catastrophe risk

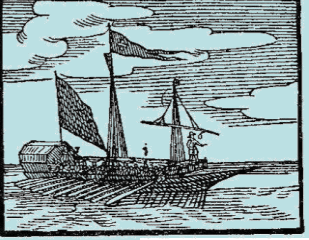




Standardní vzorec
riziko selhání protistrany

SCR for counterparty default risk

- The risk of default of a counterparty **to risk mitigating contracts** like
  - reinsurance,
  - securitizations and derivatives.
- It should also capture default risk of **receivables from intermediaries**, as well as **other credit exposures which are not covered in the spread risk sub-module**
- A differentiation is made between two kind of exposures (type 1, type 2) and a different treatment between has to be applied:
  - **Type 1 exposures**: exposures which **may not be diversified** and where the counterparty is **likely to be rated** (reinsurance, securitizations and derivatives, other risk mitigating contracts, cash at bank, deposits with ceding institutions or other commitments which have been called up but are unpaid if there are less than 15 independent counterparties, other commitments which the undertaking has provided and which depend on the credit standing of a counterparty, etc.)
  - **Type 2 exposures**: exposures which are **usually diversified** and where the counterparty is **likely to be unrated** (receivables from intermediaries, policyholder debtors (**including mortgage loans**), deposits with ceding institutions or other commitments which have been called up but are unpaid if there are more than 15 independent counterparties))
- :



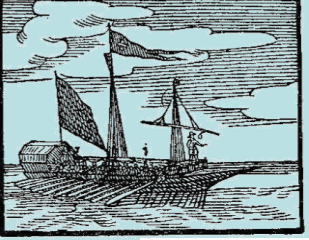
Standardní vzorec operační riziko

SCR for operational risk

- Risk of loss arising from inadequate or **failed internal processes**, **personnel** and **systems** or from **external events**

$$SCR_{op} = \min\left\{0.30 \bullet BSCR; Op_{\text{ln}ul}\right\} + 0.25 \bullet Exp_{ul}$$

- Calculated as:
  - **25% of the annual expenses** (gross of reinsurance) incurred in respect of **unit-linked** business (administrative expenses should be used, based on the latest past years expenses)
  - The maximum between a function of the **technical provisions (excluding risk margin and a floor of zero)** for all business other than unit-linked business and a function of the **premiums earned** for these businesses (gross of reinsurance)
  - A **ceiling of 30% of the BSCR is applied** as defined in directive



Standardní vzorec výpočetní postup

Capital requirement for risk sub-modules *(e.g. mortality risk sub-module)*

$$\sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j}$$

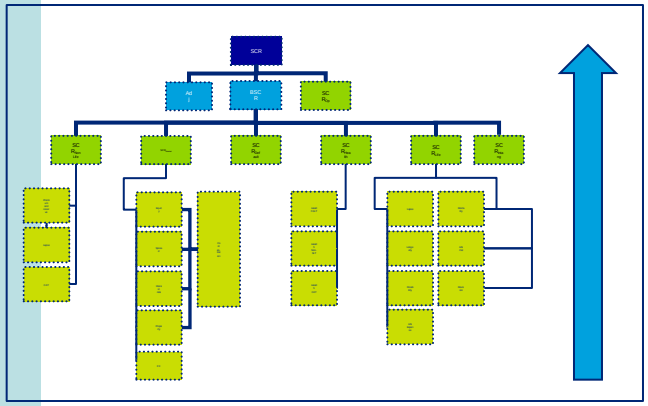
Capital requirement for risk modules *(e.g. life underwriting risk module)*

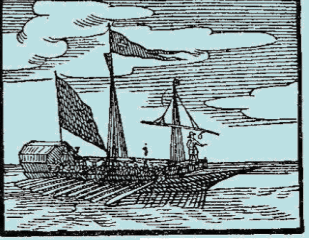
$$Basic\ SCR = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j} + SCR_{intangibles}$$

Basic Solvency Capital Requirement (BSCR)

$$+ SCR_{Operational} + Adj_{TP} + Adj_{DT}$$

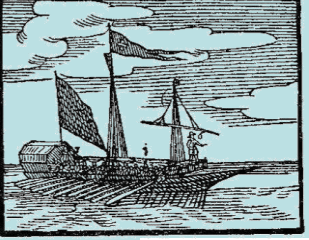
Solvency Capital Requirement (SCR)





Životní pojištění příklad závazky

- We look at the following oversimplified insurance company:
  - **No** future **contributions**
  - There are **2 groups of affiliates** with the age of 55 and 60 respectively. Every cohort has one thousand affiliates. At their pension on 65 they receive a **lump sum payment** equal to the accumulated technical reserves
  - **Reserves** for the total cohort of 55 amounts to 5.000.000
  - Reserves for the total cohort of 60 amounts to 7.500.000
  - The company **guarantees** an interest rate of 3.5%
  - **Death coverage** equals the reserves (-> no pure mortality risk for the company)
  - **Lapse rates** are 5% per annum. The insured gets 98% of the reserves in case of surrender
  - Administration **expenses** equal € 50 per affiliate and we assume an inflation of 2%
  - **No profit sharing**



Životní pojištění příklad závazky (2)

Age	Reserve BOY	Reserve MOY-	Lapses & deaths	Surrender penalty	Reserve MOY+	Reserve EOY-	Maturities	Reserve EOY+	Administration
55	5.000.000,00	5.086.747,49	-300.118,10	-5.086,75	4.781.542,64	4.864.500,00	0,00	4.864.500,00	-48.982,60
56	4.864.500,00	4.948.896,63	-294.459,35	-4.948,90	4.649.488,38	4.730.154,67	0,00	4.730.154,67	-46.952,41
57	4.730.154,67	4.812.220,48	-291.139,34	-4.812,22	4.516.268,92	4.594.623,91	0,00	4.594.623,91	-44.970,83
58	4.594.623,91	4.674.338,33	-289.808,98	-4.674,34	4.379.855,02	4.455.843,30	0,00	4.455.843,30	-43.015,91
59	4.455.843,30	4.533.149,94	-290.121,60	-4.533,15	4.238.495,20	4.312.030,96	0,00	4.312.030,96	-41.069,58
60	4.312.030,96	4.386.842,53	-291.725,03	-4.386,84	4.090.730,66	4.161.702,78	0,00	4.161.702,78	-39.117,45
61	4.161.702,78	4.233.906,23	-292.139,53	-4.233,91	3.937.532,79	4.005.847,01	0,00	4.005.847,01	-37.158,43
62	4.005.847,01	4.075.346,44	-291.387,27	-4.075,35	3.779.883,82	3.845.462,91	0,00	3.845.462,91	-35.202,83
63	3.845.462,91	3.912.179,76	-289.501,30	-3.912,18	3.618.766,28	3.681.550,05	0,00	3.681.550,05	-33.260,44
64	3.681.550,05	3.745.423,10	-295.888,42	-3.745,42	3.445.789,25	3.505.571,96	-3.505.571,96	0,00	-31.299,72

Age	Reserve BOY	Reserve MOY-	Lapses & deaths	Surrender penalty	Reserve MOY+	Reserve EOY-	Maturities	Reserve EOY+	Administration
60	7.500.000,00	7.630.121,23	-507.403,06	-7.630,12	7.115.088,05	7.238.531,25	0,00	7.238.531,25	-48.793,23
61	7.238.531,25	7.364.116,13	-508.124,01	-7.364,12	6.848.628,00	6.967.448,25	0,00	6.967.448,25	-46.349,65
62	6.967.448,25	7.088.329,98	-506.815,59	-7.088,33	6.574.426,06	6.688.489,05	0,00	6.688.489,05	-43.910,32
63	6.688.489,05	6.804.530,97	-503.535,29	-6.804,53	6.294.191,15	6.403.392,20	0,00	6.403.392,20	-41.487,48
64	6.403.392,20	6.514.487,84	-514.644,54	-6.514,49	5.993.328,81	6.097.310,05	-6.097.310,05	0,00	-39.041,77

policyholder

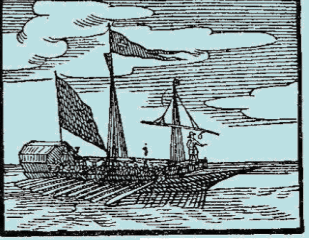
expense sink

Liabilities

- Assuming a flat term structure of interest rates of 5% we calculate the **best estimate technical provisions**

Year	0	1	2	3	4	5	…
Best estimate TP	12.019.458	11.692.777	11.359.407	11.018.640	10.670.046	4.199.509	…

Part of the portfolio reaches its maturity



Životní pojištění příklad
SCR životní riziko

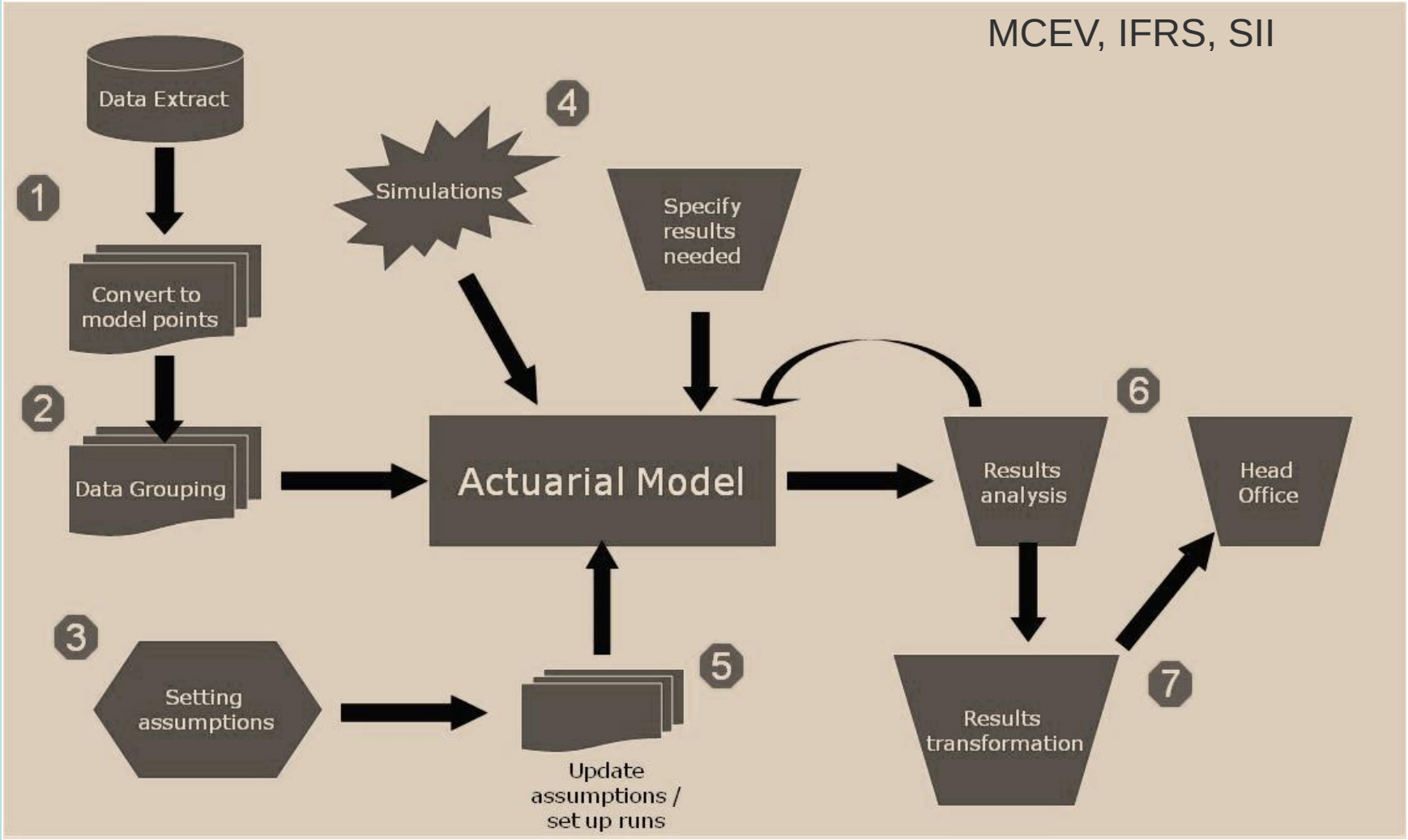
	TP Initial B/S	
	12.019.458	
	TP (BE)	**ΔNAV/charge**
Lapse Up	12.027.216	7.758
Lapse Down	12.012.441	
Lapse Mass		161.380
SCR Lapse Risk		**161.380**
SCR Expense Risk	12.091.347	**71.889**
SCR Mortality Risk	12.023.450	**3.992**
SCR Longevity Risk	12.012.709	
SCR Life$_{CAT}$	12.020.896	**1.438**
SCR Life Underwriting		**207.662**
SCR Life Underwriting Undiversified		238.699
Diversification		**13,0%**

Recall:

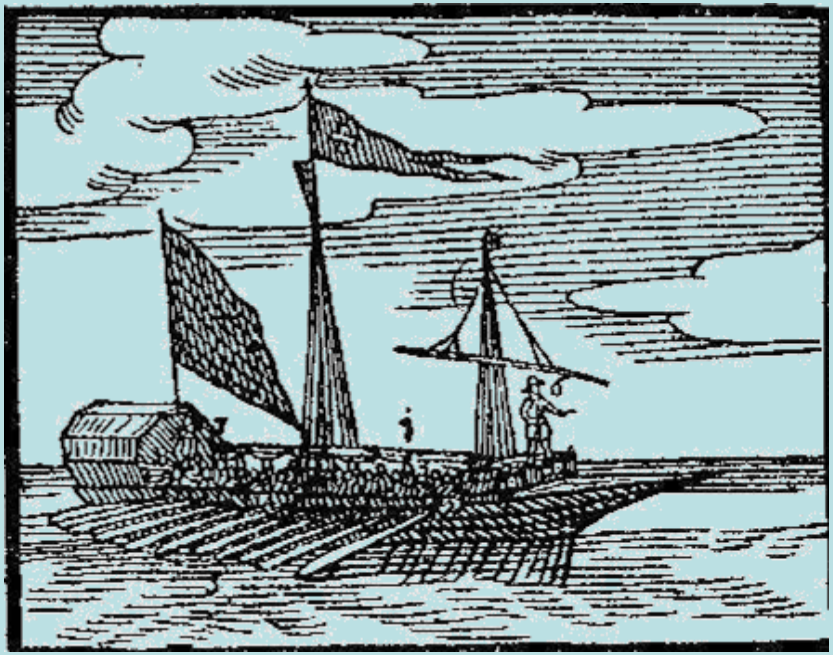
- Mortality = +15% qx,
- Longevity = -20% qx,
- Expense = +10% and inflation +1%,
- Lapse = max(50%up;50%down;mass),
- Cat = +0,15% first year

Corr	Mortality	Lapse	Expense	CAT
Mortality	1	0	0,25	0,25
Lapse	0	1	0,5	0,25
Expense	0,25	0,5	1	0,25
CAT	0,25	0,25	0,25	1

Typical Actuarial projection process



Děkuji za pozornost



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