

Pojistný matematik a Solventnost II

Pojistný matematik v praxi

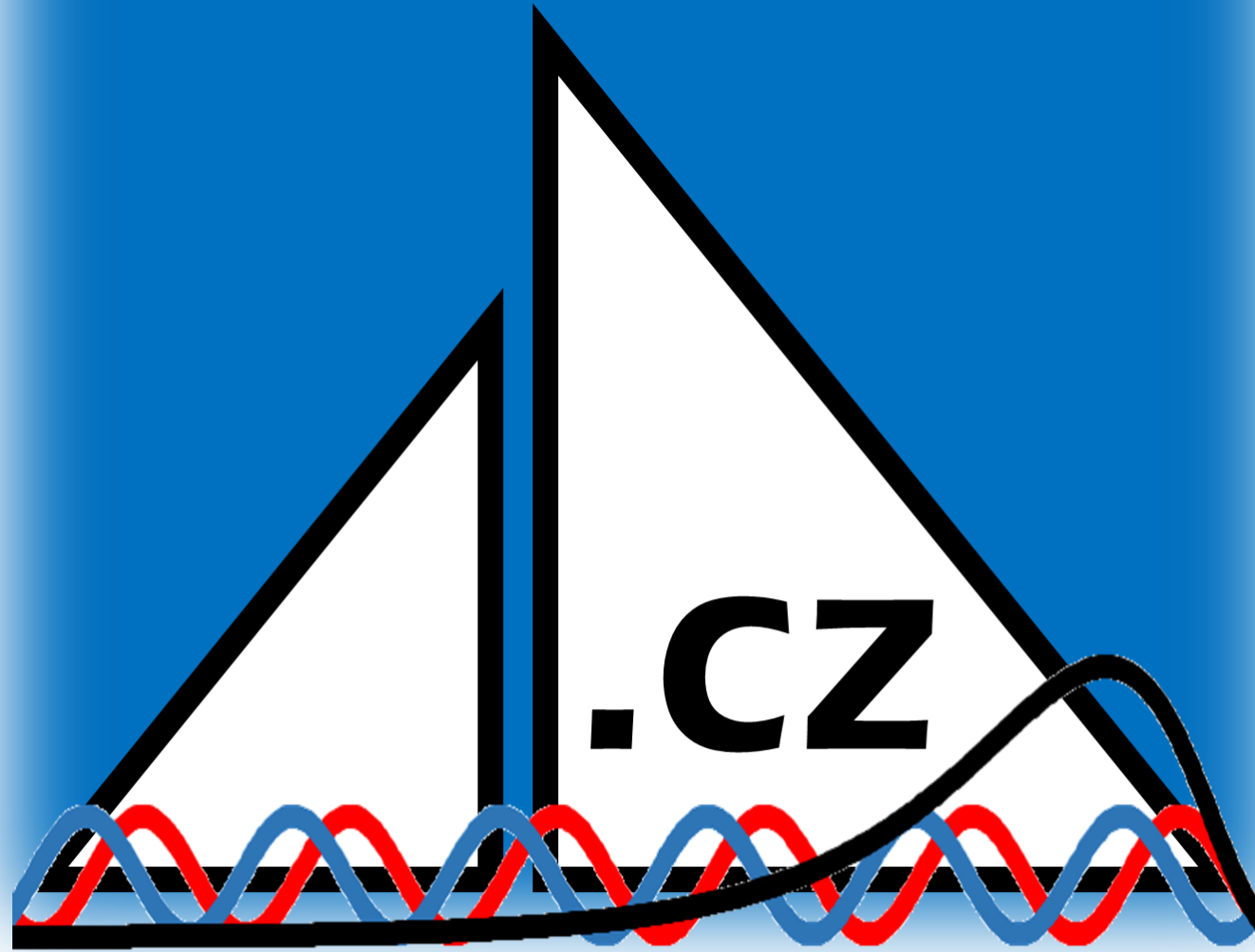
actuaria

.CZ

Dana Bohatová Chládková
6. května 2016

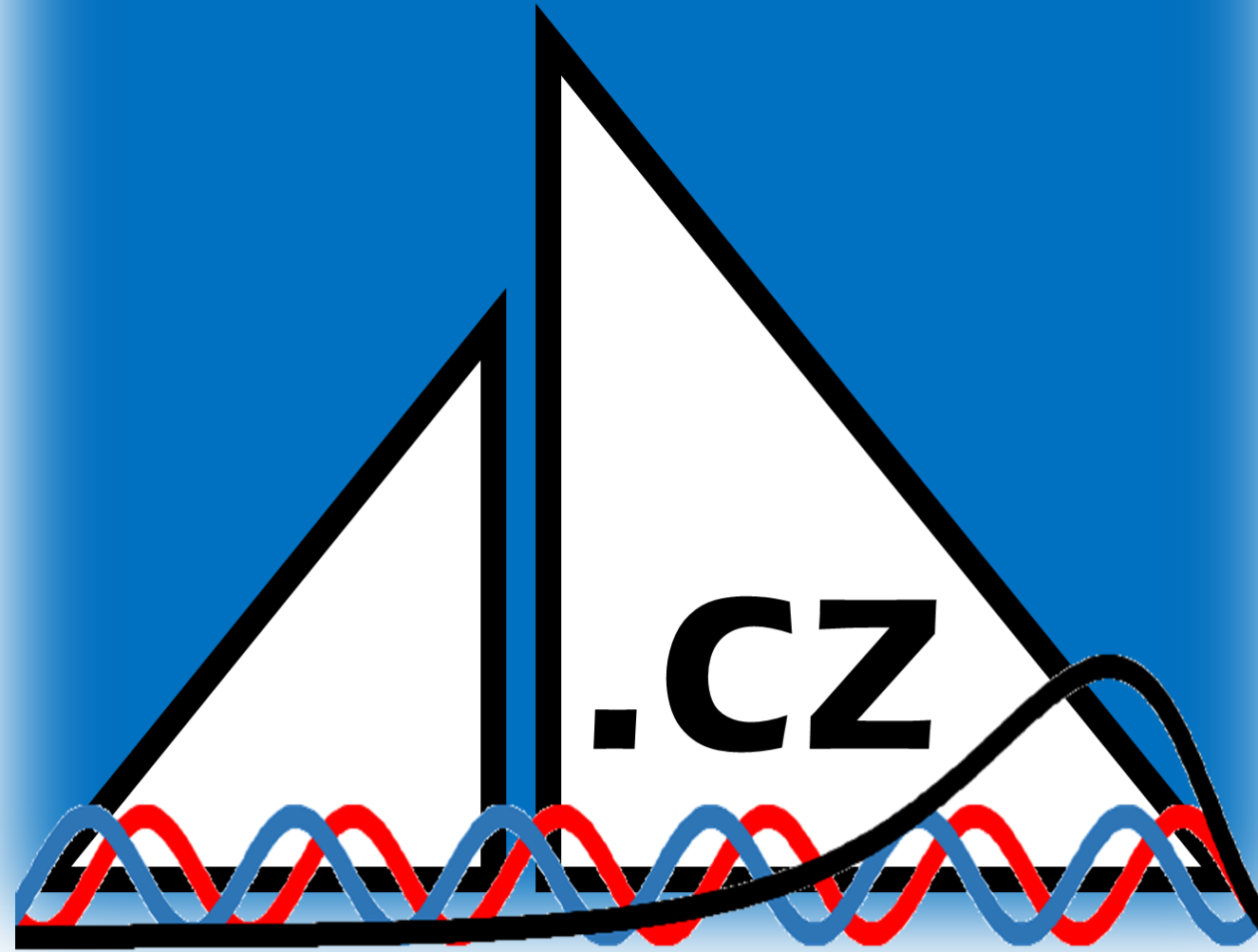
- ▲ Pojistný matematik v SII
- ▲ Výpočet technických rezerv
- ▲ SCR

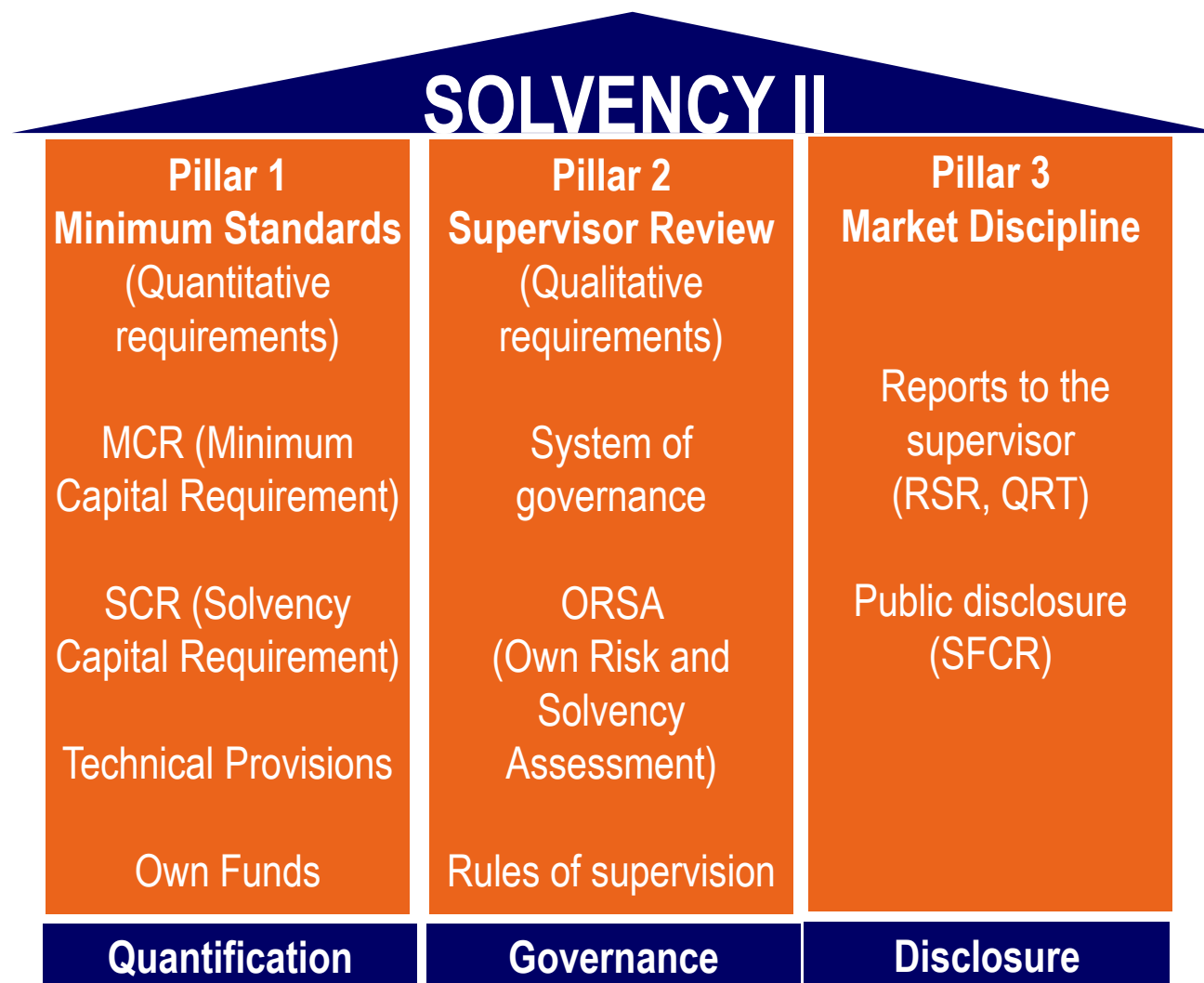
OBSAH



- ▲ Pojistný matematik v SII
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- ▲ SCR

OBSAH



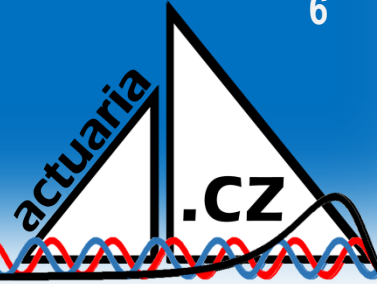


LEGISLATIVA

- ▲ L1 = Směrnice 2009/138/ES
- ▲ L2 = Nařízení komise 2015/35 z 10.10.2014
- ▲ L3 = EIOPA Guidelines
 - ▲ Obecné pokyny k oceňování technických rezerv
 - ▲ Obecné pokyny k řídicímu a kontrolnímu systému
 - ▲ Obecné pokyny k vlastnímu posouzení rizik a solventnosti (ORSA)
 - ▲ ...

ZAPOJENÍ AKTUÁRA





▲ L1 Článek 48 odst. 1

- a) koordinuje výpočet technických rezerv;
- b) zajišťuje přiměřenost používaných metodik a podkladových modelů, jakož i předpokladů učiněných při výpočtu technických rezerv;
- c) posuzuje dostatečnost a kvalitu údajů používaných při výpočtu technických rezerv;
- d) srovnává nejlepší odhady se zkušeností;
- e) informuje správní, řídicí nebo kontrolní orgán o spolehlivosti a adekvátnosti výpočtu technických rezerv;
- f) dohlíží na výpočet technických rezerv v případech stanovených v článku 82;
- g) vyjadřuje názor na celkovou koncepci upisování;
- h) vyjadřuje názor na adekvátnost zajistných ujednání;
- i) přispívá k účinnému provádění systému řízení rizik uvedeného v článku 44, zejména pokud jde o konstrukci rizikových modelů, které jsou podkladem výpočtu kapitálových požadavků stanovených v kapitole VI oddílech 4 a 5 a pokud jde o posouzení uvedené v článku 45.

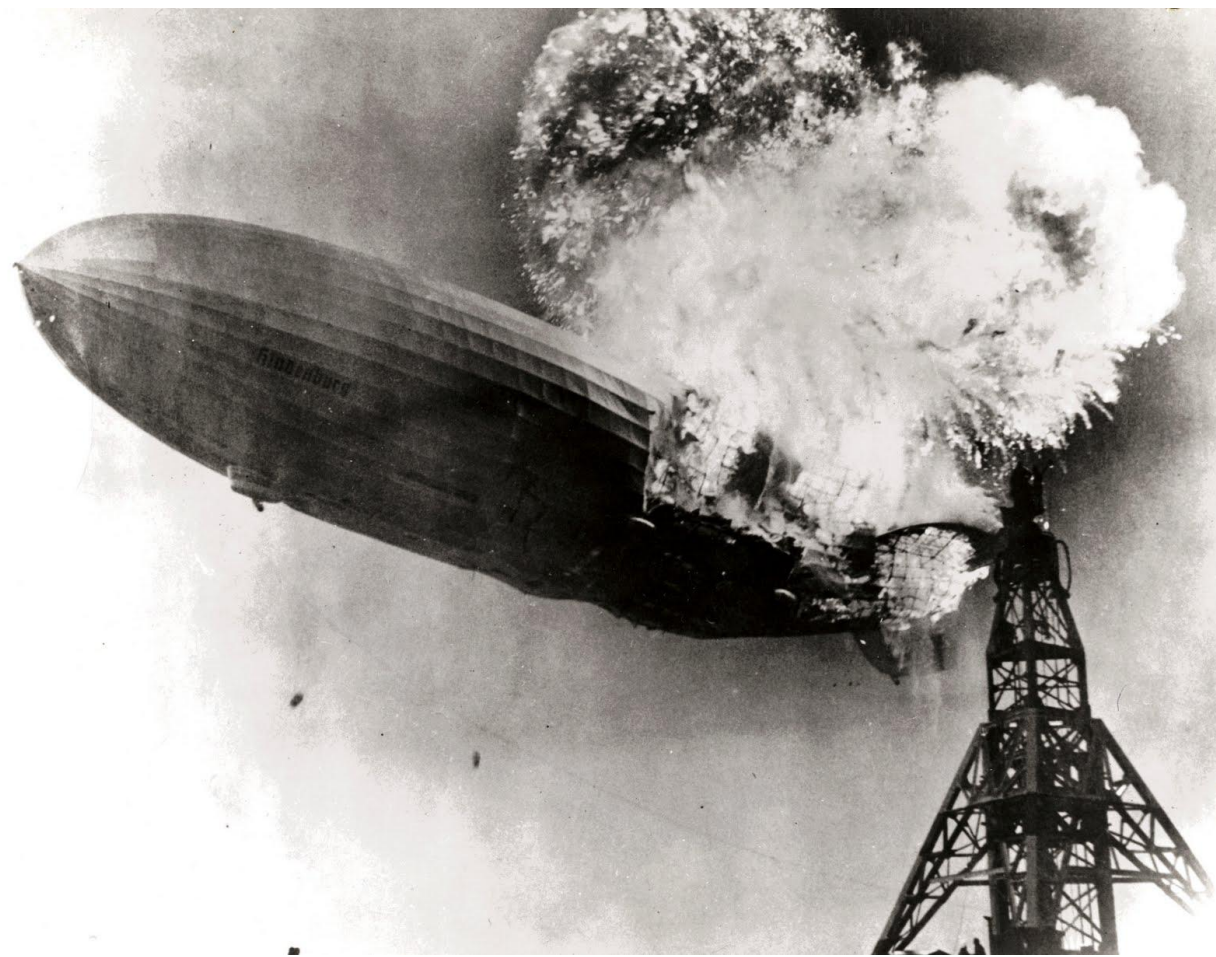
Tech.Rez.

Reporting

Názor

Řízení
rizik

- ▲ SCR a MCR výpočet
- ▲ ORSA, scénáře a stres testy
– modelování a analýza
finančních projekcí
- ▲ Modelování rizik
- ▲ Kvalita dat- posouzení
- ▲ Risk management směrnice



ZVEŘEJNĚNÍ– PILÍŘ 3

Supervisory reporting

(RTS)

Public disclosure

(SFCR)

Quantitative reporting templates
(QRTs)

kvalitativní +
kvantitativní info

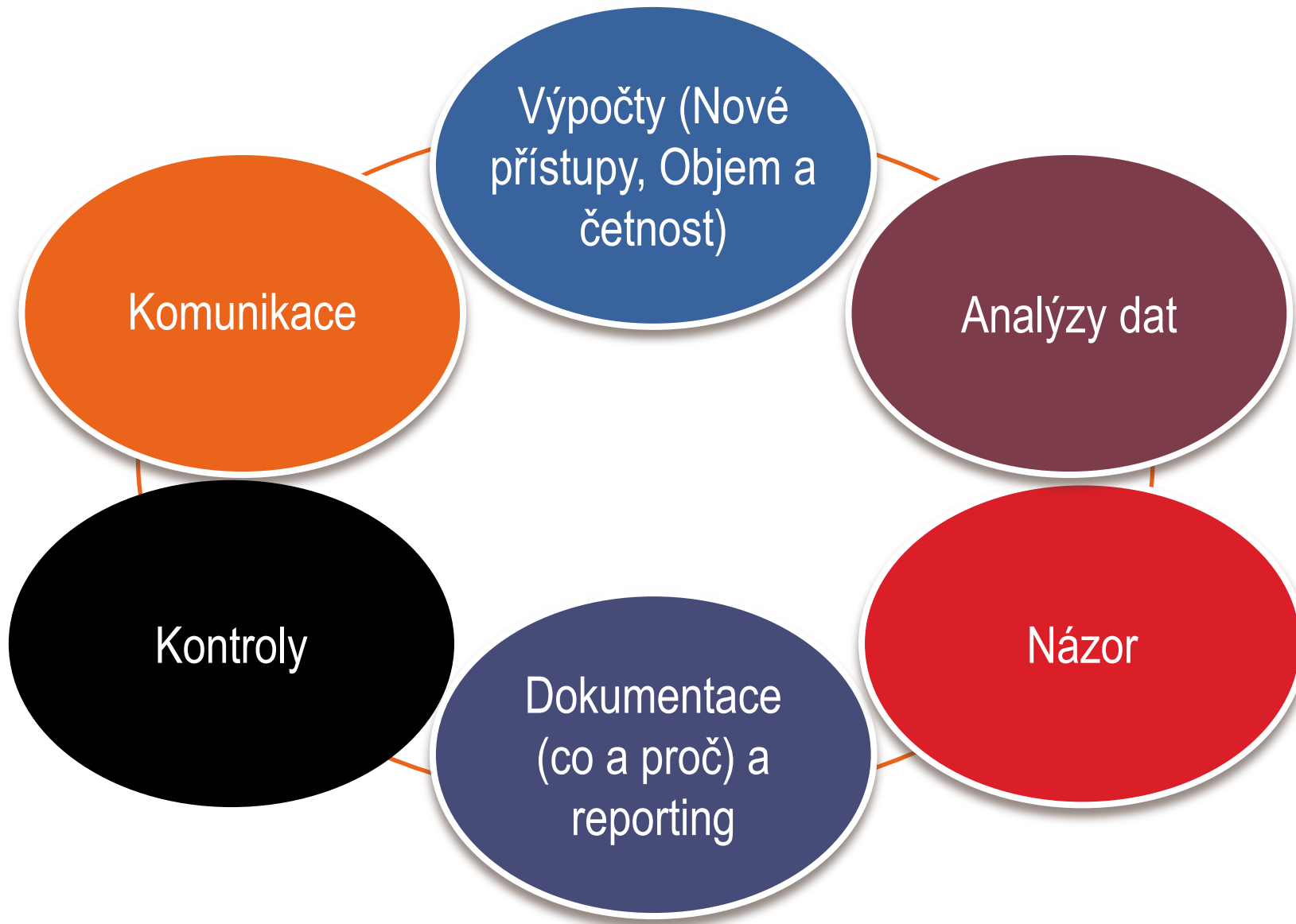
ZPRÁVA AKTUÁRSKÉ FUNKCE

- ▲ Písemná zpráva - minimálně 1x ročně
- ▲ Předkládaná správnímu, řídicímu nebo kontrolnímu orgánu
- ▲ Obsah
 - ▲ Všechny úkoly AF a jejich výsledky
 - ▲ Nedostatky
 - ▲ Doporučení, jak by tyto nedostatky měly být odstraněny.

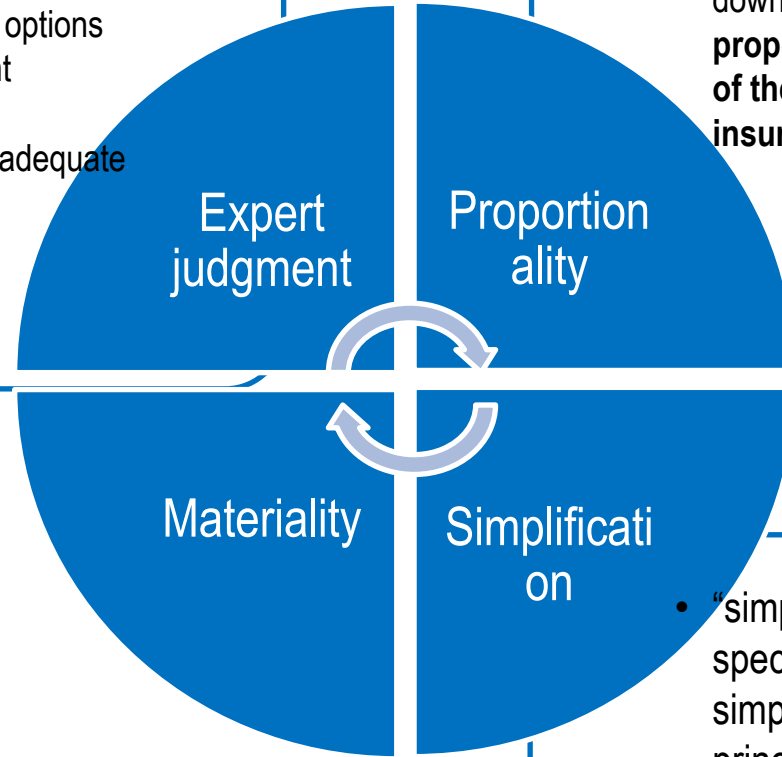
ORSA REPORT

- ▲ Rozsah ORSA
- ▲ ORSA proces a zodpovědnosti klíčových osob v ORSA procesu
- ▲ Stress testy a jejich výsledky
- ▲ Celková finanční a solventnostní situace
- ▲ Capital management strategy
- ▲ Frekvence a obsah interního reportingu
- ▲ Validace (nezávislé review ORSA)

ZMĚŇY PRO AKTUÁŘA?



- Scope
 - **Data, assumptions or model choice**
 - Should **not be applied in isolation** unless there is no alternative
 - **Prudence** in selection of alternative options
 - Only applied by experts with relevant **knowledge, understanding and comprehension** of the subject and adequate **experience**
- Documentation
- Back-testing

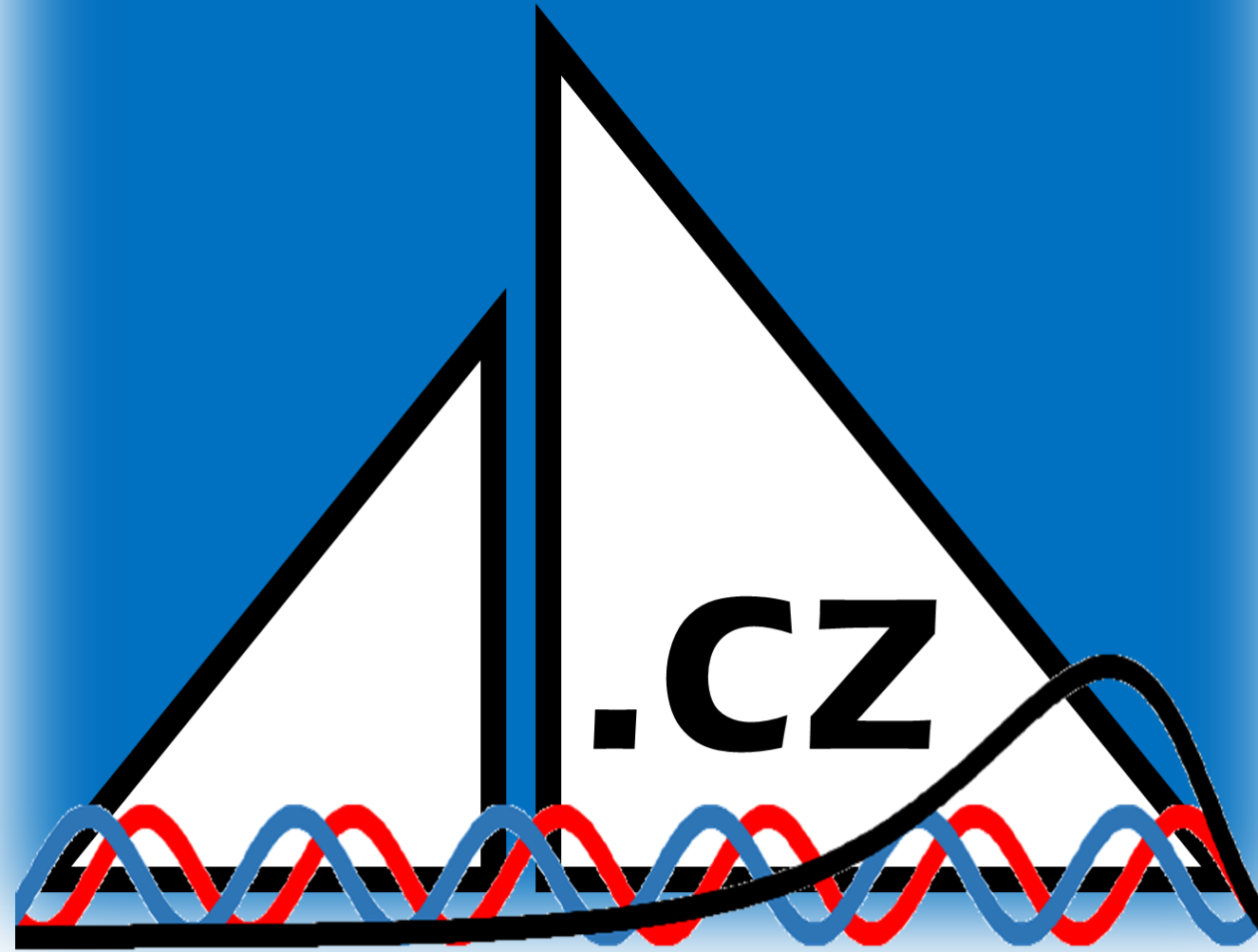


- “This Directive should **not be too burdensome for small and medium-sized insurance undertakings.**”
 “Member States shall ensure that the requirements laid down in this Directive are applied in a manner which is **proportionate to the nature, scale and complexity of the risks inherent in the business of an insurance or reinsurance undertaking.**”

- “simplified method” - a situation where a specific valuation technique has been simplified, in line with the proportionality principle.
- “**simplified method**” (or “**simplification**”) could also be used to refer to a valuation method which is considered to be **simpler than a “commonly used” benchmark or reference method.**

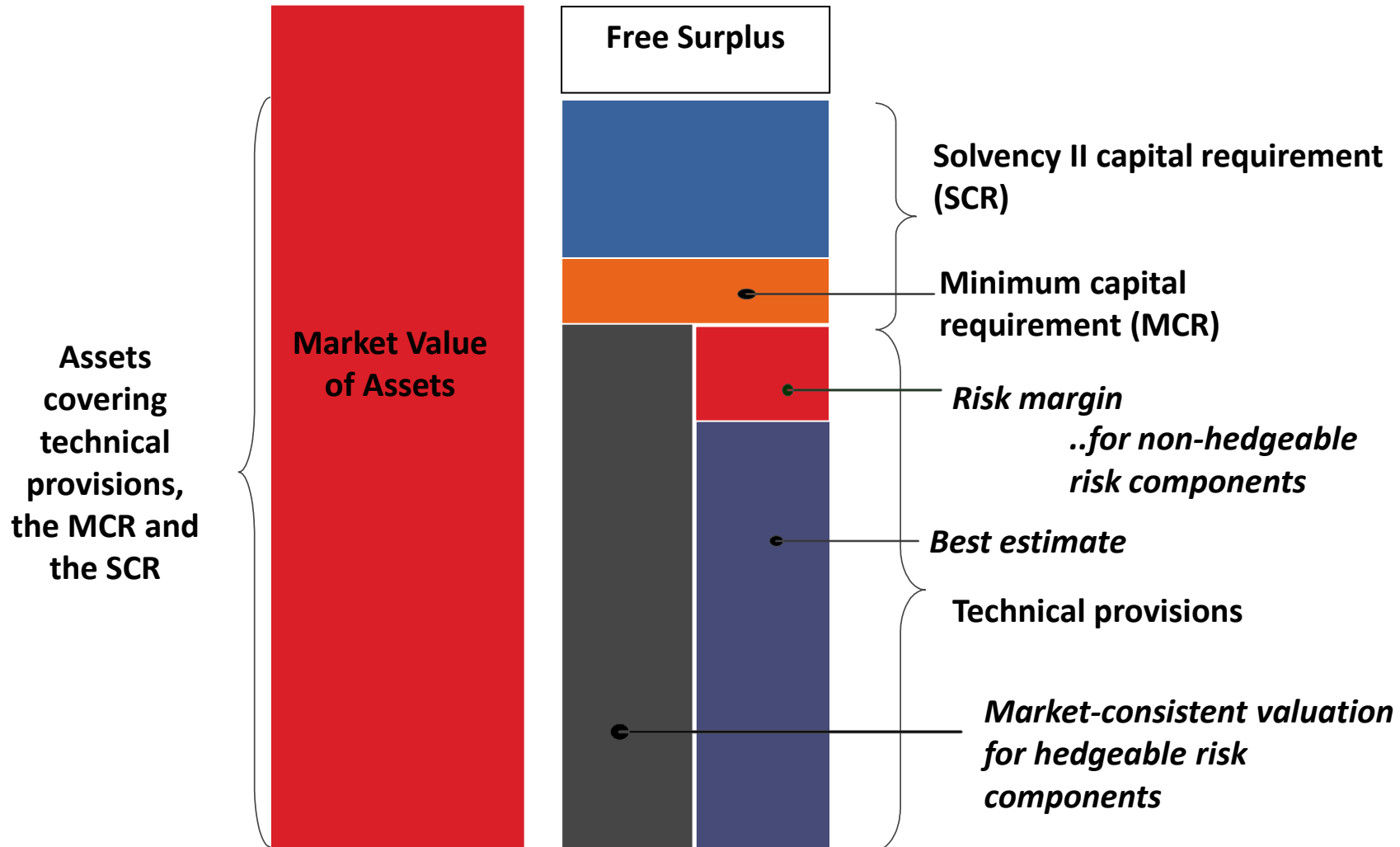
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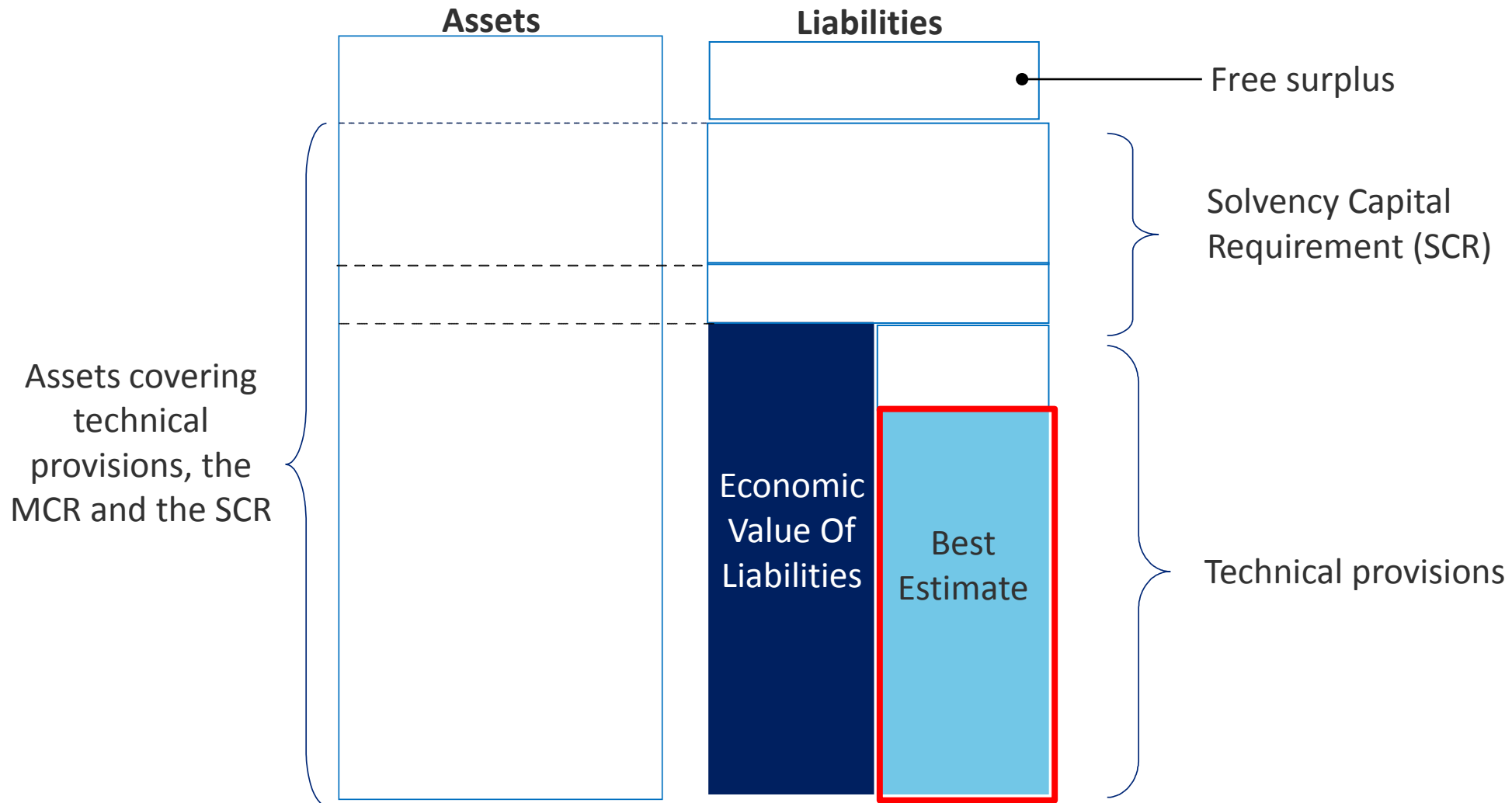


AKTIVA

ZÁVAZKY



BEST ESTIMATE (NEJLEPŠÍ ODHAD)



DEFINICE

- ▲ **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.....”



VÝPOČETNÍ PROCES

Gathering and analysing data

- Quality of internal and external data
- Data criteria
- Expert judgement

Determination Assumptions

- Adequate reflection of the uncertainty of the underlying cash-flows

Selecting and running model

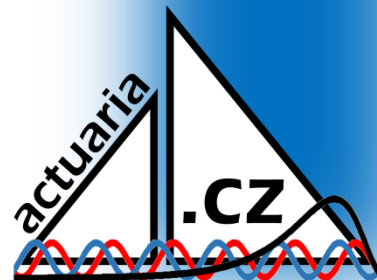
- Appropriate valuation method
- Explore key drivers

Validation and documentation

- Relevance of method and data
- Comparison against experience
- Documentation and communication



Pojistný matematik a Solventnost II - Pojistný matematik v praxi



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

NEDOSTATKY DAT

- ▲ 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

KRITÉRIA PRO DATOVOU KVALITU

Appropriateness

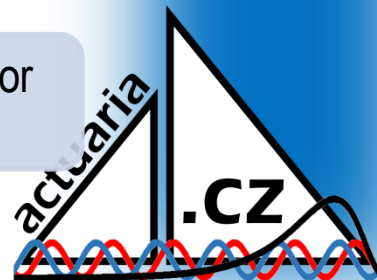
- Suitable for the intended purpose and relevant to the portfolio of risks being analysed?

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?



SEGMENTACE A UNBUNDLING

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



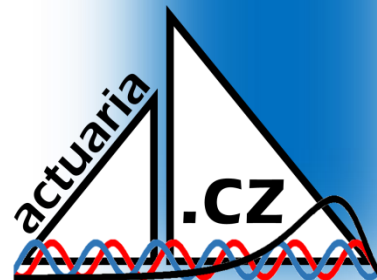
SEGMENTACE – LINES OF BUSINESS

LIFE

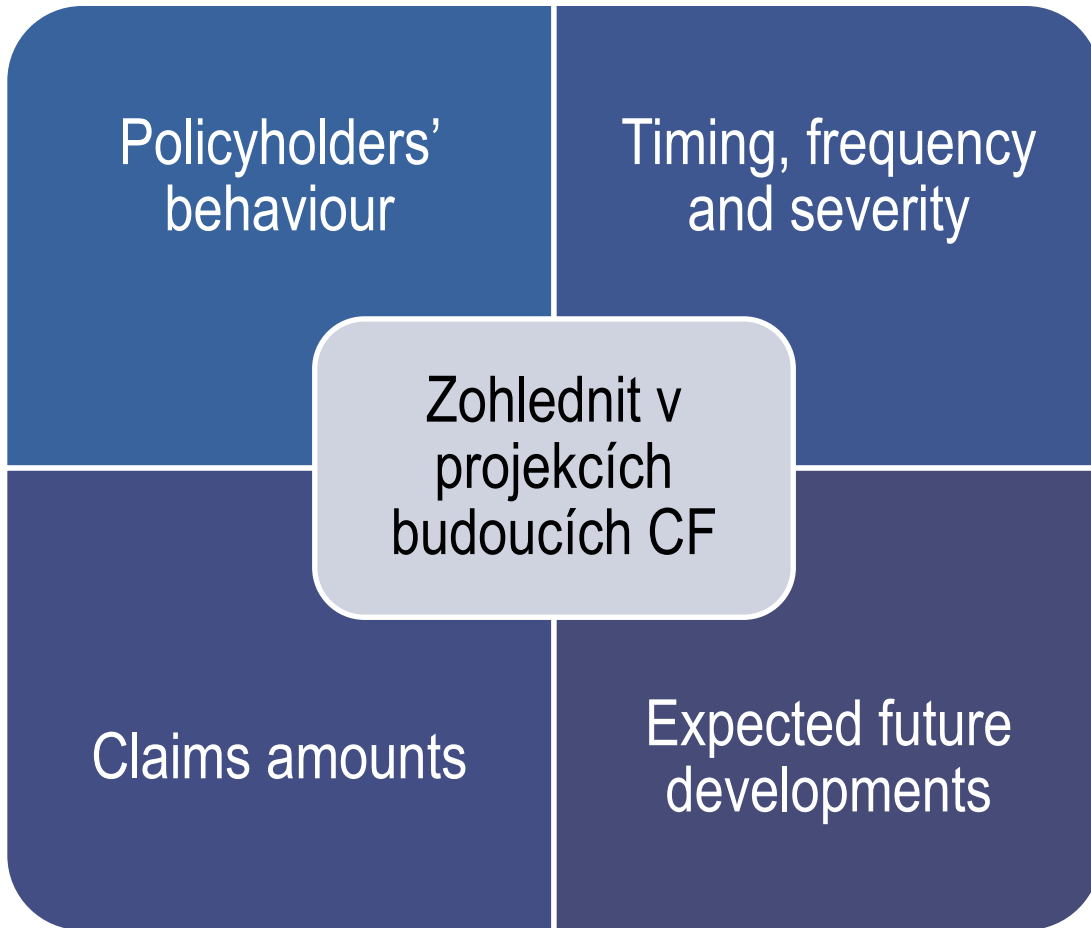
1. Health insurance
2. Insurance with profit participation
3. Index-linked and unit-linked insurance
4. Other life insurance
5. Annuities stemming from non-life insurance contracts and relating to health insurance obligations
6. Annuities stemming from non-life insurance contracts and relating to insurance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



NEJISTOTA V CASH FLOW PROJEKČÍCH



OČEKÁVANÝ BUDOUCÍ VÝVOJ

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

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CHOVÁNÍ POJISTNÍKA

- ▲ 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

JEDNÁNÍ MANAGEMENTU



CASH-FLOW - ČÁSTI

Gross cash in-flows

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

Gross cash out-flows

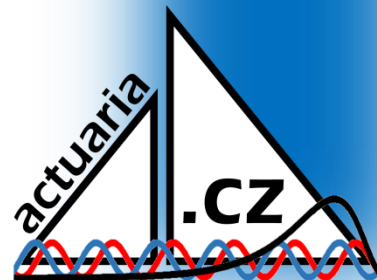
- ▲ Benefits
- ▲ Expenses
- ▲ Other e.g. taxation payments which are charged to the policyholder

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”)



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.



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

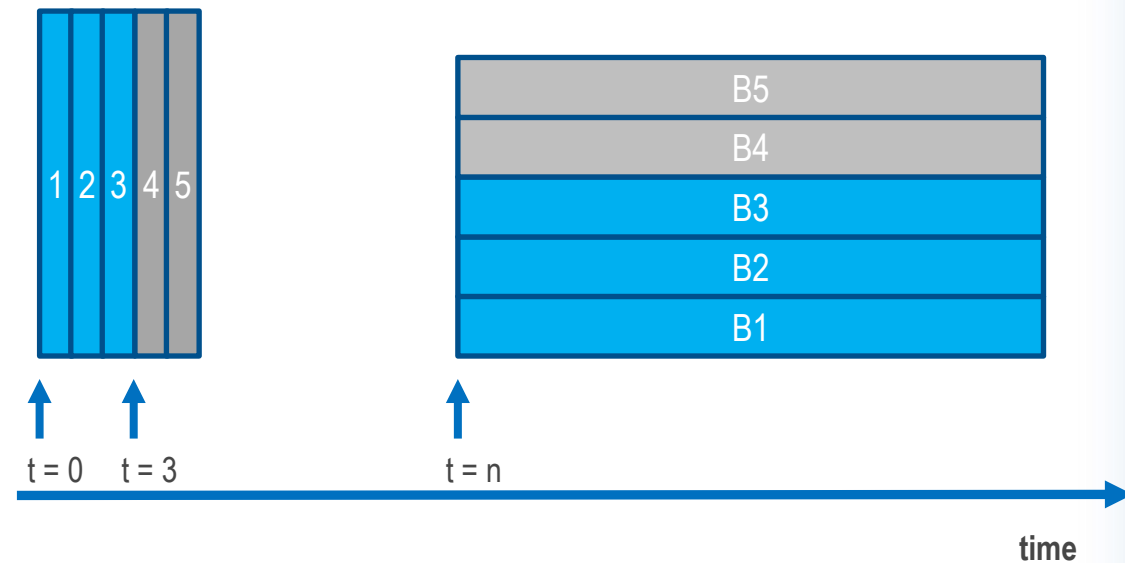
CZ

- ▲ Life policies with non-life 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)



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.



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

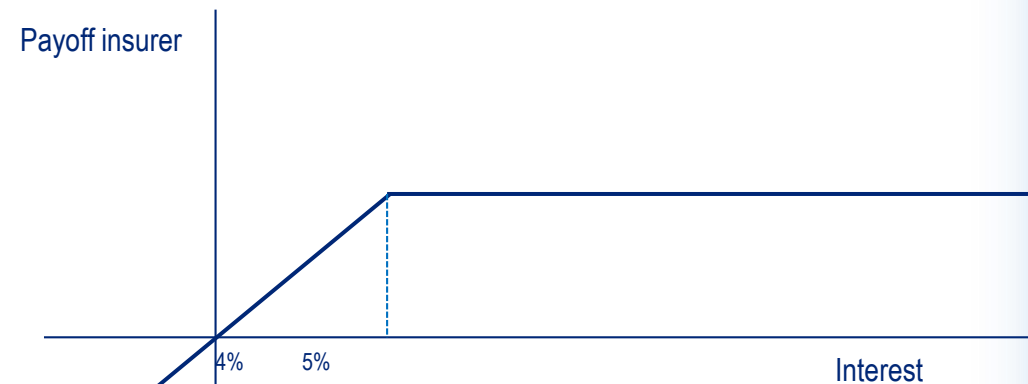
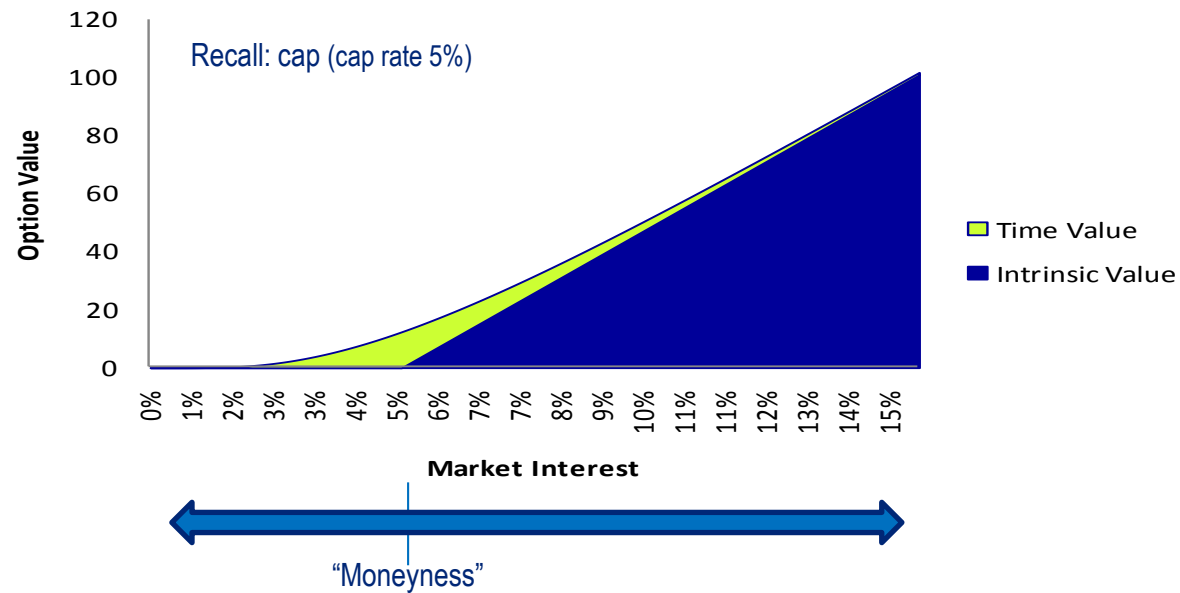
Methodologies

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



OCENĚNÍ – PŘÍKLAD PROFIT SHARING

- ▲ Consider the following profit sharing rule:
- ▲ $x\% * (y\% * \text{Return} - z\% * \text{Guaranteed Interest} - \text{Margin})$
- ▲ For simplicity assume $x\%=y\%=z\%=100\%$ and $\text{Margin} = 1\%$, for a contract with a guaranteed interest rate of 4% we get the following payoff function:



PŘEDPOKLADY - POŽADAVKY

Consistency

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

Determination

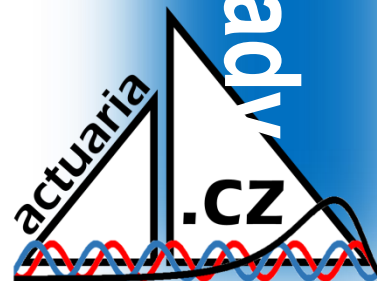
- ▲ Set in realistic manner
- ▲ Based on credible data
- ▲ Derived consistently from year to year without arbitrary changes; the changes and their impact should be quantified , traced, explained and documented

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.



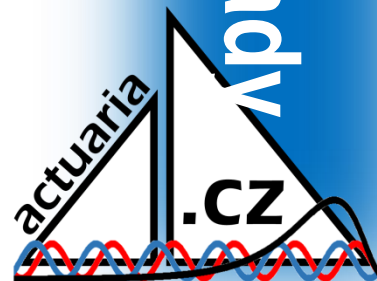
BIOMETRICKÉ PŘEDPOKLADY

- ▲ Underwriting risk related to human life conditions:
 - ▲ Longevity / Mortality
 - ▲ Disability / Morbidity
- ▲ Mortality vs. Longevity risk :
 - ▲ Mortality: risk = the number of deaths > expected
 - ▲ Longevity: risk = 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



POŽADAVKY

- ▲ 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)



NÁKLADY

- ▲ 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.

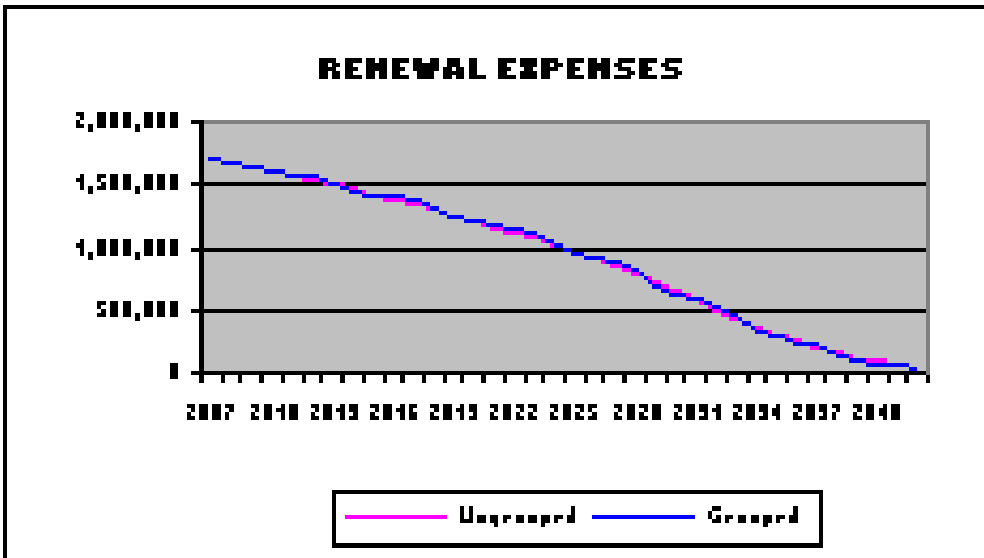
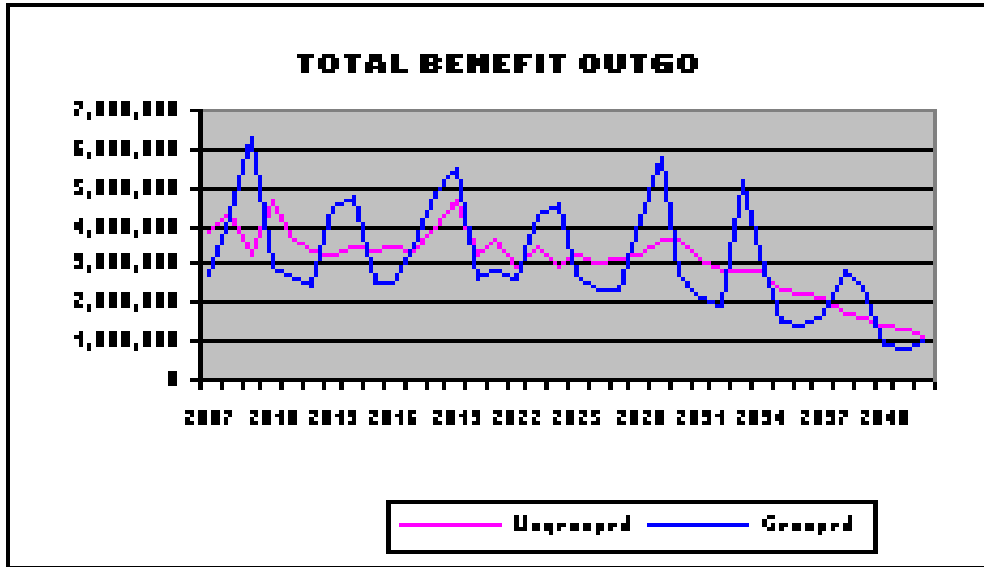
TYPES OF EXPENSES

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

DETERMINATION 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

EXAMPLE OUTPUT



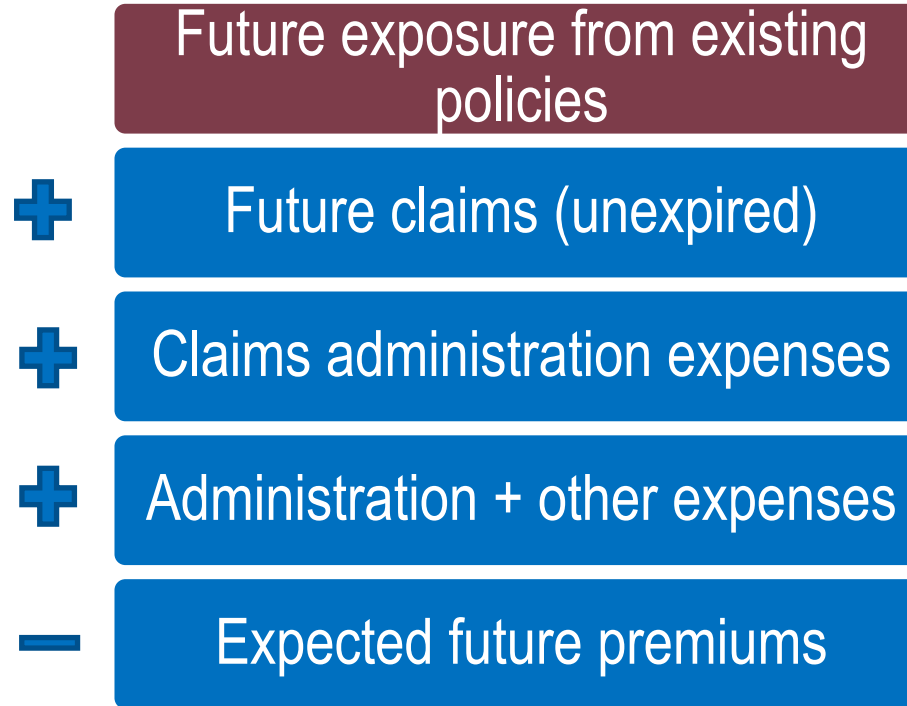
VALUATION

- ▲ 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

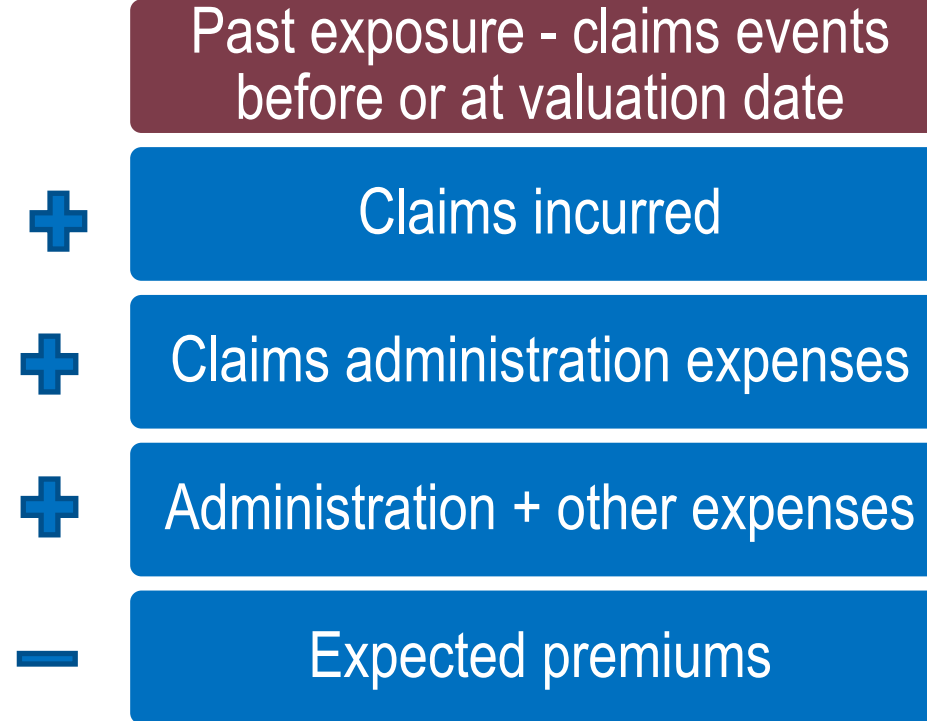
CONDITIONS FOR USING MODEL POINTS

- ▲ 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.

PREMIUM PROVISIONS



CLAIMS PROVISION



Expected Value

VÝBĚR MODELU

- ▲ **Proportionality**
- ▲ Sound rationale for the choice of one technique over other relevant techniques
- ▲ Assessment of the risks underlying obligations - nature, scale and complexity of these risks.
- ▲ Assessment of the degree of judgment required in each method and whether the undertaking is able to carry out this judgment in an objective and verifiable way
- ▲ To demonstrate that the valuation technique and underlying assumptions are realistic
- ▲ Valuation technique should be chosen on the basis of the nature of the liability being valued
- ▲ Assumptions shall be validated and reviewed
- ▲ Valuation technique and its results is auditable
- ▲ Demonstration of appropriateness of grouped data
- ▲ Undertaking shall ensure that their capabilities (e.g. actuarial expertise, IT systems) are commensurate with the actuarial and statistical techniques used

LIFE INSURANCE

- ▲ Deterministic
- ▲ **Simulation** (monte carlo) - more appropriate and robust valuation for participating contracts or other contracts with embedded options and guarantees,

NON-LIFE INSURANCE

- ▲ Deterministic (e.g. Chain ladder, Bornhuetter Ferguson, average cost per claims, outliers via case-by-case reserving, stress and scenario testing)
- ▲ Analytical techniques (e.g. Black & Scholes, Mack method)
- ▲ Stochastic



Proportionality

- Valuation method should be **suitable** to achieve a market consistent valuation - but **not more sophisticated than is needed** in order to reach this objective

Which risks?

- All risks which materially affect the **amount or timing** of cash flows required to settle the obligations (insured risks but also e.g. inflation)

Proportionality assessment

Assess nature, scale and complexity of risks

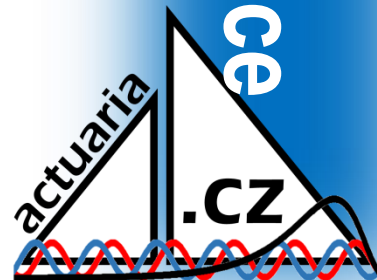
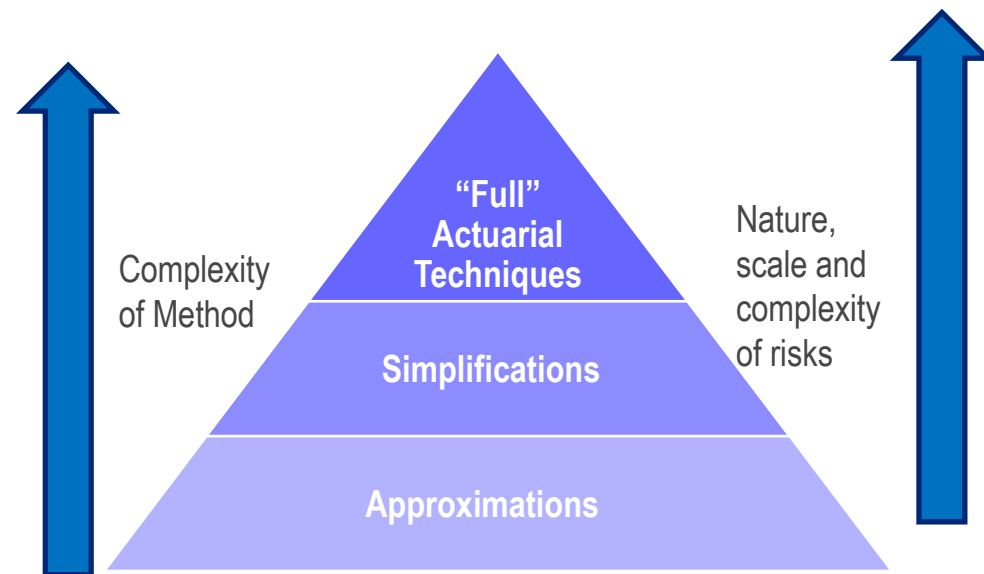
- Principles based
- Undertakings are expected to use an interpretation based on their risk profile

Assessment model error

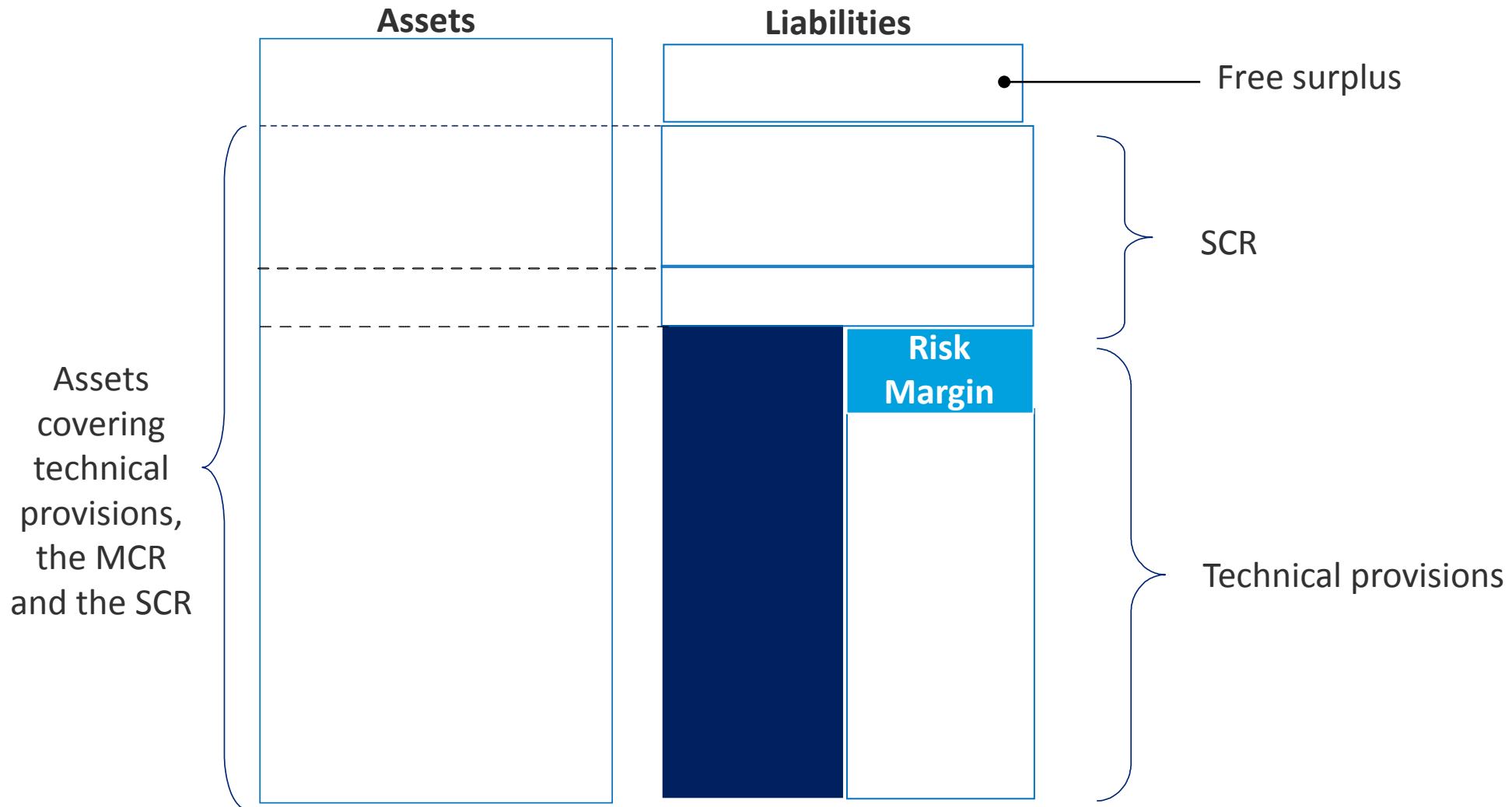
- Adequacy of valuation methodology to nature, scale and complexity of the risks

Back testing

- Part of the actuarial control cycle
- When there is a change in the undertakings' risk profile

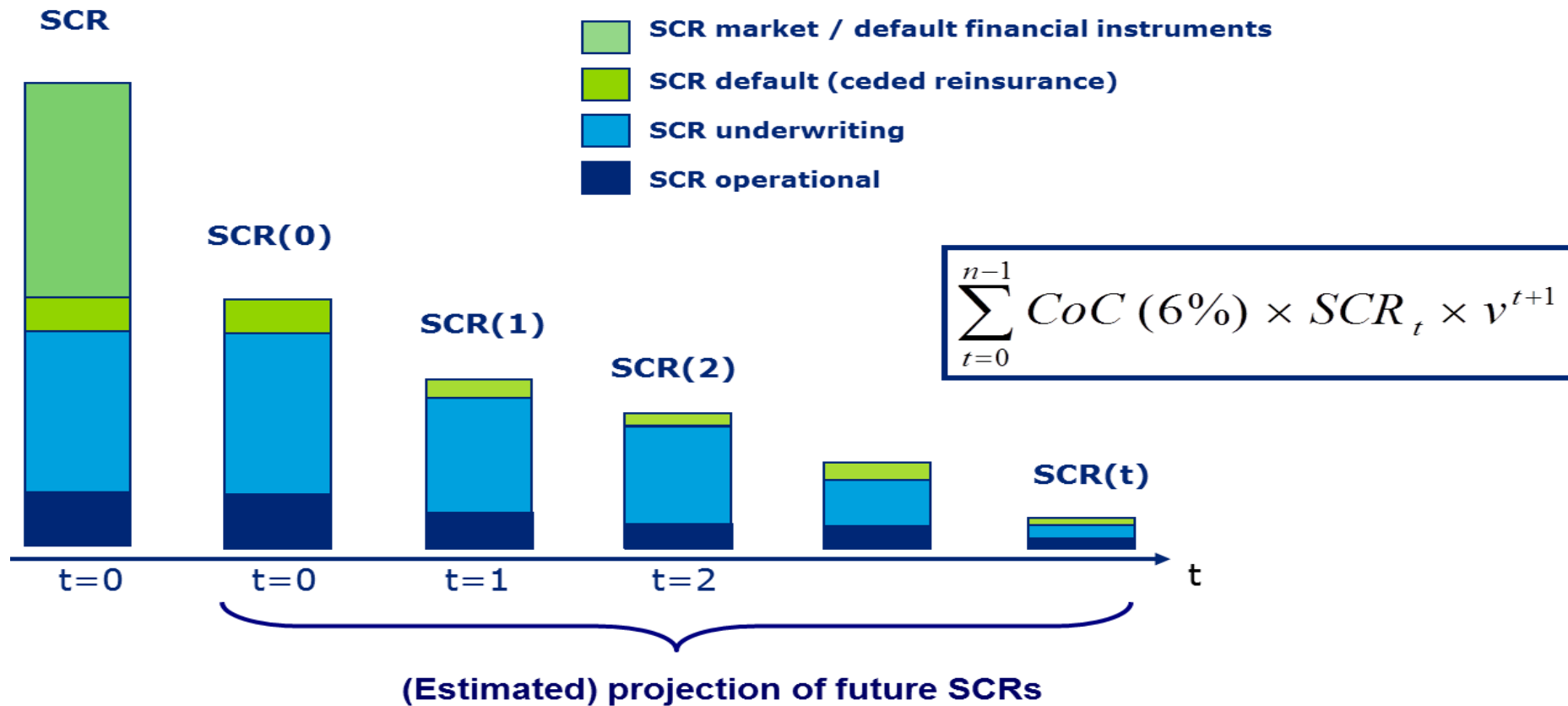


RIZIKOVÁ PŘIRÁŽKA

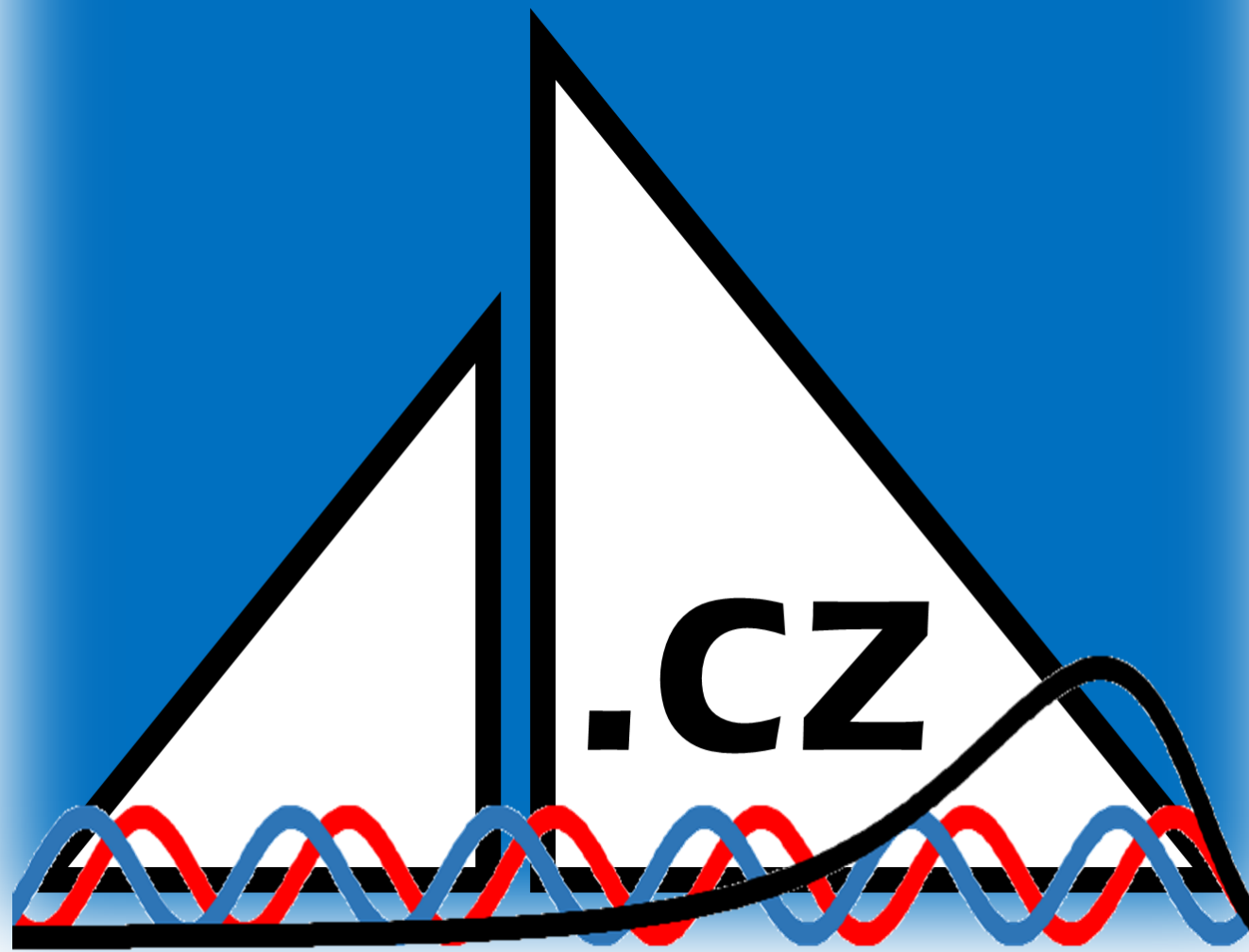


RIZIKOVÁ PŘIRÁŽKA

- ▲ 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

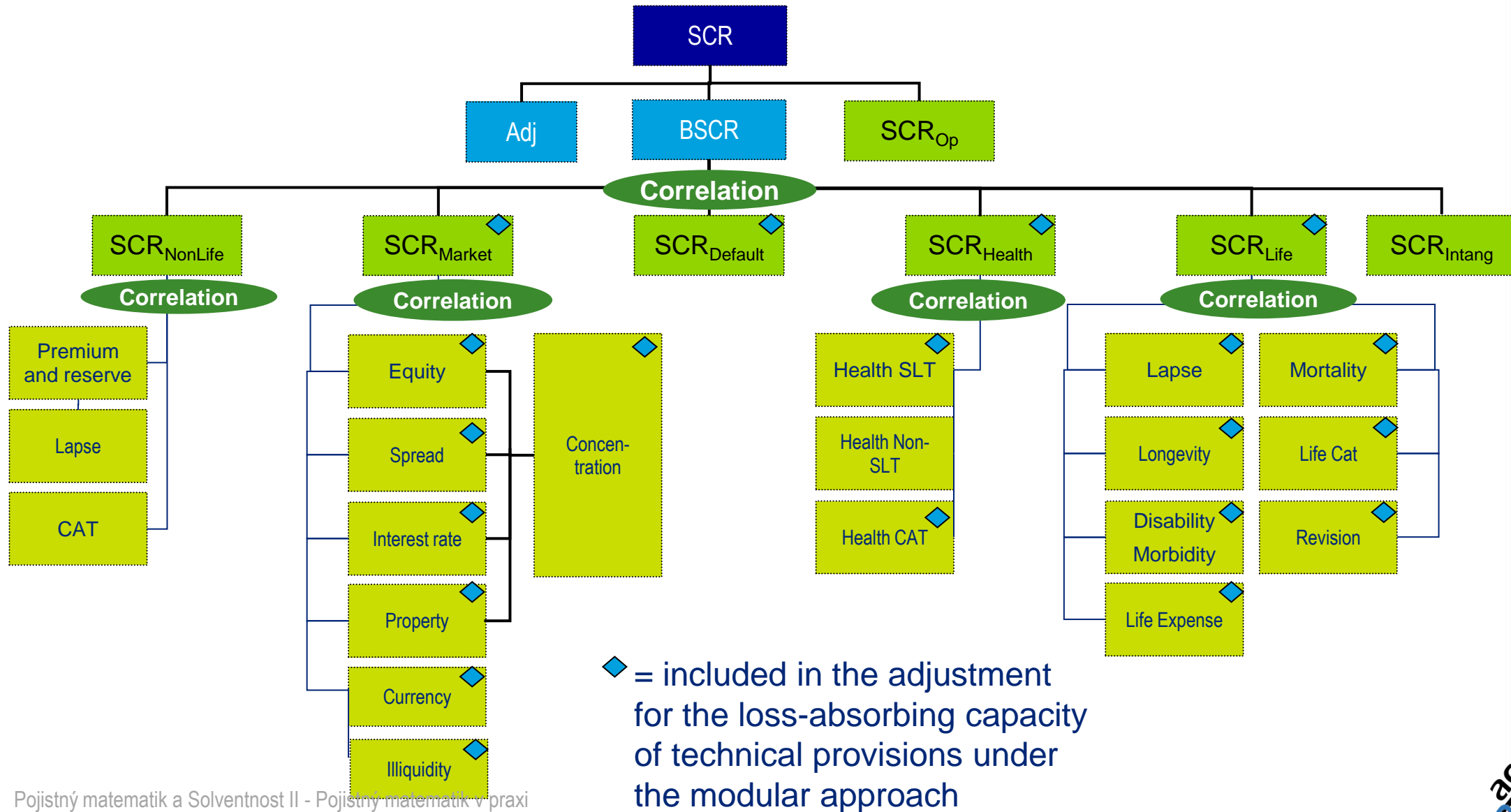


▲ Solventnostní kapitálový požadavek (SCR)



TYOLOGIE RIZIK

Standardní vzorec SCR



KROK

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:

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

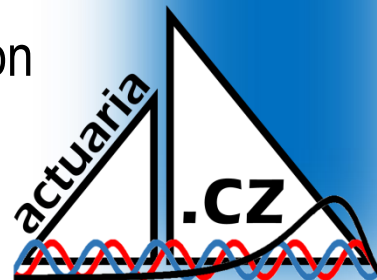
$$7 = 97 - 90$$

Step 3

- ▲ $SCR_3 = \{\text{free surplus}\}_{base} - \{\text{free surplus}\}_{equity} = 10 - 7 =$

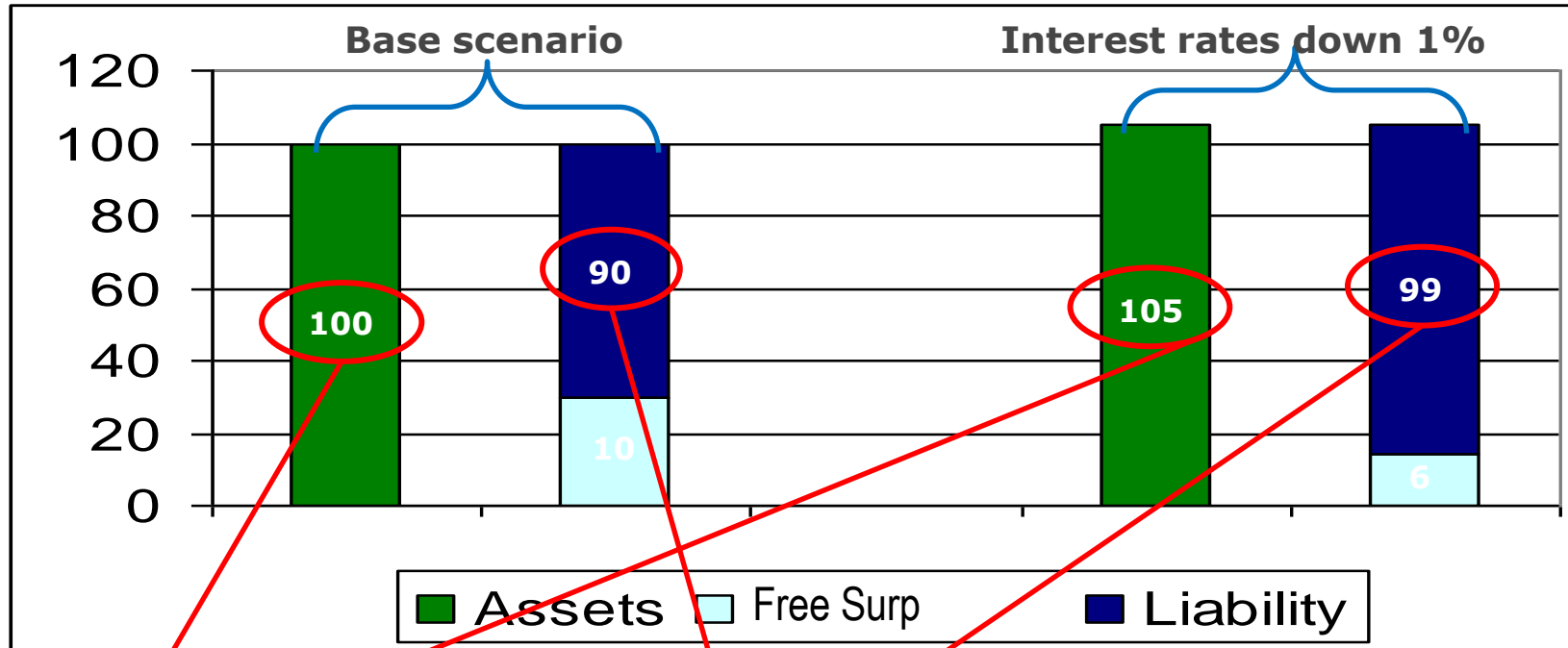
Step 4

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



PŘÍKLAD 2

SCR – šoky



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

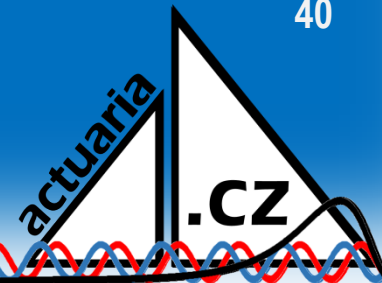
Liab duration = long
Current MV = 90
Stressed MV = 99



Asset increase = 5
Liab increase = 9
Free surplus decrease by 4
SCR
(interest rate fall) = 4

Životní pojištění příklad - závazky

40



- ▲ 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

Liabilities

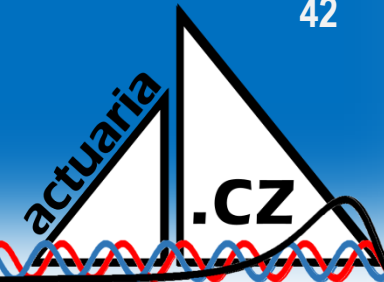
• Assuming a flat term structure of interest rates of 5% we calculate the **best estimate technical provisions**

Year	Best estimate TP
0	12.019.458
1	11.692.777
2	11.359.407
3	11.018.640
4	10.670.046
5	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)	$\Delta NAV/charge$
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%

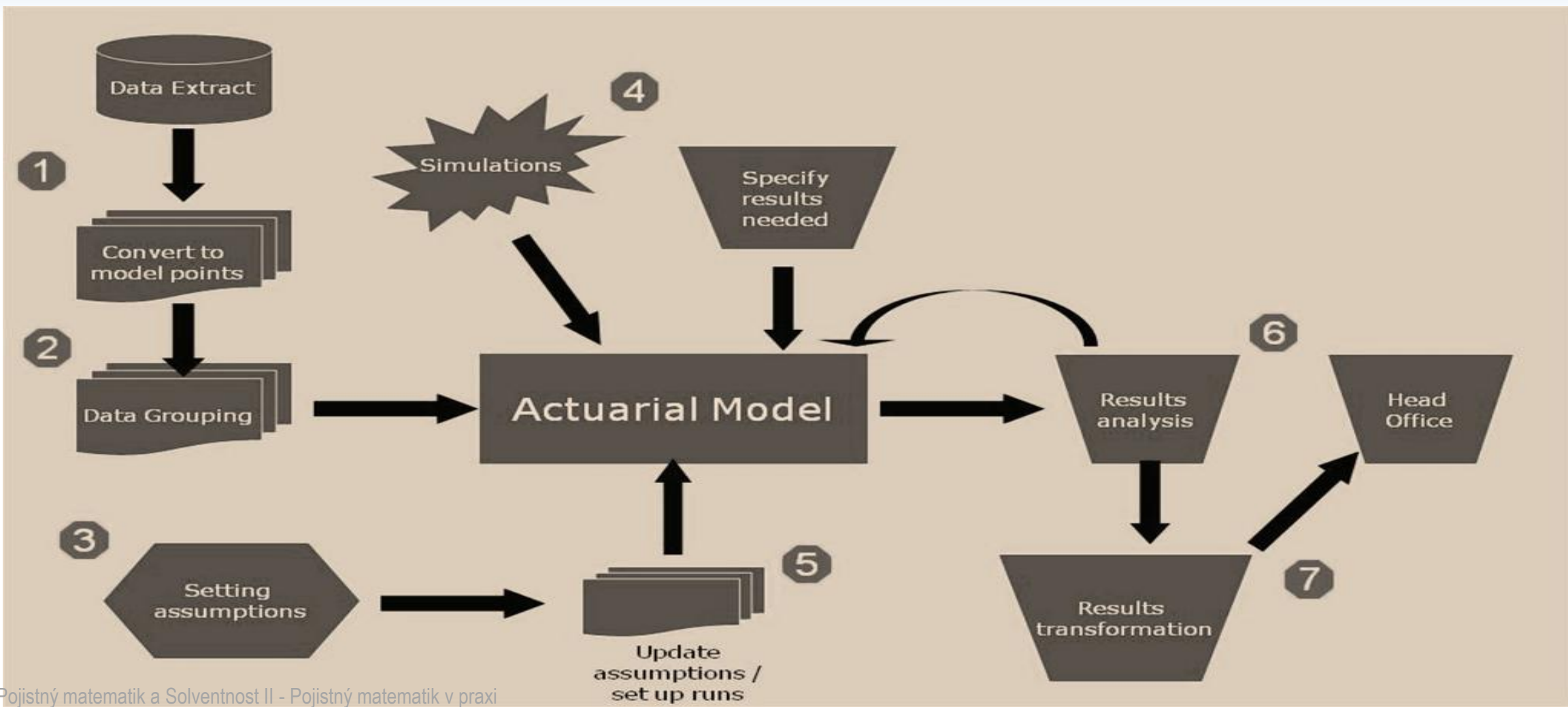
Recall:

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

<i>Corr</i>	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



actuarialia

.CZ

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