Financial Strategies and Methods for Disaster Risk Mitigation

Methods for Analyzing the Economy of Security Investments

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Outline

1. Situation and Motivation
2. General Methods for Analyzing the Economy
3. Return of Security Investment (ROSI)
4. Application of the Statistical Approach
5. Conclusion

1.
SITUATION AND MOTIVATION

1. Situation and Motivation

- Until now there are not too much scientific methods regarding the relation between costs and benefit of security investments resp. security measures
- Reasons
  - No direct benefit
  - Benefit as risk reduction
  - Difficult to measure / to calculate

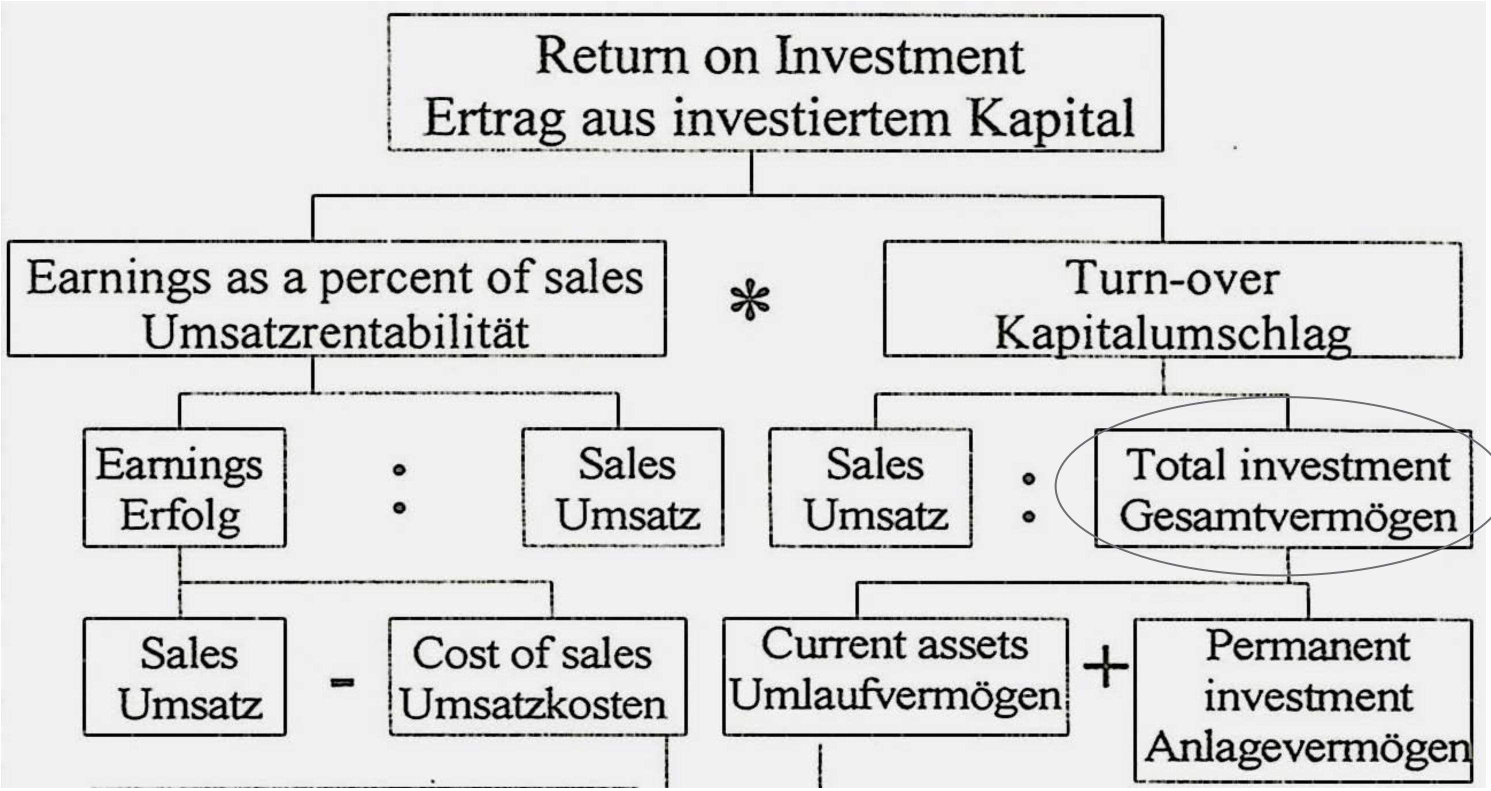
2.
GENERAL METHODS FOR ANALYZING THE ECONOMY

2. General Methods for analyzing the economy

- Methods
  - Quantitative
    - Examples: comparison of costs, comparison of profits, rentability, amortisation
  - Qualitative
    - Examples: analysis of benefit value, effectiveness chain

2. General Methods for analyzing the economy

- Measurement systems
  - Example: Return on Investment (ROI)



2. General Methods for analyzing the economy

- Measurement systems
  - Example:

    Balanced

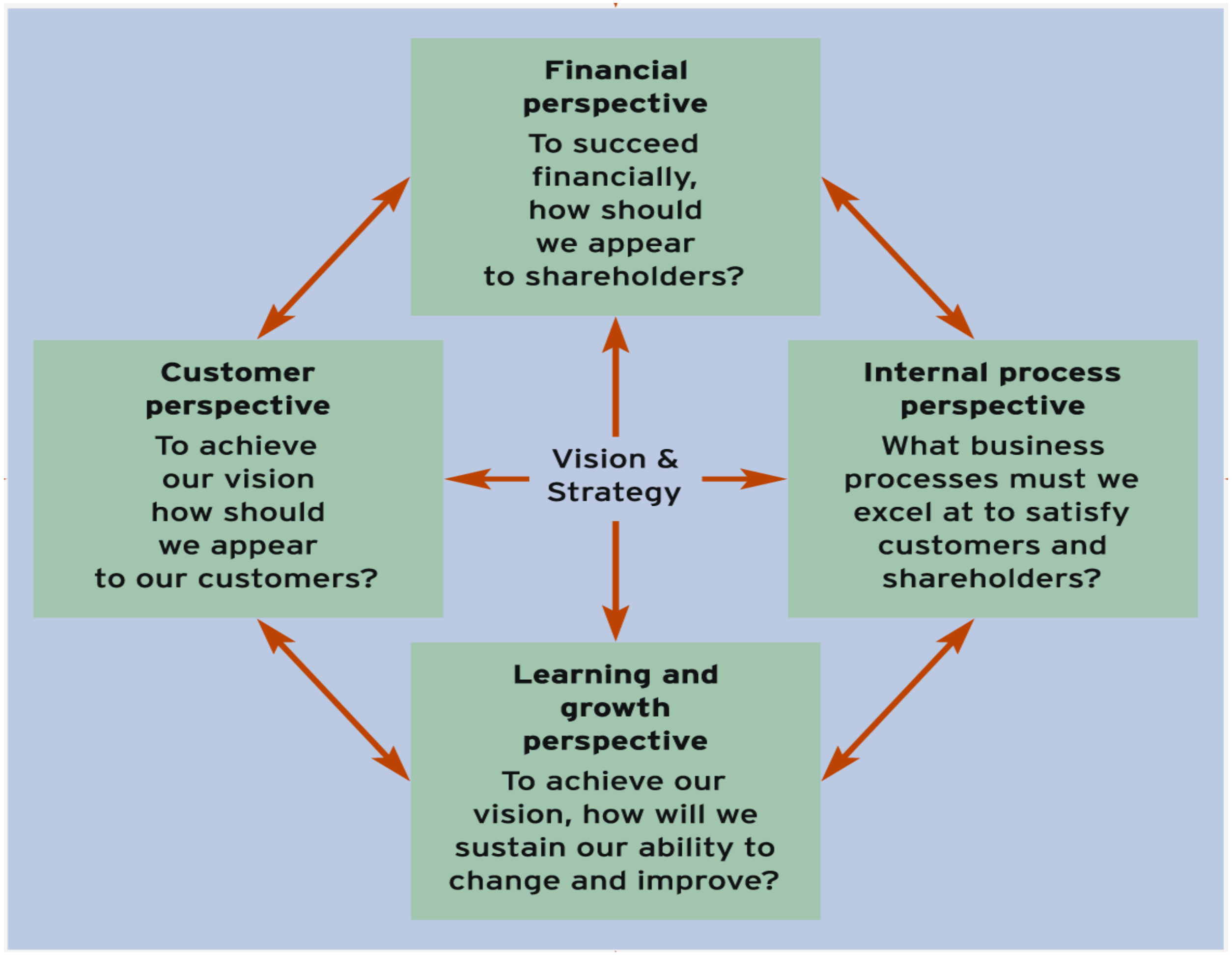
    Scorecard
  - Necessary:

    Measurement

    system for

    every

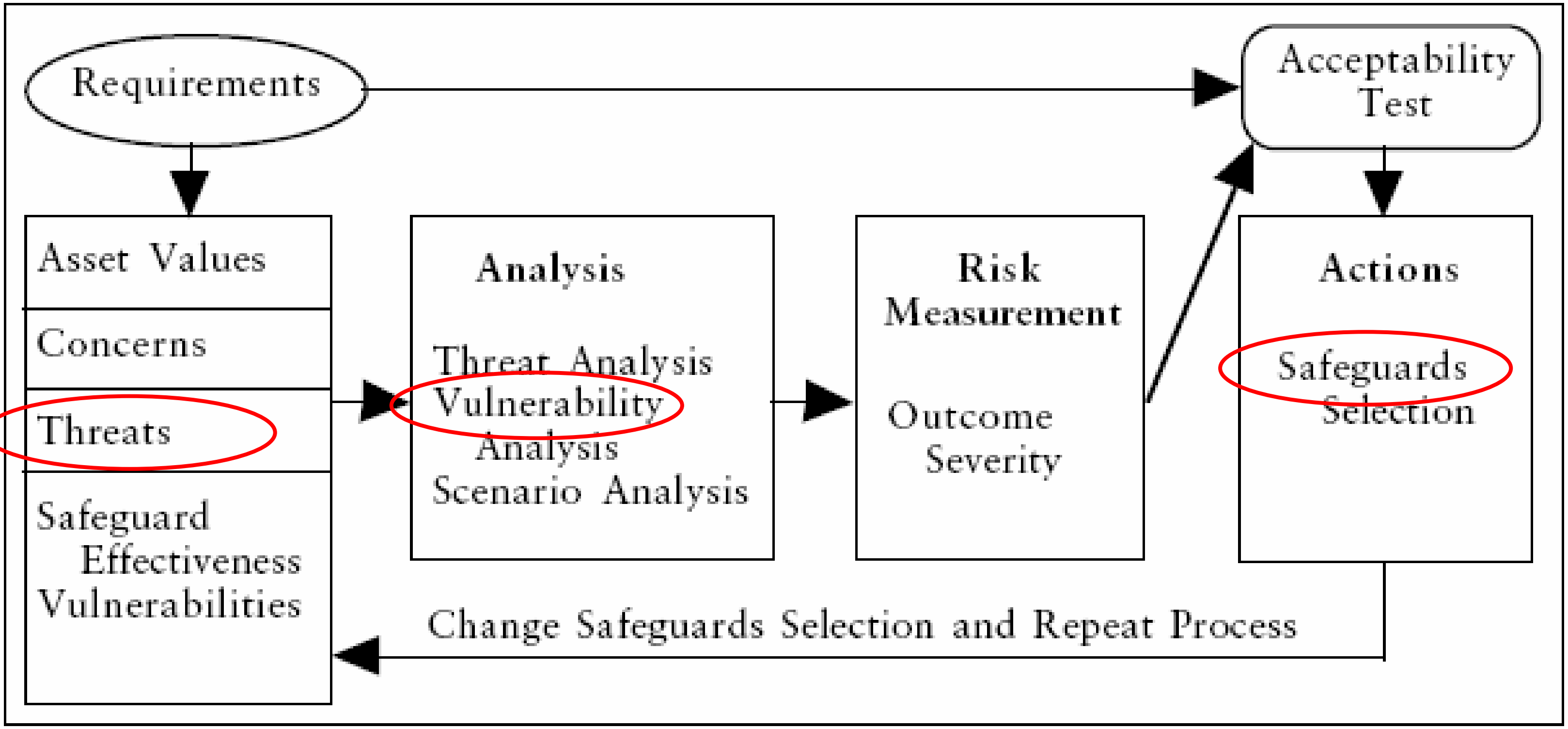
    perspective



3. RETURN OF SECURITY INVESTMENT (ROSI)

3. Return of Security Investments (ROSI)

Risk-management Modeling Framework of the National Institutes of Standards and Technology (NIST)



3. Return of Security Investments (ROSI)

- Aim: Risk mitigation through security measurements (safeguards)
- Questions
  - How expensive is security?
  - How effective / efficient is security?
  - What are the „earnings“?

3. Return of Security Investments (ROSI)

- Annual Loss Expectancy (ALE)

ALE = value of loss × expected rate of loss =

$$\sum_{i=1}^{n} I(O_i) \cdot P_i$$

where $(O_1, \cdots, O_n)$: Set of Harmful Outcomes,

$I(O_i)$: Impact of Outcome i in dollars (EUR), and

P_i: Frequency of Outcome i.

- In many cases the impacts resp. the frequency cannot be determined sufficiently exact to support investment decisions.

- Benefit

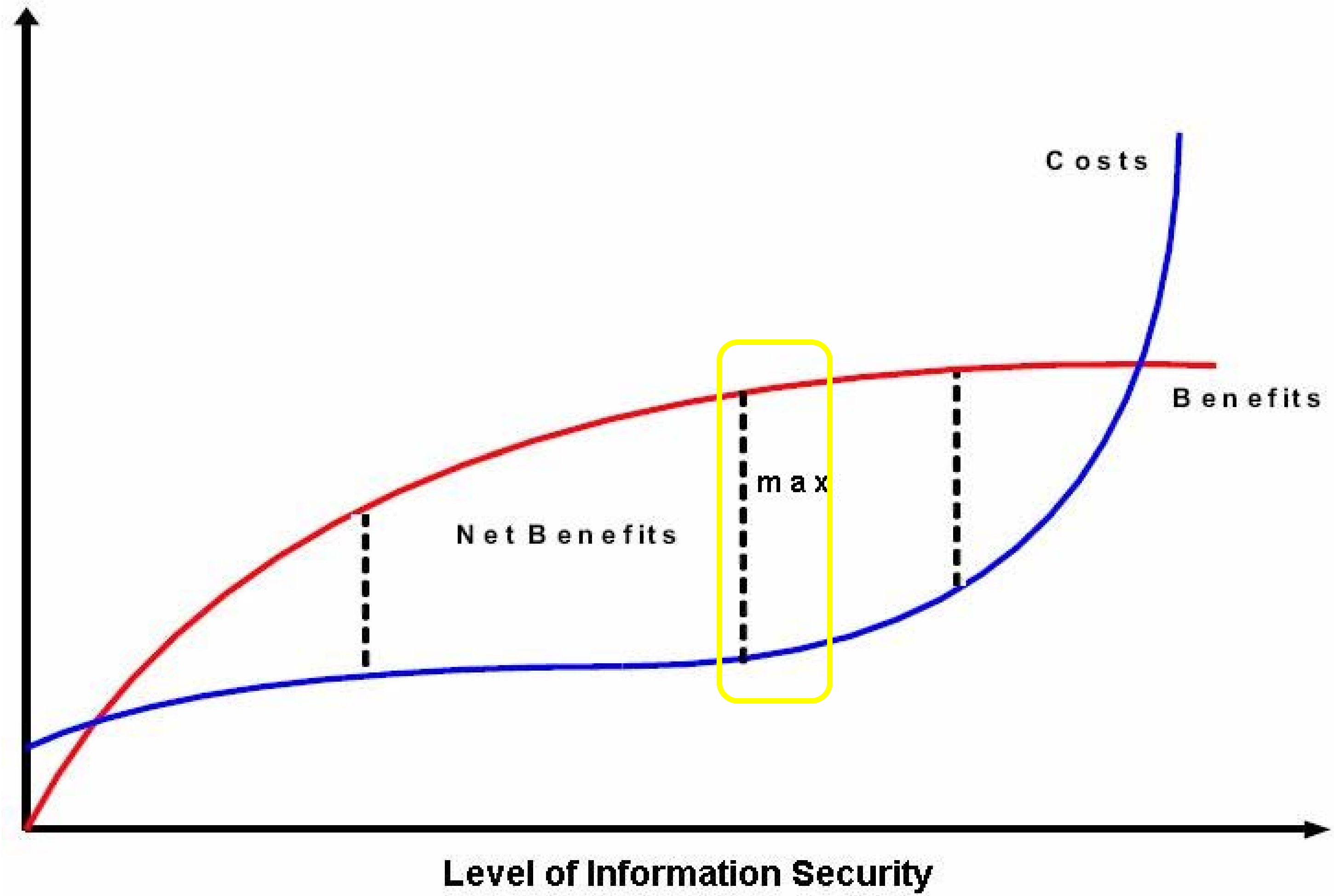
$$\mathbf{Benefit_k = ALE_0 - ALE_k}$$

- Benefit means reduction of loss expectancy.
- ALE_0 represents the ALE due to the status quo.
- ALE_k represents the k-th bundle B_k of safeguards applied.

$$\mathbf{NetBenefit_k = Benefit_k - Costs_k}$$

- *$Costs_k$ represents the costs of the* k-th bundle B_k of safeguards.

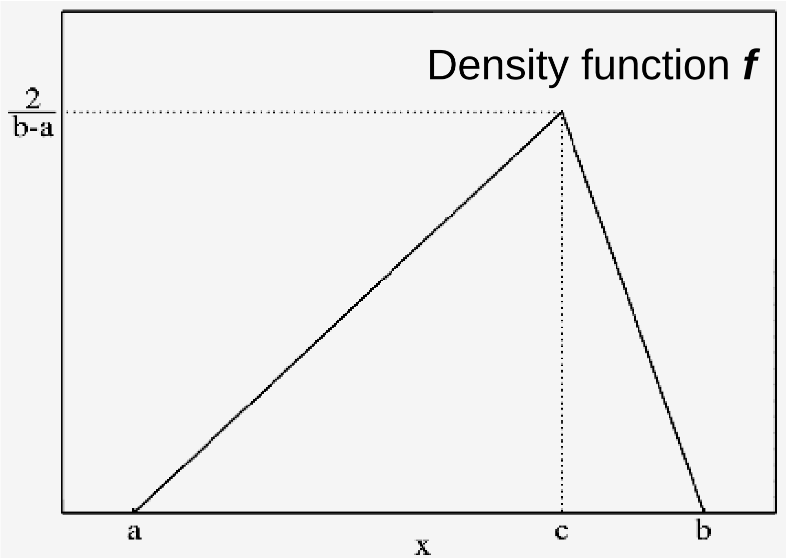
Net benefit depending on costs and benefit



Source: Sklavos / Souras, International Journal of Network Security

Handling of the uncertainty of input data by K. J. Soo Hoo

- ALE computation based on a statistical approach
  - Instead of demanding exact input data a continuous probability distribution is used for the input data.
  - If the data is estimated by experts the ***triangular distribution*** of the relevant random variable has proven successful.



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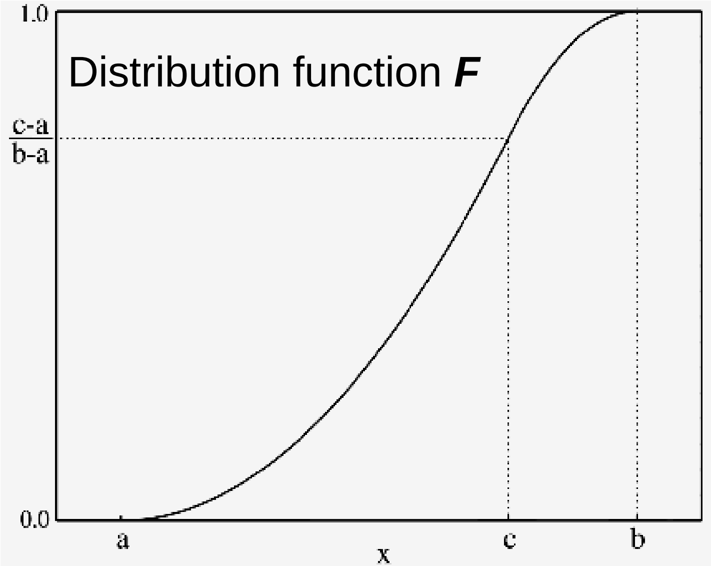


Properties of the triangular distribution

- Assume that X is a random variable. Then the following equation for the distribution function is given:

$$F(x) = P(X \leq x) = \int_{-\infty}^{x} f(t)dt \,.$$

- For the triangular distribution,

$$F(x)= \begin{cases} \dfrac{(x-a)^2}{(b-a)(c-a)} & \text{for } a \leq x \leq c \\ 1-\dfrac{(b-x)^2}{(b-a)(b-c)} & \text{for } c < x \leq b, \end{cases} \quad \text{and } E(X)= \frac{a+b+c}{3}.$$

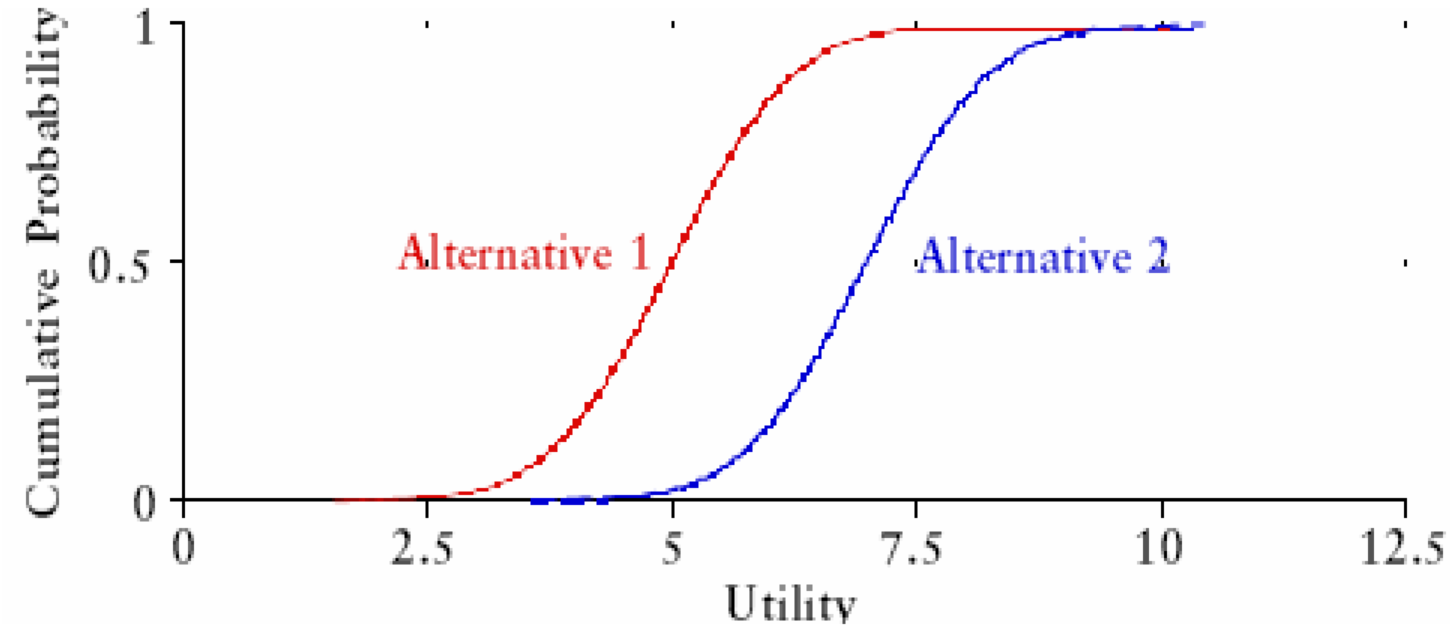
3. Return of Security Investments (ROSI)

Stochastic Dominance

- Given the distribution functions $F_1(x)$ for alternative 1 and $F_2(x)$ for alternative 2.

$F_2(x)$ dominates $F_1(x)$ *if and only if*

$$F_2(x) \le F_1(x) \text{ for all } x.$$



3. Return of Security Investments (ROSI)

Stochastic Dominance and ROSI

- The idea of stochastic dominance is used as criterion for the security investment decision:
  - Random variable X: NetBenefit (NB)
  - Distribution: triangular distribution
- The result of the ROSI computation is a distribution
  - due to the uncertainty of input data.

4.
APPLICATION OF THE STATISTICAL APPROACH

4. Application of the statistical approach

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- Examined institution: a medium-sized German real estate enterprise
- Aim of the examination: **find efficient safeguards to cope with natural hazards and other catastrophes resulting in a long-term interruption of the primary data centre**
- Method
  - Statistical ROSI approach
  - searching for the stochastic dominant distribution in a pool of alternatives

4. Application of the statistical approach

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Security bundles (emergency data center)

B_0	B_1	B_2	B_3
	X	X	X
		X	X
			X
Status Quo (no emergency data center)	Operation of IBM iSeries system	IBM iSeries plus further IBM xSeries software	IBM iSeries plus further IBM xSeries software plus additional software

- Annual Costs
  - $Costs_0 = 0$ *EUR*
  - $Costs_1 = 8160$ *EUR*
  - $Costs_2 = 16820$ *EUR*
  - $Costs_3 = 18820$ *EUR*

4. Application of the statistical approach

Annual Loss Expectancy (ALE) due to wide-spread business interruption

- Many employees are not able to do their business.
- Additionally there is lost turnover (rental).
- Loss depends on the *MTTR (Mean Time to Repair)*.
- Based on the expert estimations there were computed the a-, b- and c-values.

4. Application of the statistical approach

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Annual Loss Expectancy (ALE)

- O: Emergency outcome
- B_0: $I_0(O)$ = (1 281 600;3 355 200;7 776 000).
- Based on statistics dealing with natural hazard related to buildings in Switzerland: The yearly frequency of such an outcome is P = (0,00036;0,00082;0,0084*).*
  - *P*= 0,82‰ *is equivalent to "ist happens every 1221 years"*
- Hence, ALE_0 = (461;2751;65318).

4. Application of the statistical approach

Annual Loss Expectancy (ALE)

- Implementation of bundles B_1, B_2 and B_3 means an increasing reduction of MTTR:

$$I_0(O) > I_1(O) > I_2(O) > I_3(O)$$

- The emergency probability is not influenced by the bundles.
- *Hence,*

$ALE_1 = (288;2063;43546)$, $ALE_2 = (231;1720;34836)$ and $ALE_3 = (173;1375;28305)$.

4. Application of the statistical approach

Net benefit

- Using the net benefit formula

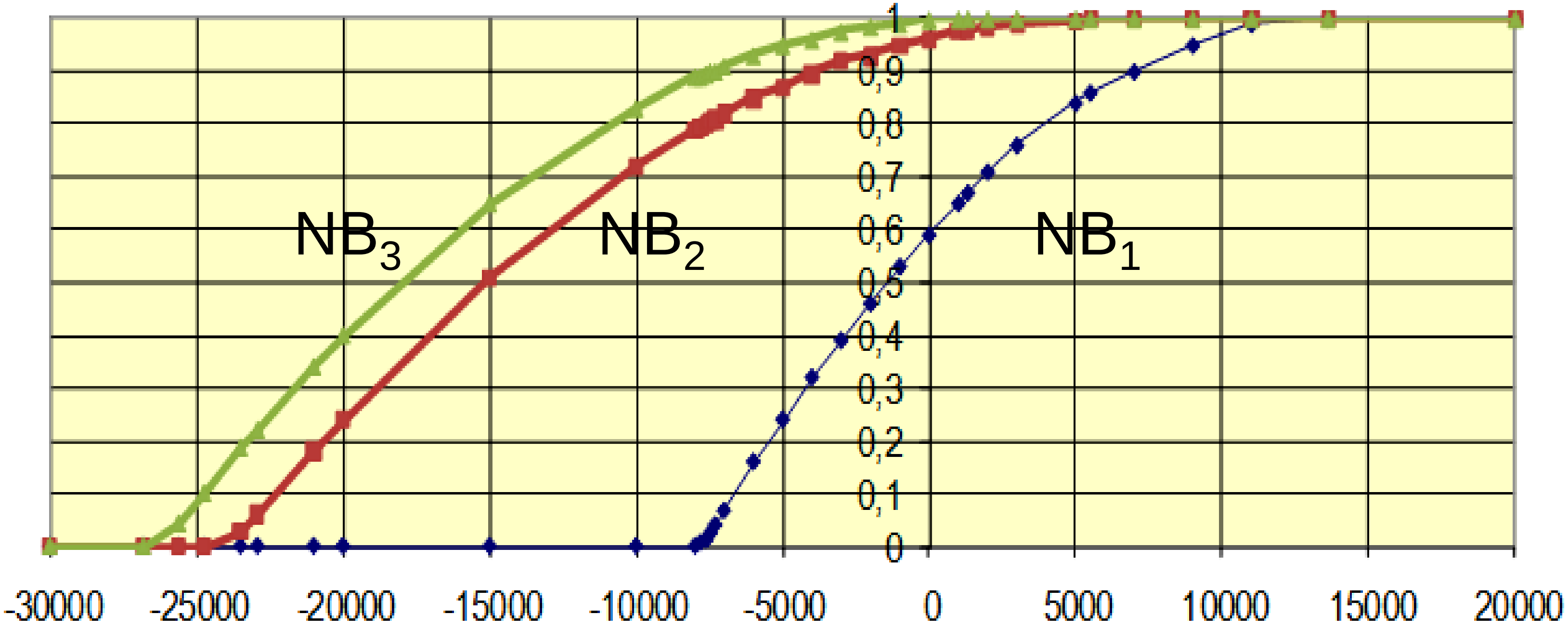
$$NetBenefit_k = ALE_0 - ALE_k - Costs_k$$

  we get $NetBenefit_1 = (-7987; -7472; 13612)$, $NetBenefit_2 = (-24750; -22917; 5502)$ and $NetBenefit_3 = (-26807; -25605; 1325)$.

- The expectancy values of the net benefit are: $E(B_1) = -616$ EUR, $E(B_2) = -14055$ EUR and $E(B_3) = -17029$ EUR.

4. Application of the statistical approach

Cumulative distribution of the net benefit



- NB_1 dominates NB_2 and NB_2 dominates NB_3.
- $NB_1(0) = P(NB_1 \leq 0) = 0{,}592 = 59{,}2\%$. So, the probability of a positive net benefit is 40,8%.

5.
CONCLUSION

Conclusion

- Using (triangular) distributions instead of single values takes into consideration the uncertainty of input data. The results are as precise as possible.
- It is possible to compute distribution functions which help to decide what kind of security bundle should be implemented if one asks for the economy of this bundle.
- If the mean value of net benefit of the stochastic dominant bundle is less than zero one should also analyze the **additional profit** which could be image improvement, increase of the company value etc.

Thank You for Your attention!

You can ask for the slides by email.

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