WORKSHOP PRIN 2022

BUILDING RESILIENCE TO EMERGING RISKS IN FINANCIAL AND INSURANCE MARKETS

June the 12th-13th 2025

An economic decision-making approach to estimate the Value for Money of Non-IBIPs insurance contracts.

Paolo De Angelis

Dipartimento di Metodi e Modelli
per l' Economia, il Territorio e la Finanza
MEMOTEF

Sapienza
Università di Roma

Agenda

- EIOPA principles to evaluate the Value for Money for an insured.
- A review of No IBIPS premium principles.
- The Utility Theory approach to evaluate the Value for Money: from the Expected utility criterion to the Percentile utility criterion.
- Some evidence.
- To the Conclusion.

The scope of the research and references 1/3

- The **POG** 'Product oversight and governance' regulation (Commission Delegated Regulation n. 2017/2358) is devoted to give to the insurance market (both insurance entities and distribution channels) a discipline for the approval process for newly developed insurance products.

- The product approval process shall ensure that the design of insurance products meets the following criteria:
  - it takes into account the objectives, interests and characteristics of customers, including any sustainability-related objectives;
  - it does not adversely affect customers;
  - it prevents or mitigates customer detriment;
  - support a proper management of conflicts of interest.

- The product approval process shall for each insurance product identify the target market and the group of compatible customers. The target market shall be identified at a sufficiently granular level, taking into account the characteristics, risk profile, complexity and nature of the insurance product, as well as its sustainability factors.

- Manufacturers shall test their insurance products appropriately, including scenario analyses where relevant, before bringing that product to the market or significantly adapting it, or in case the target market has significantly changed.

The scope of the research and references 2/3

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- The **POG** 'Product oversight and governance' discipline in the insurance sector has directed the attention of the sector supervisory authorities towards the "**value for money**" understood as the relationship between the price paid by the insured and the benefits obtained from the policy, including the quality of the service offered by the insurer and the benefits guaranteed by the policy itself.

- The "**value for money**" indicates the relationship between the price paid by the insured and the quality and adequacy of the coverage provided by the policy, as well as the quality of the service offered by the insurer.

- For **IBIPs products** (Insurance-based investment products) EIOPA - (European Insurance and Occupational Pensions Authority), the European supervisory authority for the insurance and pensions sector, has recently published a methodological document for the evaluation of the "value for money" in the IBIPs product market [*EIOPA Methodology to assess value for money in the unit-linked market del 31 ottobre 2022 [https://www.eiopa.europa.eu/document-library/methodology/methodology-assess-value-money-unitlinked-market_en?source=search)*].

- The "**value for money**" of non-IBIPs products has not yet been properly investigated and a deep debate among academics and practitioners is still ongoing.

The scope of the research and references 3/3

- The aim of this work is to propose a solution to the problem of measuring the "**value for money**" for the insured of non-IBIPs products based on the Utility Theory introduced by von Neumann and Morgenstern [1944] and evolving into a percentile approach in order to take account of a general Loss Probability Distribution with high asymmetry and kurtosis.

- Making use exclusively of the premium basic technical parameters, the model of "**value for money**" permits to represent the way in which a potential insured can evaluate the fairness of an insurance contract, coherently with his/her particular economic behavior towards risk.

- After a theoretical presentation of the mathematical structure on which the model is based on, an application of the economic model to some insurance no life and life non IBIPs contracts is proposed and an efficient frontier of the "**value for money**" is estimated, taking account of different level of the **insured risk aversion** and **risk tolerance**.

The general actuarial framework for Non - IBIPs premium calculation.

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$\pi[\tilde{X}] = \Psi\big(E[\tilde{X}], \sigma[\tilde{X}]\ or Var[\tilde{X}], \alpha\big),\ \alpha \geq 0$

Net Premium: $\pi[\tilde{X}] = E[\tilde{X}]$

Expected value principle : $\pi[\tilde{X}] = (1+\alpha)E[\tilde{X}]$

Variance principle: $\pi[\tilde{X}] = E[\tilde{X}] + \alpha\, Var[\tilde{X}]$

Standard deviation principle: $\pi[\tilde{X}] = E[\tilde{X}] + \alpha\, \sigma[\tilde{X}]$

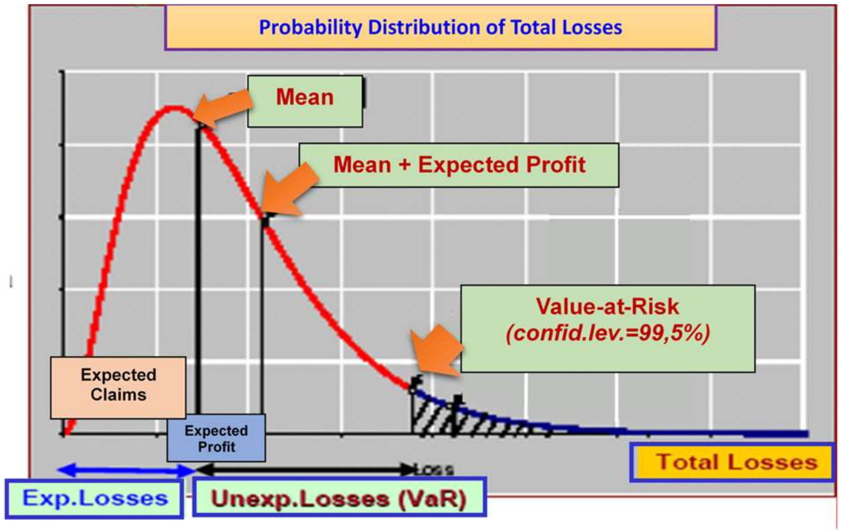
Percentile principle: $\pi[\tilde{X}] = min\{x | F_X(x) \geq 1 - \varepsilon\}$

$X = \sum_{k=1}^{\tilde{n}} \tilde{Y}_k$

Total Loss s.v.

Occurences number s.v.

Claims s.v.



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An economic approach to represent the insured behavior under uncertainty conditions 1/4

- To calculate the **value for money** from an insurance contract , it is necessary to introduce a preference ordering taking in account contemporary of the insured **risk aversion** and **risk tolerance**.

- To this aim the **Utility Theory** [von Neumann and Morgenstern (1944)] is the right theoretical framework to be considered, because it permits to calculate the certain equivalent amount to be exchanged with the stochastic claim. [cfr., De Finetti (1940); Markowitz (1952); Borch K., (1960; 1974); Daboni L., (1993)].

$$\mathbf{U}(x) = x - \left(\frac{1}{2a}\right) x^2$$

For $a>0$ and $x <= a$

The expected Utility criterion

&

The value for money (VfM)

$$\mathbf{VfM} = P^* - \pi\left[\tilde{X}\right] \geq 0$$

$$(x - P^*) - \left(\frac{1}{2a}\right)(x - P^*)^2 = p\left((x - C) - \left(\frac{1}{2a}\right)(x - C)^2\right) + (1 - p)\left(x - \left(\frac{1}{2a}\right)x^2\right) \quad [1]$$

x = insured initial wealth

P^* = *certain equivalent* amount to be exchanged with the contingent claim

1-p = probability to mantain the initial wealth

p = loss probability

a = maximum probable loss bearable by the insured

C = expected loss

An economic approach to represent the insured behavior under uncertainty conditions 2/4

- But the Total Loss probability distribution for No-IBIPs contracts is not normally distributed and usually shows Asimmetry and Kurtosis.
- Therefore the idea is to introduce in the preferences ordering based on the **Utility Theory** a percentile approach in order to obtain a **percentile certain equivalent amount** to be exchanged with the contingent claim.

$$U(x) = x - \left(\frac{1}{2a}\right) x^2$$

For $a>0$ and $x <= a$

The percentile Utility criterion

&

The value for money (VfM)

$$VaR_{\alpha}(U(x)) \approx g\big(VaR_{\alpha}(\tilde{n})\big) \Rightarrow$$

$\tilde{n}$: s.v. Binomial-distributed representing the number of Claims per year.

N: number of contracts.

$$VaR_{\alpha}(\tilde{n}) = E(\tilde{n}) + z_{\alpha}^{*}\sigma(\tilde{n}) = Np + z_{\alpha}^{*}N\sqrt{\frac{p(1-p)}{N}} \qquad [2]$$

$$p^{VaR_{\alpha}} = p + z_{\alpha}^{*}\sqrt{\frac{p(1-p)}{N}} \qquad [3]$$

the α percentile of the probability of the event and z_{α}^{*} is the α percentile of a normal distribution probability of parameters $N(0,1)$.

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An economic approach to represent the insured behavior under uncertainty conditions 3/4

From an economic point of view, the p^{VaR_α} can be interpreted as the *personal risk perception* of the insured, in reference to his/her risk aversion.

By means of the Cornish–Fisher expansion [Cornish, E. A.; Fisher, Ronald A. (1938), Abramowitz, Milton; Stegun, Irene (1964)], it is possible to calculate p^{VaR_α} based on a Z_α percentile derived from a Normal distorted probability distribution:

$$Z_\alpha = z_\alpha^* + (z_\alpha^{*2} - 1)\frac{S}{6} + (z_\alpha^{*3} - 3z_\alpha^*)\frac{K}{24} - (2z_\alpha^{*3} - 5z_\alpha^*)\frac{S^2}{36} \quad [4]$$

Where, respectively, $S = \frac{1-2p}{\sqrt{Np(1-p)}}$ and $K = \frac{1-6p\cdot(1-p)}{N\,p(1-p)}$, are asimmetry and kurtosis indices of the Binomial distribution probability.

- *The Cornish-Fisher expansion is a formula for approximating quantiles of a random variable based only on its first few cumulants; al ready used into the European Regulation [Commission Delegated Regulation 2017/653] to calculate KPIs for Packaged Retail and Insurance-Based Investment Products (PRIIPs) and in particular to estimate a VaR measure in return space for structured financial notes.*

An economic approach to represent the insured behavior under uncertainty conditions 4/4

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$$u\left(x - P_{\alpha}^{*percentile}\right) = p^{VaR_{\alpha}}\, u(x - C) + (1 - p^{VaR_{\alpha}})u(x)$$

For $\mathrm{U}(x) = x - \left(\frac{1}{2a}\right) x^2 \qquad \Rightarrow$

$$\left(x - P_{\alpha}^{Percentile}\right) - \left(\frac{1}{2a}\right)\left(x - P_{\alpha}^{Percentile}\right)^2 = p^{VaR_{\alpha}}\left((x - C) - \left(\frac{1}{2a}\right)(x - C)^2\right) + (1 - p^{VaR_{\alpha}})\left(x - \left(\frac{1}{2a}\right)x^2\right) \qquad [5]$$

$P_{\alpha}^{Percentile}$ depends on the asymmetry and kurtosis of the probability distribution of number of occurencies i.e. accounting of the insured risk aversion and resilience.

$$\mathbf{U}(\boldsymbol{x}) = \boldsymbol{x} - \left(\frac{\mathbf{1}}{\mathbf{2}\boldsymbol{a}}\right) \boldsymbol{x}^{\mathbf{2}}$$

For *a*>0 and *x* <= *a*

The percentile Utility criterion

&

The value for money (VfM)

$$\mathbf{VfM} = \boldsymbol{P}_{\boldsymbol{\alpha}}^{\boldsymbol{Percentile}} - \boldsymbol{\pi}[\widetilde{\boldsymbol{X}}] \gtrless \mathbf{0}$$

In order to validate the criterion of VfM based on the approach proposed, 2 specific insurance contracts are analyzed:

1. **HEAD of FAMILY insurance contract.**
2. **PET insurance contract.**

Analysis of the results permits to appreciate the information power of the approach proposed.

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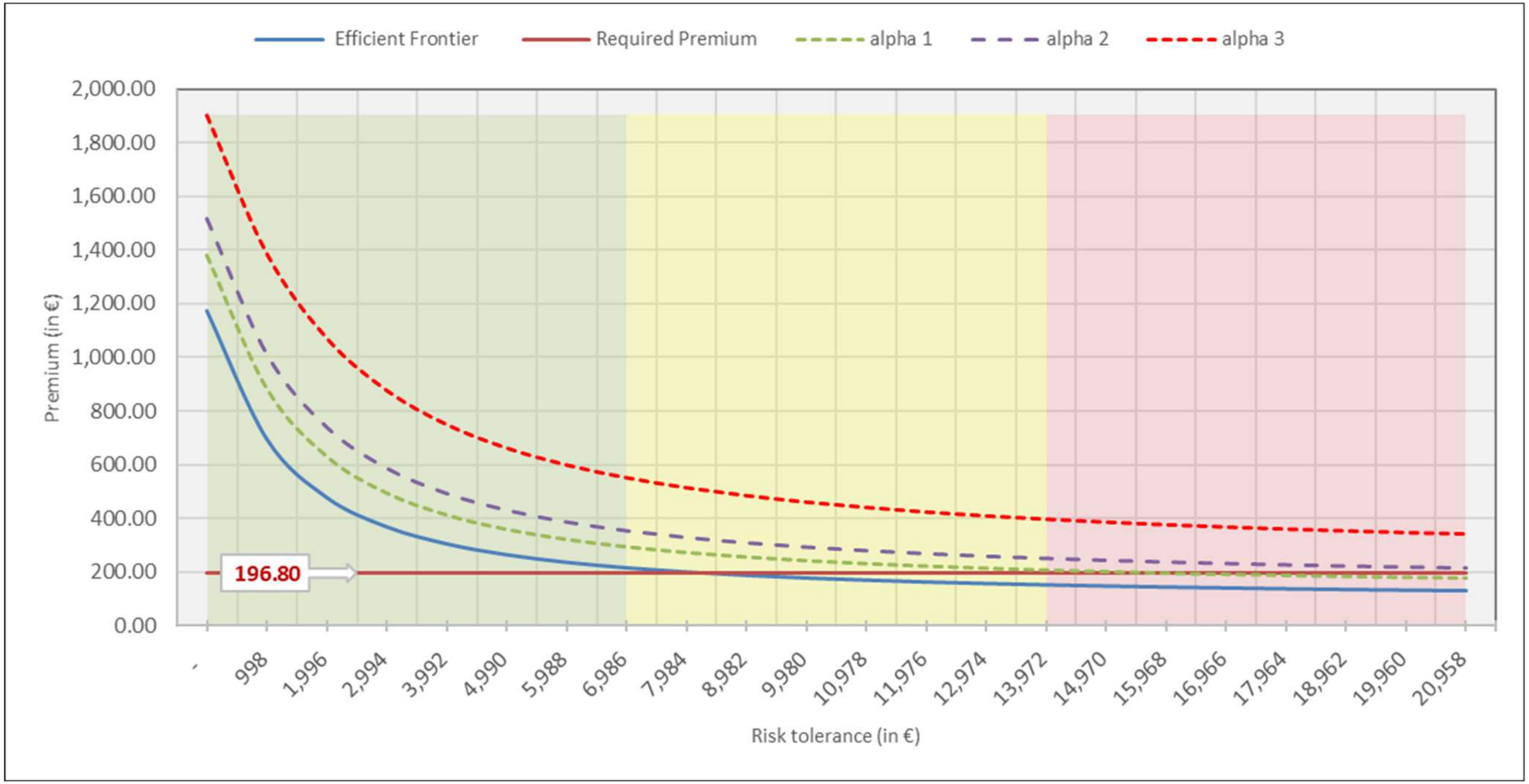
WARRANTY OR UNDERWARRANTY 1							
NAME	THIRD PARTIES LIABILITY PRIVATE LIFE						
BRANCH *(Italian classification of insurance law)*	13. General Third Parties Liabilities						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.560%
P : ANNUAL TAXABLE PREMIUM	49.68 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	150.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	500,000.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**10,000.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	10,000.00 €						
y = *log-normal percentile:*	6,878.14 €	$\mu(\ln x)$	5.960477668	$\sigma^2(\ln x)$	1.116388388	Percentile:	99.500%
z = *ex ante estimate:*	3,750.00 €						
WARRANTY OR UNDERWARRANTY 2							
NAME	ASSISTANCE						
BRANCH *(Italian classification of insurance law)*	18. Assistance						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.500%
P : ANNUAL TAXABLE PREMIUM	5.40 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	0.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	0.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**284.33 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	214.50 €						
y = *log-normal percentile:*	284.33 €	$\mu(\ln x)$	5.189472516	$\sigma^2(\ln x)$	0.178837222	Percentile:	99.500%
z = *ex ante estimate:*	160.00 €						
WARRANTY OR UNDERWARRANTY 3							
NAME	PAYMENT OF FEES						
BRANCH *(Italian classification of insurance law)*	16. pecuniary losses of various kinds						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.450%
P : ANNUAL TAXABLE PREMIUM	9.84 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	0.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	1,500.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**330.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	150.00 €						
y = *log-normal percentile:*	150.00 €	$\mu(\ln x)$	5.010635294	$\sigma^2(\ln x)$	0.000000001	Percentile:	99.500%
z = *ex ante estimate:*	330.00 €						
WARRANTY OR UNDERWARRANTY 4							
NAME	DAMAGE TO THE HOME						
BRANCH *(Italian classification of insurance law)*	8. fire and natural elements						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.480%
P : ANNUAL TAXABLE PREMIUM	131.88 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	100.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	100,000.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**5,500.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	5,500.00 €						
y = *log-normal percentile:*	3,988.69 €	$\mu(\ln x)$	5.650472334	$\sigma^2(\ln x)$	1.025202034	Percentile:	99.500%
z = *ex ante estimate:*	0.00 €						

Insurance contract 1: HEAD of FAMILY insurance contract.

TARGET MARKET PROFILE:

Positive target market: high risk aversion
Negative target market: low risk aversion
Grey area market: neutral risk aversion

Insurance contract 1 - analysis for VfM



WARRANTY OR UNDERWARRANTY 1							
NAME	ASSISTANCE						
BRANCH *(Italian classification of insurance law)*	18. Assistance						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					1.000%
P : ANNUAL TAXABLE PREMIUM	53.45 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	0.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	0.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**300.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	0.00 €						
y = *log-normal percentile:*	1.00 €	$\mu(\ln x)$	0	$\sigma^2(\ln x)$	0.00000001	Percentile:	99.500%
z = *ex ante estimate:*	300.00 €						

WARRANTY OR UNDERWARRANTY 2							
NAME	VETERINARY EXPENSES REIMBURSEMENT						
BRANCH *(Italian classification of insurance law)*	9. Other damage to property						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.718%
P : ANNUAL TAXABLE PREMIUM	147.23 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	200.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	1,500.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**1,500.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	2,000.00 €						
y = *log-normal percentile:*	2,104.44 €	$\mu(\ln x)$	5.18627329	$\sigma^2(\ln x)$	0.957179169	Percentile:	99.500%
z = *ex ante estimate:*	2,000.00 €						

WARRANTY OR UNDERWARRANTY 3							
NAME	THIRD PARTIES LIABILITY						
BRANCH *(Italian classification of insurance law)*	13. General Third Parties Liabilities						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.489%
P : ANNUAL TAXABLE PREMIUM	29.40 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	150.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	500,000.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**2,500.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	465.00 €						
y = *log-normal percentile:*	465.00 €	$\mu(\ln x)$	6.142037406	$\sigma^2(\ln x)$	0.000000001	Percentile:	99.500%
z = *ex ante estimate:*	2,500.00 €						

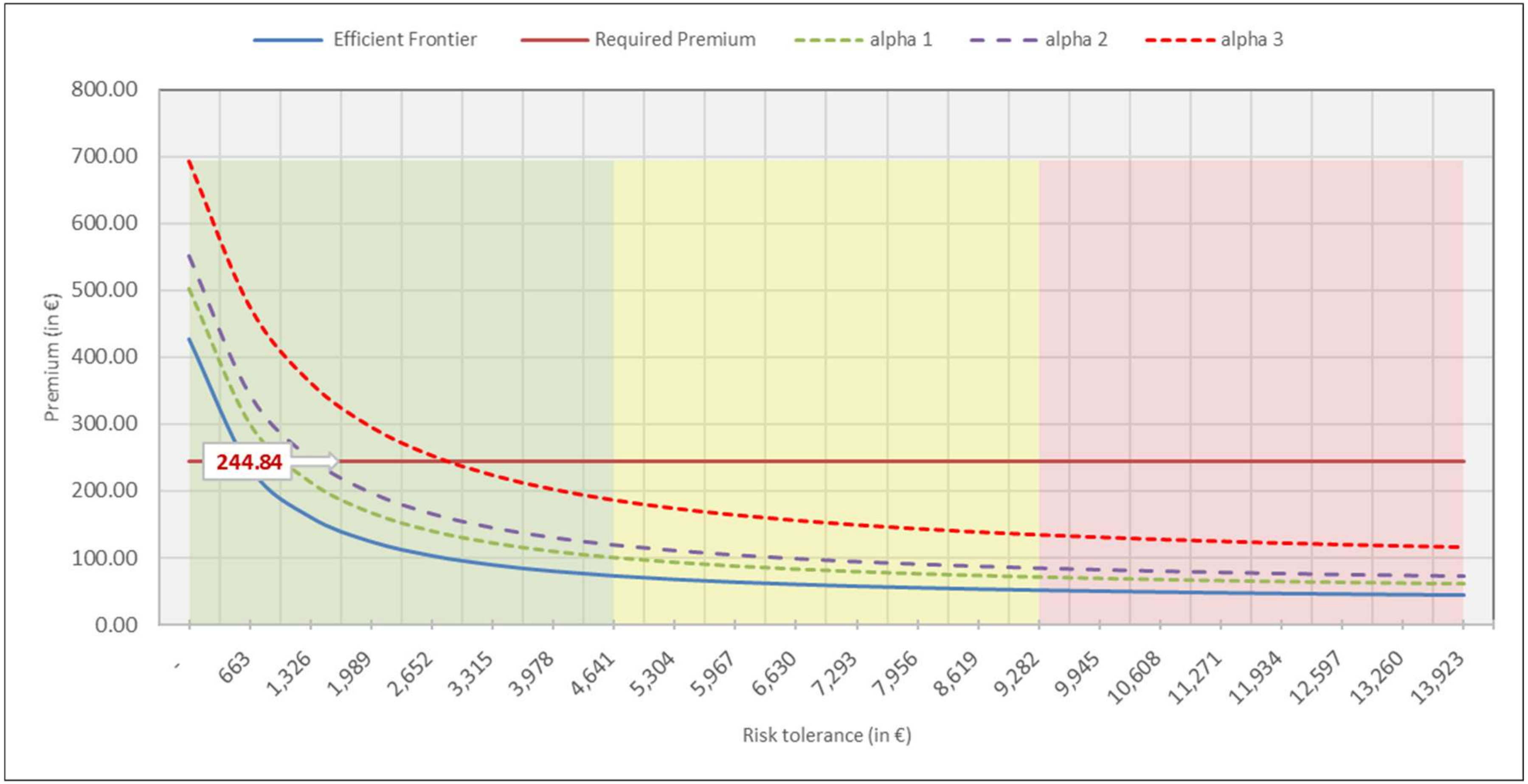
WARRANTY OR UNDERWARRANTY 4							
NAME	LEGAL PROTECTION						
BRANCH *(Italian classification of insurance law)*	17. Legal protection						
PROBABILITY DISTRIBUTION	Bernoulli	***p*** : PROBABILITY OF THE EVENT OCCURRING					0.100%
P : ANNUAL TAXABLE PREMIUM	14.76 €	***q*** : PROBABILITY OF DAMAGE > DEDUCTIBLE					100.000%
F : INSURANCE DEDUCTIBLE	0.00 €	***alpha 1*** : 1st percentile normal distribution					65.000%
M : MAXIMUM INSURANCE	10,000.00 €	***alpha 2*** : 2nd percentile normal distribution					75.000%
C : POTENTIAL LOSS=max(w;y;z)	**3,000.00 €**	***alpha 3*** : 3rd percentile normal distribution					95.000%
CLAIMS: ***w*** = *maximum observed:*	0.00 €						
y = *log-normal percentile:*	1.00 €	$\mu(\ln x)$	0	$\sigma^2(\ln x)$	0.000000001	Percentile:	99.500%
z = *ex ante estimate:*	3,000.00 €						

Insurance contract 2: PET insurance contract.

TARGET MARKET PROFILE:

Positive target market: high risk aversion
Negative target market: low risk aversion
Grey area market: neutral risk aversion

Insurance contract 2 - analysis for VfM



Percentile Utility based VfM test for life Non IBIP contracts

A standard approach for the VfM test for non life and life non IBIPs contracts 1/4

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By means of simple mathematical steps the equation [5] can be adapted for use with life non-IBIPs products. In this case, to determine the probability of the occurrence of the insured event, it seems appropriate to calculate the average annual mortality rate implicit in the survival table deemed useful.

Fixing η the age of the insured and n the duration of the contract, we have:

$$_{n}\bar{p}_{\eta} = \left(1 - \bar{q}_{\eta}\right)^{n} \qquad \bar{q}_{\eta} = 1 - \sqrt[n]{_{n}\bar{p}_{\eta}} \qquad [6]$$

where $_{n}\bar{p}_{\eta}$ is the average survival probability of the insured aged η to survive for n years and $\bar{q}_{\eta}$ is the average annual mortality rate (geometric mean).

From [6], by means of [4] and [3] it is possible to calculate $\bar{q}_{\eta}^{VaR_{\alpha}}$ and then $\bar{p}_{\eta}^{VaR_{\alpha}} = 1 - \bar{q}_{\eta}^{VaR_{\alpha}}$, therefore using [5] calculate the indifference percentile premium, on which to base the VfM test for life non-IBIPs contracts.

A standard approach for the VfM test for non life and life non IBIPs contracts 2/4

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- Term life insurance contract with constant insured capital and a single premium (SP), equation [5] becomes:

$$(x - SP_{\alpha}^{\text{Percentile}}) - \frac{1}{2a}(x - SP_{\alpha}^{\text{Percentile}})^2 =$$
$$\text{prob}_{\eta}^{\text{VaR}_\alpha}\left[(x-C) - \tfrac{1}{2a}(x-C)^2\right] + \left(1 - \text{prob}^{\text{VaR}_\alpha}\right)\left[x - \tfrac{1}{2a}x^2\right],$$

Where:

$$\text{prob}_{\eta}^{\text{VaR}_\alpha} = \overline{q}_{\eta}^{\text{VaR}} + \overline{p}_{\eta}^{\text{VaR}}\overline{q}_{\eta}^{\text{VaR}} + (\overline{p}_{\eta}^{\text{VaR}})^2\,\overline{q}_{\eta}^{\text{VaR}} + \cdots + (\overline{p}_{\eta}^{\text{VaR}})^{\text{n-1}}\,\overline{q}_{\eta}^{\text{VaR}}$$
$$= \overline{q}_{\eta}^{\text{VaR}}\left(\frac{1 - (\overline{p}_{\eta}^{\text{VaR}})^n}{1 - \overline{p}_{\eta}^{\text{VaR}}}\right).$$

- Term life insurance contract with constant insured capital and a constant periodic premium (PP), equation [5] becomes:

$$\left(x - PP_{\alpha}^{\text{Percentile}}\left(\tfrac{1-(\overline{p}_{\eta}^{\text{VaR}})^n}{1-\overline{p}_{\eta}^{\text{VaR}}}\right)\right) - \frac{1}{2a}\left[x - PP_{\alpha}^{\text{Percentile}}\left(\tfrac{1-(\overline{p}_{\eta}^{\text{VaR}})^n}{1-\overline{p}_{\eta}^{\text{VaR}}}\right)\right]^2 =$$
$$\text{prob}_{\eta}^{\text{VaR}_\alpha}\left[(x-C) - \tfrac{1}{2a}(x-C)^2\right] + \left(1 - \text{prob}_{\eta}^{\text{VaR}_\alpha}\right)\left[x - \tfrac{1}{2a}x^2\right].$$

A standard approach for the VfM test for non life and life non IBIPs contracts 3/4

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- CPI-type insurance contract with a single premium, equation [5] becomes:

$$(x - SP_{\alpha}^{\text{Percentile}}) - \frac{1}{2a}(x - SP_{\alpha}^{\text{Percentile}})^2 =$$

$$\sum_{h=0}^{n-1}\Big\{\overline{q}_{\eta}^{\text{VaR}}(\overline{p}_{\eta}^{\text{VaR}})^h\Big[x - \frac{(n-h)}{n}C - \Big(-\frac{1}{2a}\Big(x\frac{(n-h)}{n}C\Big)^2\Big)\Big]\Big\} + \Big(1 - \text{prob}_{\eta}^{\text{VaR}_\alpha}\Big)\Big[x - \frac{1}{2a}x^2\Big].$$

- CPI-type insurance contract, with a constant periodic premium, equation [5] becomes:

$$\Big(x - PP_{\alpha}^{\text{Percentile}}\Big(\tfrac{1-(\overline{p}_{\eta}^{\text{VaR}})^n}{1-\overline{p}_{\eta}^{\text{VaR}}}\Big)\Big) - \frac{1}{2a}\Big[x - PP_{\alpha}^{\text{Percentile}}\Big(\tfrac{1-(\overline{p}_{\eta}^{\text{VaR}})^n}{1-\overline{p}_{\eta}^{\text{VaR}}}\Big)\Big]^2 =$$

$$\sum_{h=0}^{n-1}\Big\{\overline{q}_{\eta}^{\text{VaR}}(\overline{p}_{\eta}^{\text{VaR}})^h\Big[x - \frac{(n-h)}{n}C - \Big(-\frac{1}{2a}\Big(x\frac{(n-h)}{n}C\Big)^2\Big)\Big]\Big\} + \Big(1 - \text{prob}_{\eta}^{\text{VaR}_\alpha}\Big)\Big[x - \frac{1}{2a}x^2\Big]$$

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A standard approach for the VfM test for non life and life non IBIP contracts 4/4

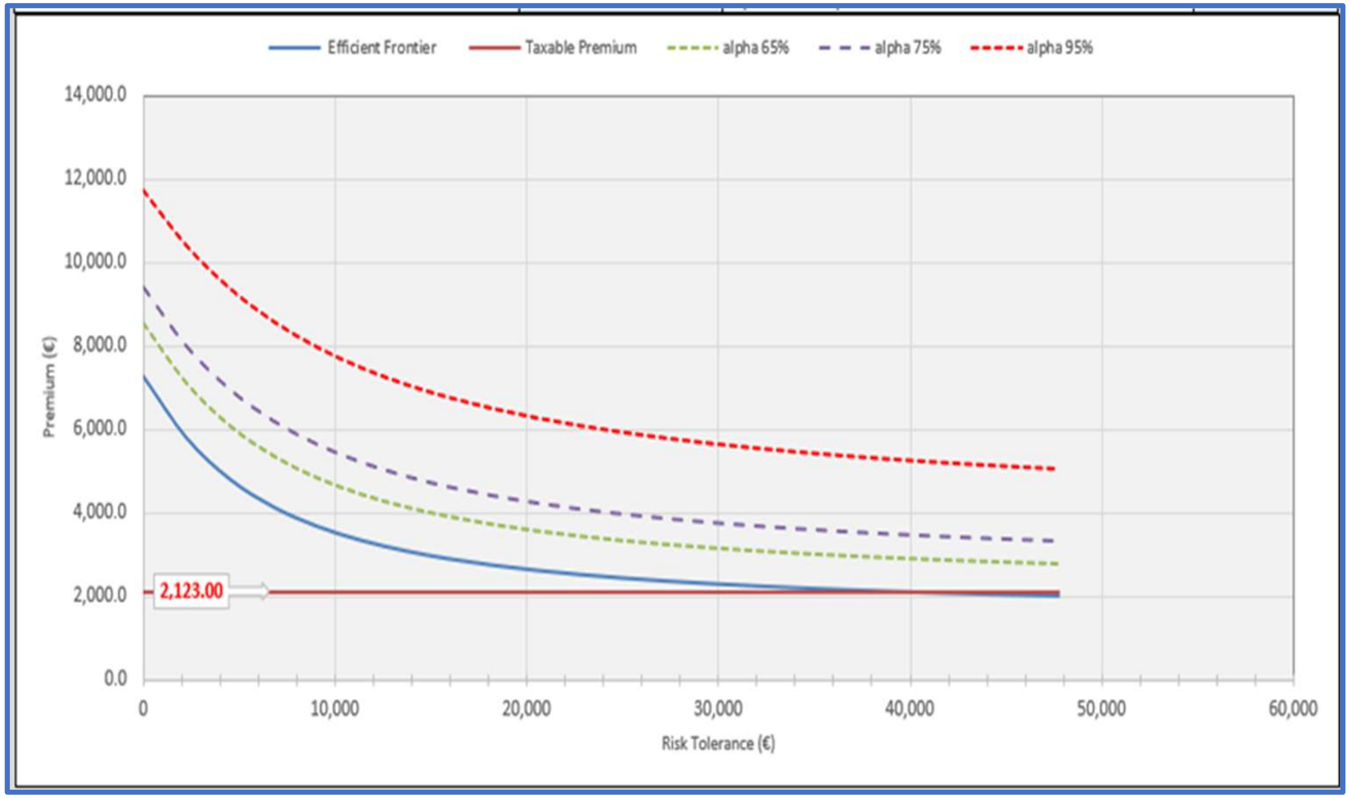
- The approach proposed can be used for the VfM estimation of a complex CPI contract, where a multiguarantee life and non life coverages are considered.

- The percentile indifference premium calculation can be performed for each guarantee and therefore the indifference premium of the product as a whole can be calculated via an additive process.

$$VfM^T = \sum_{K=1}^{n} VfM_k$$

- The graph shows the percentile indifference premium frontier of a CPI-type insurance contract with a single premium, for different tolerance thresholds.

CPI-type insurance contract with a single premium



Going to the conclusion- European Regulator considerations

- Analyses to determine and measure the value of the product for the customer (Value for Money, VfM), which were often deficient in considering the customer's point of view, either because they were based on a comparison with similar products of competing undertakings **without any determination of the value of the product per se**, or because they included assessments aimed at verifying the **sustainability of the product and its profitability only from the undertaking's side**.

- In the process of designing and approving a product, both profitability/sustainability analyses for the undertaking and product testing activities from the customer's point of view should be carried out, in accordance with POG regulations. However, the **two types of activities respond to different and potentially conflicting objectives**: **the first aims to verify the consistency of the product with the undertaking's profitability targets**, including risk-adjusted targets; the second is aimed to assess that the **amount of costs and charges is compatible with the needs, objectives and characteristics of the target market**, and is such as to allow adequate value for the customer.

- The approach proposed **appears to be compliant with the Authority expectations** as it is appropriate to measure the **value** created by the insurance product, taking account of the economic behaviour of the insured towards risk.

- It is clear that the quality of data used to calibrate the model is a **crucial issue to obtain robust results** in the same manner as a best ex ante classification of insured into the target market (best clustering procedure).

References

- Abramowitz, Milton; Stegun, Irene (1964). "Probability Functions". Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables. Dover Publications. p. 935. Retrieved September 17, 2014.
- Borch K., (1960). “The safety loading of reinsurance premiums”. Scandinavian Actuarial Journal, Volume 1960. Issue 3-4.
- COMMISSION DELEGATED REGULATION (EU) 2017/2358 of 21 September 2017, supplementing Directive (EU) 2016/97 of the European Parliament and of the Council with regard to product oversight and governance requirements for insurance undertakings and insurance distributors.
  - (https://www.eiopa.europa.eu/content/eiopaapproach-supervision-product-oversight-and governance_en?source=search)
  - (https://www.eiopa.europa.eu/document-library/methodology/methodology-assessvalue-money-unit-linkedmarket_en?source=search
- Cornish, E., and R. Fisher, (1937), “Moments and Cumulants in the Specification of Distributions”, Revue de l’Institut International de Statistiques 5, 307-320.
- De Finetti B., (1940), “Il problema dei “pieni””, Giornale istituto Italiano degli Attuari, 9.
- Daboni L., 1993, “Lezioni di tecnica attuariale delle assicurazioni contro i danni”, Edizioni LINT Trieste.
- Kaas R., G. M. (2008). Modern Actuarial Risk Teory. Springer.
- Kahneman D., T. A. (marzo 1979). Prospect Theory: ana analysis of decision under risk. Econometrica.
- Von Neumann J., M. O. (1944). Theory of Games and Economic Behavior. Princenton: Princenton University Press.

Paper submitted for publication on Soft Computing [SOCO]

An Economic Decision-Making Approach to Estimate the Value for Money of No-IBIPs Insurance Contracts

Paolo BOTTA[1], Paolo DE ANGELIS[2]

[1] Algoritmic® Srl, Rome (Italy)
[2] Sapienza University, Rome (Italy)

Abstract

The POG 'Product oversight and governance discipline in the insurance sector has directed the attention of the sector supervisory authorities toward "value for money," understood as the relationship between the price paid by the insured and the benefits obtained from the policy, including the quality of the service offered by the insurer and the benefits guaranteed by the policy itself.

An insurance policy that respects the principle of value for money should offer coverage tailored to the customer's needs, a competitive price compared to other options on the market, and high-quality customer service.

While, with reference to IBIPs (Insurance-Based Investment Products), EIOPA (European Insurance and Occupational Pensions Authority), the European supervisory authority for the insurance and pensions sector, has recently published a methodological document for the evaluation of "value for money," the non-IBIPs product market has not yet been adequately investigated.

The aim of this work is to propose a quantitative solution to the problem of measuring the "value for money" for the insured of non-IBIPs products by adopting an algorithm based on the Utility Theory introduced by Von Neumann and Morgenstern [1944] and evolving into a percentile approach in order to take into account a general Loss Probability Distribution with high asymmetry and kurtosis. By means of the basic elements of this model, we represent how a potential insured can evaluate the fairness of an insurance contract, consistent with his or her particular psychological predisposition toward risk.

The approach is then extended to non-IBIP life insurance contracts, allowing for the evaluation of insurance products that underlie different life and non-life guarantees, such as CPI-type contracts.

The proposed algorithm has been implemented in Visual Basic for application setting, therefore an application is presented and an efficient frontier is estimated, taking into account different levels of individual insured risk tolerance.

Keywords: POG, value for money, utility function, non-IBIP, VBA setting.

Thank You

paolo.deangelis@uniroma1.it