MATHEMATICAL METHODS USED FOR CALCULATE INSURANCE PREMIUM TO THE PROPERTY INSURANCE

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ABSTRACT: *The most important task of the actuarial department is to provide well grounded charges for specialized departments and sales departments subsequently.For the stringency of these calculations will depend in future the economic performance of an insurer, by a mathematical estimate as close to reality existence.The method presented in this work is a quantitative one, later charges will support certain adjustments in terms of quality.*

KEY WORDS: *property insurance; risk management; premium risk for property insurance.*

JEL CLASSIFICATION: *G22*

1. THE NECESSITY AND THE CONTENT OF THE INSURANCES

Since ancient times, the economical agents have searched to discover and to apply various means of protection against various risks at which their production and commercialization were exposed, as the persons who were performing such activities. Right now, the remarkable progress in science and technique lead to the economical and social development, to the growth of the work's productivity, generating this way a wide range of risks.

The insurance contract represents a legal act by which the insured is obliged to pay to the society of insurance a premium, this one forcing to take the risk of the occurrence of a certain event and to pay to the beneficiary (who can be the insured or a third person a compensation within the established limits). (Constantinescu, 2004)

Speaking of the legal aspect, the insurance contract is developed based of some principles which, even though aren't specifically mentioned in the policy, they must be known and respected by the two parts:

a) *The principle of compensation* it is the most important principle which provides that the compensations granted by the insurer can't be placed overs the value of the

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losses offered by the insured. In other words, no person can't benefit from the insurance, having the role to return the insured persons in the financial situation, that they had before the sinister, the subjective risk by the removal of the interest for the profit being reduced. Analyzing more closely three available principles at the grant of the compensations can be distinguished:

The principle of the proportional liability, where the rapport between compensation (D) and damage (P) can't be higher than the rapport between the granted amount (SA) and the real value (VR) of the insured thing (1.1 relation). In this case, the compensation will be equal with the damage only in the case of the total damages.

$$\frac{D}{P} = \frac{SA}{VR} \leq SA \leq VR \tag{1.1}$$

The principle of the first risk which provides that the compensation is equal with the damage eve though the thing was insured to another amount than the real value, specifying that the damage will not overcome nor the insured amount nor its real value.

$$D = P \leq SA \leq VR \tag{1.2}$$

The principle of the limited liability, according to which the compensation is granted only if the damage overcomes the default value. Thus, a part from the damage will fall, in the charge of the insured, part which is named franchise (F). The franchise is of two kinds: touched (simple) and deductible (absolute). In the case of the simple franchise, the insurer covers integral the damage if it is above the level of the franchise, otherwise everything being supported by the insured (relation 1.3). The deductible franchise is deducted from the amount of the damage, no matter of its level (relation 1.4).

$$\begin{cases} D = 0, \Leftrightarrow P \leq F \\ D = P, \Leftrightarrow P > F \end{cases} \tag{1.3} \qquad \begin{cases} D = 0, \Leftrightarrow P \leq F \\ D = P - F, \Leftrightarrow P > F \end{cases} \tag{1.4}$$

b) **The principle of the insurable interest** exists in the moment when a person can suffer a prejudice or a financial loss in the moment of occurrence of an insured risk. This principle supports the principle of compensationn, stipulating that the benefits of the insurance may cause to those a financial loss, and only in the limit of these damages. The court can not compel an insurer to pay compensations to ar in the intereset of the insured, if the insured does not have an insurable interest.

c) **The principle of subrogation** it is applied in the moment when the insurer is obliged by the insurance police, at the payment of some compensations because of the fault of a third person. The right of subrogation is based on the common law or on regulations, and insurers often have the right to subrogation even though this things is not provided expressly in the policy.

2. PROPERTY INSURANCE

This type of insurance plays an important role in protecting the mobile and imobile savings of which a person has and it covers a large gama of risks, favoured by the diferent disasters of nature or by accidents, or which creation can cause big material damages. The modern economy, being subjugate to some continous changings regarding the introduction of some new technologies, the developement of earth mevement, air circulation, marine trafic and world commerce, as well as the apperance of some new domain of activity, imposes the giving of a bigger attention to this type of insurance.

The object of insurance is represented also by the buildings thet belong to the insured and also to their contents, fixed means (machines, equipements, tools, inventory, objects etc.), circulant means (the marchandises, substances, materials and another circulant means). By exception there are assimilated also in the insurance building, the instalations and equipments that guarantee the good work building too: thermal centrals, elevators, sanitary objects etc. We will not include here the cars, the animals, agricultural cultures, those making the object of other types of insurance, presented separately.

The risk for which the insurers offer protection, are in general the same, but the type of arranjement in disimilar packets of risks, are different. In general there are three packets of risks surmise:

- **the standard packet**, also known as FLEXA[1], including the risks of fire, lightning, explosion and aircraft;
- **the extended standard packet** which means a selective or cumulative extension of standard packet on some risk: earthquake, floods and silts, storm, down pour rain, hail-imediate effects, the burglary;
- **the all risks packet** where are included all the risks of the two packets above, plus the vandalism, the fall down or/and sliding of the ground created because of natural causes, the burden of snow and /or the ice, boom[2] sonic, avalanches, the accidental falling of parts, strikes and civil disturbances.

In the base of some special clauses and with the paymnt of additional insurance, it also can odder covers for the next risk: the flood caused as a following of accidental breaking of water conducts, the specific risks of breakable goods from the plan of buildings; mobile or transportable means which can be found on another adress too than the one which reviewed in the policy of insurance; damages of consequences, produced as indirect material damages, as a follow of producing risks, accidental damages produced to the goods as a follow of high tension, electrical arc, magnetic introductory, short circuit.

In the policy of insurance ,despite the risks of insurance, are showed the excluded situations of insurance too. The main exclusion, for which the insurers don`t odder protection are:war revolution, rebellion, insurrection, military ditactorship, take from owning, nationalization, kidnapping, atomic explosion, radioactive radiation or

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[1] FLEXA is the English acronym of "**F**ire, **L**ightening, **EX**plosion and **A**ircraft"
[2] Shock wave caused by aircraft

infections, poluations, oxidation, smoking, spotting, the action of bugs, rodents, fungs, birds and of another pests: infiltration, the soil mapping, the damage or the fall down of buildings as a following of designing errors and/or execution errors, the big fault of the insured or his presumtives.

A very important aspect, from which it depends the subscribe uprightness of a saving insurances it`s represented by the evolution of risk, regarding the insurance. In this way will be made an analysis by the representant of insurance society, from two sights: the value for which the risk will be taken in the insurance and the sum which will be payed for taking this risk into the insurance.

The insurance premium (P_a) represent the sum of money that the insured will be payed to the insurer, in the exchange of taking the risks from the insurer, and it etablishes as a percent from the insurance sum (SA) (relation 2.1).

$$P_a = SA \times C_p \tag{2.1}$$

The establishment of the rate level of the tariff premium, upon which is determined the amount of premiums which will be paid by insurers, have a major special importation in insurance activity. To ensure the goods belonging to legal persons, mostly collected premiums are used to pay claims. Part of the premium, which is destined compensation coverage is called the net premium or share. To this adds additional premium destination which has to cover the costs incurred by the establishment and administration of the insurance fund, financing of preventive measures, establishing reserve funds and making a profit by the insurer. To calculate the net premium it starts from annual compensation index (I_k) that shows compensation paid by the insurer within one year, calculated as the ratio between the total amount of compensation (S_k) and the total amount of insured amounts determined by multiplying the number of insured property (N_k) and the average amounts provided (V_k) (the relation 2.2.)

$$I_k = \frac{S_k}{N_k \times V_k} \tag{2.2}$$

Biginning of an annual compensation index, the annual average index of compensation can be calculated, index which is an arithmetic average of annual compensation index. By comparing average compensation index with annual compensation index is found deviations, plus or minus, hub if the net premium would be calculated according to the average rate of compensation, revenues from insurance premiums would not cover damage produced at a time. To eliminate such a possibility, the index average of annual compensation will be corrected with the addition of risk that is obtained by calculating the standard deviation.

Calculating standard deviation, it is recommended to give up at the average index of compensation, because using simple arithmetic average is not appropriate only when damages would be uniform frequency. Relative frequency (f_k) is calculated as

the ratio between the number of goods compensated in K year (x_k) and the total number of the compensated goods in the reference period (n).

Average value of the compensation index (i) can be calculated with the 2.4 formula now, being known both annual compensation index, and relative frequency.

$$f_k = \frac{x_k}{n} \quad (2.3) \qquad\qquad\qquad i = \sum_{k=1}^{n} I_k \times f_k \quad (2.4)$$

Dispersion (σ_1^2) is calculated using the 2.5 formula, and standard deviation (σ_1) is just the square root of the variance (relation 2.6).

$$\sigma_1^2 = \sum_{k=1}^{n}(I_k - i)^2 \quad (2.5) \qquad\qquad \sigma_1 = \sqrt{\sigma_1^2} = \sqrt{\sum_{k=1}^{n}(I_k - i)^2} \quad (2.6)$$

Therefore, the net premium index *(p)* is obtained by adding the average index of annual compensation or standard deviation , 2.7 relation, and gross index (P) is calculated by adding together the first net premium index and the addition of index *(a)*, the 2.8 relation.

$$p = i + \sigma_1 \quad (2.7) \qquad\qquad\qquad P = p + a \quad (2.8)$$

To determine the rate necessary for creating reserve fund is used inequality Binayme - Cebâsev, where *X* is a random variable, and *m* is the average value of the random variable. (2.9 relation)

$$P(|X - m| < \varepsilon) > 1 - \frac{\sigma_1^2}{\varepsilon^2} \qquad\qquad\qquad (2.9)$$

Insurance premium calculated with relation (2.5) can be paid either in advance and fully, in which case some insurers offer discounts or in a number of installments. In the case of contracts forefront in several installments, the validity of this is directly related to compliance deadlines for payment of premium rates, otherwise insurers are not obliged to honor claims.

Franchise is another important element of the insurance contract, which has the following functions (Constantinescu, 2004):

• It encourages risk control measures: some insured are not willing to spend the time, energy or money to prevent damage which, if they occur, will be paid by the insurance company. For example: a person may give up installing an alarm system against burglary, when he knows that the insurance company will cover damages resulting from theft. If, in the insurance policy provides for a franchise, the insured will be encouraged to install such a system because he is aware that, in case of theft, he will have to bear part of the damages.

- It reduces costs incurred by the insurer in connection with compensation: most times, if low value claims, the insurer's administrative expenses incurred to settle the case for compensation may be greater than the amount actually paid as compensation insured; existence of franchises involves reducing the number of claims, facing the insurance company because compensation claims are eliminated for damages of little value.
- It reduces the insurance premium that the insured must pay: because deductible reduces costs incurred by the insurer in connection with compensation, this also determines the reduce of the value of premiums by the insured.

      Property insurance usually contracts for a period of one year and at the request of the insured may be concluded for periods for least than a year. An exception to this rule are the insurances concluded for stuffs which are the subject to guarantees (bank loans) in this case the policies can be concluded for multi-period up to expiry has been established warranty (full repayments of the loan).

3. CONCLUSIONS

      Economic, social, political and natural world in which people living, acting and evolving is full of uncertainties, increasingly acknowledging that a system that works to get a result next set operates in a situation of uncertainty, even if specific situations are characterized by varying degrees of risk. But the risk and uncertainty are not optional topics, they are part of the human condition.

      To cope with risks, so you can control and to counter or mitigate their negative consequences, man invented the plane, a tool that predicts the future milestones of the work he performs essential correlations between factors production and proportions of their combination and substitution at the micro level and the fundamental priorities of the national economy, allocating a significant part of material resources, money and manpower and directs economic activity. Plan contributes to widening the scope restriction certainty and uncertainty in a given economic space and time horizon. By recognizing risks and uncertainties, businesses improve their behavior and increase their knowledge improves, and thus they are able to conduct their work more efficiently or even exploit them.

      By specific means that they have available, the insurances help create the necessary conditions for realization of the objectives of the national economy, the expansion of foreign economic relations, tourism etc. They contribute to socio-economic progress of the country by maintaining the continuity of the production process by protecting and defending the integrity of public property, private, cooperative personal by creating for population additional provision and saving means.

      In an economy of uncertainty, providing a unique favors the flow of household savings to end the financial market. Uncertainties in the economy can favor or disfavor the evolution of future wealth of economic agents and the insurance contract is a conditional debt issued by the insurer and purchased by the insured.

      Increased economic efficiency of various organizations is dependent upon the scientific leadership. Management is based on a good knowledge of economic laws, fast and accurate knowledge of supply and demand of domestic and external dynamics

of prices and tariffs, technological trends, and how to use the resources available to them.

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