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CALCULATION AND ANALYSIS OF TARIFF RATES USING A FRANCHISE FOR THE BRANCH «ROSGOSSTRAKH» IN TOMSK REGION

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The insurance is one of the most flexible and stable activities to protect the interests of subjects disturbed by unforeseen negative events. An insurance is always a risk, and it is the risk of the two parties, namely, the insured and the insurer.

Actuarial calculations are the basis for each of the contracts concluded between the insurer and insured. Contracts determine the cost of services. Pricing is the most important task of insurance, as too low prices lead to losses and high prices – to a displacement of the insurance company from the market.

Set the following problems:

1) to calculate tariff rates by "Methodology of Rosstrahnadzor" on two years data from OOO "Rosgosstrakh";

2) to modify the calculating methodology of the tariff rate by using a franchise;

3) to make recommendations to each of the departments of the company.

The objects of insurance are cars insured by the KASKO. There are considered three departments of Tomsk region: D, E, and S.

According to the "Methodology of Rosstrahnadzor", the following conditions have to be fulfilled [2]:

1) a group of insurance objects is exposed to the only risk;

2) insurance contracts are concluded at the same fixed period of time;

3) during a contract insured event can occur no more than once;

4) a net premium is the same for all contracts of this aggregate and its size should be such that at the expense of the funds provides for the payment of all compensations with the given level of reliability.

Introduce designation.

The gross premium is the full amount of the insurance premium that a policyholder pays an insurer according to the contract. The gross premium is calculated on the basis of the gross rate insurance tariff, which consists of a net rate and its load. The net rate is calculated by making use the probability of infliction of insured damage. Note that the load depends on the transactions costs of the company and its desired profit [1].

Let n is a number of contracts, m is a number of claims filed for payment of compensation. The occurrence probability of the insured event on an insurance contract is

$$q = \frac{m}{n}. \tag{1}$$

According to the "Methodology of Rosstrahnadzor " [2], the net rate is defined by the formula

$$T_H = \beta_1 + \alpha_\gamma \cdot \sqrt{\frac{\alpha_2(S) \cdot (\beta_2 - \beta_1^2)}{n \cdot \alpha_1^2(S) - \alpha_\gamma^2 \cdot \mu_2(S)}}, \tag{2}$$

where

$$\beta_i = \frac{q \cdot \alpha_i(Sb)}{\alpha_i(S)}, \tag{3}$$

$$\alpha_k(S) = \frac{1}{n} \cdot \sum_{i=1}^{n} S_i{}^k \ , \tag{4}$$

$\alpha_k{}^*(Sb^y) = \frac{1}{s} \cdot \sum_{i=1}^{s} (Sb_i^y)^k$ are the estimates of the moments for completed contracts [3], S_i is an insurance amount at the conclusion of the i^{th} insurance contract, Sb_i is a compensation payable on the i^{th} contract provided that the insured event took place. Further,

$$\mu_2(S) = \alpha_2(S) - \alpha_{1^2}(S) = D(S) \tag{5}$$

is the variance. Denote

$$\Phi^{-1}(\gamma) = \alpha_\gamma \ , \tag{6}$$

where Φ^{-1} is the inverse normal distribution function. Let $\gamma = 0.303$ be the predetermined level of security.

Calculation of characteristics

The MathCAD calculations of evaluations of moments (Tables 1–2) and tariff rates (Table 3) for departments E, S, and D with data volumes $n = 66$, $n = 221$, $n = 177$ for 2011 year and $n = 53$, $n = 163$, $n = 81$ for 2012 year are presented.

Table 1

Probabilities of the insured events and moments in 2011

	q	$\alpha_1(S)$	$\alpha_2(S)$	$\alpha_1(Sb)$	$\alpha_2(Sb)$
E	0.258	7.122	81.153	1.45	11.202
S	0.267	10.436	216.929	0.766	2.893
D	0.288	7.517	105.84	0.414	0.41

Table 2

Probabilities of the insured events and moments in 2012

	Q	$\alpha_1(S)$	$\alpha_2(S)$	$\alpha_1(Sb)$	$\alpha_2(Sb)$
E	0.208	6.94	73.183	0.531	0.679
S	0.282	7.498	109.115	0.631	2.265
D	0.148	6.2	68.909	0.359	0.245

In 2011, the occurrence probabilities of the insured events in all the departments was about the same. In 2012, department D had the smallest probability.

Further, calculate the tariff rates according to the "Methodology of Rosstrahnadzor" (Table 3).

Table 3

Tariff rates for 2011 and 2012

	E	S	D
2011	0.185	0.048	0.028
2012	0.051	0.055	0.02

In 2011, there was a large payment in department E, that has violated the condition of homogeneity, and the normality assumption has been challenged. As a result, this outlier resulted in jump tariff rates. There were also calculated the total fees and profits for each of the departments, which were compared with the real data (Table 4).

Table 4

Profits in 2011 and 2012

	E		S		D	
	Theoretical	Real Data	Theoretical	Real Data	Theoretical	Real Data
2011	$6.208 \cdot 10^6$	$-2.435 \cdot 10^5$	$6.974 \cdot 10^6$	$3.451 \cdot 10^6$	$1.63 \cdot 10^6$	$3.971 \cdot 10^6$
2012	$1.286 \cdot 10^6$	$8.979 \cdot 10^5$	$3.792 \cdot 10^6$	$2.658 \cdot 10^6$	$5.651 \cdot 10^5$	$2.109 \cdot 10^6$

A further objective is the modification of calculation of tariff rates in the case of a franchise. In all previous cases, we have assumed that the insurance company reimburses the full damages resulting from the loss. This is a non-refundable deductible part of the loss. So, it is assumed that an insurer agrees to fully assume the damages. Note, franchise is a non-refundable part of the loss. Thus, it is assumed that the insured agrees to fully assume the damage does not exceed a certain limit.

There are several types of franchises.

1. Unconditional franchise

The paid compensation is a part of the loss if the loss exceeds Ω. Otherwise, the compensation is zero. Denote the paid damages as Y_j^b. Then,

$$Y_j^b = 0 \text{ if } Y_j \le \Omega,$$

$$Y_j^b = Y_j - \Omega \text{ if } Y_j > \Omega.$$

2. Conditional franchise

The paid compensation is zero if the loss is not exceeded the predetermined value. Otherwise, the loss amount is paid in full:

$$Y_j^y = 0 \text{ if } Y_j \le \overline{Y},$$

$$Y_j^y = Y_j \text{ if } Y_j > \overline{Y}.$$

Tariff rates were obtained with making use of conditional franchise (Table 5) and unconditional franchise (Table 6).

Table 5

Tariff rates for conditional franchise

	E	S	D
2011	0.184	0.0479	0.0279
2012	0.049	0.047	0.019

Table 6

Tariff rates for unconditional franchise

	E	S	D
2011	0.181	0.046	0.025
2012	0.046	0.052	0.018

Unconditional franchise is most often used in practice. Applying this franchise most decreased net rates.

Calculate dues the company could get using conditional franchise (Table 7) and unconditional franchise (Table 8).

Table 7

Dues by using conditional franchise

	E	S	D
2011	$8.663 \cdot 10^6$	$1.111 \cdot 10^7$	$3.703 \cdot 10^6$
2012	$1.815 \cdot 10^6$	$5.801 \cdot 10^6$	$9.963 \cdot 10^5$

Table 8

Dues by using unconditional franchise

	E	S	D
2011	$8.523 \cdot 10^6$	$1.052 \cdot 10^7$	$3.323 \cdot 10^6$
2012	$1.693 \cdot 10^6$	$6.322 \cdot 10^6$	$8.795 \cdot 10^5$

Then, calculate the profits on conditional franchise (Table 9) and on unconditional franchise (Table 10).

Table 9

Profits for conditional franchise

	E		S		D	
	Theoret. fr.	Theoret.	Theoret. fr.	Theoret.	Theoret. fr.	Theoret.
2011	$6.21 \cdot 10^6$	$6.208 \cdot 10^6$	$6.681 \cdot 10^6$	$6.974 \cdot 10^6$	$1.64 \cdot 10^6$	$1.63 \cdot 10^6$
2012	$1.286 \cdot 10^6$	$1.286 \cdot 10^6$	$2.947 \cdot 10^6$	$3.053 \cdot 10^6$	$5.652 \cdot 10^5$	$5.651 \cdot 10^5$

Analyze each of the departments: in department E applying conditional franchise affects slightly the profit, in S the profit calculated without using the franchise was higher in comparison with usual one, in D applying franchise gave a significant increase in profit.

Table 10

Profits for unconditional franchise

	E		S		D	
	Theoret. fr.	Theoret.	Theoret. fr.	Theoret.	Theoret. fr.	Theoret.
2011	$6.171 \cdot 10^6$	$6.208 \cdot 10^6$	$6.558 \cdot 10^6$	$6.974 \cdot 10^6$	$1.552 \cdot 10^6$	$1.63 \cdot 10^6$
2012	$1.286 \cdot 10^6$	$1.286 \cdot 10^6$	$3.792 \cdot 10^6$	$3.053 \cdot 10^6$	$5.231 \cdot 10^5$	$5.651 \cdot 10^5$

Consider the case of unconditional franchise: in department E there was nothing changed, in S income by applying franchise became less in 2011, but in 2012 the profits with using franchise were more theoretical ones, in D application of unconditional franchise gave decline in profits.

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