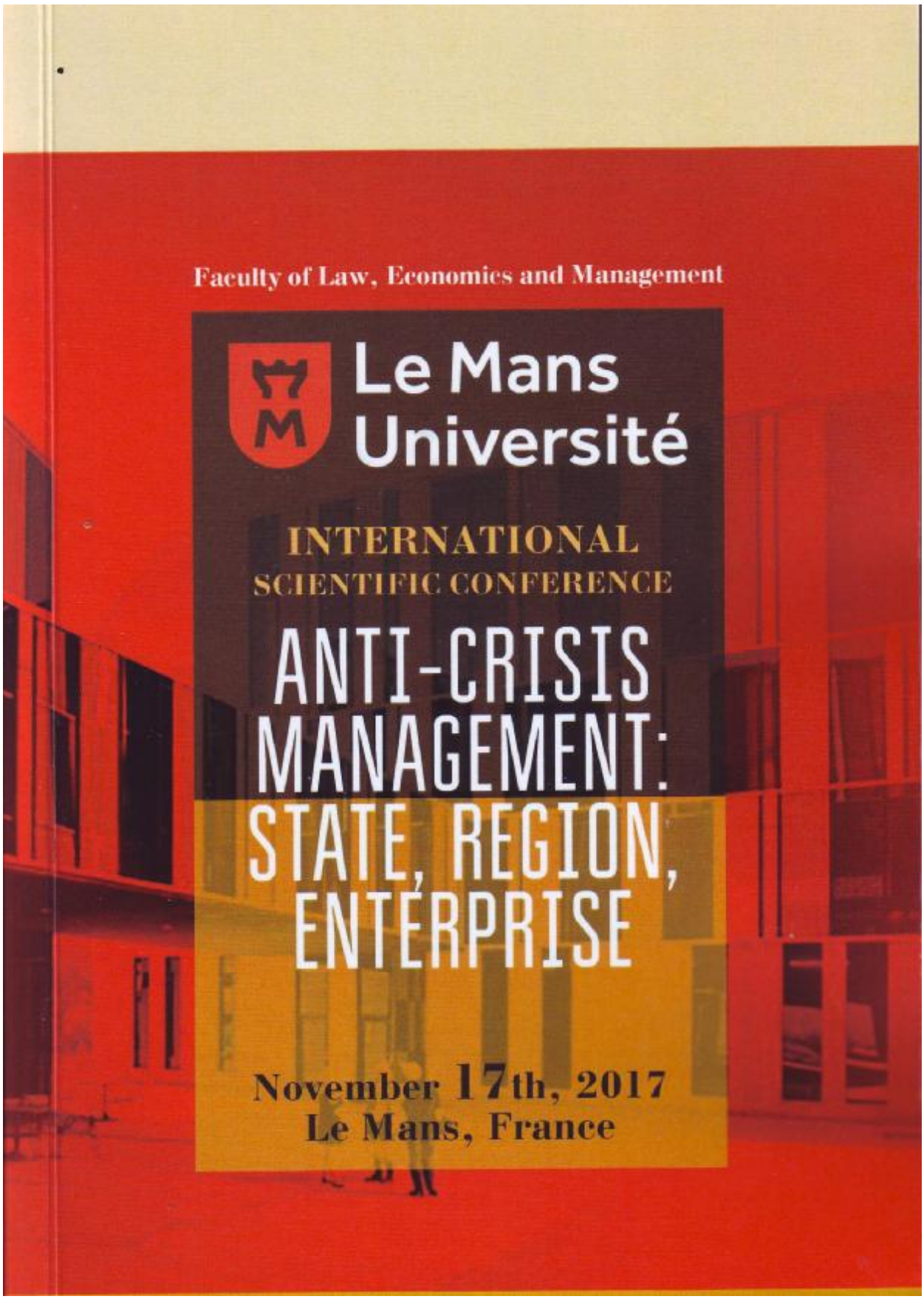
Faculty of Law, Economics and Management
Le Mans Université
INTERNATIONAL
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ANTI-CRISIS MANAGEMENT: STATE, REGION, ENTERPRISE
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OPTIMIZATION OF INSURANCE CONTRIBUTIONS IN RISK INSURANCE

Kyivmetrobud Corporation, Kryvyi Rih, is engaged in the construction of new mines and the expansion of the road network in the old ones. All these works are carried out at considerable depths underground and are accompanied by quite frequent breaks in work caused by equipment breakdowns, illnesses of workers and downtime.

To prevent losses, the corporation insures all the above cases in various insurance companies. The reason for this solution lies in the significant amounts of compensation that must be paid to insurers in the event of an insured event. Therefore, each insurer determines the maximum amount of insurance indemnity.

There is a problem of the best distribution of insurance premiums among several insurance companies.

Since the type of insurance is risky, the statistics of the occurrence of events leading to breaks in work were collected.

The table below shows the results of calculations of the main parameters of the tariff rates for insurance

Indicator of insurance	Diseases of workers	Repair of equipment	Downtime
The probability of an insured event (T_{n0})	0,0412	0,055	0,061
Standard deviation (σ_S)	8 532, 09	0,0249	0,0273
Coefficient of variation (V_S)	0,1	0,45	0,45
Trust probability (β)	0,95	0,95	0,92
Quantum of normal distribution ($\Phi^{-1}(\beta)$)	1,6449	1,6449	1,401
Risky non-interest rate (T_{nr})	0,0068	0,0409	0,038
Net bet (T_n)	0,05	0,1	0,1
Expenditure charge (f)	0,2	0,2	0,2
Gross bet (T_b)	0,06	0,12	0,12

In the table:

T_{n0} – was calculated by the formula $T_{n0}=\frac{P_{n0}}{SN}$;

σ_S – the average quadratic rejection of compensation amounts in the course of the onset of an insured event, calculated using the built-in Excel function «Standard»;

$V_S=\frac{\sigma_S}{S}$ – coefficient of variation in the amount of total insurance indemnity;

$\Phi^{-1}(\beta)$ – Calculated using the built-in Excel function «Normal»;

T_{nr} та T_n – were calculated by the formulas

$$T_n=T_{n0}+T_{nr}, \qquad T_{nr}=\Phi^{-1}(\beta)T_{n0}V_S;$$

T_b – were calculated by the formula $T_b = \frac{T_n}{1-f}$,

where S – average damage size, N – number of insurance cases, P_{n0} – the average amount of indemnity under the insurance contract, f – the burden on the expenses of the insurance company when servicing the insurance contract.

The calculations of the distribution of insurance premiums were performed by a matrix method for solving transport problems. Since the maximum amount of insurance is less than the condition of the management of the concern, but the total amount for all insurance companies more than us needed, then the method of solving the open transport problem with excess of resources was used.

For the optimal distribution of insurance premiums between insurance companies, the total amount of insurance costs should be minimal, hence

$$\sum_{i=1}^{M}\sum_{j=1}^{n} S_{ij} \to \min, i=1...M, j=1...n.$$

where S_{ij} – insurance premium taking into account the load in the i-th insurance company in the j-th type of insurance, M – the number of insurance companies, n - the number of insurance types,

$$S_{ij} = x_{ij} Z_{ij} (1 + f_{ij}),$$

where x_{ij} – the share of insurance premium in the i-th insurance company in the j-th type of insurance, Z_{ij} – the maximum amount of insurance in the i-th company for the j-th type of insurance, f_{ij} – the burden of the i-th insurance company on the j-th type of insurance

Set the limit for the target function:

1. Limitations for variable values of weight coefficients

$$\sum_{i=1}^{M} x_{ij} = 1, 0 \le x_{ij} \le 1, j=1...n,$$

2. The amount of the insurance premium for each type of insurance shall be equal to the average of the corresponding losses for previous periods

$$\begin{cases} \sum_{i=1}^{M} x_{i1} Z_{i1} \le \overline{C_1}, \\ \sum_{i=1}^{M} x_{i2} Z_{i2} \le \overline{C_2}, \\ \sum_{i=1}^{M} x_{i3} Z_{i3} \le \overline{C_3}, \end{cases}$$

where $\overline{C_1}, \overline{C_2}, \overline{C_3}$ – the average value of the sum of the patient's loss, repair and equipment, respectively.

Consequently, the system of equations for solving the problem is as follows:

$$\sum_{i=1}^{M}\sum_{j=1}^{n} x_{ij} Z_{ij} (1 + f_{ij}) \to \min, i = 1...M, j = 1...n.$$

$$\begin{cases} \sum_{i=1}^{M} x_{i1} Z_{i1} \le \overline{C_1}, \\ \sum_{i=1}^{M} x_{i2} Z_{i2} \le \overline{C_2}, \\ \sum_{i=1}^{M} x_{i3} Z_{i3} \le \overline{C_3}, \end{cases} \qquad \sum_{i=1}^{M} x_{ij} = 1, 0 \le x_{ij} \le 1, j = 1...n.$$

Using the built-in Solver function, Excel spreadsheets, we find variables x_{ij} whose values do not exceed one.

The following table shows the calculated insurance amounts based on the load of insurance companies.

Insurance company	The sick (S_{i1}), UAH	Repair (S_{i2}), UAH	Downtime (S_{i3}), UAH
№1	0,00	635 460,00	0,00
№2	17 593,56	153 332,84	0,00
№3	0,00	0,00	0,00
№4	120 923,80	310 050,00	0,00
№5	0,00	300 150,00	0,00
№6	0,00	0,00	0,00
№7	0,00	441 640,00	26 880,00
№8	0,00	0,00	24 663,82
№9	0,00	0,00	0,00
№10	0,00	0,00	0,00

After optimization, it was concluded that, with an optimized distribution of insurance premiums, the total amount of insurance costs is 2 030 694,01 UAH. This amount was less than planned at UAH 345 234.