The Second International Conference "Problems of Cybernetics and Informatics"
September 10-12, 2008, Baku, Azerbaijan. Section #6 "Analysis and Forecasting of Social-Economic Systems" www.pci2008.science.az/6/13.pdf

ECONOMETRIC MODEL OF THE MEDICAL INSURANCE SERVICES COSTS

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This article is intended to reflect the model of interconnection between the age of insured individuals and the amount of spent insurance. In accordance with provided statistical materials there were certain tests performed and relevant results obtained. The models provided are also suitable for use on most common insurance risks of the country.

General information: Positive developments in the country's economy have shown the positive results also in the insurance sector and the adoption of the law on insurance in the Azerbaijan Republic [1] has resulted in growth of activities in this area. It is known that one of the most common types of insurance, the medical insurance is intended for obtaining by citizens of the funds once collected for the use on medical treatment services and financing of preventive medical services. Based on this common approach we shall be able to distinguish the following social and economic issues on the medical insurance:

- health protection of population;
- provision of demographic development;
- development of medical services sector;
- financing of health sector and development of its technical and financial basis;
- protection of incomes of citizens and their families;
- more appropriate and targeted distribution of medical services among various population groups.

It is also known that there are two types of medical insurance:

- voluntary medical insurance (VMI);
- compulsory medical insurance (CMI).

The VMI is regulated by the law of the Azerbaijan Republic on medical insurance [2]. Thus, VMI, in addition to the medical services proposed by the general state health system to citizens, also provides the additional medical guarantees via the funds accumulated in this area and has the following advantages:

- provision of diagnostic and treatment services at the medical enterprises with high scientific and technical potential;
- application of most advanced, computer and information technology based medical methods;
- provision of comfort treatment environment;
- simplification and speeding of medical services;
- compensation of medical expenditures.

Usually, the medical insurance costs shall mean the payments made to following medical services:

- ambulatory treatment;
- stationary treatment;
- dental services;
- specialized diagnosis;
- purchasing of medical supplies;
- studies by expert doctors;
- prosthesis;
- purchasing of optical glasses and contact lenses;
- maternity costs;

- services;
- patient servicing etc.

It is natural that each insurance company customizes its insurance program and this provides various insurance guarantees dependent on insurance payments and spends relevant insurance funds.

Statement of issue: Mathematical methods are widely used in insurance, including medical insurance process studies, description and modelling of risks [3,4,5]. It is obvious that each medical insurance company is interested in expansion of client portfolio and minimization of risks. The expansion of client portfolio is directly connected to variety and quality of services and minimization of costs to age of the insured. There are other indirect factors that affect the costs, some of the being permanent and some of the being of changing nature. Our goal here is to determine the insurance costs, meaning the per capita based insurance costs (LOSS) and age based factor (AGE) interrelated to permanent non-specified factor (C(1)-parameter).

Methodology: In order to achieve the goal set there were methods of econometric modelling and optimization used.

First,

$$LOSS=C(1)+C(2)*AGE \quad (1)$$

and

$$LOSS=C(1)+C(2)*AGE+C(3)*AGE^2 \quad (2)$$

Parameters of regression equations have been evaluated by application of EViews Software Package and checked for adequacy [6]. Later there are studies performed on the basis of values of established parameters. For instance, the (2) square function provides the possibility of determination certain results by studies of its extreme(turning point). Consequently, a point where the derivative of "LOSS" variable (indicator of result) on "AGE" variable (affecting factor) becomes zero shall be the point giving an extreme (maximum and minimum) value to "LOSS", in other words to per capita medical insurance costs .

$$d(LOSS)/d(AGE)=C(2)+C(3)*AGE=0 \quad (3)$$

Should the C(3)-value be negative, then the AGE value found by equation (3) will provide the maximum value to LOSS and if positive the minimum value to LOSS. Should the interrelation between (1) and (2) of LOSS and AGE values be non-adequate, other forms of dependence can be studies. We shall note that parameters of dependence of (1) and (2) are assessed mainly for the dynamics of indicators. In dynamic order however, the stationary condition is broken [7].

Database: The database of computer modelling is provided by the application of insured of the International Insurance Company and related costs of the company on the selected individuals.

Econometric modelling and obtained results: In accordance with methodology we shall determine the dependence of age and insurance costs (1).

Thus, for the contracts executed during 2003-2006 the EViews 4 program package has determined the dependence of insurance costs from these factors as follows:

Table 1

(1) values of regression model parameters and statistical examinations.

Dependent Variable: LOSS

Method: Least Squares
Date: 03/22/08 Time: 14:25
Sample(adjusted): 9 2302
Included observations: 2294 after adjusting endpoints

Convergence achieved after 60 iterations
Backcast: OFF (Roots of MA process too large)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGE	178.1149	57.54599	3.095175	0.0020
C	15445.30	2027.354	7.618454	0.0000
AR(7)	0.837924	0.032448	25.82345	0.0000
AR(8)	0.099885	0.031399	3.181125	0.0015
MA(1)	0.037341	0.020294	1.839999	0.0659
MA(7)	-0.860755	0.028577	-30.12022	0.0000
MA(8)	-0.167559	0.035928	-4.663702	0.0000
MA(46)	-0.041185	0.010421	-3.952249	0.0001

R-squared	0.011411	Mean dependent var	22113.55
Adjusted R-squared	0.008384	S.D. dependent var	37678.38
S.E. of regression	37520.10	Akaike info criterion	23.90662
Sum squared resid	3.22E+12	Schwarz criterion	23.92663
Log likelihood	-27412.90	F-statistic	3.769466
Durbin-Watson stat	1.984381	Prob(F-statistic)	0.000452

White Heteroskedasticity Test:

F-statistic	2.659664	Probability	0.070188
Obs*R-squared	5.313956	Probability	0.070160

$$LOSS = 178.1149002*AGE + 15445.29977 \quad (4)$$

(4) statistical parameters of the model and statistical tests have shown that although the model is not quite adequate, it is of certain importance and can be used for long-term applications. Thus,

$$d(LOSS)/d(AGE)= 178.1149002$$

shows that for each 1 year of increase in age of insured the per capital costs (marginal) costs of the insurance company are evaluated at 178.1 manats.

It is known that dynamic orders of economic orders are non-stationary. Therefore the automated regression (AR) and moving average (MA) shall be added to model to terminate this. Statistical characteristics of Model (4) provided in Table 1 and other tests on compensation of residual Gauss-Markov provisions have demonstrated, that introduction of automated regression (AR) and Moving average (MA) complete stationing could not be provided. On the other side, the value of 0.011411 of the R-squared has shown that AGE aspect could cover only 1.1 percent of the resulting LOSS change. It shows that other verifying aspects shall be included or interrelation of indicators shall be found elsewhere.

Since indicators in model (4) are present in accordance with their values and quantities, they provide the coverage for long-term models. If the model indicator growth and additional growth speeds are determined by these models (for example, LOG(LOSS), DLOG(LOSS), LOG(AGE), DLOG(AGE)) the short-term coverage period and its results are provided as true for short-term.

(2) we shall evaluate the regression.

Table 2

Values and statistical parameters of the (2) model.

Dependent Variable: LOSS
Method: Least Squares
Date: 03/22/08 Time: 14:47
Sample(adjusted): 100 2302
Included observations: 2203 after adjusting endpoints

Convergence achieved after 17 iterations
Backcast: 1 99

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGE	-976.1373	444.1146	-2.197940	0.0281
AGE^2	15.57150	6.010576	2.590683	0.0096
C	35772.47	7790.800	4.591630	0.0000
AR(3)	0.096491	0.017890	5.393514	0.0000
AR(27)	0.196639	0.077759	2.528816	0.0115
AR(99)	-0.513714	0.077286	-6.646902	0.0000
MA(3)	-0.088145	1.91E-05	-4609.501	0.0000
MA(27)	-0.182845	0.072456	-2.523517	0.0117
MA(99)	0.567952	0.073927	7.682602	0.0000

R-squared	0.020861	Mean dependent var	22142.87
Adjusted R-squared	0.017290	S.D. dependent var	38028.83
S.E. of regression	37698.63	Akaike info criterion	23.91671
Sum squared resid	3.12E+12	Schwarz criterion	23.93999
Log likelihood	-26335.26	F-statistic	5.842924
Durbin-Watson stat	1.884911	Prob(F-statistic)	0.000000

White Heteroskedasticity Test:

F-statistic	2.090582	Probability	0.079558
Obs*R-squared	8.349583	Probability	0.079580

$$LOSS = -976.1373324*AGE + 15.57149955*(AGE^2) + 35772.46991 \quad (5)$$

Statistical characteristics and tests of model (5) have demonstrated the adequacy of the model. By looking at it as (5) square function we shall fund its extenimum. AGE^2 coefficient is a positive value and the parabolic wings are high and stationary point of the function is a minimum point. In the square function and at zero value point the function (LOSS) value is minimum.

$$d(LOSS)/d(AGE)= -976.1373324 + 31.143*AGE=0$$

$$31.143*AGE= 31.34 - 976.1373324$$

And this shall mean that the insurance company has the least expenditures on insured individuals at the age of 31. Thus, by spending the least on medical insurance of persons at the ages of 31, the insurance company minimizes risks.

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