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IMPROVING THE METHODS FOR COMPLEX RETRO-FORECAST ANALYSIS AND COMPLEX FORECASTING METHODS BASED ON LAGRANGE INTERPOLATION FORMULA OF THE ACCOUNTING BALANCE AT INSURANCE COMPANIES

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Abstract. A new method of complex retro-forecasting analysis and the method of complex forecasting of the balance sheet of insurance companies from in terms of the interests of their management with their theoretical and methodological basis, which are based on the Lagrange interpolation formula, expressed as functions have been proposed. The possibility of practical application of these methods is justified with the help of tests conducted on the basis of the data of the balance sheets of specific insurance companies.

Key words: insurance company, its management and balance sheet, Lagrange interpolation formula in the form of functions, method of complex retro-forecast analysis, method of complex forecast.

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Introduction. Issues of complex retro-forecast analysis and complex forecasting methods applied for analyzing balances of the Insurance Companies (IC) always attract a particular attention of financial analysts because management of IC cannot efficiently guide the performance, as well as cannot make decisions on the innovative and investment development of the companies.

Hypothesis. In terms of satisfying the needs of IC management, we put forward the hypothesis that it is recommended to use the methods for complex retro-forecast analysis and complex forecasting methods based on Lagrange interpolation formula in the accounting balance.

Theoretical basis. To achieve the aim set forth in this article it is required to determine the concepts related to the complex retro-forecast analysis and complex forecasting methods, as well as needs satisfaction of the IC management.

The concept "complex" can be regarded as a synonym for the concept of "system" which means that the content of at least two interconnected elements. The notion "complex" in terms of the essence of the complex analysis and forecasting of the accounting balance of the IC consists of five assets and liabilities sections: *a, b, c, x, d* sections (where: *a* – long-term assets of the first section; *b* – current assets of the second section; *x* – sources for equity of the liabilities of the second section; *c* – insurance reserves of the liabilities of the second section; *d* –liabilities of the third section of liabilities) which should be analyzed in their mutual interconnection.

The term "retro" (originated from Latin "retro" – "referred to the past", "retrospective") is applied to the cultural and/or tangible value and means "old thing", "historical event, incident", "historical fact" and can be used in fact-based historical analysis[1].

The concept of "analysis" is used to analyze the status of an object over a certain (past) period of time based on its peculiarities.

The forecast is the hypothetical forecast (prediction) of the future event.

If we take into consideration of the definifiton given to the word "forecast" (Richard, and

[1] http://evdemosfera.narod.ru/ist/retro/_retro.html

etc. 2011) and with a view of discount method (Richard, and etc. 2011), as well as possibility of implementing forecasts on the basis of available indicators (facts happened), we can interpret the term "complex retrospective analysis" as the combination of terms "complex", "retro", "forecast" and "analysis": is a complex retroactive forecast-based method of analysis in compliance with which the analysis based on historical (retro) facts of past periods of at least three years are implemented.

It should be noted that if the calculation process is applied for discounting occurred during the past period of time, in a complex retro-forecast analysis, the forecasting process consists of sequences of events for the last historical period, based on historical facts of past periods of at least three years. The basic difference of this method from the regular forecast is that[2] the analysit is concerned about the amount of difference between the predicted outcome for the last period and the outcome for the current period.

The difference between the complex forecasting method and complex retro-forecast analysis can be summarized as follows.

If we take into consideration the definition of the term "forecast"[3] and discounting method (Richard, and etc. 2011) in terms of indicators available in the forecast (facts occurred) it is possible to make a conclusion that the term "complex forecast" can be interpreted on the basis of its essence, i.e.: "complex forecast" represents a generalized term consisting of terms "complex" and "forecast" and implies the complex forecast. In compliance with this method, the complex forecast for the incomplete or future period is based on official historical facts of past periods of at least three years.

The benefit of the management of the insurance company (IC) is referred to the sections of assets and liabilities which comprise the balance sheet of the IC. We can carry out analysis on the basis of the interconnection of structural units of *a, b, x, d.* Implementation of this analysis will enable to find out that growth of the market value of the IC is related to the insurance reserves *c* and

[2] In the above-mentioned statements and on the encyclopedia, according to the definition of the word "forecast" can be made for future periods based on the indicators available (facts).
[3] https://gufo.me (Big Encyclopedic Dictionary)

administrative costs incorporated in the periodic expenses (for example: preference domestic consumer loans, benefits and bonuses). Therefore, *a, b, c, x, d* incorporated in the sections of assets and liabilities of the accounting balance of IC can be arranged as the mathematic equation of interconections $a + b = x + c + d$ and mathematical equation $a + b - (x + d) = c$ constitutes the model aimed at satisfying the benefits of the IC management.

Methodology. On the basis of interpretation of two models specified above, in terms of the benefit of the IC management represented by the mathematical equation $a + b - (x + d) = c$ it is required to separately specify methods for complex retro-forecast analysis and complex forecasting methods based on Lagrange interpolation formula (Rakhimov, 2006). To achieve this aim, first of all, it is advisable to provide a brief description of the essence and opportunities of applying Lagrange interpolation formula.

Let's imagine, that while studying a case it is necessary to detect functional interconnection between the values of x and y, as well as compliance of a variable x of interval $[a,b]$ with the relevant values of $x_0, x_1, \frac{3}{4}, x_n$ and a variable y with the relevant values $y_0, y_1, \frac{3}{4}, y_n$. Herein, analytical reflection of this connection is unknown. For example, this unknown function $y = ts(x)$ in the interval $[a,b]$ in the certain or polynominal function can be represented as

$y_0 = ts(x_0), y_1 = ts(x_1), , ..., y_n = ts(x_n)$

where values in the interval $[a,b]$ are determined in the function $y = ц(x)$ which can be seen in the polynominal function $\leq n$ where $\sim(x)$.

The values $x_0, x_1, \frac{3}{4}, x_n$ can be represented as parameter y of polynominal function $y_0, y_1, \frac{3}{4}, y_n$. Such issue is called interpolation function. Interpolation polynominal function can be represented as follows:

$$P(x) = C_0(x-x_1)(x-x_2)\dots(x-x_n) + C_1(x-x_0)(x-x_2)\dots(x-x_n) + C_2(x-x_0)(x-x_1)(x-x_3)\dots(x-x_n) + \cdots + C_n(x-x_0)(x-x_1)(x-x_2)\dots(x-x_{n-1}) \quad (1)$$

where $C_0, C_1, \dots, C_n$ coefficients

$$P(x_0) = y_0, P(x_1) = y_1, \frac{3}{4}, P(x_n) = y_n \quad (2)$$

should be selected to satisfy the requirements of

$$y_0 = C_0(x_0-x_1)(x_0-x_2)\dots(x_0-x_n),$$

where

$$C_0 = \frac{y_0}{(x_0-x_1)(x_0-x_2)\dots(x_0-x_n)}$$

If we assume (1) that $x = x_1$, then

$$y_1 = C_1(x_1-x_0)(x_1-x_2)\dots(x_1-x_n),$$

where

$$C_1 = \frac{y_1}{(x_1-x_0)(x_1-x_2)\dots(x_1-x_n)}$$

and etc. So if we assume that (1) $x = x_n$

$$y_n = C_n(x_n-x_0)(x_n-x_1)\dots(x_n-x_{n-1}),$$

in this case we get the equation

$$C_n = \frac{y_n}{(x_n-x_0)(x_n-x_1)\dots(x_n-x_{n-1})}.$$

Based on the above-stated formulas it is possible to illustrate polynominal function in the form of the following formula:

$$P(x) = \frac{(x-x_1)(x-x_2)\dots(x-x_n)}{(x_0-x_1)(x_0-x_2)\dots(x_0-x_n)}y_0 + \frac{(x-x_0)(x-x_2)\dots(x-x_n)}{(x_1-x_0)(x_1-x_2)\dots(x_1-x_n)}y_1 + \dots + \frac{(x-x_0)(x-x_1)\dots(x-x_{n-1})}{(x_n-x_0)(x_n-x_1)\dots(x_n-x_{n-1})}y_n \quad (3)$$

In this formula (3) functions are called as Lagrange interpolation formula (Rakhimov, 2006).

If to provide formula (3) in short, its fractions $p_1, p_2, \dots, p_n$ can be determined as follows:

$$p_1 = \frac{(x-x_1)(x-x_2)\dots(x-x_n)}{(x_0-x_1)(x_0-x_2)\dots(x_0-x_n)};$$

$$p_2 = \frac{(x-x_0)(x-x_2)\dots(x-x_n)}{(x_1-x_0)(x_1-x_2)\dots(x_1-x_n)};$$

.....

$$p_n = \frac{(x-x_0)(x-x_2)\dots(x-x_{n-1})}{(x_n-x_0)(x_n-x_2)\dots(x_n-x_{n-1})}. \quad (4)$$

(4) if we put $p_1, p_2, \dots, p_n$ in formula (3), it is possible to get the following equation.

$$y_{forecast} = P(x) = p_1y_0 + p_2y_1 + \dots + p_ny_n \quad (5)$$

Here: $y_{forecast}$ – *n* is a forecast indicator which is calculated with the help of indicators *x* and y known earlier.

Now we refer formula (3) to the essence of two issues stated above. For this purpose we divide sections of assets and liabilities of the accounting balance sheet of the IC into 5 (five) *a, b, x, c, d* parts according to Figure 1.

On the basis of the schematic model illustrated in Figure 1, to provide economic essence to formula (1), the indicators *a, b, c, x, d* of the balance of the IC will be connected with the

schematic model of Figure 1. Thus, for the model $a + b - (x + d) = c$ on the basis of formulas (3)-(5) we consider the essence of complex retro-forecast analysis in details.

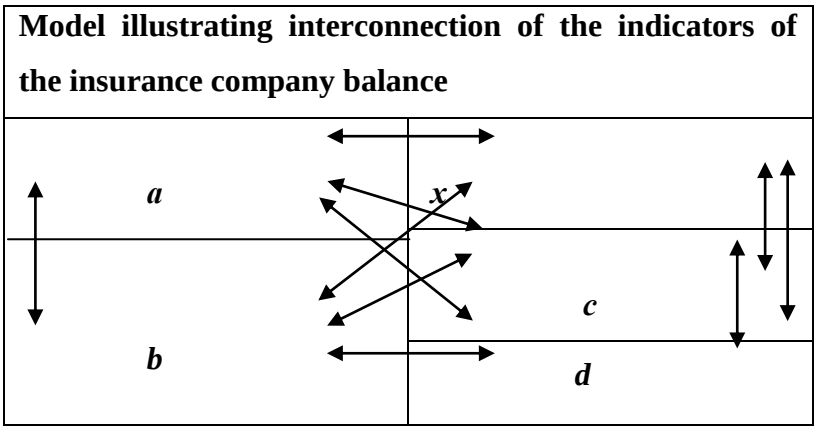

Figure 1. Sections (groups of indicators) of the insurance company balance and schematic model representing their interrelation

First method, i.e. if mathematical equation $a + b - (x + d) = c$ illustrates the model used to satisfy the benefits of the IC management, it is complex retro-forecast analysis method.

Taking into account schematic model illustrated in Figure 1, we provide complex retro-forecast analysis method based on formulas(1)-(3) for the model $a + b - (x + d) = c$. For this purpose, first of all, we are revealing mathematic-algorithm essence of is complex retro-forecast analysis based on Lagrange interpolation formula for interconnection of *a, b, x, d* of the accounting balance. Herewith, first of all, we observe the connection of *c* indicator with a indicator within the period (in terms of quarters or years).

Table 1

Dynamics of indicators (c) and (b) of the accounting balance by the second model of the complex retro-forecast analysis for selected period of time

Indicators	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**...**	***Period n***
Sources for equity	c_1	c_2	c_3	c_4	…	c_n
Current assets	b_1	b_2	b_3	b_4	…	b_n

Herein (in Table 1) it is possible to determine indicators of insurance reserves (c_1, c_2, c_3, c_4) of periods 1,2,3,4 and indicators of current assets (b_1, b_2, b_3) of periods 1,2,3 using Lagrange interpolation formula which will help to identify current assets $b_{4э}$ for period 4 as retro-forecast indicators. With this aim in formulas (3)-(5) given above we consider indicatots of Table 1 in their sequence.

$$P(c) = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)} b_1 + \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)} b_2 + \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)} b_3 \qquad (6)$$

Herewith we will determine fraction with the help of formula (6) as follows.

$$p_1 = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)}; p_2 = \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)}; p_3 = \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)}. \qquad (7)$$

Putting values of p_1, p_2, p_3 from formula (7) into formula (6) and accepting $b_{4э}$ as a sample we can develop the formula for calculating retro-forecast indicators:

$$b_{4э} = P(c) = p_1 b_1 + p_2 b_2 + p_3 b_3 \qquad (8)$$

Indicator $b_{4э}$ calculated with the help of formula (8) for period 4 is based on the real value of b_4 indicating current assets from the accounting balance and therein application of the following quality criterion is advisable:

$$b_{4э} - b_4 = \Delta b_4 \qquad (9)$$

The algorithmic process based on the formulas (6)-(9) can be illustrated in the following way:

1) if $\Delta b > 0$, real opportunities of the IC are used at a lower level than retro-forecast indicators accepted as a sample;

2) if $\Delta b < 0$, real opportunities of the IC are used at a higher level than retro-forecast indicators accepted as a sample;

3) if $\Delta b = 0$, real opportunities of the IC are used at the same level as retro-forecast indicators accepted as a sample.

The results obtained with the application of formula (9), that is, the difference between retro-forecast indicator of Table 1 for period 4 and the indicator of the real balance can provide a quantitative evaluation of the balance sheet of the IC.

Considering the issue from the point of view of the management's benefit, algorithmic process for the first interrelation of model $a + b - (x + d) = c,$ we will replace indicator (*b*) with indicators (*a*), (*x*), (*d*) one by one, further applying the second, third and fourth interrelations in formulas (6)-(9), we can get final values of the balance sheet for at least three-year period of time. Table 2 given below illustrates algorithmic process of the complex retro-forecast analysis.

Table 2.

Algorithmic process of complex retro-forecast analysis based on the interrelation of balance's indicator by the second and the third models for selected periods

Balance indicators	**Period 1**	**Period 2**	**Period 3**	**Period 4**		
				Real indicators	**Forecast sample analysis**	**Difference (+;-)**
Long-term assets (a)	a_1	a_2	a_3	a_4	$a_{4э}$	Δa_4

Current assets (b)	b_1	b_2	b_3	b_4	$b_{4э}$	Δb_4
Total balance assets ($a+b$)	a_1+b_1	a_2+b_2	a_3+b_3	a_4+b_4	$a_{4э}+b_{4э}$	$\Delta a_4+\Delta b_4$
Equity sources (x)	x_1	x_2	x_3	x_4	x_4	Δx_4
Insurance reserves (c)	c_1	c_2	c_3	c_4	c_4	$\Delta c_4=0$
Liabilities (d)	d_1	d_2	d_3	d_4	$d_{4э}$	Δd_4
Total balance assets ($x+c+d$)	$x_1+c_1+d_1$	$x_2+c_2+d_2$	$x_3+c_3+d_3$	$x_4+c_4+d_4$	$x_4+c_{4э}+d_{4э}$	$\Delta x_4+\Delta c_4+\Delta d_4$

On the basis of the algorithmic process shown in Table 2, correspondingly, using indicators of periods 1,2,3 for period 4, indicators of periods 2,3,4 for period 5, indicators of period 3,4,5 for period 6,.... of periods ($n-3$), ($n-2$), ($n-1$)-for period n and applying formulas (8)-(9), complex retro-forecast indicators accepted as sample and real balance indicators which comply with complex retro-forecast indicators it is possible to determine the algorithmic process for complex retro-forecast analysis.

Thus, taking into consideration that algorithmic process for complex retro-forecast analysis by model $a+b-(x+d)=c$ is reflected in Table 2, putting indicators of periods 1,2,3 provided in the Table into formula (8) we can determine the results of $a_{4э}$, $b_{4э}$, $x_{4э}$, $d_{4э}$ complex retro-forecast indicators accepted as samples:

$$\left.\begin{cases} a_{4э}=P(x)=p_1a_1+p_2a_2+p_3a_3 \\ b_{4э}=P(x)=p_1b_1+p_2b_2+p_3b_3 \\ x_{4э}=P(x)=p_1x_1+p_2x_2+p_3x_3 \\ d_{4э}=P(x)=p_1d_1+p_2d_2+p_3d_3 \end{cases}\right\}\text{- Process 1} \qquad (10)$$

In this way, that is in the way similar to process 1, we can determine algorithmic processes for periods 5, 6 and o on up to period *n* in the form of the following formulas (11)-(13):

$$\begin{cases} a_{5э} = P(x) = p_2 a_2 + p_3 a_3 + p_4 a_4 \\ b_{5э} = P(x) = p_2 b_2 + p_3 b_3 + p_4 b_4 \\ x_{5э} = P(x) = p_2 x_2 + p_3 x_3 + p_4 x_4 \\ d_{5э} = P(x) = p_2 d_2 + p_3 d_3 + p_4 d_4 \end{cases} \text{- Process 2} \qquad (11)$$

$$\begin{cases} a_{6э} = P(x) = p_3 a_3 + p_4 a_4 + p_5 a_5 \\ b_{6э} = P(x) = p_3 b_3 + p_4 b_4 + p_5 b_5 \\ x_{6э} = P(x) = p_3 x_3 + p_4 x_4 + p_5 x_5 \\ d_{6э} = P(x) = p_3 d_3 + p_4 d_4 + p_5 d_5 \end{cases} \text{- Process 3} \qquad (12)$$

.....

$$\begin{cases} a_{nэ} = P(x) = p_{n-3} a_{n-3} + p_{n-2} a_{n-2} + p_{n-1} a_{n-1} \\ b_{nэ} = P(x) = p_{n-3} b_{n-3} + p_{n-2} b_{n-2} + p_{n-1} b_{n-1} \\ x_{nэ} = P(x) = p_{n-3} x_{n-3} + p_{n-2} x_{n-2} + p_{n-1} x_{n-1} \\ d_{nэ} = P(x) = p_{n-3} d_{n-3} + p_{n-2} d_{n-2} + p_{n-1} d_{n-1} \end{cases} \text{-Process } k \quad (13)$$

Deduction of indicators (a_3, b_3, x_3, d_3) obtained with the help of application of formula (11), deduction of indicators (a_4, b_4, x_4, d_4) obtained with the help of formula (12), deduction of indicators (a_n, b_n, x_n, d_n) obtained with the help of formula (13) we arrange in compliance with criterion 9:

$$\begin{array}{llll} a_{4э} - a_4 = \Delta a_4 & a_{5э} - a_5 = \Delta a_5 & .... & a_{nэ} - a_n = \Delta a_n \\ b_{4э} - b_4 = \Delta b_4 & b_{5э} - b_5 = \Delta b_5 & .... & b_{nэ} - b_n = \Delta b_n \\ x_{4э} - x_4 = \Delta x_4 & x_{5э} - x_5 = \Delta x_5 & .... & x_{nэ} - x_n = \Delta x_n \\ d_{4э} - d_4 = \Delta d_4\,, & d_{5э} - d_5 = \Delta d_5\,, & .... & d_{nэ} - d_n = \Delta d_n \end{array} \qquad (14)$$

Various scenarios determined with the help of formulas (6)-(9) specified above can be presented in the following way:

1) if $\Delta b\ (or\ \Delta x, \Delta a, \Delta d) > 0$, real opportunities of the IC are used at a lower level than retro-forecast indicators accepted as a sample;

2) if $\Delta b\ (or\ \Delta x, \Delta a, \Delta d) < 0$, real opportunities of the IC are used at a higher level than retro-forecast indicators accepted as a sample;

3) if $\Delta b\ (or\ \Delta x, \Delta a, \Delta d) = 0$, real opportunities of the IC are used at the same level as retro-forecast indicators accepted as a sample.

Placement of results received with the application of formula (14) in Table 3 enables to assess the quality of indicators of the IC balance.

Table 3

Assessment of the quality of interrelation of accounting balance indicators by the second model for selected periods

Balance indicators	**Period 4**	**Period 5p**	**...**	**Period (n-1)**	**Period n**
Long-term assets (a)	Δa_4	Δa_5	...	Δa_{n-1}	Δa_n
Current assets (b)	Δb_4	Δb_5	...	Δb_{n-1}	Δb_n
Total balance assets ($a + b$)	$\Delta a_4 + \Delta b_4$	$\Delta a_5 + \Delta b_5$	...	$\Delta a_{n-1} + \Delta b_{n-1}$	$\Delta a_n + \Delta b_n$
Equity sources (x)	Δx_4	Δx_5	...	Δx_{n-1}	Δx_n
Insurance reserves (c)	$\Delta c_4 = 0$	$\Delta c_5 = 0$	...	$\Delta c_{n-1} = 0$	$\Delta c_n = 0$
Liabilities (d)	Δd_4	Δd_5	...	Δd_{n-1}	Δd_n
Total balance assets ($x + c + d$)	$\Delta x_4 + \Delta c_4 + \Delta d_4$	$\Delta x_5 + \Delta c_5 + \Delta d_5$	...	$\Delta x_{n-1} + \Delta c_{n-1} + \Delta d_{n-1}$	$\Delta x_n + \Delta c_n + \Delta d_n$

On the basis of the results of accounting balance indicators calculated within the framework of process 1, process 2 and so on up to process *k* by the second model shown in Table 3 it is possible to carry out complex retro-forecast analysis aimed at satisfaction of the benefit of the IC management.

Second method, i.e. the complex forecast method aimed at satisfying the benefits of the IC management illustrated with the mathematical equation $a + b - (x + d) = c$.

Taking into account schematic model provided in Figure 1 above, we consider the essence of the complex retro-forecast method based on formulas (1)-(3) for model $a + b - (x + d) = c$. For this purpose, first of all, using Lagrange interpolation formula we reveal the mathematical-algorithmic model of the complex forecast process of interrelation of section (c) with the rest sections *a, b, x, d*. Herein, first of all, the relation of the first indicator *c* with indicator *d* is illustrated in Table 4 by periods of time (by quarters or years).

Table 4

Dynamics of indicators of (c) and (d) of accounting balance by the second model with the aim of complex forecast for selected periods

Indicators	**Period 1**	**Period 2**	**Period 3**	**Period 4**
Insurance reserves	c_1	c_2	c_3	$c_{4r} = c_3 * ? \%$
Long-term and current (or short-term) liabilities	d_1	d_2	d_3	$d_{4forecast}$

Herewith (according to Table 4) it is possible to determine indicators (c_1, c_2, c_3) for insurance reserves for periods 1,2,3 and indicators (d_1, d_2, d_3) for current (or short-term) liabilities with the help of Lagrange interpolation formula. Therein, it is possible to determine forecast indicators of $d_{4forecast}$ for long-term and current (or short-term) liabilities for period 4 according to the formula $c_{4т.к} = c_3 * ? \%$ (where the sign "?" indicates the amount of interest

required). Pursuing this aim we put indicators presented in Table 4 instead of variables in formulas (3)-(5).

$$P(c) = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)} d_1 + \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)} d_2 + \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)} d_3 \qquad (15)$$

With the help of formula (15) we determine the following fractions.

$$p_1 = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)}; p_2 = \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)}; p_3 = \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)}. \qquad (16)$$

By putting values p_1, p_2, p_3 of formula (16) into formula (15) we can receive the formula of finding forecast indicators of $d_{4forecast}$:

$$d_{4forecast} = P(c) = p_1 d_1 + p_2 d_2 + p_3 d_3 \qquad (17)$$

The results obtained with the help of formula (17) are considered to be the complex forecast indicators for period 4 shown in Table 4.

By putting indicators (b), (x), (a) correspondingly instead of indicator (d) in formula (17) according to the model $a + b - (x + d) = c$ specified above, we can develop the following formula:

$$a_{4forecast} = P(c) = p_1 a_1 + p_2 a_2 + p_3 a_3 \qquad (18)$$

$$x_{4forecast} = P(c) = p_1 x_1 + p_2 x_2 + p_3 x_3 \qquad (19)$$

$$b_{4forecast} = P(c) = p_1 b_1 + p_2 b_2 + p_3 b_3 \qquad (20)$$

Complex forecast indicators calculated with the help of formulas (17)-(20) in Table 5

Table 5

Algorithmic process of complex retro-forecast analysis based on the interrelation of

balance's indicator by the second and the third models for selected periods

Balance indicators	**Period 1**	**Period 2**	**Period 3**	**Period 4 (Forecast period)**
Long-term assets (a)	a_1	a_2	a_3	$a_{4forecast}$
Current assets (b)	b_1	b_2	b_3	$b_{4forecast}$
Total balance assets ($a+b$)	$\boldsymbol{a_1 + b_1}$	$\boldsymbol{a_2 + b_2}$	$\boldsymbol{a_3 + b_3}$	$\boldsymbol{a_{4forecast} + b_{4forecast}}$
Equity sources (x)	x_1	x_2	x_3	$x_{4forecast}$
Insurance reserves (c)	c_1	c_2	c_3	$c_{4fct} = c_3 * ?\,\%$
Liabilities (d)	d_1	d_2	d_3	$d_{4forecast}$
Total balance assets ($x+c+d$)	$\boldsymbol{x_1 + c_1 + d_1}$	$\boldsymbol{x_2 + c_2 + d_2}$	$\boldsymbol{x_3 + c_3 + d_3}$	$\boldsymbol{x_{4fct} + c_{4fct} + d_{4fct}}$

Indicators for periods 1,2,3 calculated with the help of formulas (17)-(20) within the framework of $a + b - (x + d) = c$ model can be used for calculated for complex forecast indicators of predicted period 4. In the similar process of determining complex forecast indicators for period *n* will look as it follows:

$$\begin{cases} d_{(n)forecast} = P(c) = p_1 d_1 + p_2 d_2 + \ldots + p_{n-1} d_{n-1} \\ a_{(n)forecast} = P(c) = p_1 a_1 + p_2 a_2 + \ldots + p_{n-1} a_{n-1} \\ x_{(n)forecast} = P(c) = p_1 x_1 + p_2 x_2 + \ldots + p_{n-1} x_{n-1} \\ b_{(n)forecast} = P(c) = p_1 b_1 + p_2 b_2 + \ldots + p_{n-1} b_{n-1} \end{cases} \quad (21)$$

Complex forecast indicators obtained from formulas (17)-(20) and formula (21) are presented in Table 6 given below.

Table 6.

Algorithmic process of complex retro-forecast analysis based on the interrelation of balance's indicator by the second model for selected periods

Balance indicators	**Period 1**	**Period 2**	.. .	**Period n-**	**Period $(n+1)$ (Forecasted period)**
Long-term assets (a)	a_1	a_2	.. .	a_{n-1}	$a_{(n)forecast}$
Current assets (b)	b_1	b_2	.. .	b_{n-1}	$b_{(n)forecast}$
Total balance assets ($a+b$)	a_1+b_1	a_2+b_2	.. .	$a_{n-1}+b_{n-1}$	$a_{(n)forecast}+b_{(n)forecast}$
Equity sources (x)	x_1	x_2	.. .	x_{n-1}	$x_{(n)forecast}$
Insurance reserves (c)	c_1	c_2	.. .	c_{n-1}	$c_{(n)forecast}=x_{n-1}*?\%$
Liabilities (d)	d_1	d_2	.. .	d_{n-1}	$d_{(n)forecast}$
Total balance assets ($x+c+d$)	$x_1+c_1+d_1$	$x_2+c_2+d_2$	.. .	$x_{n-1}+c_{n-1}+d_{n-1}$	$x_{(n)fct}+c_{(n)fct}+d_{(n)fct}$

Tables 5 and 6 illustrate the forecast of insurance reserves (c) by the model $a+b-(x+d)=c$ on the basis of accounting balance indicators. Using this technique it has become possible for the IC management to forecast how increase of part (c) and reduction of part (x) can bring revenue and additional bonuses and in what amount which exceeds the sum specified in the labour contract.

LITERATURE REVIEW

Based on foreign literature analysis among foreign scholars who have contributed to the analysis and forecasting of accounting balances of insurance companies the following economists can be mentioned: D.Hampton, R.Higgins, Benninga Simon, Mayes Timothy R. and Todd M. Shank, Jiambalvo James, Palepu Krishna G. and Paul M. Healy, Elaine Henry, Steve W. J. Lin and Ya-wen Yong, Sharmila S., Senthil Kumaran, Allan Timmermann.

The following Russian scientist have contributed to the research of the financial condition of insurance companies, their solvency and financial sustainability by means of analyzing indicators of accounting balance: Rinchino T.Yu, Mozolkina O.A., Repina K.V., Lapteva N.A. and Laptev G.G., Vinnikova I.S., Kulokov S.V., Jilyakov D.I. and Zaretskaya V.G., Shvetsova I.N. and Pashkevich M.A., Petrova V.I., Uvarova A.Ya., Astafurova I.S. and other scientists who have studied various aspects of this issue in their scientific papers.

In Uzbekistan the following scholars and experts devoted their studies to the financial analysis of insurance companies in Uzbekistan: Khodjayeva M.Kh., Shirinov S.E., Ochilov I.K., Shokhazamiy Sh.Sh. and Sunnatov Yu.U. These scholars used traditional methods while carrying out financial analysis.

However, it should be noted that the scholars mentioned above haven't researched the issues of complex financial analysis and forecast in their scientific papers. The analysis technique applied in Uzbekistan for assessing financial condition of insurance companies based on accounting standards established on the basis of national accounting standards, primarily relied on determining economic indicators (coefficients) and applying previously-used classical analysis methods. In addition, it should be noted that both domestic scholars and foreign economists haven't considered the possibility of using Lagrange interpolation formula in the complex analysis and forecast methods to analyze indicators of accounting balances of insurance companies[4].

[4] In addition to Lagrange interpolation formula in the compact form applied by the Uzbek scientist Shokhazamiy Sh.Sh. and his trainee Sunnatov Yu.U.

However, the methods of applying Lagrange interpolation formula in the complex analysis and forecast methods to analyze indicators of accounting balances of economic entities, in particular, insurance companies haven't been worked out yet.

Generally speaking, as literature review of scientific papers of prominent foreign and domestic economists and scholars shows, submitting reliable financial statements by insurance companies as well as providing transperancy, as well as searching complex analysis and forecast of accounting balance indicators and their practical application will enable to formulate theoretical and practical conclusions. These conclusions will contribute to the development of appropriate theoretical proposals and practical recommendations aimed at application of mathematic and econometric methods to develop perfect methodology for complex analysis and forecast of indicators of accounting balances of domestic insurance companies in term of the approved Action Strategy.

Having generalized researches given above which are devoted to the common issues of financial analysis and methodology, the issues of complex analysis and forecast of indicators of accounting balances of insurance companies haven't been properly studied. Thus fact justifies the urgency of carrying out relevant researches in this area.

EXPERIMENTAL ANALYTICAL TEST OF THE METHOD

First method, **i.e. the model represented as $a + b - (x + d) = c$ and designed to satisfy the benefits of the IC management is subject to the empirical test implemented on the basis of accounting balance data of Insurance Company "Uzagrosugurta" JSC with the application of complex retro-forecast analysis.** To achieve this aim, on the basis of mathematical-algorithmical process specified above, we perform complex retro-forecast analysis of interrelations of the rest sections *a, b, x, d* of the section (*c)* of the accounting balance shown in Figure 1. For this purpose, we implement analysis gradually, starting from one element of this interrelation, indicator b with indicator c in terms of complex forecast illustrated in Table 7 by periods (quarters or years).

Table 7.

Indicators for retro-forecast analysis for interrelation of indicators (c) and (b) of the accounting balance of IC "Uzagrosugurta" JSC

(on the basis of the data for 2012-2015)

Indicators	Period 1 (2012)		Period 2 (2013)		Period 3 (2014)		Period 4 (2015)	
	Indicator	Its real balance value	Indicator	Its real balance value	Indicator	Its real balance value	Indicator	Its real balance value
Insurance reserves	c_1	45389455,8	c_2	44975361,7	c_3	53381866,0	c_4	57814079,6
Current assets	b_1	43726939,8	b_2	54313332,4	b_3	75800604,8	b_4	77337990,8

Herein (in Table 7) it is possible to determine retro-forecast indicators (c_1, c_2, c_3, c_4) for insurance reserves for periods 1,2,3,4 and indicators (d_1, d_2, d_3) for current assets for periods 1,2,3 with the help of Lagrange interpolation formula. In this regard we can calculate sample $b_{4з}$ accepted for period 4. For this purpose we can calculate the value of $b_{4з}$uing formulas (3)-(5) in Table 7.

$$b_{4з} = P(c) = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)}b_1 + \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)}b_2 + \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)}b_3 =$$
$$\frac{(57814079,6-44975361,7)(57814079,6-53381866,0)}{(45389455,8-44975361,7)(45389455,8-53381866,0)} * 43726939,8 +$$
$$\frac{(57814079,6-45389455,8)(57814079,6-53381866,0)}{(44975361,7-45389455,8)(44975361,7-53381866,0)} * 54313332,4 +$$
$$\frac{(57814079,6-45389455,8)(57814079,6-44975361,7)}{(53381866,0-45389455,8)(53381866,0-44975361,7)} * 75800604,8$$

(22)

Therewith, using formula (23) it is possible to determine the following values as fractions:

$$p_1 = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)} = \frac{(57814079{,}6-44975361{,}7)(57814079{,}6-53381866{,}0)}{(45389455{,}8-44975361{,}7)(45389455{,}8-53381866{,}0)} = -17{,}193549;$$

$$p_2 = \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)} = \frac{(41524238{,}2-17108342{,}7)(41524238{,}2-36447859{,}5)}{(31695861{,}8-17108342{,}7)(31695861{,}8-36447859{,}5)} = 15{,}819380;$$

$$p_3 = \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)} = \frac{(41524238{,}2-17108342{,}7)(41524238{,}2-31695861{,}8)}{(36447859{,}5-17108342{,}7)(36447859{,}5-31695861{,}8)} = 2{,}374169. \quad (23)$$

By putting values p_1, p_2, p_3 of formula (23) into formula (22) we can determine the value of retro-forecast indicator accepted as sample $b_{4э}$:

$$b_{4э} = P(c) = p_1 b_1 + p_2 b_2 + p_3 b_3 = (-17{,}193549) * 43726939{,}8 + 15{,}819380 * 54313332{,}4 + 2{,}374169 * 75800604{,}8 = 287345416{,}30$$

(24)

Based on $b_{4э}$ indicator calculated with the help of formula (24) and real value b_4 of current assets of the accounting balance for period 4 we can calculate the value of quality criterion:

$$b_{4э} - b_4 = 287345416{,}3 - 77337990{,}8 = 210007425{,}5 = \Delta b_4 \quad (25)$$

As a result of the algorithmic process calculated with the help of formulas (22)-(25), it is obvious that $\Delta b_4 > 0$, and according to this fact that IC does not entirely use its opportunities and potential in relation to its retro-forecast indicators.

Considering from the point of view of the benefits of the IC management $a + b - (c + d) = x$ and putting consequently indicators (*a*), (*x*), (*d*) instead of (*b*) indicator, and further by putting the second, third and fourth interrelations of formulas (22)-(25) into similar formulas (26)-(29), we can receive the results indicated in Table 8 in terms of at least 3 quarter or a year period of time within the algorithmic process of the complex retro-forecast analysis.

Table 8.

Results of complex retroprognois analysis of the interrelation of indicators of the accounting balance of IC "Uzagrosugurta" JSC

(for 2012-2015)

Balance indicators	**Period 1**	**Period 2**	**Period 3**	**Period 4**		
				Real indicator	**Retro-forecast sample indicator**	**Difference (+;-)**
1	**2**	**3**	**4**	**5**	**6**	**7=6-5**
Long-term assets (a)	19883565,2	24550342,3	35638522,8	48617040,6	131114021,58	82496980,98
Current assets (b)	43726939,8	54313332,4	75800604,8	77337990,8	287345416,30	210007425,50
Total balance assets ($a+b$)	**63610505,0**	**78863674,7**	**111439127,6**	**125955031,4**	**418459437,88**	**292504406,48**
Equity sources (x)	17108342,7	31695861,8	36447859,5	41524238,2	293789133,44	252264895,24
Insurance reserves (c)	45389455,8	44975361,7	53381866,0	57814079,6	57814079,60	0,00
Liabilities (d)	1112706,5	2192451,2	21609402,1	26616713,6	66856224,85	40239511,25
Total balance assets ($x+c+d$)	**63610505,0**	**78863674,7**	**111439127,6**	**125955031,4**	**418459437,88**	**292504406,48**

On the basis of the algorithm process shown in Table 8, correspondingly, the indicators of historical periods 1,2,3 can be used for period 4, the indicators of historical periods 2,3,4 can be used for period 5, the indicators for historical periods 3,4,5 can be used for period 6, and the indicators of historical periods 4,5,6 can be used for period 7. By applying formulas (22)-(25) it has become possible to determine the algorithmic process of the complex retro-forecast analysis for identifying relevant balance indicators accepted as a sample.

In this regard, the algorithmic process of the complex retro-forecast analysis by the model $a+b-(x+d)=c$ is illustrated in Table 8. By putting indicators of periods 1,2,3 into formula (24), we can calculate the values of complex retro-forecast indicators $a_{4э}$, $b_{4э}$, $x_{4э}$, $d_{4э}$ accepted as a sample:

$$\begin{cases} a_{4э} = P(c) = p_1a_1 + p_2a_2 + p_3a_3 = (-17{,}19355) * 19883565{,}2 + 15{,}81938 \\ * 24550342{,}3 + 2{,}374169 * 35638522{,}8 = 131114021{,}58 \\ b_{4э} = P(c) = p_1b_1 + p_2b_2 + p_3b_3 = (-17{,}19355) * 43726939{,}8 + 15{,}81938 \\ * 54313332{,}4 + 2{,}374169 * 75800604{,}8 = 287345416{,}3 \\ x_{4э} = P(c) = p_1x_1 + p_2x_2 + p_3x_3 = (-17{,}19355) * 17108342{,}7 + 15{,}81938 \\ * 31695861{,}8 + 2{,}374169 * 36447859{,}5 = 293789133{,}44 \\ d_{4э} = P(c) = p_1d_1 + p_2d_2 + p_3d_3 = (-17{,}19355) * 1112706{,}5 + 15{,}81938 \\ * 2192451{,}2 + 2{,}374169 * 21609402{,}1 = 66856224{,}85 \end{cases}$$ - Process 1 (26)

In the similar way (as illustrated by Process 1) using algorithmic processes of the complex retro-forecast analysis for periods 5,6,7 by the second model (for processes 2,3,4) and applying formulas (22)-(25) it is possible to find out the following sample values:

$$\begin{cases} a_{5э} = P(c) = p_2a_2 + p_3a_3 + p_4a_4 = 1{,}058591 * 24550342{,}3 + (-5{,}029327) \\ * 35638522{,}8 + 4{,}970735 * 48617040{,}6 = 88413453{,}48 \\ b_{5э} = P(c) = p_2b_2 + p_3b_3 + p_4b_4 = 1{,}058591 * 54313332{,}4 + (-5{,}029327) \\ * 75800604{,}8 + 4{,}970735 * 77337990{,}8 = 60696310{,}06 \\ x_{5э} = P(c) = p_2x_2 + p_3x_3 + p_4x_4 = 1{,}058591 * 31695861{,}8 + (-5{,}029327) \\ * 36447859{,}5 + 4{,}970735 * 41524238{,}2 = 56650773{,}15 \\ d_{5э} = P(c) = p_2d_2 + p_3d_3 + p_4d_4 = 1{,}058591 * 2192451{,}2 + (-5{,}029327) \\ * 21609402{,}1 + 4{,}970735 * 26616713{,}6 = 25944813{,}0 \end{cases}$$ - Process 2 (27)

$$\begin{cases} a_{6э} = P(c) = p_3a_3 + p_4a_4 + p_5a_5 = 18{,}983928 * 35638522{,}8 + (-32{,}008517) \\ * 48617040{,}6 + 14{,}024588 * 70261233{,}4 = 105784682{,}16 \\ b_{6э} = P(c) = p_3b_3 + p_4b_4 + p_5b_5 = 18{,}983928 * 75800604{,}8 + (-32{,}008517) \\ * 77337990{,}8 + 14{,}024588 * 79045056{,}1 = 72093253{,}12 \\ x_{6э} = P(c) = p_3x_3 + p_4x_4 + p_5x_5 = 18{,}983928 * 36447859{,}5 + (-32{,}008517) \\ * 41524238{,}2 + 14{,}024588 * 47372989{,}1 = 27180952{,}02 \\ d_{6э} = P(c) = p_3d_3 + p_4d_4 + p_5d_5 = 18{,}983928 * 21609402{,}1 + (-32{,}008517) \\ * 26616713{,}6 + 14{,}024588 * 35419123{,}0 = 55008438{,}97 \end{cases}$$ -Process 3 (28)

$$\begin{cases} a_{7э} = P(c) = p_4a_4 + p_5a_5 + p_6a_6 = 3{,}646476 * 48617040{,}6 + (-5{,}522961) \\ * 70261233{,}4 + 2{,}876485 * 78464100{,}1 = 14931616{,}34 \\ b_{7э} = P(c) = p_4b_4 + p_5b_5 + p_6b_6 = 3{,}646476 * 77337990{,}8 + (-5{,}522961) \\ * 79045056{,}1 + 2{,}876485 * 112392110{,}1 = 168742577{,}4 \\ x_{7э} = P(c) = p_4x_4 + p_5x_5 + p_6x_6 = 3{,}646476 * 41524238{,}2 + (-5{,}522961) \\ * 47372989{,}1 + 2{,}876485 * (-29927795{,}4) = -196308876{,}4 \\ d_{7э} = P(c) = p_4d_4 + p_5d_5 + p_6d_6 = 3{,}646476 * 26616713{,}6 + (-5{,}522961) \\ * 35419123{,}0 + 2{,}876485 * 125095461{,}2 = 261273970{,}36 \end{cases}$$ - Process 4 (29)

In the next step we determine the deduction of indicators (a_3, b_3, x_3, d_3) obtained with the help of formula (26), the deduction of indicators (a_4, b_4, x_4, d_4) obtained with the help of formula (27), the deduction of indicators (a_5, b_5, x_5, d_5) obtained with the help of formula (28), the deduction of indicators (a_6, b_6, x_6, d_6) obtained with the help of formula (29) and in this way we determine the following criteria (similar to criterion (25)):

$$a_{4з} - a_4 = 131114021{,}58 - 48617040{,}6 = 82496980{,}98 = \Delta a_4$$
$$b_{4з} - b_4 = 287345416{,}3 - 77337990{,}8 = 210007425{,}5 = \Delta b_4$$
$$x_{4з} - x_4 = 293789133{,}44 - 41524238{,}2 = 252264895{,}24 = \Delta c_4$$
$$d_{4з} - d_4 = 66856224{,}85 - 26616713{,}6 = 40239511{,}25 = \Delta d_4 \qquad (30)$$

$$a_{5з} - a_5 = 88413453{,}48 - 70261233{,}4 = 18152220{,}08 = \Delta a_5$$
$$b_{5з} - b_5 = 60696310{,}06 - 79045056{,}1 = -18348746{,}04 = \Delta b_5$$
$$x_{5з} - x_5 = 56650773{,}15 - 47372989{,}1 = 9277784{,}05 = \Delta c_5$$
$$d_{5з} - d_5 = 25944813{,}0 - 35419123{,}0 = -9474310{,}0 = \Delta d_5 \qquad (31)$$

$$a_{6з} - a_6 = 105784682{,}16 - 78464100{,}1 = 27320582{,}06 = \Delta a_6$$
$$b_{6з} - b_6 = 72093253{,}12 - 112392110{,}1 = -40298856{,}98 = \Delta b_6$$
$$x_{6з} - x_6 = 27180952{,}02 - (-29927795{,}4) = 57108747{,}42 = \Delta c_6$$
$$d_{6з} - d_6 = 55008438{,}97 - 125095461{,}2 = -70087022{,}23 = \Delta d_6 \qquad (32)$$

$$a_{7з} - a_7 = 14931616{,}34 - 102971557{,}3 = -88039940{,}96 = \Delta a_7$$
$$b_{7з} - b_7 = 168742577{,}4 - 129765233{,}1 = 38977344{,}30 = \Delta b_7$$
$$x_{7з} - x_7 = -196308876{,}4 - 60990308{,}2 = -257299184{,}6 = \Delta c_7$$
$$d_{7з} - d_7 = 261273970{,}36 - 53037382{,}7 = 208236587{,}66 = \Delta d_7 \qquad (33)$$

On the basis of the result of algorithmic processes calculated in reliance on formulas (30)-(33),

for example, it is possible to witness the cases when $\Delta b_4 > 0$, $\Delta b_5 < 0$, $\Delta b_6 > 0$, $\Delta b_7 > 0$, and according to this fact, we can draw the conclusion that the IC does not fully use available opportunities of retro-forecast indicators accepted as a sample by the criteria Δb_4, Δb_6, Δb_7, Δb_5. In the same way relevant conclusions can be made on the cases arisen by other criteria values.

Using the data provided in Table 9 obtained with the help of formulas (30)-(33) it is possible to evaluate the indicators of the accounting balance of the IC.

Table 9

Values of quality criteria determined by IC "Uzagrosugurta" JSC (based on the accounting balance indicators for 2012-2018)

Balance indicators	**Difference between sample forecast indicators and real balance indicators (+;-)**			
	Period 4 (2015)	**Period 5 (2016)**	**Period 6 (2017)**	**Period 7 (2018)**
Long-term assets (a)	82496980,98	18152220,08	27320582,06	-88039940,96
Current assets (b)	210007425,5	-18348746,04	-40298856,98	38977344,3
Total balance assets ($a + b$)	292504406,48	-196525,95	-12978274,91	-49062596,66
Equity sources (x)	252264895,24	9277784,05	57108747,42	-257299184,6
Insurance reserves (c)	0,00	0,00	0,00	0,00
Liabilities (d)	40239511,25	-9474310,0	-70087022,23	208236587,66
Total balance assets ($x + c + d$)	292504406,48	-196525,95	-12978274,81	-49062596,95

Basing on the results of the accounting balance indicators calculated within the framework of processes 1-4 by the first model provided in Table 9, it is possible to make the following conclusion.

It should be noted that values of the determined quality criteria illustrate, that IC

"Uzagrosugurta" JSC over this period of time has used the potential of its opportunities at various levels. In particular, as the retro-forecast indicator accepted as a sample illustrates, in 2015 the IC didn't use its opportunities in fill extent. In 2016, the IC fully utilized real opportunities by current assets and liabilities in relation to retro-forecast indicators accepted as a sample. In 2017 and 2018 the situation was similar, and the IC fully used available opportunities. Only in 2018 the IC to the full extent utilized only long-term assets and sources of equity.

Second method, **i.e. the model represented as $a + b - (x + d) = c$ and designed to satisfy the benefits of the IC management is subject to the empirical test implemented on the basis of accounting balance data of Insurance Company "Uzagrosugurta" JSC with the application of complex forecast method.** To achieve this aim, on the basis of mathematical-algorithmical process specified above, we apply complex forecast method for the rest sections *a, b, x, d* of the section (*c)* of the accounting balance shown in Figure 1. For this purpose, we implement complex forecast gradually, starting from one element of this interrelation, indicator c with indicator a in terms of complex forecast illustrated in Table 10 by periods (quarters or years).

Table 10

Issue of complex forecast of required 10% growth of indicator *x* on the basis of indicator *a* on the basis of the interrelation of indicators (c) and (d) of the accounting balance of IC "Uzagrosugurta" JSC in terms of the Manager model

Indicators	Period 1 (2016)		Period 2 (2017)		Period 3 (2018)		Period 4 (2019)	
	Indicator	Its real balance value	Indicator	Its real balance value	Indicator	Its real balance value	Indicator	Its real balance value
Insurance reserves	c_1	66514177,40	c_2	95688544,30	c_3	118709099,50	$c_{4req} = c_3 * ?\,\%$	10% growth

Long-term and current (or short-term) liabilities	d_1	35419123,00	d_2	125095461,20	d_3	53037382,70	$d_{4forecast}$	?

Herein (in Table 10) indicators of insurance reserves (c_1, c_2, c_3) for periods 1,2,3 and indicators of long-term and current (or short-term) liabilities (d_1, d_2, d_3) for periods 1,2,3 using Lagrange interpolation formula the amount of required indicator for insurance reserves is determined as $c_{req} = c_3 * ?\,\%$ (where: ? indicates the amount of interest required. We calculate 10% of this value, i.e. multiplying it by 1,1 coefficient which constitutes 118709099,50*1,1=130580009,45) which enables to determine forecast indicator $d_{4forecast}$ for period 4 by long-term and current (or short-term) liabilities. With this aim as it has been shown above, we use the following formula. Herein we put indicators provided in Table 10 instead of variables of this formula.

$$P(c) = \frac{(c-c_2)(c-c_3)}{(c_1-c_2)(c_1-c_3)}d_1 + \frac{(c-c_1)(c-c_3)}{(c_2-c_1)(c_2-c_3)}d_2 + \frac{(c-c_1)(c-c_2)}{(c_3-c_1)(c_3-c_2)}d_3 =$$
$$\frac{(130580009{,}45-95688544{,}30)(130580009{,}45-118709099{,}50)}{(66514177{,}40-95688544{,}30)(66514177{,}40-118709099{,}50)}35419123{,}00 +$$
$$\frac{(130580009{,}45-66514177{,}40)(130580009{,}45-118709099{,}50)}{(95688544{,}30-66514177{,}40)(95688544{,}30-118709099{,}50)}125095461{,}20 +$$
$$\frac{(130580009{,}45-66514177{,}40)(130580009{,}45-95688544{,}30)}{(118709099{,}50-66514177{,}40)(118709099{,}50-95688544{,}30)}53037382{,}70$$

(34)

Using the formula specified above we determine the following fraction with the help of formula (35).

$$p_1 = \frac{(130580009{,}45-95688544{,}30)(130580009{,}45-118709099{,}50)}{(66514177{,}40-95688544{,}30)(66514177{,}40-118709099{,}50)} = 0{,}272003;$$

$$p_2 = \frac{(130580009,45-66514177,40)(130580009,45-118709099,50)}{(95688544,30-66514177,40)(95688544,30-118709099,50)} = -1,132383;$$

$$p_3 = \frac{(130580009,45-66514177,40)(130580009,45-95688544,30)}{(118709099,50-66514177,40)(118709099,50-95688544,30)} = 1,860380. \quad (35)$$

By putting values $p_1, p_2, p_3$of formula (35) into formula (34) we obtain the formula $d_{4forecast}$ used for finding out forecast indicators and in this way we determine forecast indicator $d_{4forecast}$:

$$d_{4forecast} = P(c) = p_1 d_1 + p_2 d_2 + p_3 d_3 = 0,272003 * 35419123,0 + (-1,132383) * 125095461,2 + 1,860380 * 53037382,7 = -33352160,47$$

(36)

By putting indicators (b), (x), (a) instead of indicator (d) in sequence into formula (36), on the basis of the formula provided below we find out the value of forecast indicators $a_{4forecast}, b_{4forecast}, x_{4forecast}$:

$$a_{4forecast} = P(c) = p_1 a_1 + p_2 a_2 + p_3 a_3 = 0,272003 * 70261233,40 + (-1,132383) * 78464100,10 + 1,860380 * 102971557,30 = 121826076,51$$

(37)

$$b_{4forecast} = P(c) = p_1 b_1 + p_2 b_2 + p_3 b_3 = 0,272003 * 79045056,10 + (-1,132383) * 112392110,10 + 1,860380 * 129765233,10 = 135642223,14$$

(38)

$$x_{4forecast} = P(c) = p_1 x_1 + p_2 x_2 + p_3 x_3 = 0,272003 * 47372989,10 + (-1,132383) * (-29927795,40) + 1,860380 * 60990308,20 = 160240450,79$$

(39)

Table 11 given below provides the complex forecast indicators calculated using formulas (36)-(39).

Table 11.

Complex forecast of (*b*), (*x*), (*d*) accounting balance indicators of IC "Uzagrosugurta" JCS on the basis of their real value

(for 2019 on the basis of the data of 2016-2018)

Balance indicators	**Period 1 (2016)**	**Period 2 (2017)**	**Period 3 (2018)**	**Period 4 (2019: forecasted period)**
Long-term assets (a)	70261233,40	78464100,10	102971557,30	121826076,51
Current assets (b)	79045056,10	112392110,10	129765233,10	135642223,14
Total balance assets ($a + b$)	**149306289,50**	**190856210,20**	**232736790,40**	**257468299,65**
Equity sources (x)	47372989,10	-29927795,40	60990308,20	160240450,79
Insurance reserves (c)	66514177,40	95688544,30	118709099,50	130580009,45
Liabilities (d)	35419123,00	125095461,20	53037382,70	-33352160,47
Total balance assets ($x + c + d$)	**149306289,50**	**190856210,10**	**232736790,40**	**257468299,77**

Relying on the data provided in Table 11, in terms of the position ($a + b - (x + d) = c$ complex forecast method had passed through empirical experimental test on the basis of the balance indicators of IC "Uzagrosugurta" JSC. In addition, forecast indicators for 2019 have been identified on the basis of the balance sheet data of IC "Uzagrosugurta" JSC over the period of 2016-2018. In accordance with this indicator, it has been determined that insurance reserves (c) will increase by 10% , from 118709099,5 thousand UZS up to 130580009,45 thousand UZS

by 11870999,95 thousand UZS which arises from the rest four indicators: increase of long-term assets (*a*) from 102971557,30 thousand UZS to 121826076,51 thousand UZS, i.e. by 18854519,21 thousand UZS; increase of current assets (*b*) from 129765233,10 thousand UZS to 135642223,14 thousand UZS, i.e. by 876990,04 thousand UZS; increase of equity sources (*x*) from 60990308,20 thousand UZS to 160240450,79 thousand UZS, i.e. by 99250142,59 thousand UZS; decrease of liabilities (*d*) from 53037382,7 thousand UZS to (-33352160,47) thousand UZS, i.e. 86389543,17 thousand UZS. These values have been determined with the use of the complex forecast analysis on the basis of Lagrange interpolation formula. Sharp reduction of liabilities illustrate that it is possible for IC to get higher profit not only due to its equity and insurance premiums but also by getting short-term loan with low interest rates and directing them to the working capital.

In conclusion it should be noted that managers of the IC "Uzagrosugurta" JSC can apply this method in future for developing business-plans. Herewith due to the increase of the current assets of the IC and raising Charter capital it would be possible to use additional opportunities and offer various additional insurance services.

Taking into consideration above-mentioned statements and using the method specified above while making relevant additions and alterations to the developed business-plan, or developing forecst for the business-plan for 2020, IC "Uzagrosugurta" JSC can use its accounting balance indicators on the basis of the algorithm-mathematic process.

CONCLUSION AND PROPOSALS

Taking into consideration corporate governance rules, complex forecast of the benefits of the IC management is considered to be the urgent issue.

Possibility to determine and forecast of the quality of managers participating in the IC management and performance of the accounting department with the help of (*a, b, c, x, d*) balance sections enable to carry out analytical assessment of the quality of the IC balance and interrelation of the elements specified above.

Summing up our research, to obtain mathematical solution of the issue of complex retro-forecast

analysis and complex forecast of the IC balances, it is advisable to apply Lagrange interpolation formula in the form of functions. In addition, there should be noted the relevance of application of new advanced methods of complex retro-forecast analysis and complex forecast of the IC balances.

Carrying out complex retro-forecast analysis and complex forecast in terms of the model designed to satisfy the benefits of the IC managers is crucially important for investors.

Performing analytical experimental testing of complex retro-forecast analysis and complex forecast method for the balance in terms of the benefit of the IC management should be based on their mathematic-algorithmic process.

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