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MATHEMATICAL AND STATISTICAL MEASURES IN THE MECHANISM OF ENTERPRISES ADAPTATION TO THE CHANGES

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МАТЕМАТИКО-СТАТИСТИЧНІ ЗАСОБИ У МЕХАНІЗМІ АДАПТАЦІЇ ПІДПРИЄМСТВ ДО ЗМІН

Анотація. Підприємства функціонують у динамічному, швидко змінюваному середовищі. Здатність гнучко реагувати на зміни та отримувати з них переваги є однією із найважливіших передумов ефективної діяльності будь-якого підприємства. Застосування математико-статистичних засобів при формуванні механізму адаптації підприємства до змін створює можливості для спрощення самої процедури його формування та підвищення ефективності його подальшого впровадження на підприємстві. Метою даної статті виступає теоретико-методичне обґрунтування математико-статистичних методів, моделей та інструментів при формуванні механізму адаптації підприємства до змін та оцінка ефективності впровадження такого механізму. Покроковий алгоритм аналізу діяльності підприємства складатиметься із трьох основних блоків: вибір методів аналізу змін; моделювання змін під потреби підприємства; формування інструментарію аналізу змін із урахування прийнятих методів та моделей для аналізу та реагування на зміни підприємством. Методика застосування методів математичного моделювання вибору альтернативних варіантів змін зводиться до трьох основних послідовних етапів: формулювання та побудова математичної моделі завдання, що необхідно розв'язати; знаходження оптимального варіанту змін для потреб конкретного підприємства; аналіз отриманих при застосуванні методів математичного моделювання варіантів змін та подальший зворотній зв'язок із компонентами механізму адаптації підприємства до змін.

Abstract. Enterprises operate in a dynamic, rapidly changing environment. The ability to flexibly respond to changes and to benefit from them is one of the most important prerequisites for the effective operation of any enterprise. Using of the mathematical and statistical tools in the formation of the mechanism of enterprises adaptation to the changes creates opportunities for simplifying the procedure of its formation and increasing the efficiency of its further implementation at the enterprise. The purpose of this article is theoretical and methodological substantiation of mathematical-statistical methods, models and tools in the formation of the mechanism and evaluation of the effectiveness of the implementation of such a mechanism. The algorithm of the analysis of enterprise activity consists of three main blocks: the choice of methods of analysis of changes; modeling changes for enterprise needs; the formation of a tool for analyzing changes taking into account accepted methods and models for analysis and response to changes in the enterprise. Methods of use of

mathematical modeling choosing alternatives to reduce changes in three main consecutive stages: formulation and building of mathematical models of tasks; finding an optimal variation for a particular business; forming the components of the mechanism of enterprises adaptation to changes.

Key words: adaptation, enterprise, mechanism, management, methods, models, tools.

Ключові слова: адаптація, підприємство, механізм, управління, методи, моделі, інструменти.

Problem statement.

Enterprises operate in a dynamic, rapidly changing environment. The ability to flexibly respond to changes and to benefit from them is one of the most important prerequisites for the effective operation of any enterprise. However, such a capacity can only be formed if the enterprise is adapted to changes that takes into account changes in the external and internal environment and creates additional competitive advantages for the enterprise. The essence and the main components of such a mechanism are quite complex due to the huge number of changes that are taking place in the modern world. The use of mathematical and statistical tools in the formation and mechanism of the enterprises adaptation to changes creates opportunities for simplifying the procedure of its formation and increasing the efficiency of its further implementation at the enterprise.

Analysis of recent research and publications.

In recent years, many foreign and domestic scientists have devoted considerable attention to enterprises adaptation. The question of enterprises adaptation today is investigated by following scientists: P. Acoff, I. Ansoff, N. Biloshurskaya, P. Browning, M. Budnik, N. Vasyutkin, V. Dubchak, A. Kozhevina, G. Kozachenko, V. Kucherenko, T. Landina, L. Melnyk, B. Milner, Pastukhova, I. Pitaykina, L. Rastrigina, J. Hyman, A. Cuning, G. Hanaliyev, E. Chyzenkova, O. Shatilova, W. Yaqub, V. Yachmeneva and others.

However, the basis for the use of mathematical and statistical tools in shaping the mechanism of the enterprises adaptation to changes requires more complex elaboration.

Selection of previously unsettled parts of the general problem.

The study of mathematical and statistical tools in forming a mechanism of enterprises adaptation to changes have not a systemic character, does not analyze the complex possibilities of combining different methods, models, tools of such mechanisms.

The purpose of this article is theoretical and methodological substantiation of mathematical-statistical methods, models and tools in the formation of the mechanism of the enterprises adaptation to changes and evaluation of the effectiveness of such a mechanism implementation.

Presentation of the main research material.

Any indicators of the activity of the enterprise are in constant motion, therefore one of the priority tasks in forming the mechanism of the enterprises adaptation to the changes is the ongoing analysis and evaluation of the main changes that affect the performance of the enterprise. It should be noted that the analysis should be conducted on a permanent basis, since the adaptation

mechanism for change should be capable and sensitive to any changes. Detection of such changes is a rather difficult task in the presence of a huge number of changes.

To simplify the procedure for analyzing changes, various mathematical and statistical methods of analysis of the enterprise are used. The algorithm of this analysis consists of three main blocks:

- choice of methods of analysis of changes;
- modeling changes for the needs of the enterprise;
- development of tools for analyzing changes taking into account accepted methods and models for analysis and response to changes in the enterprise.

Such an algorithm has a constant feedback with the previous steps, since the identified alternatives in the next steps provide for their consideration from the very beginning of the algorithm.

In the activity of the enterprise there are constantly a lot of changes that are characterized by significant amounts of data, which the enterprise must learn to process in a short period and with the least cost of time. Such a change analysis can be carried out over a period of time (interval data) or at a particular moment (moment data). Formation of interval or moment data takes place depending on the needs of the enterprise.

Particular attention deserves consideration of panel data. Panel data allow enterprises to consider changes not only in time but also in space [1, 2, 3, 4].

Often, three types of models are used using panel data [5, p. 23]:

- 1) combined regression model for panel data;
- 2) model of panel data with fixed effects;
- 3) panel data model with selective effects.

The forecasting of changes is relevant to the formation and implementation of the mechanism of the enterprises adaptation to changes. Problems forecasting solved by using these methods, which are dependent on the type of dynamic series [6, p. 26]:

1. Non-stationary dynamic range:
 - with a trend - linear regression;
 - seasonal component
- seasonal coefficient method;
 - with the trend and the seasonal component - the method of seasonal coefficients.

2. Stationary Dynamic Row:

- a method of chain substitutions.

One of the simplest methods of forecasting changes is the linear regression method. The procedure for calculating the predictive values of the indicators using the linear regression method can be simplified presented in three stages [6, p. 25]:

1. Construction of the linear equation of the trend. The trend equation coefficients are calculated using the least squares method.

2. Estimation of the quality of the trend equation using the determination coefficient and the criteria for checking the significance.

3. Calculation of estimates and forecast based on the coefficients of the trend equation and the values of the time parameter.

One of the common methods of forecasting changes is the method of chain substitutions. Scheme of the procedure for calculating the predicted values of the indicator on the basis of the method of chain substitutions in a simplified form can be represented as [6, p. 28]:

1. Calculation of growth rates
2. Calculation of average monthly or quarterly growth rates
3. Calculation of estimates and forecast based on average monthly or quarterly growth rates and actual values of the indicator.

However, it should be noted that forecasting changes in enterprises with seasonal nature of production has its own specific features, for example, are agro-industrial enterprises. Let's consider on their example features of changes forecasting.

Summarizing the main aspects of the activities of agro-industrial enterprises, we can propose the use of a methodological approach in forecasting data for such enterprises, which is summarized by the author [6, p. 27]:

1. Calculation of the values of the trend
2. Calculation of seasonal factors:
 - Calculate the ratio of actual values to the values of the trend
 - Calculation of the average monthly or quarterly values of the balances
 - Calculation of seasonal factors.
3. Calculate estimates and forecasts based on seasonality and trend values.

To study seasonality, we use the method of analyzing dynamic series, which consists in determining the components of the factors that creep into each value of a dynamic series - decomposition. Decomposition can be used for short-term and long-term forecasts. One of the simplest methods for analyzing the changes is the construction and research of the series of dynamics of indicators, called time series [7].

According to the methods of decomposition, four components of the dynamic series are distinguished: trend, cyclic, seasonal and irregular (or random) [8, p. 21].

When modeling the seasonal and cyclical fluctuations in the dynamics of economic indicators of the enterprise on terms no trends in their development used approximation of the time series of trigonometric polynomials, in particular, series of Fourier. Function, given at each point investigated interval of time, you can imagine an infinite number of pairs of sines and cosines - the so-called harmonics. Finding the finite sum of members with sinuses and cosines is called harmonic analysis [7, p. 54].

Considering the methods and models of the analysis of changes in the enterprise, attention should also be paid to the methods, the introduction of these changes, which should contribute to the effectiveness of the mechanism of the enterprises adaptation to change.

Scientists have developed various methods for making changes that in the aspect of our research can be systematized in the context of five groups [9; 10, p. 172-173; 11, p. 10; 12, p. 7-8]:

- methods focused on people and the culture of the organization are realized through a set of tools, techniques aimed at improving the relations between employees, identifying problems during the planning and implementation of changes, motivation and reducing the resistance of employees to the necessary changes, etc.;
- methods focused on tasks and technology, implemented through modeling and analysis of production processes, quality management, etc.;
- methods focused on the structure and strategy, which are practically implemented through the flexibility and adaptability of organizational structures, the use of tools for planning and forecasting change;
- design methods implemented through application of design technologies and tools at the enterprise are the basis for implementation of the constraint "resources - time - quality";
- methods aimed at changing the business model of the enterprise.

However, even thoroughly analyzed changes, effectively formed models will not work for the success of the enterprise, unless you develop tools for implementing such changes in the enterprise. Here are different methods of choosing alternatives. The most common methods are mathematical modeling. Methods of mathematical modeling choosing alternatives to reduce changes in the three main consecutive stages:

Stage 1 - the formulation and building of mathematical model that have tasks, that need necessary solutions. That is the construction of a mathematical model for selecting alternatives for change. In addition, this mathematical model must take into account all the restrictions required by the company with respect to alternative variations of changes. Here an implementation model and an estimation model of variations are formed. When forming an implementation model determine what can change in the enterprise. The estimated model also shows which company can get results due to the introduction of various changes. This stage of forming a mathematical model primarily aimed at identifying options and the results of the implementation of changes in the company.

Stage 2 - Finding the optimal variation for the needs of a particular company. It should be noted that the universal principle of optimality does not exist. Therefore, for each mathematical model set its own principle of optimality, sometimes such principles of optimality may be several. In the future finding the optimal solution is quite simply solved mathematical

means. Therefore, when using multiple optimality principles, the company can receive optimal solution for the problem.

Stage 3 - analysis obtained by using mathematical modeling changes and variations. Another optimal solution may be chosen, if it exists, or the principle of optimality for the task is completely changed.

Note that mathematical modeling techniques provide opportunities to companies in a very limited time using small resources to get answers to difficult questions. However, all tasks and constraints with the using of such methods should be clearly stated and take into account the achievements of the previous stages of the mechanism of the enterprises adaptation to changes.

Conclusions and suggestions.

The activities of any enterprise coexist with constantly arising changes, both in the external and internal environment. Such changes are characterized by dynamism and a wide range of data that describes them. In order to analyze such data, various mathematical and statistical methods of data analysis are used, each of which has its advantages and disadvantages. However, the result of any analysis should be the simulation and prediction of the development of the situation with one or another combination of changes. The application of different approaches to the formation of models that reflect changes in the activities of the enterprise should take place taking into account the specific features of business activities. It should also be emphasized that the precondition for the formation and implementation of an effective mechanism for adapting the enterprise to change is the development of a response tool for change, which is subordinated to the results of data analysis and emerging models. Such an integrated approach will enable enterprises to simplify the very procedure for the formation and implementation of a mechanism for adaptation to changes.

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