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Probabilistic forecast model as a time management tool

Anatoliy Babichev[1], Anna Chkheailo[2], Lyashenko Vyacheslav[3]

lyashenko.vyacheslav@gmail.com

[1]Department of Management and Administration, V. N. Karazin Kharkiv National University, Ukraine

[2]Department of Management, Business and Professional Communications, V. N. Karazin Kharkiv National University, Ukraine

[3]Department of Media Systems and Technology, Kharkiv National University of Radio Electronics, Ukraine

Abstract: Forecasting plays an important role in economic research. This allows you to justify and make informed and effective decisions. For these purposes, various methods, approaches and models can be used. At the same time, among the possible models, we highlight probabilistic models that allow us to take into account individual characteristics of the processes, phenomena, and objects under study. We can also build models with given characteristics, which allow us to plan some developments. At the same time, the process of predictive modeling is important in the allocation of various resources. Here, a special place is occupied by the resource of time, which allows one to effectively influence the redistribution of other resources. Thus, we consider probabilistic forecasting models as a time management tool. Using the example of specific probabilistic characteristics, we justify the construction of a certain probabilistic forecast model. We show the possibility of using such a model in time management. The work also provides a number of diagrams and graphs that allow you to understand the progress of this study.

Key words: Model, Forecast, Probability, Banking, Time management

Introduction

The functioning and development of individual economic entities, economic sectors or areas, and the country as a whole depends on effective and timely decisions [1]-[3]. Making such decisions is based on a comprehensive analysis of the process, phenomenon or object under study. This analysis should cover both general trends and specific features of what is being studied [4]-[9]. Various methods, approaches, theories can also be used here [10]-[16]. Moreover, the choice of such tools depends on the specific conditions of the task.

One of the directions in the research should be considered the construction of predictive models [17], [18]. These models allow you to understand the trends inherent in a process, phenomenon or object, and also consider the possibility of assessing their further functioning. This, ultimately, helps to justify the most effective decisions for the implementation of certain plans. A predictive model also helps us understand the specifics of what is happening and understand possible limitations in the development of what we are studying.

Among predictive models, a special place is occupied by models that are based on the probabilistic characteristics of what is being studied [19], [20]. This allows us to take into account (or model) some characteristics of the process, phenomenon or object that we are studying. Thanks to such an assessment, it is possible to simulate various situations and the impact of certain

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restrictions on achieving the goals. It is also possible to develop various scenarios, make reasonable choices to make the necessary decisions, and influence the development and functioning of the subject being studied.

An important aspect in decision making is also the ability to evaluate and manage various resources, where such a specific resource as time should be noted [21], [22]. At the same time, by building a predictive model, we can more effectively estimate our time resources and distribute the distribution of other resources over time. Using time management, we can holistically shape our goals and actions for the necessary planning and implementation of assigned tasks.

Thus, the main goal of this study is to consider the probabilistic forecast model as a time management tool in planning individual tasks.

Related work

Considering time management, we can talk about various areas of research in this area. Here we highlight both purely theoretical works and practical developments related to a specific subject area.

Y. A. Olawale and M. Sun consider time management in the process of cost control and timing of commissioning of construction industry facilities [23]. First of all, the authors examine the reasons that influence cost and time overruns. Next, measures are proposed to reduce the consequences of the negative impact of such causes. The basis of the study is the classification of such reasons and their qualitative description. However, the formalization of such a process is not described.

S. Yu, X. Yu B. Shirinzadeh and Z. Man study time management algorithms in manufacturing processes [24]. This study is devoted to the continuous control of robotic manipulators with a limited time mode. The work proposes a new procedure for such control. It is based on Lyapunov's theory of stability. A formalization of the management process is proposed. This allows you to build various models taking into account the time-optimal parameters of the robot’s movement.

X. Zhou, V. Koltun and P. Krähenbühl consider tracking the functioning of some objects in the form of a set of points [25]. This helps to formalize certain concepts of time management theory. For these purposes, the work considers the possibility of using deep neural network methods. The use of digital image analysis methods is also proposed. Thus, it becomes possible to detect and monitor the development of a certain process or the functioning of an object. This allows you to simulate various situations in time management.

W. F. Cascio uses time management tools to assess the impact of employee behavior on the efficiency of a business entity [26]. This approach allows us to highlight the strengths and weaknesses in the organization of personnel work and make the necessary improvements in their work. For these purposes, classical methods of analysis were used. However, this approach is limited in formalizing the general process of assessing the efficiency of a business entity, taking into account time management.

P. S. Budhwar, D. S. Saini and J. Bhatnagar evaluate the effectiveness of women as managers [27]. In this case, special attention is paid to the topic of time management. The study was conducted on data from India.

L. H. Melnyk, O. I. Karintseva, O. V. Kubatko, Y. M. Derevianko and O. M. Matsenko consider the issues of restructuring socio-economic systems in new economic conditions [28]. At

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the same time, special attention is also paid to time management. The importance of such a component in the context of the transition to a digital economy is noted.

L. K. Ozanne studies various aspects of the use of time management in modern banking management [29]. For these purposes, high-quality data analysis tools are used. The object of study is time banking. The conclusion provides a number of practical recommendations.

C. Valor Martínez and E. Papaoikonomou pay attention to time banking issues based on the use of time management tools [30]. Particular attention is paid to time banking in times of crisis. Attention is drawn to the insufficient amount of empirical data. Therefore, the main tools for such research are qualitative methods. Mixed methods are also used. At the same time, there is a lack of high-quality formalized models.

S. Umamaheswari and A. Valarmathi consider the role of artificial intelligence in ensuring the development of the banking sector [31]. Moreover, such a generalization also applies to time management in banking. Thus, there is a transformation of management: from managing monetary resources to managing resources from the point of view of time dynamics. This allows you to improve existing business models and optimize the decisions that are made. It also becomes possible to automate individual processes.

Thus, we can note the predominant use of qualitative methods of analysis in time management. Therefore, an important aspect of the research is the development or adaptation of some models for their use in time management.

On the relationship between predictive modeling and time management

Predictive modeling, like time management, operates with the concept of time. Therefore, it is logical to consider the relationship between such components from the point of view of the overall research process. This is somewhat depicted in Figure 1.

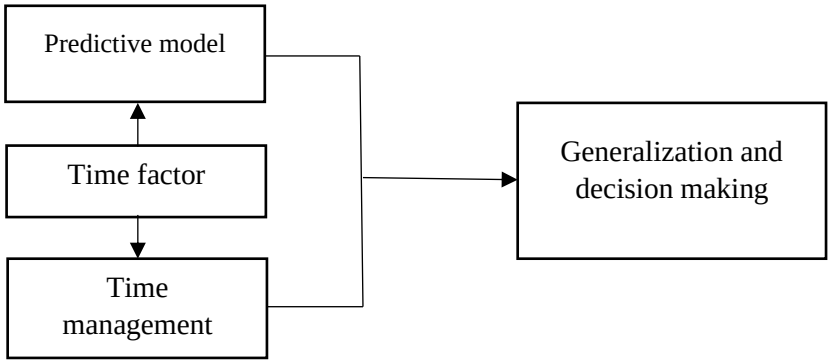

Figure 1: Relationship between predictive modeling and time management

Thus, predictive modeling helps to determine possible changes in the functioning of a certain object in subsequent time periods. This allows you to adjust the operation of such an object taking into account the time factor and optimize its activity. Then the optimization of such a resource as time occurs. Ultimately, predictive modeling improves time management efficiency.

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Probabilistic forecast model

To substantiate the purpose of this study, we will consider a probabilistic forecast model. This choice is due to the fact that the probabilistic model allows us to take into account the main characteristics of what is being studied. At the same time, a probabilistic forecast allows us to make certain decisions in the context of time management.

The corresponding forecast model is based on the fact that we will try to determine the coincidence of a certain ratio of data parameters over time [32]. Moreover, such a coincidence can also be interpreted as its falling into a certain area of interest over time (Figure 2).

In this case, the formalized recording of such a model looks like this:

$$P(x_1 < X(t) < x_2, y_1 < Y(t) < y_2) = \int_{y_1}^{y_2}\int_{x_1}^{x_2} f(x(t), y(t))dxdy, \quad (1)$$

where $P(...)$ is the probability of hitting the area of interest specified above;

$f(x(t), y(t))$ – the law of the distribution of a random variable, which allows you to calculate the probability of a random variable falling into any subset of its possible values.

$$f(x(t), y(t)) = \frac{1}{2 \cdot \pi \cdot \sigma_X \cdot \sigma_Y \cdot \sqrt{1-\rho_{XY}^2}} \times$$
$$\times exp[-\frac{1}{2 \cdot (1-\rho_{XY}^2)} \cdot (\frac{(x-a_X)^2}{\sigma_X^2} + \frac{(y-a_Y)^2}{\sigma_Y^2} - , \quad (2)$$
$$-2 \cdot \rho_{XY} \cdot \frac{x-a_X}{\sigma_X} \cdot \frac{y-a_Y}{\sigma_Y})]$$

where

$x(t)$ – the current value of the random variable X;

$y(t)$ – the current value of the random variable Y;

a_X – mathematical expectation, which reflects the central tendency of a random variable X;

a_Y – mathematical expectation, which reflects the central tendency of a random variable Y;

σ_X – root mean square deviation, which characterizes the rate of change of a random variable X;

σ_Y – root mean square deviation, which characterizes the rate of change of a random variable Y;

ρ_{XY} – the correlation coefficient, which reflects the degree of interrelationship of the specified indicators.

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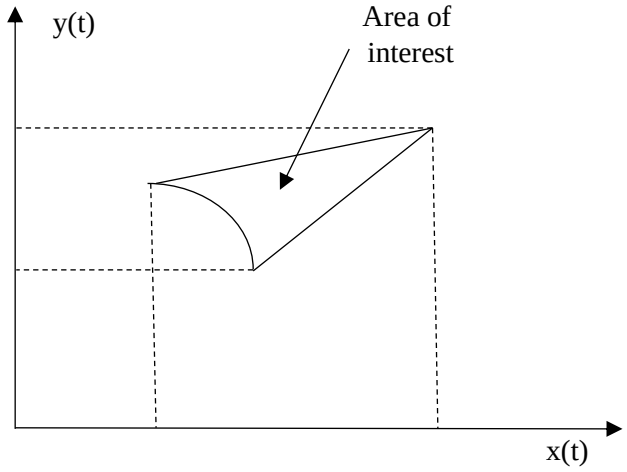

Figure 2: Geometric interpretation of the probabilistic forecast model

In this way, we can model various processes and determine their characteristics taking into account the time factor.

Results and its discussion

As examples, consider some data from banking activities.

Let's assume that we want to explore the possibility of changes in bank liquidity over time, depending on profitability. In this case, we will consider the same model parameters, with the exception of liquidity indicators. In the first case, we assume that liquidity values vary within 58-62%. In the second – 37-42%. At the same time, the bank expects that the yield at successive time intervals changes by 0.2% points each time. The result is a certain value that characterizes the probability of falling into the area of interest (reaching liquidity values).

For the corresponding analysis, we use formulas (1) and (2).

Figure 3 shows the first result, Figure 4 shows the second.

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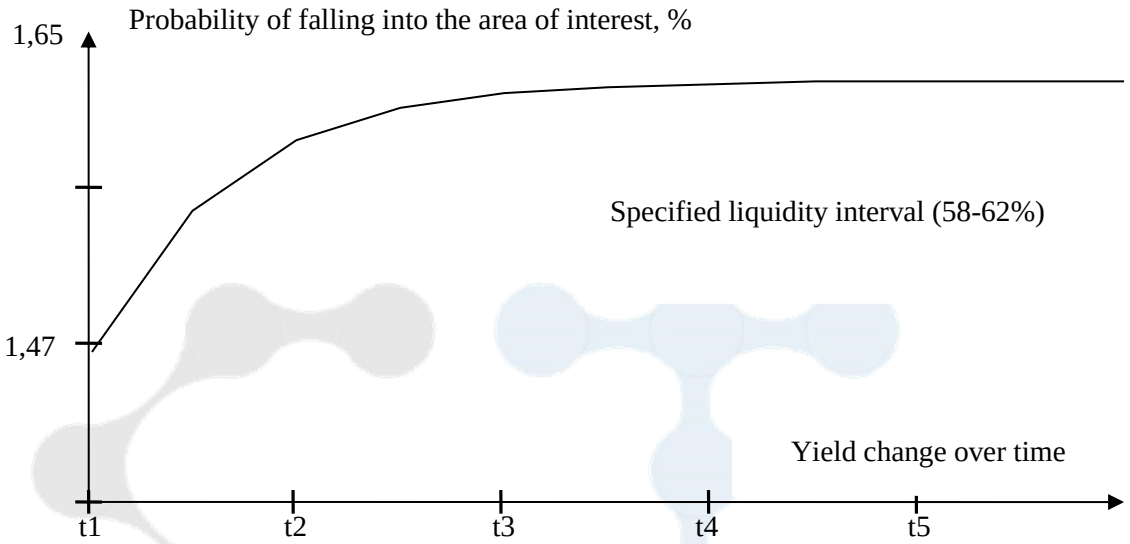

Figure 3: Possible changes in liquidity and profitability over time (Example 1)

We see that the corresponding change in liquidity has insignificant probabilistic indicators. At the same time, over time, a stabilization of such indicators is observed.

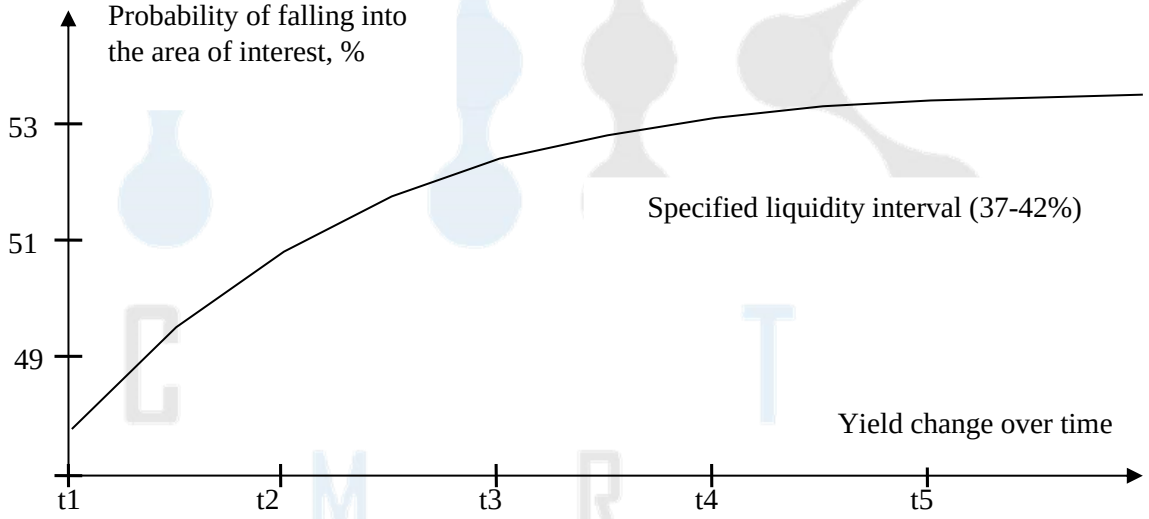

Figure 4: Possible changes in liquidity and profitability over time (Example 2)

This shows a completely different possibility of achieving a given level of liquidity. This allows you to make informed decisions taking into account the time factor and forecast indicators that are the most realistic. In the second case, we also see that we will need more time to stabilize the required liquidity indicators. In this case, there is a smooth increase in the change in the value that characterizes the probability of falling into the area of interest However, this approach allows for more realistic planning of time and achievement of certain indicators.

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Conclusion

The work discusses the main points of time management. For these purposes, various literature sources were analyzed and a conclusion was made about the advisability of considering predictive models.

We examined a probabilistic forecast model and showed the possibility of combining it with time management. A formalization of this approach is presented. A specific example shows the feasibility of using the proposed approach in the implementation of time management.

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