

methods was used. Methods of analysis and synthesis were applied to generalize the theoretical foundations of communication competence and its significance in human resource management, as well as to form a holistic understanding of its components. A systemic approach allowed considering communication competence as an element of a broader human resource management system. Methods of deduction and induction were used to derive general principles of effective communication based on specific aspects and, conversely, to detail concrete manifestations of competence in various management situations. Comparative analysis enabled the comparison of different approaches to defining communication competence and its impact on management effectiveness. It is proven that a manager's communication competence is fundamental for the successful performance of managerial functions, as it permeates all aspects of interaction and directly affects the accuracy of task execution and the achievement of organizational goals. It is substantiated that in conditions of uncertainty and risk, especially those caused by military aggression and crisis phenomena, the role of anti-crisis communications, the ability to manage conflicts effectively, and the communication of complex decisions critically increases. The components of crisis communication are detailed, including preparation of communication channels, immediate response, provision of reliable and consistent information, the need for coordination among communicators, manifestation of empathy towards personnel, and ensuring two-way feedback. The scientific novelty lies in deepening the theoretical and methodological foundations of a manager's communication competence by integrating aspects of anti-crisis communications, conflict management, and the communication of complex decisions into its structure as key elements relevant to the functioning of enterprises in modern Ukrainian realities. An expanded vision of communication competence as a strategic resource for ensuring the psychological well-being of personnel and organizational stability in the face of external shocks is proposed. The research results provide managers and human resource specialists with practical recommendations for developing and improving communication competence. The developed principles of anti-crisis communication can be effectively implemented in personnel training and development processes, as well as in internal regulations of enterprises, to increase their readiness to respond to crises, manage conflicts effectively, and communicate complex management decisions successfully. This will contribute to increasing the overall effectiveness of human resource management and strengthening the organizational culture.

Key words: communication competence, manager, human resource management, crisis communications, conflict management.

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THEORETICAL AND SCIENTIFIC APPROACHES TO THE APPLICATION OF ECONOMETRIC METHODS AND MODELS IN ECONOMIC RESEARCH IN UKRAINE

Pavlov K., Skorokhod I., Karlin M., Begun S., Spas V. Theoretical and scientific approaches to the application of econometric methods and models in economic research.

Econometric methods and models are widely used in economic research to analyze and forecast economic processes and to justify management decisions. They help to formalize complex economic relationships, identify key influencing factors, and develop scientifically sound forecasts. In today's world, econometric methods and models are increasingly described in various scientific papers. This is primarily because they allow researchers to identify patterns and relationships between various economic indicators, as well as to make reasonable forecasts of future economic events. Econometric methods and models play an important role in modern economic research, providing tools for quantitative analysis of economic phenomena, theory testing, and forecasting. Their value lies in their ability to transform abstract economic hypotheses into empirically verifiable conclusions, allowing researchers not only to describe but also to explain cause-and-effect relationships. The purpose of this study is to analyze the primary econometric methods and models used in scientific research, to assess their practical value and applicability in different types of economic research, and to determine recommendations for choosing appropriate models to maximize the accuracy and reliability of the results. The methodology of this study is based on an integrated approach that covers the theoretical and scientific aspects of the application of econometric methods and models in economic research. To achieve the objectives of the study, several methods were used to consider stochastic differential equations, which are an important tool for modeling dynamic systems under the influence of random factors. The first stage of the research was to develop various types of econometric models, such as regression, time series, and random process analysis. An important aspect of this stage is the analysis of one of the most popular time series models, the Autoregressive Integrated Moving Average (ARIMA) model. The theoretical analysis also included the study of scientific works by domestic researchers on econometric methods and models. Attention was paid to econometric methods and models that allow analyzing economic phenomena, assessing the impact of various factors on economic indicators, and forecasting indicators depending on various events. To forecast changes in the stock market, it was proved that it is advisable to use stochastic differential equations. It has been determined that econometric methods and models are an important tool in economic research for analyzing and forecasting economic processes that will allow quantifying the relationships between various economic variables and using these estimates to make informed management decisions. Prospects. Econometric methods and models are a dynamic field that is constantly evolving, adapting to new challenges, opportunities, and the growing complexity of economic systems. Among the prospects for the use of econometric methods and models in economic research are integration with machine learning and artificial intelligence; spatial econometrics and network analysis; dynamic stochastic general equilibrium models and their integration; accessibility and interpretability of models. The prospects of econometric methods and models in economic research are related to their ability to adapt to new data sources, integrate advanced computing technologies, and constantly improve tools for quantitative analysis.

Keywords: econometric methods and models, economic research, modeling, stochastic differential equations.

Statement of the problem, generally and its connection with important scientific or practical tasks. Econometric methods and models have become essential tools in modern economic research. They help researchers analyse empirical data, test hypotheses, investigate relationships between variables, and predict future trends. Econometric approaches allow researchers to quantify economic phenomena and are of practical importance for both academic science and real-world economic decision-making.

Analysis of recent research and publications. Today, econometric methods and models are widely used in all spheres of life, particularly in decision-making

processes. In the work of S. I. Begun, N. L. Khomyuk and O. O. Podzizey "Econometric methods and models in managerial decision-making in the context of digital transformation", modern econometric tools adapted to the conditions of the digital economy are analyzed, as well as ways of integrating such models into the process of managerial decision-making to ensure their accuracy and efficiency [1].

In the work of M. Pavlova, "Formation of a model of effective attraction of international investments for the development of territorial communities in Ukraine", an econometric model of attracting international investments for the development of communities in Ukraine is built.

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With the help of the constructed model, it is possible to analyse the impact of various political and economic factors on the level of investment and develop an optimal tax policy and investment guarantee system [2]. Also, the practical application of various econometric models is reflected in the works of the following scientists: A. Bykova, O. Galeev [3], T. Shabelnyk [4], etc.

Formulation of the objectives of the article (statement of the task). The article is aimed at analysing the primary econometric methods and models used in scientific research, assessing their practical value and applicability in various types of economic research, and determining recommendations for selecting appropriate models to achieve maximum accuracy and reliability of results.

Presentation of the primary material of the study. It is fundamentally important to first clearly define the terminological essence of econometric methods and models within the framework of scientific research to comprehensively understand their goals and scope of application. Econometrics, as a scientific discipline, integrates economic theory, mathematical methods, and statistical analysis to study economic phenomena quantitatively. It is based on the development and application of econometric models, which are essentially a formalised, logically structured description of empirical information, which is critically important for an in-depth analysis of specific economic problems. The use of econometric methods and models allows us to carry out a multifaceted analysis of complex economic systems, to assess the degree of influence of various endogenous and exogenous factors on key financial indicators, as well as to form reasonable forecasts regarding the future values of these indicators under the condition of changes in certain events or conditions. An essential characteristic of econometric tools is their ability to operate with large amounts of data (Big Data), which ensures the construction of the most detailed and statistically reliable forecast models. This allows researchers to verify existing economic theories and identify non-obvious patterns and relationships in the financial environment.

Scientific research uses a wide range of econometric models, each with its own specifics and scope. Traditionally, they are classified into three main categories: regression models, time series models, and random process analysis models. This differentiation is due to the nature of the data being analysed and the type of dependencies that the researcher seeks to identify.

The linear regression model is one of the fundamental and most common forms of regression models. Its conceptual simplicity and high interpretive capacity make it the cornerstone of modern econometrics. This model establishes a linear functional relationship between one dependent variable (an explanatory variable, or response) and one or more independent variables (explanatory variables, or regressors).

The linear regression model is as follows:

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i \quad (1)$$

where y_i – is the dependent variable,

x_i – independent variable,

β_0, β_1 – are regression coefficients showing how the change of each independent variable by one affects,

ε_i – a random error or residual that considers the deviation of the actual values from the expected ones.

The linear regression model has gained considerable popularity in scientific research due to its exceptional practical value and ability to simplify the processes of analysis and forecasting significantly. Its main advantage lies in the intuitive clarity of the interpretation of the coefficients, which allows you to quantify the influence of independent variables on the dependent variable.

This makes it particularly appropriate for analyses characterized by relative simplicity and well-defined linear relationships. Examples of such use are assessing the impact of macroeconomic indicators, such as the unemployment rate, inflation or interest rates, on gross domestic product (GDP), or analyzing the dependence of demand for specific

products on price, consumer income and other determinants under certain market conditions.

However, despite its universality, linear regression also has certain limitations that must be considered when applying it. Key disadvantages include:

- sensitivity to abnormal values (outliers): Linear regression is sensitive to the presence of outliers in the data, as they can significantly distort the estimates of the coefficients, leading to incorrect conclusions.

- Assumption of normal distribution of residuals and homoscedasticity: Classical linear regression assumes that residual values (model errors) have a normal distribution with a zero mean and constant variance (homoscedasticity). Violation of these assumptions (for example, the presence of heteroscedasticity or autocorrelation) can lead to inefficient or biased estimates of standard error coefficients, making statistical hypotheses difficult to test.

Insufficient flexibility to model complex nonlinear relationships: Linear regression is inherently limited to modelling only linear dependencies. In the real world, many economic and social processes are complex and nonlinear in nature, and a linear model may not adequately describe them. This requires applying more complex analysis techniques, such as nonlinear regression, polynomial regression, or other advanced econometric approaches.

Time series models are necessary econometric models widely used in economic research and forecasting. A time series is a sequence of observations ordered over time, such as daily stock prices, monthly inflation rates, or annual GDP values. Forecasting using the time series method is to find future values of the time series with as much accuracy as possible based on its past values and information about its behavior in the past [5].

This approach assumes that past patterns and dynamics of a series can be extrapolated to the future.

The peculiarity of the analysis of time series is that they mainly consider three main components at once, which form the structure of the dynamics of the indicator:

1. Trend (Trend): This component reflects the long-term, smooth movement of the time series towards the growth or decline of a specific value. A trend can be linear, non-linear, or complex and reflect fundamental changes in the economy or other systems.

2. Seasonality: The seasonal component shows regular, recurring fluctuations in a time series that occur over a specific period (e.g., days of the week, months, quarters, seasons). These fluctuations are due to the influence of certain seasonal factors, such as climatic conditions, holidays, marketing campaigns, etc.

3. Randomness (Residual / Irregular Component): This component represents unpredictable, random fluctuations that cannot be explained by trend or seasonality. Randomness reflects the influence of unaccounted factors or unexpected events that directly impact the result of observations.

The main time series models and methods are built based on the decomposition and analysis of these variables, such as autoregression (AR), moving average (MA), autoregression-moving average (ARMA) models, integrated models (ARIMA) and their seasonal variants (SARIMA), and more complex models for non-stationary series analysis, such as ARCH/GARCH models for volatility modelling.

One of the most popular time series models is the Autoregressive Integrated Moving Average model, ARIMA, which is described by the formula:

$$\Delta^d y_t = c + \phi_1 \Delta^d y_{t-1} + \dots + \phi_p \Delta^d y_{t-p} + \theta_1 \varepsilon_{t-1} + \dots + \theta_q \varepsilon_{t-q} + \varepsilon_t \quad (2)$$

where y_t – is the value of the time series at time t ,

$\Delta^d y_t$ – the difference of the degree series d ,

The difference of the first degree is written as a constant $\Delta y_t = y_t - y_{t-1}$

ε_t – white noise value,

$\phi_1, \dots, \phi_p$ – coefficients of the autoregressive model,

$\theta_1, \dots, \theta_q$ is the coefficient of the moving average model [6].

When modelling based on ARIMA models, estimating the values of the model parameters that best match the data is essential. The process of evaluating the parameters of the ARIMA simulation involves the selection of appropriate values for the three primary parameters of the model, namely the autoregression order (p), the integrated order (d), and the moving average order (q). The moving average (q) order represents the number of lagged values of the error term to include in the model. The integrated 45 order (d) represents the number of times a distinction operator has been applied to the time series data to make it stationary [7].

The ARIMA model is often used to predict time series data based on data from previous periods. In scientific research, it is used to predict strategic indicators, etc. The advantage of this model lies in the "smoothing" of time series, i.e. in the detection of average values of a certain number of observations. Integration and moving average. Another advantage of this model is its unique accuracy in the short term, with relatively minor deviations in values.

However, the ARIMA model also has certain drawbacks. First, it is highly sensitive to emissions. Any anomalous phenomena significantly affect the accuracy of forecasts. To predict more complex processes, in which the nature of anomalies (random processes) is more common, stochastic differential equations are used.

Stochastic differential equations are one of the most efficient random process models. Such equations combine classical differential equations with elements of probability theory, which makes it possible to describe the dynamics of systems in the presence of stochastic (random) factors. View of stochastic differential equations:

$$\begin{aligned} dx(u, t) &= a(x(u, t), \mu_t, t) dt \\ &+ \int_{R_d} b(x(u, t), \mu_t, t, q) W(dt, dq) x(u, 0) \\ &= u, \mu_t = \mu_0 \circ x(\cdot, t)^{-1} \end{aligned} \quad (3)$$

Stochastic differential equations are a highly specialized and powerful mathematical apparatus that allows you to model dynamical systems under the constant influence of random factors. Their application is especially appropriate in areas where processes are characterized by significant uncertainty and volatility. A striking example is forecasting changes in the stock market, where asset prices constantly fluctuate under the influence of unpredictable economic news, events and behavior of market participants. SDRs are also widely used in quantitative finance to model option prices (e.g., the Black-Scholes model), interest rate dynamics, and risk management.

Although stochastic differential equations can provide the most accurate predictions in complex stochastic environments, they have their characteristics and challenges: Complexity of calculation: Solving stochastic differential equations is much more difficult than solving deterministic differential equations or traditional econometric models. This often requires the application of numerical methods, such as the Euler-Maruyama method or Monte Carlo simulations, which are computationally intensive.

Due to random components (noise), prediction using stochastic differential equations can be very sensitive to

the initial conditions and values of the model parameters. Minor discrepancies in these data can lead to significant differences in results, making simulations unstable and requiring careful calibration and validation. This sensitivity highlights the importance of quality data and a deep understanding of stochastic processes.

Stochastic differential equations are an essential tool for modelling dynamical systems under the influence of random factors. They find applications in various sciences and fields, including physics (Brownian motion), biology (epidemic spread, population dynamics), engineering modelling noise in systems) and, of course, economics and finance, where processes are markedly random.

However, for their practical use, the researcher needs a strong level of knowledge in probability theory, stochastic calculus, numerical methods, and statistical modelling. Practical skills are critical because such an econometric model is complicated to calculate and interpret [8].

This requires specialists not only theoretical training, but also significant experience in working with appropriate software and analysis methods [8].

Conclusions and prospects for further research in this direction. It is difficult to overestimate the importance of using econometric models and methods in modern scientific research, especially in economics, finance, sociology and related disciplines. They are a fundamental tool that provides scientists with the opportunity not only to observe but also to analyse and predict complex economic phenomena deeply. This, in turn, is critically important for forming sound management decisions and developing effective policies, because they are based on reliable empirical data.

Applying econometric models allows researchers to go beyond qualitative description, making accurate quantitative estimates of the relationships between variables. These quantitative estimates become a solid basis for forecasting future trends and developing economic scenarios [7].

For example: linear regression models, despite their relative simplicity, remain indispensable for assessing the direct influence of some variables on others, helping to identify the key determinants of a particular phenomenon; time series models such as ARIMA provide a detailed analysis of the dynamics of macroeconomic indicators (GDP, inflation, unemployment) and effective forecasting of the behavior of financial markets, taking into account trends, seasonality and cyclicity; Stochastic models, including stochastic differential equations, allow the element of randomness and uncertainty to be integrated into analysis. This makes the simulations significantly more realistic, especially for highly volatile systems like stock markets, where unpredictable factors play a key role.

In conclusion, econometric methods and models in general allow researchers to reliably support their hypotheses and assumptions about the problem under study. They transform intuitive guesses or qualitative observations into quantitatively grounded conclusions, significantly increasing research results' scientific reliability and practical value. Thus, econometrics is not just a tool but a fundamental methodology to deeply understand economic processes.

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Анотація.

Павлов К. В., Скороход І. С., Карлін М. І., Бегун С. І., Спас В. В. Теоретико-наукові підходи до застосування економетричних методів та моделей в економічних дослідженнях.

Економетричні методи та моделі широко застосовуються в економічних дослідженнях для аналізу та прогнозування економічних процесів, а також для обґрунтування управлінських рішень. Вони дозволяють формалізувати складні економічні зв'язки, виявити ключові фактори впливу та розробити науково обґрунтовані прогнози. У сучасному світі економетричні методи та моделі все більше описуються у різних наукових працях. Насамперед це пов'язано з тим, що вони дозволяють дослідникам виявляти закономірності та взаємозв'язки між різними економічними показниками, а також робити обґрунтовані прогнози щодо майбутніх економічних подій. Економетричні методи та моделі відіграють важливу роль у сучасних економічних дослідженнях, надаючи інструментарій для кількісного аналізу економічних явищ, перевірки теорій та прогнозування. Їхнє значення полягає в здатності перетворювати абстрактні економічні гіпотези на емпірично перевірені висновки, дозволяючи дослідникам не просто описувати, а й пояснювати причинно-наслідкові зв'язки. Метою дослідження є аналіз основних економетричних методів і моделей, які застосовуються в наукових дослідженнях, оцінка їх практичної цінності та застосовності у різних типах економічних досліджень, а також визначення рекомендацій щодо вибору відповідних моделей для досягнення максимальної точності та надійності результатів. Методологія дослідження базується на комплексному підході, який охоплює теоретичні та наукові аспекти застосування економетричних методів та моделей в економічних дослідженнях. Для досягнення цілей дослідження було використано низку методів, що дозволяють розглянути стохастичні диференціальні рівняння, які є важливим інструментом для моделювання динамічних систем під впливом випадкових факторів. Першим етапом дослідження стало опрацювання різних видів економетричних моделей, таких як регресійні, часові ряди та аналіз випадкових процесів. Важливим аспектом цього етапу є аналіз однієї із найпопулярніших моделей часових рядів – моделі авторегресійної інтегрованої ковзної середньої, ARIMA. Теоретичний аналіз також охопив вивчення наукових робіт вітчизняних дослідників з питань вивчення економетричних методів та моделей. Увага була приділена економетричним методам та моделям, які дозволяють проаналізувати економічні явища, оцінити вплив різних факторів на економічні показники та прогнозувати показники залежно від різних подій. Для прогнозу змін на фондовому ринку було доведено, що доцільно використовувати стохастичні диференціальні рівняння. Було визначено, що економетричні методи та моделі є важливим інструментом в економічних дослідженнях для аналізу та прогнозування економічних процесів, які дозволять кількісно оцінити взаємозв'язки між різними економічними змінними та використовувати ці оцінки для прийняття обґрунтованих управлінських рішень. Економетричні методи та моделі є динамічною галуззю, що постійно розвивається, адаптуючись до нових викликів, можливостей, а також до зростаючої складності економічних систем. Серед перспектив використання економетричних методів та моделей в економічних дослідженнях слід виділити: інтеграцію з машинним навчанням та штучним інтелектом; просторову економетрику та мережевий аналіз; динамічні стохастичні загальнорівноважні моделі та їх інтеграцію; доступність та інтерпретованість моделей. Перспективи економетричних методів та моделей в економічних дослідженнях пов'язані з їхньою здатністю адаптуватися до нових джерел даних, інтегрувати передові обчислювальні технології та постійно вдосконалювати інструменти для кількісного аналізу.

Ключові слова: економетричні методи та моделі, економічні дослідження, моделювання, стохастичні диференціальні рівняння.

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