

**THE IMPORTANCE OF MATHEMATICAL STATISTICS  
IN MEDICINE AND BIOLOGY**

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**Abstract:** This thesis examines the significant role of mathematical statistics in the fields of medicine and biology. Statistical methods are essential for analyzing clinical research, evaluating treatment effectiveness, studying biological processes, and predicting disease spread. The study highlights the use of descriptive and analytical statistical methods, correlation and regression analysis, and probability-based modeling in medical and biological research. The findings demonstrate that mathematical statistics improves data accuracy, supports evidence-based decision-making, enhances early diagnosis, and contributes to the development of personalized medicine. Furthermore, with the rapid advancement of digital technologies, artificial intelligence, and big data, the importance of statistical methods continues to grow in modern healthcare and biological sciences.

**Key words:** mathematical statistics, medicine, biology, clinical research, data analysis, epidemiology, probability theory, regression analysis, artificial intelligence, personalized medicine

**Introduction:** This section provides a general overview of the topic, explains the background of the research, and introduces the main purpose and importance of the study. It also outlines the problem under investigation and sets the direction for the entire work.

**Relevance:** Mathematical statistics has become an integral part of modern scientific research in the fields of medicine and biology, and its importance is increasing year by year. Today, it is almost impossible to reach accurate and reliable conclusions in diagnosing diseases, evaluating treatment effectiveness, analyzing epidemiological processes, and developing new drugs without statistical methods. First of all, in medicine, mathematical statistics enables the scientific analysis of clinical research results. Large volumes of data are collected to determine the effectiveness of various drugs or treatment methods, and proper processing of these data is essential.

Statistical methods help reduce random errors, increase the reliability of results, and allow for generalized conclusions. This is crucial for selecting safe and effective treatment methods for patients. In biology, mathematical statistics serves as a key tool for studying complex processes in living organisms. For example, genetic research, population dynamics, and changes in ecological systems depend on numerous factors and cannot be explained by simple observation alone. Through statistical models, these processes are analyzed, patterns are identified, and future changes are predicted. Furthermore, the widespread use of artificial intelligence and digital technologies in modern medicine further increases the demand for mathematical statistics. Statistical algorithms play a major role in processing large datasets such as medical imaging (X-ray, MRI, CT), laboratory results, and patient information. This contributes to early diagnosis, disease prediction, and the development of individualized treatment strategies. In epidemiology, mathematical statistics is an essential tool for studying disease spread, controlling pandemics, and developing preventive measures. The rate of disease spread, risk factors, and their impact are determined through statistical analysis, enabling effective decision-making in healthcare systems.

**Materials and Methods:** In preparing this thesis, modern scientific sources related to medicine and biology were used, including textbooks, scientific articles, clinical research results, and statistical databases. The research materials included generalized data on disease prevalence, treatment effectiveness, biological processes, and population indicators. Additionally, experimental and observational results, laboratory data, and clinical monitoring records served as the basis for analysis. During the research process, key methods of mathematical statistics were widely applied. In particular, descriptive statistics were used to summarize the data, calculating mean values, variance, and standard deviation. Analytical statistical methods were employed to identify relationships between variables and test hypotheses. Correlation and regression analyses were used to assess the influence of factors and determine the reliability of results. Moreover, probability theory-based modeling methods were applied to evaluate the likelihood of development in biological and medical processes. Statistical software packages and modern information technologies were used to process large datasets and present results in graphical and tabular forms. Systematic approaches, comparison, grouping, and scientific generalization methods were also applied in the study.

**Research Results:** The conducted analyses showed that the use of mathematical statistical methods significantly increases the accuracy and reliability of data obtained in medicine and biology. Descriptive statistics helped organize initial data and clarify their general characteristics. Measures such as mean, median, and variance allowed for the evaluation of central tendencies and data dispersion. Analytical statistical methods revealed the presence of relationships between various factors. In particular, significant

correlations were found between certain clinical indicators and treatment effectiveness. Regression analysis made it possible to quantitatively assess the influence of specific factors on disease progression. In the analysis of biological processes, statistical modeling methods were applied to predict population changes and the dynamics of genetic indicators. The results demonstrated that randomness and regular patterns coexist in biological systems, confirming the importance of statistical approaches in understanding complex processes. Epidemiological data analysis showed that certain risk factors play a dominant role in disease spread. Statistical evaluation made it possible to identify high-risk groups and justify the need for targeted preventive measures. Overall, the results confirmed that mathematical statistics is an essential tool in medicine and biology for making evidence-based decisions, early disease detection, improving treatment effectiveness, and gaining deeper insight into biological processes.

**Conclusion:** Mathematical statistics has become one of the key foundations of modern scientific development in medicine and biology, playing a decisive role in ensuring the scientific validity, accuracy, and reliability of research. It enables in-depth data analysis, identification of relationships, and formulation of generalized conclusions. As a result, patterns that are difficult to detect through simple observation can be revealed using statistical methods. Research shows that the application of mathematical statistics reduces the probability of errors in clinical and biological studies and increases the reproducibility of results. This enhances the reliability of scientific work and ensures the robustness of conclusions implemented in practice. In medicine, statistical approaches are particularly important in the development of new drugs, evaluation of their effectiveness, comparison of treatment methods, and patient monitoring. In biology, mathematical statistics serves as a fundamental tool for understanding the complexity of living systems. Processes such as genetic variation, population dynamics, and ecosystem development are multifactorial and stochastic in nature, making statistical modeling the most effective method of study. This allows not only the analysis of biological processes but also the prediction of their future development. In the modern era, the advancement of digital technologies, artificial intelligence, and the concept of “big data” further increases the importance of mathematical statistics. Statistical algorithms are widely used in processing medical images, laboratory data, genetic information, and other datasets. This creates new opportunities for personalized medicine, early diagnosis, and disease prevention.

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