

Value and application exploration of applied mathematics from the perspective of modern economic management

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ABSTRACT

Applied mathematics, as a powerful tool, has gradually shown its unique value in the field of economic management. This paper discusses the important application and value of applied mathematics in modern economic management. As a bridge connecting abstract thinking and concrete practice, applied mathematics provides accurate quantitative relations description and scientific analysis means for economic activities through the construction of mathematical models and numerical analysis methods. In risk analysis and control, quality management, marketing management and other aspects, the application of mathematics to help enterprises to identify and evaluate risks, improve product quality, optimize marketing strategies, so as to enhance market competitiveness. In addition, applied mathematics also promotes the economic subject to further deepen the reform, optimize the economic structure and industrial layout, and achieve sustainable development. Through example analysis, the paper shows the practical application effect of applied mathematics in economic management, and emphasizes its indispensability in modern economic management.

KEYWORDS

modern economic management; applied mathematics; value; application

In today's society, with the rapid development of economy and the increasingly fierce market competition, economic management is facing unprecedented challenges. As a bridge connecting theory and practice, applied mathematics is becoming more and more important in modern economic management. Scholars at home and abroad have widely applied mathematical methods in various fields of economic management, and have achieved remarkable results. Foreign research started earlier, especially in risk assessment, market prediction and quality control, and has formed a relatively complete theoretical system and practical experience (Zheng Yiren, 2024) ^[1]. Although domestic research started late, it has developed rapidly in recent years, especially in financial market analysis, enterprise strategy formulation and resource allocation optimization, and achieved fruitful results.

However, in the face of the increasingly complex and changeable market environment, how to further tap the potential of applied mathematics and guide the practice of economic management with more scientific and accurate methods is still an urgent problem to be solved. The purpose of this study is to explore the application value of applied mathematics in modern economic management, provide accurate characterization of the quantitative relationship in economic activities by the construction of fine mathematical model and efficient numerical analysis method, and reveal the essential law and quantitative relationship of economic phenomena. This will not only help enterprises to make more scientific and reasonable economic decisions and enhance

market competitiveness, but also provide strong support for the government's macroeconomic control, promote economic entities to further deepen reform and achieve sustainable development.

The significance of this study is that, on the one hand, it can enrich the theoretical system of applied mathematics and expand its application scope in the field of economic management; on the other hand, it can verify the effectiveness and practicability of the mathematical model through empirical research, and provide operational tools and methods for economic management practice. At the same time, this study also helps to improve the mathematical literacy and decision-making ability of economic managers, cultivate inter-disciplinary talents with interdisciplinary knowledge background, and inject new vitality into the innovative development of modern economic management.

1 Overview of the foundations of applied mathematics

1.1 Definition and characteristics of applied mathematics

As a core branch of mathematics discipline, the core essence of applied mathematics is to effectively apply complex mathematical theories and methods to the solving process of practical problems. Compared with pure mathematics's focus on theoretical system construction and logical derivation, applied mathematics focuses more on exploring how to transform mathematical principles into operational technical means to deal with diverse and complex problems in the real world (Yu Li, Zheng Jinshan, Liu Hui, 2023) ^[2]. The close combination of theory and practice makes applied mathematics play the role of a bridge between abstract mathematical thinking and concrete practical operation, which not only deepens the connotation of mathematical science, but also provides strong theoretical support and methodological guidance for the development of many disciplines. Through the application of applied mathematics, people can transform the original abstract and difficult to reach mathematical concepts into operational practical solutions, and then drive the innovation of science and technology and social progress.

1.2 Main areas of applied mathematics

Applied mathematics plays a vital role in many fields such as natural science and social science. Its core curriculum, including probability theory, mathematical statistics and mathematical models, provides key mathematical tools and methods for a wide range of fields. In the field of economic management, probability theory and mathematical statistics provide a solid theoretical basis for risk assessment, market prediction and quality control, while mathematical models help managers to build and analyze complex economic systems to make scientific and reasonable decision-making. In addition, differential equation can accurately describe the dynamic changes of economic system, provide strong support for economic forecasting and macro-control; fuzzy mathematics improves the flexibility and accuracy of decisions, helping managers to respond to and grasp business opportunities in complex markets. These mathematical tools and methods together constitute an indispensable part of modern economic management.

2 The application value of applied Mathematics in modern economic management

2.1 Adjust and control the quantity relationship of economic activities

In the field of modern economic management, the complexity and dynamics of the quantitative relationship are becoming more and more significant. With its unique advantages, applied

mathematics provides an accurate characterization of the quantitative relations in economic activities by constructing fine mathematical models and efficient numerical analysis methods. This method not only involves the traditional supply and demand relationship, cost-benefit analysis, but also extends to market equilibrium, risk assessment and other levels (Chen Yong, 2022)^[3]. Using mathematical tools such as calculus and linear algebra, economists and managers can deeply explore the driving force of economic growth, the sensitivity of market changes and the specific impact of policy adjustments on economic activities, so as to make more scientific and reasonable economic decisions. At the same time, facing the increasingly complex market environment, enterprises need to rely on accurate data and models to analyze and predict the market trends. The probability theory, mathematical statistics and other methods in mathematics are applied to help enterprises establish mathematical models, and implement quantitative analysis of market demand, production cost, sales income and other key factors, so as to provide reliable scientific basis for enterprises to make decisions. In addition, the application of the mathematical model also optimizes the allocation of resources in the production and logistics of modern enterprises. Through mathematical means such as linear planning and network optimization, the reasonable arrangement of production planning, the optimization of transportation route and the reduction of production cost are realized, and the resource utilization efficiency is significantly improved.

2.2 Analyze and clarify the quantitative relationship

Applied mathematics provides a powerful means of scientific analysis in the field of economic management by constructing a precise mathematical model. These models can deeply analyze economic phenomena, reveal their essential laws and quantitative relations, so as to provide a solid foundation for enterprise decision-making. In the marketing practice, enterprises can use mathematical models to accurately predict the market demand, and flexibly adjust the product strategies and pricing strategies accordingly, so as to effectively deal with the market fluctuations, and further expand the market share (Liu Xiaoli, 2021)^[4]. At the level of financial management, the mathematical model assists enterprises to formulate scientific fund operation plans, to ensure that the funds are both safe and liquid, and to provide a solid guarantee for the sustainable and stable development of enterprises.

Moreover, the optimization techniques in applied mathematics have had a profound impact on economic management. Under the premise of limited resources, enterprises must find the best resource allocation strategy among various constraints. Optimization technology is the key to solve this problem. Whether it is the linear planning application in production planning or the path optimization problem in logistics management, applied mathematics can help enterprises find the best solution, and significantly improve production efficiency and economic benefits. For example, in financial market analysis, financial institutions can use time-series models to predict stock prices, so as to develop appropriate investment strategies and risk management measures. By analyzing historical data, financial institutions can identify the trends and cyclical fluctuations of stock prices, and then buy and sell at the right time to obtain investment returns.

2.3 Promoting economic entities to further deepen reform

Applied mathematics provides quantitative analysis tools to make economic decisions develop in a more scientific and precise direction. In macroeconomic control, market prediction and risk assessment, the application of mathematical methods has significantly enhanced the efficiency of economic management. It plays an important driving force in deepening the reform of economic subjects. With the help of mathematical modeling and simulation analysis technology, economic

subjects can estimate the effectiveness of reform measures, judge potential risks, and then plan a more reasonable and efficient reform path (Song Jingbo, 2019) ^[5]. In addition, applied mathematics also promotes the optimization of economic structure and industrial layout, which reveals the profound correlation and interaction between different industries, provides a scientific optimization benchmark for economic subjects, and helps the rational allocation and efficient use of resources, so as to promote the realization of sustainable development. Taking the mixed ownership reform as an example, the government and enterprises can use the game theory model to analyze the strategic interaction between the interested parties, so as to determine the most ideal equity structure and governance system. For example, in the mixed ownership reform, the government and enterprises can use the game theory model to analyze the game relationship between different stakeholders, and determine the optimal ownership structure and governance mechanism.

3 The practical application of applied mathematics in the modern economic management

3.1 Risk analysis and control

In today's rapidly changing and highly uncertain market context, companies are facing increasingly complex and unpredictable risks and challenges. In order to effectively avoid financial losses and ensure economic security, it is particularly important to build a systematic and scientific risk assessment system. As the pillar of this system, mathematical statistical method has inestimable value for accurately measuring risk and guiding rational investment.

Take an enterprise that implements a diversified project investment strategy as an example, which has set a budget of 5 million yuan for each project. However, the expected return rate for the initial project is only 8%, which is relatively low. In order to optimize the overall investment effect, the enterprise adopts the portfolio investment strategy to diversify the risks and improve the return potential through the diversified allocation of funds. In this process, the application of mathematical statistical methods plays a key role.

Enterprises use standard deviation analysis to accurately assess the risks of each project, and deeply analyze the overall expected return of the portfolio, so as to realize a comprehensive and scientific assessment of investment risks. At the same time, with the help of advanced statistical technology, enterprises can accurately calculate the risk value of a single project, providing strong data support for the decision-makers. In the single asset investment decision, the enterprise accurately calculates the separation rate and strictly compares it with the preset risk threshold to ensure that the investment plan is stable and fully considers the risk management. These measures have significantly improved the scientific nature and rigor of investment decisions, laid a solid foundation for the long-term development of enterprises, and further highlighted the core role and great value of mathematical statistical methods in modern enterprise risk management.

3.2 Quality management

Mathematical statistics, as a subject based on the in-depth analysis of a wide range of real data, plays a pivotal role in mining the deep laws behind the data and providing scientific basis for enterprise decision-making. Especially in the field of economic management, mathematical statistics has become a key means for enterprises to monitor the quality of products and services, and to find and solve potential quality problems in time. For example, the summation symbol $\sum$ in mathematical statistics, with its simple and efficient calculation method, such as $\sum_{i=1}^{100} i$, can quickly get the sum of all 1 to 100 integers, fully demonstrates the excellent ability of mathematical statistics in

simplifying complex calculation.

In the practice of quality management, the application of mathematical statistical method is particularly prominent and has achieved remarkable results. By accurately calculating the number of defects per million quality tests (DPMO), the enterprise can clearly understand the actual situation of the product quality. The decrease of DPMO value means the continuous improvement of product quality, and the need to strengthen quality control and take more effective management measures. The integration of mathematical statistics not only greatly improves the precision and accuracy of enterprise quality management, but also significantly improves the management efficiency and standardization level. More importantly, mathematical statistics encourages enterprises to make decisions according to objective and detailed data in the process of quality management, so as to effectively promote the improvement of product quality and enhance the comprehensive competitiveness and market share of enterprises in the fierce market competition. This change not only highlights the profound influence of mathematical statistics in the field of quality management, but also reflects its core value and significance in promoting the sustainable development of enterprises.

3.3 Marketing management

As a powerful tool of marketing management, mathematics has a profound impact on the realization of enterprise market goals and the promotion of competitiveness. Its applications in market forecasting, consumer insight, product positioning and pricing, as well as marketing resource optimization have brought unprecedented decision support to enterprises.

In the field of market prediction, mathematical models such as time series analysis and regression analysis have become a powerful tool for enterprises to gain insight into the future market trends. Through the time series analysis, the historical sales data reveals the changing trend of market demand, while the regression analysis explores the internal connection between market demand and the key factors such as price and promotion, and provides scientific basis for enterprises to predict the market response under different marketing strategies. In terms of consumer behavior analysis, mathematical algorithms such as cluster analysis and decision tree help enterprises accurately depict consumer portraits. Through the data of consumers' purchase records and browsing behavior, cluster analysis divides consumers into groups with similar characteristics, so that enterprises can design products and services to meet diversified consumer needs. The decision tree further guides enterprises to identify the key nodes of consumer decision-making and optimize their marketing strategies. In terms of product positioning and pricing strategy, multi-dimensional scale analysis and joint analysis provide scientific decision-making basis for enterprises. Multi-dimensional scale analysis reveals the competitive position of the product in the market, and the joint analysis deeply analyzes the consumer preference and its influence on the purchasing decision, providing precise guidance for the formulation of pricing strategy. Finally, in terms of marketing resource optimization, mathematical tools such as linear planning, optimization algorithm and dynamic planning can help enterprises realize the maximum utilization of marketing resources. Whether it is the proportional allocation of advertising, or the formulation of long-term marketing plans, these mathematical methods ensure that enterprises can optimize the market goals with limited resources.

4 Conclusion

The application value of applied mathematics in modern economic management cannot be underestimated. It not only provides accurate quantitative analysis and control means for economic

management, so that the complex relations in economic activities can be clarified and optimized, but also promotes the process of further deepening the reform of economic subjects. Through the practical application of risk analysis and control, quality management and marketing management and other aspects, the application of mathematics helps enterprises and government agencies in the efficient and more scientific decision-making process. In terms of risk analysis, mathematical statistical methods enable enterprises to effectively identify and evaluate risks and formulate strategies; in quality management, mathematical statistics help enterprises to improve product quality and market competitiveness; in marketing management, mathematical models and algorithms provide decision support in market prediction, consumer behavior analysis, product positioning and pricing strategy. Therefore, applied mathematics is not only a bridge connecting abstract thinking and concrete practice, but also an important force to promote the continuous progress and development of modern economic management. In the future, with the continuous improvement of mathematical theory and the rapid development of computer technology, the application prospect of applied mathematics in economic management will be broader, and new vitality will be injected into the sustainable development of economy and society.

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