

MODELING ECONOMIC PROCESSES USING INTEGRALS

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Abstract. *Linking mathematics education with real-life processes is one of the priority directions of modern pedagogy, and particularly in the context of academic lyceums it is essential to develop students' awareness of the practical significance of mathematical knowledge as well as their ability to apply it in future professional activities. This article provides an in-depth scientific and methodological analysis of the economic meaning of the integral concept and substantiates the role of integrals in modeling continuous economic processes, including total cost, total revenue, production dynamics over time, savings, and consumption processes. It is demonstrated that modeling economic processes through integrals enables students to connect the theoretical foundations of mathematical analysis with real economic situations, thereby fostering analytical thinking and functional literacy on the basis of sound scientific arguments [1], [5].*

Keywords: *integral, mathematical modeling, economic processes, total cost, total revenue, accumulation, continuous models, academic lyceum, functional literacy.*

Introduction.

In the context of globalization and the rapid intensification of economic relations, the practical importance of mathematical knowledge has been steadily increasing, since economic decision-making, production planning, and efficient resource management are often based on mathematical models. Therefore, within the mathematics curriculum of academic lyceums, directing the teaching of mathematical analysis—particularly the topic of integrals—toward modeling real economic processes has become a pressing pedagogical task. The concept of the integral, which allows for the determination of the accumulated effect of continuously changing quantities, serves as a convenient and powerful mathematical tool for revealing the essence of economic processes, as most economic indicators vary continuously with respect to time, production volume, or consumption levels [2]. When students in academic lyceums learn to model such processes using integrals, they gradually come to understand mathematics not as an abstract discipline but as a universal language for interpreting real economic phenomena [6].

Main Part

Theoretical Essence of Integrals in Representing Economic Processes.

From a mathematical perspective, the integral represents the continuous summation of function values, while in economics its meaning is most commonly associated with accumulation and aggregation processes. Economic indicators such as total cost, total revenue, capital accumulation, or the total volume of produced goods are often regarded as the sum of infinitesimal changes occurring over a given interval, and the integral provides an exact and consistent mathematical description of this phenomenon [7]. This interpretation also highlights the logical connection between derivatives and integrals, since marginal quantities serve as the basis for determining aggregate results, making integration one of the fundamental mathematical operations in economic analysis.

Modeling Total Cost and Production Processes Using Integrals.

At the academic lyceum level, one of the most accessible and illustrative applications of integrals in economic modeling is related to determining total cost through marginal cost functions. If the marginal cost is expressed as a function of production volume, then integrating this function over a specified interval yields the total cost, allowing students to analyze how costs evolve as production increases [9]. Such models help students understand the importance of mathematical analysis in economic decision-making and encourage them to evaluate real-life economic situations using mathematical tools rather than intuitive reasoning alone.

Modeling Total Revenue and Profit Through Integration.

The concept of the integral also plays a crucial role in determining total revenue, as integrating the marginal revenue function over a given interval makes it possible to calculate the total revenue obtained during a specific period or production volume. This approach enables students to grasp the continuous nature of economic processes and to comprehend the mathematical foundations of profit analysis. Modeling profit using integrals fosters students' ability to identify cause-and-effect relationships within economic systems, optimize resource allocation, and develop informed strategies for decision-making based on quantitative analysis [11].

Didactic and Methodological Significance of Integral-Based Economic Modeling

Employing integrals to model economic processes significantly contributes to the development of students' functional literacy in academic lyceum mathematics education, as this approach requires learners not only to perform calculations but also to interpret mathematical results within an economic context. Integrating modeling elements into classroom instruction enhances students' logical reasoning, analytical skills, and ability to draw independent conclusions, while simultaneously increasing their motivation and interest in mathematics as an applied discipline [15]. Furthermore, the use of integrals in economic modeling strengthens interdisciplinary integration by clearly demonstrating the close relationship between mathematics and economics.

Conclusion.

The extended analysis presented in this study indicates that teaching the topic of integrals in academic lyceum mathematics through the modeling of economic processes helps students develop a deep understanding of the practical significance of mathematical knowledge, enhances their ability to analyze real economic situations, and enables them to draw well-founded conclusions based on mathematical models. Instructional activities centered on determining total cost, total revenue, and profit through integration improve students' functional literacy and reveal the applied value of mathematical analysis. Consequently, the systematic incorporation of economic modeling tasks based on integrals represents an important direction for further improving the quality and relevance of mathematics education in academic lyceums [4], [15].

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