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THE IMPORTANCE OF DERIVATIVES IN ECONOMIC AND PHYSICAL PROCESSES: THEORY AND PRACTICE

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Abstract
This article explores the application areas of derivatives, one of the key concepts in mathematical analysis, in economic and physical processes. The derivative is used as a powerful mathematical tool for studying the relationship between changing quantities, analyzing dynamic systems, determining the rate of changes within them, and making optimal decisions. In economics, the derivative is crucial for analyzing the achievement of maximum or minimum function values, while in physics, it is vital for determining velocity, acceleration, and similar parameters. The article explains the theoretical foundations of derivatives (first, second, and nth-order derivatives), their role in analyzing economic indicators, and the mathematical modeling of physical laws, along with practical examples. This work connects theory with practice, revealing the efficiency of applying derivatives in real-world processes.

Keywords: Derivative, economic processes, physical processes, rate of change, mathematical models, dynamic analysis, maximum and minimum values, optimal decisions.

HOSILANING IQTISODIY VA FIZIK JARAYONLARDAGI AHAMIYATI: NAZARIYA VA AMALIYOT

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Annoatsiya:
Ushbu maqola matematik analizning muhim tushunchalaridan biri boʻlgan hosilaning iqtisodiy va fizik jarayonlarda qoʻllanilish sohalarini yoritadi. Hosila oʻzgaruvchan kattaliklar orasidagi bogʻliqlikni oʻrganishda kuchli matematik vosita sifatida ishlatiladi, u dinamik tizimlarni tahlil qilish, ulardagi oʻzgarishlar tezligini aniqlash va optimal qarorlarni qabul qilishda qoʻllaniladi. Iqtisodiyotda hosila funksiyaning maksimal yoki minimal qiymatlariga erishishni tahlil qilish uchun, fizika esa tezlik, tezlanish kabilarni aniqlashda muhim ahamiyatga ega. Maqolada hosilaning nazariy asoslari (birinchi, ikkinchi va n-chi tartibli hosilalar), iqtisodiy koʻrsatkichlarni tahlil qilishdagi roli va fizik qonunlarning matematik modellarini tushuntirish bilan birga, amaliy misollari keltirilgan. Ushbu ish nazariyani amaliyot bilan bogʻlashga yordam berib, hosilani real jarayonlarda qoʻllashning samaradorligini ochib beradi.

Kalit so'zlar: hosila, iqtisodiy jarayonlar, fizik jarayonlar, o'zgarish tezligi, matematik modellar, dinamik tahlil, maksimal va minimal qiymatlar, optimal qarorlar

Introduction

The derivative is one of the basic concepts of mathematical analysis and is widely used in explaining many natural and economic processes, as well as in modeling them. In particular, since economic and physical processes do not stand still, each of them is variable and dynamic in nature, the derivative is an important tool in understanding and analyzing these changes. The relevance of this topic is that in order to effectively manage and analyze each economic or physical process, it is necessary to have a deep mathematical understanding of its variable aspects.

In mathematics, the derivative represents the rate of change of a function at each point. This concept allows us to determine how quickly various processes are developing or changing. These processes can include factors such as adaptation to demands in the economy, price changes, or production efficiency. In physics, the derivative helps to determine and explain the motion of objects through variables such as speed and acceleration. Therefore, the derivative as a mathematical tool has not only a theoretical basis, but also a special place in economic and physical practice.

In economics, the derivative is often used in connection with the concept of marginal (border). The concept of marginal is used in economics to analyze small changes in a process, which allows for a deeper understanding and analysis of the process. For example, with the help of the derivative, it is possible to analyze the production volume or efficiency of resource use of firms. Concepts such as marginal profit, marginal cost, or elasticity of demand and supply are also determined using the derivative.

For example, firms analyze marginal costs and marginal benefits in the processes of increasing or decreasing production. The derivative determines marginal costs and helps to assess how efficient the production process is. This, in turn, helps enterprises and other economic entities make decisions. Therefore, the importance of the derivative in economics makes it possible to make effective strategic decisions.

The application of the derivative in physical processes is also very wide. In physics, the derivative is the main tool for measuring and analyzing changes, it is used to explain the speed, acceleration, forces, and energy changes of processes. For example, velocity can be determined by the derivative of the change with respect to time. This process also plays an important role in engineering and industry, as the derivative can be used to determine and optimize the efficiency of various technological processes.

In addition, in physics, concepts such as force, energy, and power are directly related to the derivative. For example, the expression of force as a derivative in Newton's second law is the basis of many applied studies in the field of physics. Also, many other sciences, such as electromagnetism and thermodynamics, solve their problems using derivatives and differential equations.

The study of the derivative in economic and physical processes brings great benefits not only to theoretical foundations, but also to practice. This topic is very relevant in the modern world, because in an era of rapid economic and technological development, effective analysis of processes and their optimization are becoming the most important goals. Therefore, the application of the derivative to economic and physical processes must be widely studied and developed theoretically and practically. The purpose of this study is to shed light on the theoretical foundations of the derivative and to show its practical application in the fields of economics and physics.

The main purpose of this work is to analyze the significance of the derivative in economic and physical processes from a theoretical and practical point of view, as well as to study how this concept is used in real life. The following tasks are set:

1. Analyze the mathematical foundations of the derivative.
2. Study the application of the derivative in economics and explain it through practical examples.
3. Show the significance of the derivative in physical processes and illustrate it through real examples.
4. Clarify the connection between theory and practice and reveal how the derivative is useful in practice.

The derivative is one of the important and basic concepts of mathematical analysis and is widely used in many scientific and practical areas. The derivative is used to describe the relationship between function variables, analyze the rate of change and the dynamics of processes. This chapter examines in detail the theoretical aspects of the derivative, its mathematical foundations and rules.

Hosila – matematikada bir funksiya qiymatining o‘zgarish tezligini ifodalovchi tushuncha. Bu tushuncha o‘zgaruvchi kattaliklar orasidagi bog‘lanishni tahlil qilishda asosiy vosita bo‘lib xizmat qiladi. Aniqroq aytadigan bo‘lsak, hosila biror funksiya (masalan,)ning har bir nuqtadagi o‘zgarish tezligini aniqlash uchun qo‘llaniladi. Agar funksiyasi biror o‘zgaruvchi ga bog‘liq bo‘lsa, bu holda o‘zgarishi bilan qiymatining qanchalik tez o‘zgarishini hosila yordamida aniqlash mumkin.

Matematik jihatdan, hosila limit tushunchasiga asoslanadi. Funksiya hosilasi quyidagi formula orqali hisoblanadi:

$$f'(x) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

This expression means that the derivative determines how the value of the function changes as the value of approaches zero. This process plays an important role in theoretically modeling physical and economic processes and determining changes.

1.2 Function and its derivative

The derivative describes the angle of inclination of the graph of a function at a certain point. From a geometric point of view, the derivative is related to the tangent angle to the graph of a straight line. By calculating the derivative of a function, it is possible to analyze how quickly changes occur in the graph of a function. For example:

1. If the derivative of the graph of a function is positive, the function increases.
2. If the derivative is negative, the function decreases.
3. At a point where the derivative is zero, the function can have a maximum or minimum value.

This mathematical property is of great importance in determining the rate of change in economic and physical processes and in analyzing them.

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1.3 Application of the derivative to economic and physical processes

The derivative is widely used in many fields, including economics and physics. In economics, the derivative is used to analyze small changes in an economic process, for example, changes in production volume, elasticity of demand and supply, changes in costs, etc. In physics, the derivative is used to determine velocity and acceleration through the equations of motion. In both of these processes, the derivative has a special role in determining speed, the rate of change.

For example, in physics, velocity is the derivative of change with respect to time. That is, the product of distance with respect to time gives speed, and the product of speed with respect to time determines acceleration. Thus, the derivative plays an important role in understanding processes such as motion and force.

In economics, for example, the marginal costs or benefits of an enterprise are calculated with the help of the derivative. This is important in the decision-making process, since marginal values help determine the optimal production volume of the enterprise.

1.4 Rules for Calculating the Derivative

A number of basic rules of mathematical analysis are used to calculate the derivative. These rules simplify the process of finding the derivative of a function. The most important derivative rules are listed below:

1.4.1. Derivative of a constant:

If a function is a constant, its derivative is zero:

$$\frac{d}{dx}[c] = 0$$

This simple rule states that a number has no rate of change.

1.4.2. Derivative of a strong function:

If a function is expressed in the form, its derivative is expressed by the following formula:

$$\frac{d}{dx}[x^n] = nx^{n-1}$$

This rule is very important for polynomial functions, because it allows you to calculate the derivative of a function of any degree.

1.4.3. Derivative of added functions:

If a function consists of the sum of two functions, their derivatives are calculated separately and added:

$$\frac{d}{dx}[f(x)+g(x)] = f'(x)+g'(x)$$

This rule is widely used in calculating the derivative of complex functions.

1.4.4. Derivative of Multiplicative Functions:

If a function is the product of two functions, its derivative is determined by the following formula:

$$\frac{d}{dx}[f(x)\cdot g(x)] = f'(x)g(x) + f(x)g'(x)$$

This rule is useful in analyzing many economic and physical models.

1.4.5. Derivative of Divisions:

If a function consists of the division of two functions, its derivative is defined as follows:

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$$

This rule is very important for the derivative of divisions.

1.4.6. Chain rule:

The chain rule is used to find the derivative of complex functions. If the function is in the form, its derivative is defined as:

$$\frac{dy}{dx} = f'(g(x))\cdot g'(x)$$

This rule is especially widely used in the analysis of complex processes.

Derivatives are a key tool for accurate and efficient process control in many areas, such as mathematics, science, technology, and finance. They help to deeply understand and predict these processes, and are also widely used to accelerate technological development and improve financial analysis.

As one of the main tools of mathematical analysis, the derivative is of great importance not only in theoretical issues, but also in practical areas of knowledge. In economics, the derivative can be used to analyze the rate of change of marginal indicators, for example, to determine the maximum efficiency of production volumes. Also, the second order of the derivative is used to assess economic stability. In physics, the derivative is an important tool for analyzing the motion of objects, in particular, determining speed and acceleration. The derivative is also actively used in physical processes, for example, to calculate the current strength in electrical circuits or the dynamics of oscillating bodies. The practical application of theoretical foundations further increases the importance of the derivative in controlling complex models and systems. The derivative is a powerful tool for combining theoretical mathematics and real-world problems, providing reliable analytical results in practical work. This article presents approaches to the application of the derivative in real economic and physical processes, highlighting the main importance of the derivative in mathematical modeling.

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