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CONCEPT OF DERIVATIVE AND ITS APPLICATION

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The Concept of Derivative and Its Applications

Abstract: This article briefly explains the concept of the derivative, its definition, main properties, and its mathematical and practical applications.

Keywords: Derivative, limit, function, mathematical analysis, differentiation, rate of change, extremum, application.

INTRODUCTION. One of the important branches of higher mathematics is mathematical analysis, one of its central concepts is the derivative. The concept of derivative represents the rate of change of a function and it is of great importance not only theoretically, but also practically. This article discusses the concept of derivative, its mathematical definition and areas of application.

DISCUSSION. The derivative is a quantity that shows how fast the value of the function changes with respect to the change of the argument. Mathematically, the derivative is defined by the following limit:

$$\lim_{x \to x_0} \frac{f(x)-f(x_0)}{x-x_0} = f'(x_0)$$

This expression allows you to find the derivative of a function at a given point. If this limit exists, the function is said to be differentiable at this point.

The geometric meaning of the product is that it is equal to the tangent of the tangent angle of the test at a given point on the graph of the function. In the physical sense, the derivative represents quantities such as speed and acceleration. For example, the time derivative of the path function gives the velocity.

The properties of the function can be studied in depth with the help of derivatives. Including:

- The intervals of increase and decrease of the function are determined;
- Extremum points (maximum and minimum) are found;
- Convexity and concavity of the curve are checked;
- Graphing becomes much easier.

There are also derivation rules: separate formulas have been developed for addition, multiplication, division and complex functions. These rules simplify the calculation process.

In order to simplify and speed up the derivation process, a table of derivatives of elementary functions in mathematical analysis is compiled. With the help of this table, the basic formulas can

be used in the differentiation of complex functions. The derivative table is important for solving practical problems, as well as for strengthening theoretical knowledge.

Below are the derivatives of the most common elementary functions:

Derivatives of basic functions:

- $C = \text{const} \rightarrow C' = 0$
- $x^n \rightarrow (x^n)' = n \cdot x^{n-1}$
- $\sqrt{x} \rightarrow (\sqrt{x})' = 1 / (2\sqrt{x})$
- $1/x \rightarrow (1/x)' = -1/x^2$

Exponential and logarithmic functions:

- $e^x \rightarrow (e^x)' = e^x$
- $a^x \rightarrow (a^x)' = a^x \ln a$
- $\ln x \rightarrow (\ln x)' = 1/x$
- $\log_a x \rightarrow (\log_a x)' = 1 / (x \ln a)$

Trigonometric functions:

- $\sin x \rightarrow (\sin x)' = \cos x$
- $\cos x \rightarrow (\cos x)' = -\sin x$
- $\tan x \rightarrow (\tan x)' = 1 / \cos^2 x$
- $\cot x \rightarrow (\cot x)' = -1 / \sin^2 x$

Derivation rules. In addition to the derivative table, differentiation rules are also important:

- $(f + g)' = f' + g'$
- $(f \cdot g)' = f'g + fg'$
- $(f / g)' = (f'g - fg') / g^2$
- $(f(g(x)))' = f'(g(x)) \cdot g'(x)$

RESULTS

The concept of derivative is widely used in various fields of science and is an important tool in the analysis of many processes in real life.

In physics, motion processes are studied using derivatives. For example, if the law of motion of a body $s(t) = t^2 + 3t$ given in form, its speed $v(t) = s'(t) = 2t + 3$ determined by $t = 2$ speed at time 7 m/s will be equal to Acceleration is the product of velocity, $a(t) = 2$ is equal to This shows that the body is accelerating uniformly. In economics, profit and cost functions are analyzed using the derivative. For example, the profit function $P(x) = -x^2 + 6x$ if there is, its maximum value is found through the derivative.$P'(x) = -2x + 6 = 0$ from Eq $x = 3$ is determined. Therefore, the greatest profit is obtained at this point.

In mathematical analysis, the derivative is used to determine the intervals of increase and decrease of the function. For example, $f(x) = x^3 - 3x^2$ the derivative of a function $f'(x) = 3x(x - 2)$ will be. This allows you to determine where the function increases or decreases.

In geometry, the derivative is used to find the equation of effort. For example, $f(x) = x^2$ of the function $x = 1$ point attempt $y = 2x - 1$ is expressed by the equation. This will help determine the direction of the graph at that point.

In technology and engineering, the derivative is used in modeling various processes, determining speed and changes. Indicators such as changes in current in electric circuits, speed of movement in mechanical systems are determined using the derivative.

CONCLUSION

In conclusion, the concept of derivative is the most important and integral part of the science of mathematical analysis. It serves as an important tool for in-depth study of the laws of changes of functions, analysis of their behavior and solving various problems on a scientific basis. With the help of the derivative, the intervals of increase and decrease of the function, extremum points, the shape of the graph and many other properties are determined. This makes it possible to carry out mathematical analysis in a more perfect and systematic way.

Also, the concept of derivative is widely used not only in theoretical mathematics, but also in physics, economics, technology, engineering and many other practical fields. For example, determining the speed and acceleration in physical processes, finding the maximum profit in economic analysis, and evaluating the performance of various systems in engineering is done using the derivative. This increases its vital importance.

In addition, the concept of derivative plays an important role in the development of scientific thinking. Through it, students and researchers develop logical thinking, analysis and generalization skills. Studying the derivative helps to simplify and understand complex processes, to express them through a mathematical model.

Therefore, in-depth study of the concept of derivative and the ability to apply it in practice is one of the important requirements of modern education. In the future, as the development of science and technology accelerates, the importance of the derivative will increase. Therefore, the derivative is not only a mathematical concept, but also an important tool for understanding and managing real life.

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