ISSN: 2582-4686 SJIF 2021-3.261, 2022-2.889, 2023-5.384, 2024-6.875 ResearchBib IF: 9.948 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-5, ISSUE-2

Applications of definite integrals

Mansurxo'jayev Azizxo'ja Muxtorxo'ja o'g'li

Tashkent State University of Economics International Financial Academic Lyceum

Mathematics teacher

Annotation. The article considers the concept of a certain integral and some of its applications.

Key words: mathematical analysis, definite integral, applications of definite integral.

The course of mathematical analysis contains a variety of material, however, one of its central sections is the definite integral. Integration of many types of functions is sometimes one of the most difficult problems of mathematical analysis. Calculating a definite integral is not only of theoretical interest. Sometimes problems related to human practical activity are reduced to calculating it. Definition. The limit to which the sum (1) tends when the largest of the lengths of all partial intervals tends to zero is called the definite integral of the function f (x). The ends a and b of this interval (the integration interval) are called the limits of the integral - lower

(a) and upper (£>). It is denoted by: /д fix) dx

The definite integral has great practical application. Let us consider examples of its application.

Example 1. Calculate the area of the figure bounded by the parabola y = - x2 + 6x - 5 and the straight lines

y - ^X ^ x , x .

Mathematical analysis or classical mathematical analysis is a set of sections of mathematics that correspond to the historical section called "infinitesimal analysis", combining differential and integral calculus. Classical mathematical analysis is the basis of modern analysis, which is considered one of the three main areas of mathematics, along with algebra and geometry. At the same time, the term "mathematical analysis" in the classical sense is used mainly in educational programs and materials. In the Anglo-American tradition, classical mathematical analysis corresponds to course programs called "calculus".

The article summarizes many years of teaching experience at a technical university. Frequently encountered mistakes and the most difficult moments associated with studying the topic "Geometric Applications of a Definite Integral" are considered using numerous examples. The tasks are carefully selected to best illustrate all the difficulties that may arise when mastering this material.

The proposed work demonstrates various approaches to solving the same problem. Such examples allow you to compare methods, noting their strengths and weaknesses, and choose the simplest of them.

The article will be useful not only for young teachers who can use it when preparing and conducting classes, but will also help students expand their capabilities in studying this topic.

It is quite easy to obtain the desired value using the integral equation. The limits of integration are the values of Q1 and Q2, where TR – TC.

1) – x2 + 8x – 13 = x2 – 8x + 17, which means x1 = QA = 3 and x2 = QB = 5.

Geometrically, the economic profit zone is the area of intersection of the graphs of the given functions. Thus, the difference of the definite integrals of the functions TR and TC, i.e. the difference in the areas of the curvilinear trapezoids, is the desired value of the area (the necessary and sufficient conditions are met for both functions).

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Traditionally, the practical application of the integral is illustrated by calculating the areas of various figures, finding the volumes of geometric bodies, and some applications in physics and engineering. However, the role of the integral in modeling economic processes is not considered. Often, economic applications of the integral are not discussed in classes in the economic direction. At the same time, integral calculus provides a rich mathematical apparatus for modeling and studying processes occurring in the economy.

Let us dwell on several examples of the use of integral calculus in economics. Let us start with the concept of consumer surplus1 (CS-consumer's surplus), which is widely used in the market economy. For this, we will introduce several economic concepts and notations. Demand for a given product (D-demand) is the relationship between the price of a product and the volume of its purchase that has developed at a certain point in time. The demand for a single product is graphically represented as a curve with a negative slope, reflecting the relationship between the price P (price) of a unit of this product and the quantity of the product Q (quantity) that consumers are willing to buy at each given price. The negative slope of the demand curve has an obvious explanation: the more expensive the product, the smaller the quantity of the product that consumers are willing to buy, and vice versa.

Another key concept of economic theory is defined in a similar way - the supply (S-supply) of a product: the relationship between the price of a product and the quantity of the product offered for sale that has developed at a certain point in time. The supply of a single product is graphically represented as a curve with a positive slope, reflecting the relationship between the price of a unit of this product P and the quantity of the product Q that consumers are willing to sell at each price. Note that economists have found it convenient to depict the argument (price) on the ordinate axis, and the dependent variable (quantity of the product) on the abscissa axis. Therefore, the graphs of the supply and demand functions look like this. And finally, we will introduce another concept that plays a major role in modeling economic processes – market equilibrium. The state of equilibrium is characterized by such price and quantity at which the volume of demand coincides with the amount of supply, and graphically the market equilibrium is depicted by the point of intersection of the demand and supply curves (Fig. 2), $E^*(p^*; q^*)$ is the equilibrium point. In what follows, for the convenience of analysis, we will not consider the dependence $Q = f(P)$, but the inverse functions of demand and supply, characterizing the dependence $P = f(Q)$, then the argument and value of the function will be graphically depicted in the way that is familiar to us. We will now move on to considering applications of integral analysis for determining consumer surplus. To do this, we will depict on the graph the inverse function of demand $P = f(Q)$. Let us assume that market equilibrium has been established at the point $E^*(q^*; p^*)$.

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