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PRACTICAL APPLICATIONS OF THE PRECISION INTEGRAL

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Abstract
Mathematical analysis is an initial and at the same time main branch of higher mathematics. With the intensive development of mathematics, its enrichment of new concepts and new ideas, the scope of application to various branches of science and technology expands, mathematics penetrates into all spheres of human activity. Without knowing the methods of mathematical analysis, it is difficult to understand the processes taking place in nature, the issues considered in the natural science and technical literature. But the practical applications of the concrete integral are not limited to this, and with its help many more problems find their solution.

Keywords: Plane, Surface, Function, Curve, Revenue, Volume, Unit Price, Decreasing, Price Value, Producer, Consumer, Cash.

Introduction

Calculation of the surfaces of forms in a plane. As we know, $y = f(x) \geq 0$ function graph, $x = \mathrm{a}$ and $x = \mathrm{b}$ vertical straight lines, and $y = 0$ I mean OX The surface of a curved trapezoid, bounded by a coordinate axis, is precisely through the integral

$$S=\int_a^b f(x)dx \tag{1}$$

calculated by the formula. We will look at this formula in more general terms.

If $[a;b]$ the cross-section is f(x)≤0, then the corresponding curved trapeze is located below the axis OX, and the net integral value is the negative number. Therefore, in this case, the curved trapeze surface

$$S = -\int_a^b f(x)dx = \left|\int_a^b f(x)dx\right| \tag{2}$$

is found by formula.

Some economic applications of the exact integral. When the concept of a definite integral was introduced, we saw the question of determining the volume of output in terms of variable labor productivity. For example, in an enterprise, labor productivity is increased for each working day

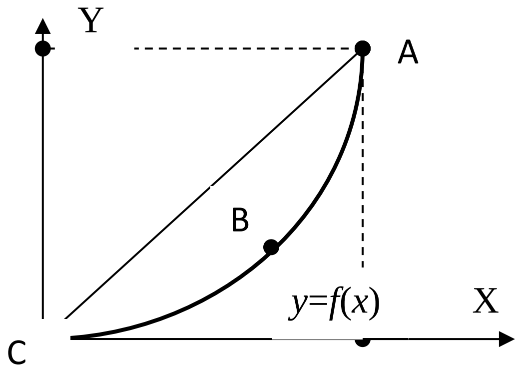
$$z = f(t) = -0{,}0033t^2 - 0{,}089t + 20{,}96$$

be given with a function. In which 0≤t≤8 is t, t represents time in hours. We find the volume of products that this enterprise produces during the year (258 working days):

$$Q = 258\int_0^8(-0{,}0033t^2 - 0{,}089t + 20{,}96)dt = 258\cdot(-0{,}0011t^3 - 0{,}0445t^2 + 20{,}96t)\Big|_0^8 =$$
$$= 258\cdot(-0{,}5632 - 2{,}848 + 167{,}68) = 258\cdot 164{,}2688 = 42381{,}3504$$

This means that the enterprise produces 42,381 units in a year. Here we will learn about the solution of a number of economic problems with the help of a concrete integral.

It's a matter of calculating the djini coefficient. We look at the function y=f(x), x[0,1], which represents how unevenly income is distributed among the population ∈(see Figure 1 on the next page). At the same time, y determines the share of income, x determines the share of the population.



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The OBA curve that represents this function graph is called the Lorents curve.

Income is y=x, evenly distributed among the population, in which case the Lorentz curve becomes the OA section in the bisector. Therefore, for any x∈[0,1], 0≤f(x)≤x double inequality is satisfied. In this case, the larger the surface of the OABO geometric shape, the greater the degree of uneven distribution of gains. Therefore, the ratio of the OABO form surface to the OAC triangle surface is taken as a measure of the uneven distribution of income among the population. This ratio is called the Djini coefficient and is determined by k. Here, expressing surfaces by means of a definite integral, we derive the following formula for the Djini coefficient: $k = \frac{S_{OABO}}{S_{OAC}} = \frac{\int_0^1 [x - f(x)]dx}{\int_0^1 xdx} = 2\int_0^1 [x - f(x)]dx$ For example, we calculate the Djini coefficient by the formula (11), given by the function Lorents curve y=x/(3–2x), x∈[0,1], given by the function:

$$k = 2\int_0^1 (x - \frac{x}{3-2x})dx = 2\int_0^1 (x + \frac{x - 1{,}5 + 1{,}5}{2x-3})dx = 2\int_0^1 (x + \frac{1}{2} + \frac{3}{2}\cdot\frac{1}{2x-3})dx =$$

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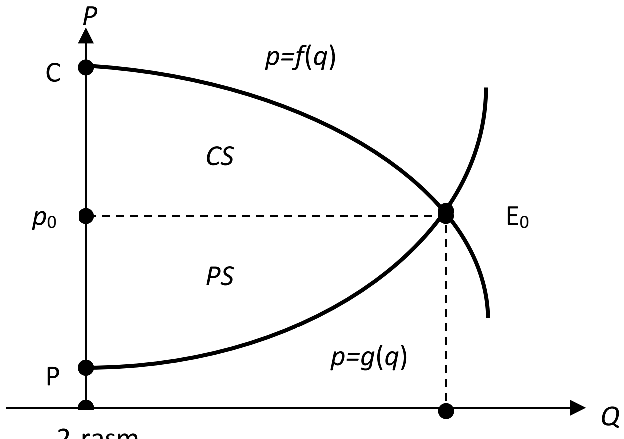
$$=2(\frac{x^2}{2}+\frac{x}{2}+\frac{3}{4}\cdot\ln|2x-3|)\Big|_0^1=2(1-\frac{3}{4}\cdot\ln 3)\approx 0{,}352$$

It is a matter of the achievements of the consumer and the producer. At the outset, we introduce the concepts of demand and supply functions.

The function p=f(q), which represents the link between the price *of a unit of product* p and the price q of *that product being purchased by the consumer* , is called the demand function. In economics, price p, volume (quantity) is denoted by the letter q, and so the demand function was written as *p=f(q)* rather than the traditional *y=f(x)* form (see Figure 2).

Based on the content, this function will be reducing, since as the price of the product p increases, the volume of purchase of this product q decreases (see figure above).



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The function p=g(q), which represents the link between the price of a unit of product p and the volume of production of that product q, is called the offer function. On the basis of content, this function is a grower, since as the price of a product p increases, the output of this product increases (see figure above).

The graphs of supply and demand functions intersect at some point E0(q0,p0). At this point, the volume of the consumer's demand and the volume of the producer's supply are mutually equal. This condition is called market equilibrium. The values of product volume q0 and price p0, which create market equilibrium, $\begin{cases} f(q)=p \\ g(q)=p \end{cases}$ are found in the system of equations (4) for the given supply and demand functions.

Under a market equilibrium, consumers can purchase a unit of product at a price of p0 and spend a total of P0 Q0 in order to meet their Q0 volume requirements. But some consumers, for one reason or another, can't wait until market equilibrium is reached. In addition, the manufacturer also tries to sell its product at a price as high as possible at a price above the p0 price. Therefore, instead of putting the product of the amount q0 demanded by the consumer on the market at once and selling it all at once at the price of p0, he puts his product on the market in small batches of the size Δqi (i=1,2,3,····, n) and sells it at the price f(qi)> p0. As a result, instead of spending p0 q_0 to buy the product he needs, the consumer

$$S_n(f)=\sum_{i=1}^{n} f(q_i)\Delta q_i$$

amount cost. The process of product production and its purchase occur seamlessly. Therefore, the requirement function *f(x)* can be obtained as continuous and the number of batches of small-small Δqi of the product n→∞. In this case , based on the definition of the exact integral, the real cost of the consumer's cost to purchase a product of q0 is determined by the following formula:

$$S = \lim_{n\to\infty} S_n(f) = \lim_{n\to\infty} \sum_{i=1}^{n} f(q_i)\Delta q_i = \int_0^{q_0} f(q)dq$$

From this it can be seen that if a consumer buys a product of the q0 volume he is demanding at the price of the market equilibrium of p0, his expense

$$CS = S - p_0 q_0 = \int_0^{q_0} f(q)dq - p_0 q_0 = \int_0^{q_0}[f(q) - p_0]dq$$

The amount would be less. This is why CS is referred to as a consumer's achievement and sometimes as a consumer's overhead. In Figure 2 above, this figure is represented as a trapezoidal surface with a p0 E0C curve.

Similarly, a producer would have a cash flow of p0q0 if he sold a product of the q0 volume he offered at a price of p0 in the market balance. But instead of waiting for the market equilibrium to occur, he immediately puts on the market the product he produces in the volume Δqi (i=1,2,3,⋯, n) and sells each of it at the price of g(qi)<p0. As a result, the producer's original cash earned by selling a product in Q0 volume will be as follows:

$$S = \lim_{n\to\infty} S_n(g) = \lim_{n\to\infty} \sum_{i=1}^{n} g(q_i)\Delta q_i = \int_0^{q_0} g(q)dq < p_0 q_0 .$$

Thus, the producer would have additional cash when he sold his product on the condition of market equilibrium

$$PS = p_0 q_0 - \int_0^{q_0} g(q)dq = \int_0^{q_0}[p_0 - g(q)]dq$$

. Hence PS is called a manufacturer's achievement. In Figure 2 above, this figure is represented as a P p0E0 curved trapezoidal surface.

For example, we define consumer and producer gains when the demand function is p=f(q)=240–q2 and the proposition function is p=g(q)=q2+2q+20. To do this, let's first solve this system of equations:

$$\begin{cases} p = 240 - q^2 \\ p = q^2 + 2q + 20 \end{cases} \Rightarrow \begin{cases} p = 240 - q^2 \\ 240 - q^2 = q^2 + 2q + 20 \end{cases} \Rightarrow \begin{cases} p = 240 - q^2 \\ q^2 + q - 110 = 0 \end{cases} \Rightarrow \begin{cases} p_0 = 140 \\ q_0 = 10 \end{cases}$$

This means that the market equilibrium price will be p0=140 and the volume will be q0=10.

Then, according to the formula (6), the consumer's achievement

$$CS = \int_0^{q_0}[f(q) - p_0]dq = \int_0^{10}[240 - q^2 - 140]dq = (100q - \frac{q^3}{3})\Big|_0^{10} = 666,(6) \approx 667 ,$$

And the manufacturer's achievement is based on the formula (7),

$$PS = \int_0^{q_0}[p_0 - g(q)]dq = \int_0^{10}[120 - q^2 - 2q]dq = (120q - \frac{q^3}{3} - q^2)\Big|_0^{10} = 766,(6) \approx 767$$

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