UDC 372.8

Mathematics

Georgi SAHAKYAN
Ph. D. in Physics and Mathematics, ASU.
E-mail: ter_saak_george@mail.ru

USING MATHCAD PROGRAMM TO DETERMINE AREA OF FIGUREST

Գ. Սահակյան

MATHCAD ԾՐԱԳՐԻ ՕԳՏԱԳՈՐԾՈՒՄԸ ՊԱՏԿԵՐՆԵՐԻ ՄԱԿԵՐԵՍՆԵՐԻ ՈՐՈՇՄԱՆ ՀԱՄԱՐ

Հոդվածում քննվում է Mathcad մաթեմատիկական փաթեթի կիրառումը «Տրված կորերով սահմանափակված պատկերի մակերեսի որոշումը» թեման ուսումնասիրելու գործընթացում:

Բանալի բառեր՝ *պատկերի մակերեսը, Mathcad-ի կիրառությունները*

Г. СААКЯН

ИСПОЛЬЗОВАНИЕ ПРОГРАММЫ MATHCAD ДЛЯ ОПРЕДЕЛЕНИЯ ПЛОЩАДЕЙ ФИГУР

В работе рассматривается применение математического пакета Mathcadв процессе изучения темы “Определение площади фигур, ограниченных данными кривыми ”.

Ключевые слова: *площадь фигуры, применения Mathcad*

The paper considers the application of the Mathcad mathematical package in the process of studying the topic “Determining the area of figures bounded by these curves."

Key words: *the area of figure, Mathcad applications*

Modern information technologies make it possible to speed up and increase the effectiveness of the learning process, to make it more visual, convenient for the assimilation of the material in question.Numerous articles on the use of IT in math classes only mention the use of programs that are part of Microsoft Office ([1], [3], [4]). However, the use of a number of mathematical programs, such as, for example, **Mathcad**, **MatLab**, in our opinion, will allow us to make the lessons quite effective. From this point of view, the Mathcad mathematical package has the necessary resource for illustrating various mathematical concepts, as well as for calculating the quantities and expressions used in mathematics. On the other hand, **Mathcad** has a fairly convenient interface, which allows you to get acquainted with the principles of work in its environment in a very short time. Using a mathematical package will also save time needed to calculate various mathematical expressions (derivative, integral, etc.)

and thereby increase the time it takes to analyze the results, which is ultimately more important than the process of calculating them. The **Solve** function in **Mathcad** ([2]) in most cases allows you to determine their approximate values.

This article discusses the use of the **Mathcad** program in determining the area of shapes bounded by given curves.When solving such problems by classical methods described in the course of mathematical analysis, sometimes difficulties arise associated with the construction of graphs of functions and determination of the required figure, intersection points of the curves necessary when using the area formula of curvilinear trapezoids. In this sense, **Mathcad** has the necessary capabilities to conveniently and quickly solve such problems. We present an algorithm for solving such problems.

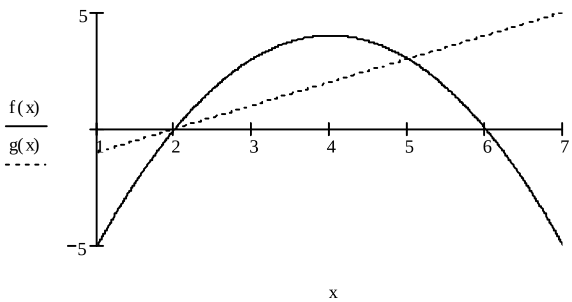
1. Using the X-Y Plot from the **Graph** tools, construct graphs of the given functions in the same coordinate system.
2. Change the construction interval so as to clearly represent the given figure.
3. Determine the function **Solve**necessary intersection points of the given curves.
4. Find the area of the parts that make up the figure, using the formula for the area of a curved trapezoid.
5. Define the area to be searched as the sum (or difference) of the obtained areas.

Consider the application of the specified algorithm for some typical examples.

Example 1. Determine the area of the figure bounded by the curves $y=-x^2+8x-12$and $y=x-2$.

Solve. We will take advantage of the graphical capabilities of the program and construct graphs of functions in the same coordinate system, and we will define the intervals for constructing graphs so as to have a clear idea of the resulting figure.

$$f(x)-g(x)\ \text{solve}, x \rightarrow \begin{pmatrix} 2 \\ 5 \end{pmatrix}$$



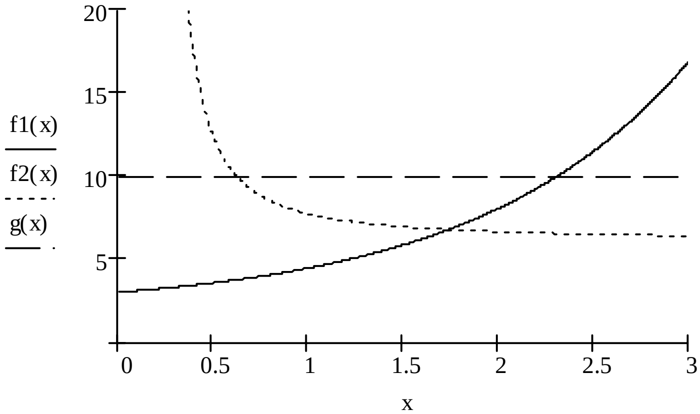
$$S := \int_2^5 (f(x)-g(x))\,dx \qquad S = 4.5$$

Fig.1

We define the given functions in **Mathcad** and determine the points of their intersection through the **Solve** function. Next, using the formula for determining the area of a curved trapezoid, we find the desired value (Fig. 1)

Example 2. Determine the area of the figure bounded by curves, $y=e^{0.9x}$, $y=5+e^{\frac{1}{x}}$ and $y=10$.

Solve. We construct the function graphs by choosing an interval convenient for clarity, for example, $[0,\ 3]$. It can be seen from the figure that in order to use the area formula of a curvilinear trapezoid, we need the abscissas of the intersection points of the function graphs $y=e^{0.9x}$ and $y=5+e^{\frac{1}{x}}$ with the function graph $y=10$. We will find them using the **Solve** function (Fig. 3). To obtain approximate abscissas, use the **Float** rounding function. The required area consists of the areas of two figures, the calculation of which is shown in Figure 2.



$f1(x) - g(x)$ solve, x, float, 2 $\rightarrow$ 2.3 $f1(x) - f2(x)$ solve, x, float, 2 $\rightarrow$ 1.7

$f2(x) - g(x)$ solve, x, float, 2 $\rightarrow$ .63 = 0.63

$S1 := \int_{0.63}^{1.7} (g(x) - f1(x))\,dx$ $S1 = 5.388$ $S2 := \int_{1.7}^{2.3} (g(x) - f2(x))\,dx$ $S2 = 2.006$

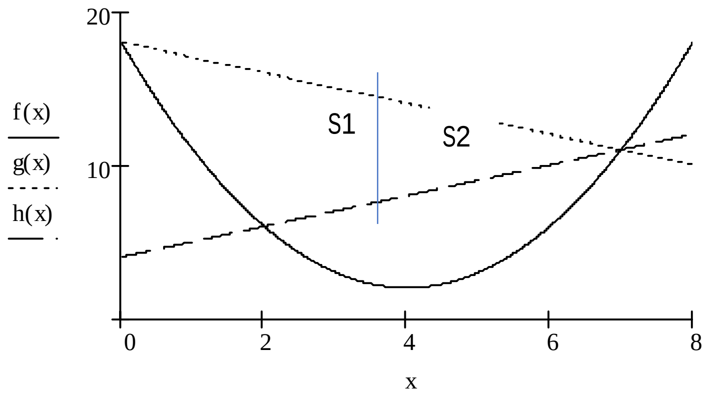
$S := S1 + S2$ $S = 7.394$

Fig. 2

Example 3. Determine the area of the figure bounded by curves, $y=-x^2-8x+18$, $y=18-x$ and $y=x+4$.

Solve. Let's start the solution by plotting. Then we define the intersection points of the graphs of the functions $y=-x^2-8x+18$ and $y=18-x$, as well as the graphs of the functions $y=18-x$ and $y=x+4$. The figure shows that the required area S consists of areas $S1$ and $S2$ two figures (Fig. 3). Calculation of cadda from these areas is possible again using formulas to calculate the area of a curved trapezoid.

$f(x) := x^2 - 8x + 18$ $\qquad$ $g(x) := 18 - x$ $\qquad$ $h(x) := x + 4$



$f(x) - g(x) \text{ solve}, x \rightarrow \begin{pmatrix} 0 \\ 7 \end{pmatrix}$ $\qquad$ $f(x) - h(x) \text{ solve}, x \rightarrow \begin{pmatrix} 2 \\ 7 \end{pmatrix}$ $\qquad$ $g(x) - h(x) \text{ solve}, x \rightarrow 7$

$S1 := \int_0^2 (g(x) - f(x))\,dx$ $\qquad$ $S1 = 11.333$ $\qquad$ $S2 := \int_2^7 (g(x) - h(x))\,dx$ $\qquad$ $S2 = 25$

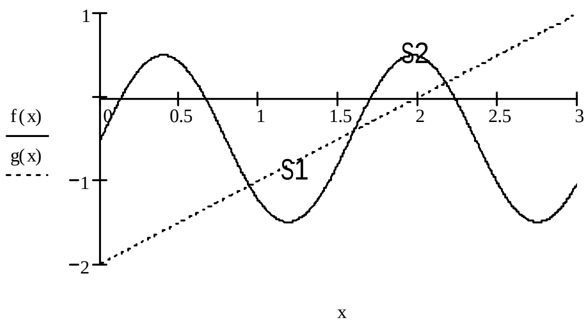
$S := S1 + S2$ $\qquad$ $S = 36.333$

Fig.3

Example 4. Determine the area of the figure bounded by curves, $y = \sin 4x - 0.5$ and $y = x - 2$.

Solve. We plot the given functions by choosing the interval for construction so that the required figure would be clearly presented. Then we define the intersection points of the function graphs. It can be seen from the figure that the required area S again consists of areas $S1$ and $S2$ two figures (Fig. 4).

$f(x) := \sin(4x) - 0.5$ $\qquad g(x) := x - 2$



$S1 := \int_{0.931}^{1.61} (g(x) - f(x))\, dx \qquad S1 = 0.3 \qquad S2 := \int_{1.61}^{2.196} (f(x) - g(x))\, dx \qquad S2 = 0.211$

$S := S1 + S2 \qquad S = 0.511$

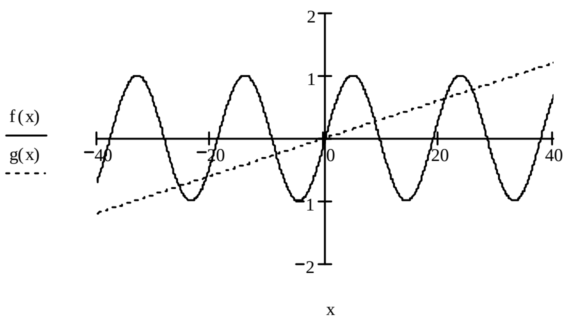
Fig. 4

Further calculations are presented in the figure.

Example 5. Determine the area of the figure bounded by the curves $y = \sin\left(\frac{x}{3}\right)$ and $y = 0.03$.

Solve. We plot the given functions by selecting the interval for construction $[-40, 40]$. Such a choice allows us to imagine the area of which figure does not need to be determined.

$f(x) := \sin\left(\frac{x}{3}\right) \qquad g(x) := 0.03x$



$S1 := \int_{0}^{8.64} (f(x) - g(x))\, dx \qquad S1 = 4.778 \qquad S2 := \int_{8.64}^{20.88} (g(x) - f(x))\, dx \qquad S2 = 10.657$

$S3 := \int_{20.88}^{25.96} (f(x) - g(x))\, dx \qquad S3 = 0.92 \qquad S := 2(S1 + S2 + S3) \qquad S = 32.71$

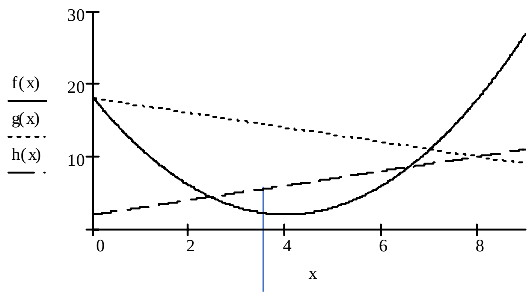
Fig.5

It can be seen from the figure that the required figure is symmetrical relative to the OY axis, and therefore, we restrict ourselves to calculating only the swamps of the figure, which is located to the right of the OY axis. As in the previous examples, we find the points of intersection of the graphs that we need. Then we determine the areas of the three figures that make up the figure obtained to the right of OY. Given the symmetry, we can only double their sum (Fig. 5).

Example 6. Determine the area of the figure bounded by curves, $y=-x^2-8x+18$, $y=18-x$ and $y=x+2$.

Solve. We construct the graphs of the given functions on the interval $[0,9]$. In Figure 6 they are separated by a vertical bar). Having again defined the intersection points, it is easy to find the required area as the sum of the areas of the two curved areas of two curved trapezoid (Fig. 6).

$f(x) := x^2 - 8x + 18$ $\quad$ $g(x) := 18 - x$ $\quad$ $h(x) := x + 2$



$f(x) - g(x)$ solve, $x \rightarrow \begin{pmatrix} 0 \\ 7 \end{pmatrix}$ $\quad$ $f(x) - h(x)$ solve, $x \rightarrow \begin{pmatrix} \frac{9}{2} + \frac{1}{2}\cdot\sqrt{17} \\ \frac{9}{2} - \frac{1}{2}\cdot\sqrt{17} \end{pmatrix} = \begin{pmatrix} 6.562 \\ 2.438 \end{pmatrix}$

$g(x) - h(x)$ solve, $x \rightarrow 8$

$S1 := \int_0^{2.438} (g(x) - f(x))\,dx$ $\quad$ $S1 = 15.973$ $\quad$ $S2 := \int_{2.438}^{8} (g(x) - h(x))\,dx$ $\quad$ $S2 = 30.936$

$S := 2(S1 + S2)$ $\quad$ $S = 93.818$

Fig.6

Literature

1. **Ушакова В. А.**, «*Использование информационных технологий* на уроках *математики»,* Молодой ученый, 2016, №8, с. 1053-1055.

2. **Սահակյան Գ.Հ.,** Mathcad 2000, Ուսումնական ձեռնարկ, Երևան, 2004,148 էջ:

Ինտերնետ կայքեր՝

3. https://nsportal.ru › primenenie-informatsionnykh-tekhnologiy-na-urokakh
4. https://xn--j1ahfl.xn p1ai/library/ispolzovanie_informatcionnih_tehnologij_v_obuchenii_153151.html

Հոդվածը տպագրության է երաշխավորել ԱրՊՀ մաթեմատիկայի ամբիոնը։