APPLICATIONS OF DIFFERENTIAL EQUATIONS TO ECONOMICS

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ABSTRACT
Applications of differential equations to economics in three articles. It is effective to use analytical methods in solving economic problems, in addition to moving areas of directions and isoclines.

Keywords: Differential equation, specific solution, initial condition, gross domestic product, exchange rate.

INTRODUCTION

It is known that x is an arbitrary variable, y is a function of this variable, and y' is a derivative connecting

$$F(x, y, y') = 0 \quad (1)$$

the connection is called a 1st-order differential equation.

If in relation (1) replacing y with the function $\varphi(x)$ results in the expression $F\big(x, \varphi(x), \varphi'(x)\big) = 0$, then the function $\varphi(x)$ is called the solution of the equation (1) .

If

$$\frac{\partial F}{\partial x} + \frac{\partial F}{\partial y} y' = 0$$

$$F(x, y, C) = 0$$

the equation (1) is formed after the parameter C is removed from the connection, then

$$F(x, y, C) = 0 \qquad (2)$$

the implicit function is called the general integral of equation (1).

The undisclosed function $F(x, y, C_0) = 0$ generated from the general integral $F(x, y, C_0) = 0$ as a result of assigning a certain value $C = C_0$ to an arbitrary variable C is called the particular integral of the differential equation (1). From a geometric point of view, the general integral represents a family of curves that depend on the parameter C in the plane of coordinates and are called integral curves of the equation. The particular integral corresponds to the curve of this family corresponding to $C = C_0$.

From (2) in some cases

$$y = \varphi(x, C) \quad (3)$$

it is possible to create a general solution of equation (1).

The process of finding the general integral as well as the general solution is called integration of equation (1).

Any function $y = \varphi(x, C_0)$ generated from the general solution $y = \varphi(x, C)$ as a result of assigning a certain value $C = C_0$ to the constant C is called a particular solution of the differential equation (1).

For convenience, the differential equation (1) is solved with respect to the derivative

$$\frac{dy}{dx} = f(x, y) \quad (4)$$

in the form of an equation or symbolically involved differentials

$$M(x, y)dx + N(x, y)dy = 0 \ (5)$$

an attempt is made to express it in the form of an equation.

(1) is called the initial condition of the equation

$$y(x_0) = y_0 \quad (6)$$

The problem of finding solutions that satisfy the given condition is called the Cauchy problem or the elementary problem.The Cauchy problem for equation (4) is briefly written as:

$$\frac{dy}{dx} = f(x, y), \qquad y|_{x=x_0} = y_0 \,.$$

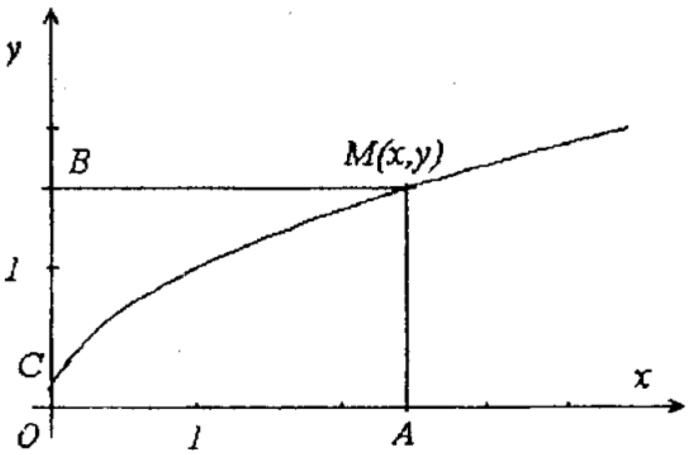
The field of directions of the differential equation to the family of straight lines passing through each point of the given equation $y' = f(x, y)$ and forming an angle $\alpha = arctgf(x, y)$ with the abscissa axis is called A line with the same direction area at each point is called an isocline. The concept of an isocline can be explained as follows: The geometric position of the points of an integrated curve with the same direction is called an isocline. The family of isoclines of the equation $y' = f(x, y)$ is defined by the equations $f(x, y) = k$. [1]

METHODS

It is known that the equation $y' = f(x)g(y)$ is a differential equation with separable variables. Below we will look at the problem, the solution of which will be brought to him.

Matter. A rectangle formed by passing straight lines parallel to the coordinate axes from any point of the curve is divided into two parts by this curve. Of these pieces, the face of the OX stick to the arrow is twice as big as the other one. If it is known that the curve passes through the point $M_0(1; 1)$, find it.

Solving. Through the point of the curve $M(x; y)$, we draw a straight line MA parallel to Oy axis and a straight line MB parallel to the Ox axis. (picture 1)



Picture 1.

According to the condition of the problem, $S_{OCMA} = 2S_{CBM}$. It is known that

$$S_{OCMA} = \int_0^x ydx \,, \quad S_{CBM} = S_{OBMA} - S_{OCMA} = xy - \int_0^x ydx$$

For unknown function $\int_0^x ydx = 2\left(xy - \int_0^x ydx\right)$ or $3\int_0^x ydx = 2xy$ we form connections.

As a result of differentiating both sides of the last connection with respect to x, we create the differential equation $2xy' = y$. It is not difficult to find that the solution of the equation in which the variables are separated is $y' = Cx$. Using the initial condition, we find $C = 1$. Thus, the desired curve consists of a parabola

$y^2 = x$.

Answer: $y^2 = x$. [2]

RESULTS

The mechanical meaning of the derivative of a function represents the instantaneous speed of a material point. If we consider the considered function as a variable quantity with some regularity in the economy, then the problem of finding this regularity through its speed and certain parameters is reduced to the problem of solving a differential equation. For example, the rate of change of the exchange rate and parameters related to its change can be calculated using a differential equation. Through the law of the rate of change of the gross domestic product, we determine the law of its increase or decrease with the help of a differential equation. It can be observed that the change of the gross domestic product is exponential. [3]

DISCUSSION

Another way to solve a differential equation is to use the field of directions and isoclines. First, a curve and its family are created using the field of directions and isoclines. Then, using the graph, its equation is created. But since this method is a more numerical method, in practice, the equation of the function is built only for a finite number of steps, so for a large number of steps, the above analytical method is more effective. That is, when solving economic problems, the more precisely the problem is solved, the more appropriate it is. [4]

CONCLUSION

The further development of the economy certainly involves solving many problems. The role of mathematics is incomparable in this. Therefore, differential equations are also important. Solving differential equations analytically is an effective solution to these problems.

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