



## Mathematical Economics: Quantitative foundations of Economics

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### Abstract

Mathematical Economics is a method of economics that uses math principles and tools to create economic theories and to explore economic quandaries. Mathematics allows economists to construct specifically defined models from which accurate results can be obtained. It is the application of mathematical methods to represent theories and analyze problems in economics. Although the discipline of economics is heavily influence by the bias of researcher, mathematics allows economists to precisely define and test economics theories against real world data. This paper deals with uses of mathematics in economics.

**Keywords:** Mathematics, economics

### Introduction

Mathematics is thought to be an essential and elementary component of economics. Math can be applied to economics for two reasons: one is the mathematical tools desired to create and appreciate economic arguments, the second one is, facilitate to speak confidently about economics using mathematical abbreviations. The application of mathematical techniques to the analysis of economic problems is a methodological possibility. This technique often called as Mathematical economics. Mathematical economics is the application of mathematical methods to represent theories and analyze problems in economics. Mathematics allows for the formulation of theoretical relationships with rigor, generality, and simplicity. Further, the language of mathematics allows economists to make specific, positive claims about controversial or contentious subjects that would be impossible without mathematics. Mathematics allows economists to form meaningful, testable propositions about wide-ranging and complex subjects which could less easily be expressed informally. Much of economic theory is currently presented in terms of mathematical economic models, a set of stylized and simplified mathematical relationships asserted to clarify assumptions and implications.

### Need for Quantitative Analysis in Economics

In economics, quantitative analysis refers to the application of mathematics and statistics in the analysis of economic data. The primary goal of using quantitative analysis in economics is to provide precision in deducing economic theories and measuring economic parameters so that they can be compared with other values that are similar to theirs in other fields. For example, if we want to know the relationship between the price of apples and the quantity of apples that are demanded, we can collect data on these two variables and use quantitative techniques to determine the relationship between these variables. The application of mathematics (to specify the form of the demand equation) and statistics (to estimate the required demand equation) can be used to derive a relationship between the variables in this situation.

Prior to the invention of calculus, economics was considered to be entirely a non-mathematical science. In economics, the

use of verbal techniques supported by tables was supposed to be sufficient for explaining and describing everything.

In economics, almost all of the thinkers and writers used literary forms to express themselves, and mathematics and statistics had no place in the field. Many relationships and thoughts were described verbally, despite the fact that they could be presented in a much shorter form using Mathematical symbols and equations instead. When economics began to develop and gain popularity, the theories and analyses underlying it became increasingly complex. Simple verbal methods were incapable of explaining or analyzing them. Even if it were possible, the analysis would have been extremely time-consuming and tedious. The application of mathematics to the same task could make it easier, shorter, and faster. Economic theory is a positive science, and because of this, mathematical symbols and equations can be used to represent the cause and effect relationship between the variables in a shorter and more accurate manner. In economics, the formulation of such cause and effect relationships is referred to as the development of economic models. Statisticians can also help to quantify the effect of variables that are included in a model by employing statistical methods and techniques

The study of mathematics helps in the determination of the relationship between economic variables or economic laws. For example, mathematical aspects can aid in the representation of the functional relationship between price and demand, input and output, and so on and so forth.

### The Importance of Mathematics in Economics and Its Applications

The application of mathematics in economics is a translation of economic theory from its verbal form into mathematical language. In economics, mathematics is particularly well suited to the development of theories and models, as it is a powerful shorthand for logic and reasoning. In place of terms, mathematical symbols can be used, and equations can be used in place of sentences. It gives economic models and theories a concrete form, making them more precise and applicable in real-world situations.

The following are some examples of mathematical tools that are used in economic analyses:

- **To study Cause and Effect relationship**

Economics is a positive science, which means that it studies cause and effect relationships. The relationship between the variables can thus be demonstrated as a cause and effect relationship. For example, the quantity demanded of a commodity (such as apples) is determined by the price of the commodity. The quantity of apples demanded can then be written as the dependent variable, and the price of apples can be written as the independent variable. When we use mathematics to illustrate such relationships, we can be much more precise. For example, the mathematical relationship between demand for X and its price is written as  $D_x = f(P_x)$ .

- **To analyze more variables**

More variables are analyzed with the help of graphs, which are also used in economics to clarify our discussions. For two variables, the graphs that we typically use are two-dimensional. It is not possible to use graphs when there are three or more variables because the verbal description will become extremely complicated. In such cases, we can turn to mathematics for assistance. In the case of three or more variables, the application of mathematics makes the analysis possible and easier. For example, the application of the matrix method.

- **In order to convert sentences into symbols**

We can substitute mathematical symbols for economic terms and equations for sentences. Findings from mathematical treatment can be interpreted more quickly than findings from graphical and verbal methods, allowing for more rapid arrival at conclusions. A simple formula to express that the quantity demanded of X is dependent on its price is written as  $D_x = f(P_x)$ .

- **To find the slope of a straight line**

It is necessary to use coordinate geometry to demonstrate the relationship that exists between graphs and equations. It is also employed in the determination of the slopes of demand and supply curves.

- **To study marginal concepts**

When it comes to studying marginal concepts, mathematics is equally important in economics as it is in other fields. Calculus, a branch of mathematics, is frequently used in economics because of its versatility. Differential calculus is used to discuss the marginal concepts (marginal utility, marginal product, marginal cost, marginal revenue, marginal profit, and so on) that are commonly used in economics. Differential calculus is a mathematical tool that can be used to solve problems.

- **To determine the values of economic variables**

From marginal values, the concept of integration is applied in order to calculate aggregate values (such as the sum of all revenue, all costs, all profit, and so on). In a similar vein, the concept of integration is used to calculate the surplus of consumers and the surplus of producers. As a result, mathematics is employed to determine the values of various economic variables.

- **To express economic phenomena algebraically**

Algebra is used extensively in economics for the solution of simple, simultaneous, and quadratic equations, as well as for

the solution of quadratic equations. It is also used to solve simultaneous equations, as can be seen in multi-market or general equilibrium models, which are examples of matrix algebra in action. In addition, mathematics can be used to solve linear and nonlinear programming problems, among other things. In a similar vein, game theory, which can be applied in duopoly and oligopoly markets, can be used to solve problems in a mathematical manner.

### Conclusion

- Without the use of mathematical concepts are incomplete.
- To understand economics properly we need to use mathematics in each point.
- With the use of mathematical techniques, economic concepts are understood in such a way that one can grow their interest in the subject

### References

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