



ON METHODS OF MATHEMATICS IN ECONOMICS

Bipinkumar V

Department of Mathematics, SreeNarayana College,

Cherthala, Alappuzha, Kerala, India.

vbkumarsncmaths@gmail.com

Abstract

Mathematics helps economists to perform quantifiable experiments and create models for predicting future economic growth. The advances acquired in computing power, the modern techniques to handle very large data, the process of finding rate of changes using differentiation and other advanced mathematical technologies have played a major role in making quantitative methods a fundamental aspect of economics. This paper is an attempt to review the mathematical techniques used in developing theories in economics.

Keywords: Mathematical economics, quantitative methods, econometrics.

Introduction

Mathematical economics is a method of economics that uses mathematical principles and tools to generate various economic theories. The strong and logical foundation of mathematics helps to carry out the investigations related to economics. Also mathematics permits economists to construct precisely defined models from which they are able to extract useful conclusions. These conclusions which are derived with the help of mathematical logic can be tested using statistical data and used to make quantifiable predictions about future economic activity. The combination of statistical methods, mathematical tools and economic principles enabled the development of the branch named econometrics. Advancements in computing power, data analysis techniques and other advanced mathematics applications have played a very key role in making quantitative methods a standard element of economics.

Mathematical economics relies upon defining all the relevant assumptions, conditions, and all the causal structures of economic theories in mathematical terms. There are a lot of advantages of using mathematics for the develop theory of economics. First, it allows economic theorists to use mathematical tools such as algebra and calculus to describe economic phenomena and draw precise inferences from their basic assumptions and definitions. Second, it allows economists to realise these theories and inferences so that they can be tested empirically using quantitative data. Thus mathematics can be used to produce quantitative predictions about economic matters for the benefit of businesses, investors, and policymakers.

The objective of this study is to analyse the applications of mathematical tools and theories in economics related problems. The methodology used is based on secondary data available such as text books and websites. The basic definitions of economics, mathematics and statistics can be seen in [2], [3] and [4]. More facts related to applications of mathematics in economics is given in [1].



Importance of Consumer theory

Consumer theory is the study that helps people to decide on how to spend their money based on their individual preferences and budget constraints. Consumer theory is a branch of microeconomics which shows how individuals can make choices, subject to how much income they have available to spend and the prices of goods and services. In other words consumer theory may be considered as the art of making decisions regarding day to day life. Demand theory describes the way that changes in the quantity of a good or service demanded by consumers affects its price in the market, The theory states that the higher the price of a product is, all else equal, the less of it will be demanded, inferring a downward sloping demand curve. The Customer Theory is an understanding of the customer that enables us to more accurately predict the total response to a given offer. In the present era of very big data, it can be effectively used to manage results, metrics and numbers and to obtain better output.

Production theory and consumer demand theory

The production theory explains the principles in which the business has to take decisions on how much of each commodity it sells and how much it produces and also how much of raw material. It deals with fixed capital and labour involved in the business and how much it is to be used to get the maximum benefit. There are various types of consumer behaviour, such as Complex buying behaviour which is encountered when consumers are buying an expensive, infrequently bought products, Dissonance-reducing buying behaviour, Habitual buying behaviour, Variety seeking behaviour.

Consumer demand theory provides insight into a clear understanding of the market demand and forms a strong basement of modern microeconomics. In particular, this theory critically and logically analyses the consumer behaviour, especially market purchases, based on the satisfaction of requirements and utility generated from the consumption of a commodity. Types of demand are categorised as Joint demand, Composite demand, Short-run and long-run demand, Price demand, Income demand, Competitive demand, Direct and derived demand.

Development of mathematical economics

In earlier days, economics relied heavily on verbal, logical argument, situational explanations, and inference based on obtained evidences to attempt to make sense of economic phenomenon. Economists often has to deal with competing models capable of explaining the same recurring relationship called an empirical regularity, but could not definitively quantify the size of the association between the related central economic variables.

Later, mathematical economics developed in the sense that it proposed formulas to quantify changes in the economy. This laid very strong foundations for economics as a whole, and new economic theories featured with the help of some type of mathematical logic. Economics is the branch of science which is closely related to human life while mathematics is the branch which is commonly known as queen of sciences.

Mathematical economics concentrates on clarification of economic theory and creating more and more accuracy and precision, certainty to both theoretical and empirical economics. Formulating statements about economic theories in mathematical terms must always depend on precise definitions of the specified terms that are being treated as quantities in a mathematical model. Such ambiguity and fudging is exactly what the practice of mathematical



economic purports to avoid in its quest to provide hard, precise answers to the questions of decision-makers and policymakers. At best, this sharply limits the level of certainty that can be placed on the conclusions thereby generated and, at worst, sophisticated mathematics can be used to cloak fundamentally misleading results and conclusions.

It is definitely a fact that economic phenomena always involve subjective and unobservable elements that take place within the human minds of the economic agents under study, such a precise definition is never entirely possible in economics. This inevitably leads to ambiguities of interpretation and the related factors that can't be readily fit into a mathematical or econometric model. As a result, economists, and those who rely on them as experts and authorities, tend to gloss over these issues in the interest of confidence and certitude in pushing their preferred economic explanations and policy prescriptions. They can be found in nearly every industry in the economy, providing advice on management, finance, accounting, marketing, data, education, health, government, environment, politics, etc. Mathematical economics students with their strong data, analytical, and problem solving skills are highly valued in this industry.

Applied mathematics in economics

Mathematics and economics are complementary disciplines. Most branches of modern economics use mathematics and statistics extensively, and some important areas of mathematical research have been motivated by economic problems. Mathematical economics is the application of mathematical methods to represent theories and analyze problems in economics. Mathematics allows economists to form meaningful, testable propositions about wide-ranging and complex subjects which could less easily be expressed informally

Applied mathematics is applying mathematical techniques in various fields like engineering, physics, medicine, business, biology, industry, and computer science. Therefore, applied mathematics is essentially a scientific blending of specialized knowledge in various branches of science and mathematical science. The strong connections between mathematics and economics are possible in the implementation of methodical system of formation of professional competence of future economists through the application of mathematical methods and models, knowledge and skills, which, in turn, ensures the production of basic economic knowledge and the decision making capabilities of economists .

Mathematics generates the logic which gives us ability to understand patterns, to quantify relationships, and to predict the future. Mathematics helps us to understand the world and its phenomenon in a better way. The world and its underlying rules are definitely interconnected. Learning mathematics make sense of the world and solve complex and real problems.

Economics as a social science

Economics is generally regarded as a social science, although some critics of the field argue that economics falls short of the definition of a science for a number of reasons, including a lack of testable hypotheses, lack of consensus, and inherent political overtones. Economics helps you to think strategically and make decisions to optimise the outcome. Especially in demand are people who have studied Economics and Finance as they are particularly well-prepared for jobs in banking and the financial sector, such as in



accountancy firms. Applied mathematics is the application of mathematical methods by different fields such as physics, engineering, medicine, biology, finance, business, computer science, and industry. Thus, applied mathematics is a combination of mathematical science and specialized knowledge.

Econometrics is a scientific combination of economic theory, mathematical economics, economic statistics and mathematical statistics. The main concern of Mathematical Economics is to express economic theory in mathematical form (equations) without regard to measurability or empirical verification of the theory. The study of economics helps people understand the world around them. It enables people to understand people, businesses, markets and governments, and therefore better respond to the threats and opportunities that emerge when things change.

Use of mathematical models

Algebra, calculus, graph theory and statistics are the different important branches of mathematics that are widely used in economics. Understanding this is extremely important so as to know what mathematics contribute to economics. Moreover, proper knowledge of mathematics is also essential for evaluation and application of the theories developed in economics using mathematical tools.

A mathematical model of the economy is a formal description of certain relationships between quantities, such as prices, production, employment, saving, investment, etc., with the purpose to analyse their logical implications. Economists use models as the primary tool for explaining or making predictions about economic issues and problems. Broad applications include: optimization problems as to goal equilibrium, whether of a household, business firm, or policy maker. Static (or equilibrium) analysis in which the economic unit (such as a household) or economic system (such as a market or the economy) is modelled as not changing.

Mathematics helps economists to perform quantifiable experiments and create models for predicting future economic growth. Advances in computing power, large-data techniques, and other advanced mathematical technologies have played a major role in making quantitative methods a fundamental aspect of economics. The field of Statistics deals with collection, organisation, analysis, interpretation and presentation of data. Statistics plays a vital role in understanding economic data such as the relationship between the quantity and price, supply and demand, economic output, GDP, per capita income of nations etc.

A basic knowledge in mathematics is essential for life. For instance, knowledge of mathematics is essential for cooking. It is very common to use a half or double of a recipe. In this case, people use proportions and ratios to make correct calculations for each ingredient. Statistics can be applied in data acquisition, analysis, explanation, interpretation, and presentation. The uses of statistics in research can lead researchers to summarization, proper characterization, performance, and description of the outcome of the research. Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions.

Statistics help in providing data as well as tools to analyze the data. Some powerful techniques are index numbers, time series analysis, and also forecasting. These are immensely useful in the analysis of data in economic planning. Further, statistical techniques help in framing planning models too. Business Mathematics is mathematics used by commercial enterprises to record and manage business operations. Commercial organizations use mathematics in accounting, inventory management, marketing, sales forecasting, and financial analysis.



Mathematical tools used in economics

A lot of mathematical concepts are used in the theories of economic analysis and in the explanation of various economic problems by establishing relationships between different economic variables. Mathematical functions are excessively used in developing economic models to establish relationship between two or more economic variables. It is always a fact that many variables directly or indirectly affect many problems in economics.

Decisions shape human life. Mathematics serves as a very strong tool to evaluate and improve the quality of information in the face of uncertainty, to present and clarify options, to model available alternatives and their consequences, and even to control the smaller decisions necessary to reach a larger goal.

Economics is the study of how societies use scarce resources to produce valuable commodities and distribute them among different people. Thus economics is an important subject because of the fact of scarcity and the desire for efficiency. Economics is defined as a science that deals with the making, distributing, selling and purchasing of goods and services. An example of economics is the study of the stock market. Economic theory is based on the assumption that investors and consumers are rational and very “efficient machines,” namely, that they make the best choices for themselves. Laboratory tests reveal that investors' behaviour is much more complicated relative to the behaviour assumed in most economic theories. Statistics is the mathematical science involving the collection, analysis and interpretation of data. A number of specialties have evolved to apply statistical and methods to various disciplines. For instance, Astrostatistics is the discipline that applies statistical analysis to the understanding of astronomical data. Science and mathematics are intimately connected, particularly in fields such as chemistry, astronomy and physics. More complex mathematics, such as geometry, algebra and calculus, can help students solve chemistry problems, understand the movements of the planets and analyse scientific studies. Even in the case of economics, mathematics plays a very important role.

Problems of Profit Maximisation

The Linear and non-linear programming problems of maximisation of profit subjected to certain given constraints constitute the branch of Operations Research. This branch of mathematics has a significant relevance in economic viewpoint. In Warfield, business and a lot of other day to day situations the theory of maximisation of profit is important. Apart from the areas discussed here, mathematics is applied in one form or the other in a lot of important practical life areas which are economically important. In addition other branches like game theory also rest in the shoulders of mathematics. If a function can be formulated using various interrelated variables, then the rate of change of one of the variable with respect to the other variables may be obtained by differentiating the function. Similarly integration, differential equations, results on various sequences and series etc. are having large number of applications in problems of economic importance. The theory of mathematics based on logic, reasoning, accuracy and deductive methods definitely provide the economist the power to analyse the existing factors of the system under consideration and to arrive in a scientific conclusion.



Conclusion

Mathematics is incredibly important in human life and it is very important realizing them. We use mathematical concepts, logic, reasoning and other skills such that speed and accuracy that we learn from doing mathematical problems, every day. The laws of mathematics govern everything around us, and a good understanding of these laws definitely enable one to encounter significant problems in life.

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