ON QUANTITATIVE METHODS OF MATHEMATICS

Bipinkumar V

Department of Mathematics, Sree Narayana College,

Cherthala, Alappuzha, Kerala, India.

vbkumarsncmaths@gmail.com

Abstract

The various quantitative methods of mathematics are widely used to perform quantifiable experiments and derive useful conclusions. The increase in computational power, the ability to derive precise answers, the use of mathematical logic and reasoning and the modern techniques to handle very large data have played a major role in making quantitative methods a fundamental aspect of many scientific areas. This paper is an attempt to review the quantitative methods and mathematical techniques used in other branches of science.

Keywords: Quantitative methods, mathematical tools, statistical tests.

Introduction

Applied mathematics is a strong basement that uses mathematical principles and tools to generate various theories in many branches of science. The concrete and logical foundation of mathematics helps to carry out the investigations related to economics. Also mathematics permits construction of precisely defined models from which it is able to extract useful conclusions. These conclusions which are derived with the help of mathematical logic and reasoning can be tested using statistical data and used to make quantifiable predictions. The combination of mathematical methods, mathematical tools and mathematical logic enabled the excessive development of many branches of sciences. Advances acquired in mathematical computing power, data analysis techniques and other advanced mathematics applications have played a very key role in making quantitative methods a standard element of many branches of science.

Mathematics is a science having precise logical foundation. The world relies upon defining almost all its relevant assumptions, conditions, and all the causal structures in mathematical terms. There are a lot of advantages of using mathematics for the developing theories of other sciences. The use of mathematical tools such as algebra and calculus can help to describe the changes occurring in the respective fields and draw precise inferences from their basic assumptions and definitions. Also, it allows 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 that are very important in designing many policy related matters. The objective of this study is to analyse the applications of mathematical tools and theories in many branches of science. The methodology used is based on secondary data available. The basic definitions of mathematics and statistics can be seen in [1] and [2] . More facts related to applications of mathematics is given in [3] and [4].

Importance of mathematics

Mathematics is incredibly important in all aspects of human life and it is very important realizing the underlying facts to have a clear interpretation of the occurrence of many incidents. We can significant use of mathematical concepts, logic, reasoning and other skills such that speed and accuracy that we learn from doing mathematical problems in many of the situations that occur every day. The laws of mathematics govern everything around us, and a good understanding of these laws definitely enable one to effectively encounter the problems in day to day life. For instance, 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. Similarly 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. Understanding the theories mathematically enables the customer 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. 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.

It is definitely a fact that many problems in science always involve subjective and unobservable elements under study and a precise definition of the problem is never entirely possible without the help of mathematics. This inevitably leads to the interpretation and the related factors that can't be readily fit into a mathematical model. As a result, the people who rely on them as experts and authorities, tend to analyse these problems mathematically. 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. Mathematics students having good knowledge in theory of mathematics, logical and analytical problem solving skills are highly valued in the world.

Applied mathematics and statistics

Mathematics and statistics are complementary disciplines. Most branches of sciences use mathematics and statistics extensively, and some important areas of mathematical research have been motivated by the problems evolved from other branches of sciences. Applied mathematics is the application of mathematical methods to represent theories and analyse problems in other sciences. Mathematics and its tools allow to form meaningful, testable propositions about wide-ranging and complex subjects which could less easily be expressed informally and the drawn results may be effectively used to make significant changes in the respective areas. Statistics and mathematics are used largely in applying mathematical techniques and statistical tests 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 real life problems are possible in the implementation of methodical system of formation of professional competence of future scientists 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.

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. A scientific combination of the theory, mathematical tools, statistical methods and tests form a strong foundation of deductive logic in many branches of sciences. As an example, 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 and statistical models

A basic knowledge in mathematics is essential for life. For instance, knowledge of mathematics is essential even 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. 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 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.

Use of statistical tests and tools

A lot of mathematical concepts are used in the theories and 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 real life. The 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.

Mathematics as a science deals with the making, distributing, selling and purchasing of goods and services. An example is the study of the stock market. The 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.
Quantitative data collection methods include various forms of surveys such as online surveys, paper surveys, mobile surveys and kiosk surveys, face-to-face interviews, telephone interviews, longitudinal studies, website interceptors, online polls, and systematic observations. Quantitative information is often called data, but can also be things other than numbers. Qualitative information involves a descriptive judgment using concept words instead of numbers. There are mainly different types of Quantitative research. They may be classified as descriptive, correlational, causal, comparative quasi-experimental, and other forms of experimental research. Many attempts are made to establish relationships among the variables. These types of design are very similar to true experiments, but with some key differences. Examples of quantitative measurement methods include tracking logs, questionnaires, structured observation, knowledge and achievement tests and physiological health status measures. Primary Quantitative Research Methods include longitudinal survey, correlational research, causal and comparative research (quasi-experimental research) and experimental research

Linear and non-linear programming problems

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. In addition to these statistical measures such as correlation, regression, chi-square test etc. are widly used in many research areas.

Conclusion

Applied mathematics is applying mathematical methods, tools, logic and quantitative techniques in various fields like engineering, physics, chemistry, 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.

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