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Recent Advances in Mathematics To Develop Economics

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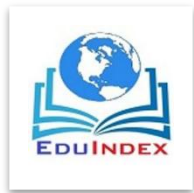
Abstract

Economics is a social science concerned chiefly with description and analysis of the production, distribution, and consumption of goods and services. The market for a product or service is said to be in equilibrium at a price when the quantity demanded equals the quantity supplied. This precalculus based article provides an introductory overview of key notions in economics. It shows how consumer behavior and firms profit-optimizing decisions give rise to a market's demand and supply curves. Algebraic and graphical representations of demand and supply functions are used to examine properties related to a market's equilibrium. The two main branches of economics are microeconomics and macroeconomics. A lot of professionals in banking and accountancy hold economics degrees. For any career related to finance, an economics degree is a good foundation to build on.

Keywords: Supply&Demand, Price&Quantity, Methodological possibility, equilibrium, Research analysis, GDP and EGM.

Introduction

Every academic discipline has its own standards by which it judges the merits of what researchers claim to be true. In the Physical Sciences this typically requires experimental verification. In History it requires links to the original sources. In Economics there are two purposes to apply mathematics in economics, one is the mathematical tools needed to make and understand economic arguments, the second one is, though, is to teach you to speak mathematics as a second language, that is to make you comfortable talking about economics using the shorthand of mathematics. An economist of 19th century cannot even understand the economic Journals of present times. The major development of the second quarter of 20th century in the field of economics was the mathematization of economics. The



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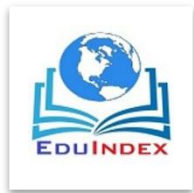
application of mathematical techniques to the analysis of economic problems is a methodological possibility.

During the last six decades, this methodological option has been linked to history of a significant part of economic analysis. The main objectives of the study are the use of mathematical tools in economic theory and to study the application of mathematical techniques in economic research analysis. The methodology of the study is based on secondary data.

E1: Mathematical economics is the application of mathematical methods to represent theories and analyze problems in economics. By convention, these applied methods are beyond simple geometry, such as differential and integral calculus, difference and differential equations, matrix algebra, mathematical programming, and other computational methods. Proponents of this approach claim that it allows the formulation of theoretical relationships with rigor, generality, and simplicity.

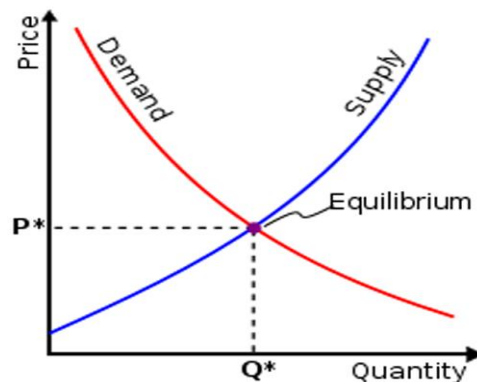
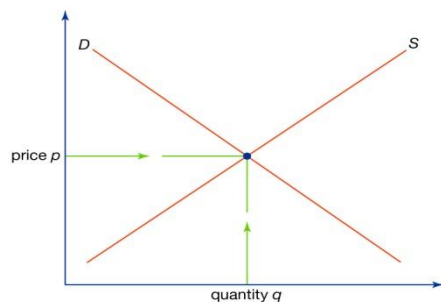
The uses of Differential calculus, Maxima and Minima etc., in economics are attempted to study in this article. The major finding of the study is mathematics played a pivotal role in economic theory and research. As one of the most important macroeconomic statistics indicators, GDP is an effective tool for people to understand and grasp the macroeconomic operation of a country; it is also an important basis for formulating economic policies. However, the calculation of GDP is very complicated, so a good economic growth model (EGM) can effectively form the economic progress problem, and it can reduce the loss of human and material resources.

Mathematics allows economists to form meaningful, testable propositions about wide-ranging and complex subjects which could less easily be expressed informally. Further, the language of mathematics allows economists to make specific, positive claims about controversial or contentious subjects that would be impossible without mathematics. 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. It shows how consumer behavior and firms profit-optimizing decisions give rise to a market's demand and supply curves. Algebraic and graphical representations of demand and supply functions are used to examine properties related to a market's equilibrium.



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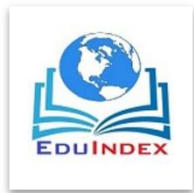
Supply and demand



E2: 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 modeled as not changing
- [comparative statics](#) as to a change from one equilibrium to another induced by a change in one or more factors
- [Dynamic](#) analysis, tracing changes in an economic system over time, for example from [economic growth](#).
- Formal economic modeling began in the 19th century with the use of [differential calculus](#) to represent and explain economic behavior, such as [utility](#) maximization, an early economic application of [mathematical optimization](#). Economics became more mathematical as a discipline throughout the first half of the 20th century, but introduction of new and generalized techniques in the period around the [Second World War](#), as in [game theory](#), would greatly broaden the use of mathematical formulations in economics.

This rapid systematizing of economics alarmed critics of the discipline as well as some noted economists. [John Maynard Keynes](#), [Robert Heilbroner](#), [Friedrich Hayek](#) and others have criticized the



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broad use of mathematical models for human behavior, arguing that some human choices are irreducible to mathematics.

E3: Linear models

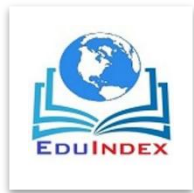
Restricted models of general equilibrium were formulated by John von Neumann in 1937. Unlike earlier versions, the models of von Neumann had inequality constraints. For his model of an expanding economy, von Neumann proved the existence and uniqueness of an equilibrium using his generalization of Brouwer's fixed point theorem. Von Neumann's model of an expanding economy considered the matrix pencil $A - \lambda B$ with nonnegative matrices A and B ; von Neumann sought probability vectors p and q and a positive number λ that would solve the complementarity equation $p^T (A - \lambda B) q = 0$, along with two inequality systems expressing economic efficiency.

In this model, the (transposed) probability vector p represents the prices of the goods while the probability vector q represents the "intensity" at which the production process would run. The unique solution λ represents the rate of growth of the economy, which equals the interest rate. Proving the existence of a positive growth rate and proving that the growth rate equals the interest rate were remarkable achievements, even for von Neumann. Von Neumann's results have been viewed as a special case of linear programming, where von Neumann's model uses only nonnegative matrices. The study of von Neumann's model of an expanding economy continues to interest mathematical economists with interests in computational economics.

E4: Variational calculus and optimal control

Economic dynamics allows for changes in economic variables over time, including in dynamic systems. The problem of finding optimal functions for such changes is studied in variational calculus and in optimal control theory. Before the Second World War, Frank Ramsey and Harold Hotelling used the calculus of variations to that end.

Following Richard Bellman's work on dynamic programming and the 1962 English translation of L. Pontryagin et al.'s earlier work, optimal control theory was used more extensively in economics in



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addressing dynamic problems, especially as to [economic growth](#) equilibrium and stability of economic systems, of which a textbook example is [optimal consumption and saving](#). A crucial distinction is between deterministic and stochastic control models. Other applications of optimal control theory include those in finance, inventories, and production for example.

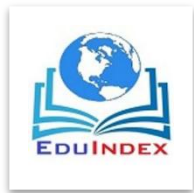
Derivatives and integrals are often used to describe the process of economic development. However, there are still some shortcomings in using classical calculus to model real data. In recent years, the existence of solutions to fractional order differential equations has been studied in. In addition, fractional calculus is widely used to construct economic models; it incorporates the effects of memory in evolutionary processes; experimental results show that the fractional order model is superior to integer order model, such as.

Summarizing, based on fractional calculus, this paper conducts modeling of India's economic growth. Through a case study, it shows that fractional calculus has a better effect than integral calculus in modeling. It would be possible to use Monte Carlo simulation to generate sample data and then conduct modeling comparison. In this paper, real data are used for modeling and then showing the advantage of fractional calculus. The purpose of the two methods is the same, but the case analysis is often more complex and difficult than simulation, so a simulation is not used in this paper.

E5: Functional analysis

It was in the course of proving of the existence of an optimal equilibrium in his 1937 model of [economic growth](#) that [John von Neumann](#) introduced [functional analytic](#) methods to include [topology](#) in economic theory, in particular, [fixed-point theory](#) through his generalization of [Brouwer's fixed-point theorem](#). Following von Neumann's program, [Kenneth Arrow](#) formulated abstract models of economic equilibrium using [convex sets](#) and fixed-point theory.

In general, equilibrium need not be unique. In their models, the ("primal") vector space represented *quantities* while the "dual" vector space represented *prices*. Even in finite dimensions, the concepts of functional analysis have illuminated economic theory, particularly in clarifying the role of prices as [normal vectors](#) to a [hyper-plane supporting](#) a convex set, representing production or



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consumption possibilities. However, problems of describing optimization over time or under uncertainty require the use of infinite-dimensional function spaces, because agents are choosing among functions or [stochastic processes](#).

Conclusion:

Mathematics is an intrinsic part of investigation, testing, design and analysis work undertaken by the Indian statistical Institute [ISI]. It makes it possible to develop a comprehensive data-base of information in a cost-effective way. It enables us to draw value from the data through exploration of the patterns in it, and estimation of the confidence that might reasonably be put in the inferences drawn. A fascinating aspect of the application of mathematics in industry is that, in the practical environment, no particular solution ever seems directly applicable. Rather, the principles of past findings must be understood as a basis for drawing out further solutions, thereby enhancing and developing new theory to fit the real world. To extend and apply that theory appropriately in the practical environment.

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