

HISTORY OF MATHEMATICAL ECONOMICS

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. 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.

The use of mathematics in the service of social and economic analysis dates back to the 17th century. Then, mainly in German universities, a style of instruction emerged which dealt specifically with detailed presentation of data as it related to public administration. Gottfried Achenwall lectured in this fashion, coining the term statistics. At the same time, a small group of professors in England established a method of "reasoning by figures upon things relating to government" and referred to this practice as Political Arithmetick. Sir William Petty wrote at length on issues that would later concern economists, such as taxation, velocity of money and national income, but while his analysis was numerical, he rejected abstract mathematical methodology. Petty's use of detailed numerical data (along with John Graunt) would influence statisticians and economists for some time, even though Petty's works were largely ignored by English scholars.

The mathematization of economics began in the 19th century. Most of the economic analysis of that time was what would later be called classical economics. Subjects were discussed and dispensed with through algebraic means, but calculus was not used. More importantly, until the appearance of Johann Heinrich von Thünen's work "The Isolated State" in 1826, economists did not develop explicit and abstract models for behavior in order to apply the tools of mathematics. Thünen's model of farmland use represents the first example of marginal analysis. Thünen's work was largely theoretical, but he also gave empirical data in order to support his generalizations. In comparison to his contemporaries, Thünen built economic models and tools, rather than applying previous tools to new problems.

Meanwhile, a new cohort of scholars trained in the mathematical methods of the physical sciences gravitated to economics, advocating and applying those methods to their subject, and described today as moving from geometry to mechanics.

These included W.S. Jevons who presented paper on a "general mathematical theory of political economy" in 1862, providing an outline for use of the theory of marginal utility in political economy. In 1871, he published "The Principles of Political Economy", declaring that the subject as science "must be mathematical simply because it deals with quantities". W.S. Jevons expected that only collection of statistics for price and quantities would permit the subject as presented to become an exact science. Others preceded and followed in expanding mathematical representations of economic problems.

For example, Augustin Cournot, a professor of mathematics, developed a mathematical treatment in 1838 for duopoly—a market condition defined by competition between two sellers. This treatment of competition, first published in "Recherches into the Mathematical Principles of Wealth", is referred to as Cournot duopoly. It is assumed that both sellers had equal access to the market and could produce their goods without cost. Further, it assumed that both goods were homogeneous. Each seller would vary one output based on the output of the other and the market price would be determined by the total quantity supplied. The profit for each firm would be determined by multiplying their output and the per unit Market price. Differentiating the profit function with respect to quantity supplied for each firm left a system of linear equations, the simultaneous solution of which gave the equilibrium quantity, price and profits. Cournot's contributions to the mathematization of economics would be neglected for decades, but eventually influenced many of the marginalists. Cournot's models of duopoly and Oligopoly also represent one of the first formulations of non-cooperative games. Today the solution can be given as a Nash equilibrium but Cournot's work preceded modern game theory by over 100 years.