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Chapter 1 : Foundations of Mathematical Economics by Michael Carter

Foundations of Mathematical Economics Michael Carter November 15, Solutions for Foundations of Mathematical Economics.

History of economic thought 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. Most of the economic analysis of the time was what would later be called classical economics. Subjects were discussed and dispensed with through algebraic means, but calculus was not used. Jevons who presented paper on a "general mathematical theory of political economy" in , providing an outline for use of the theory of marginal utility in political economy. Marginalists and the roots of neoclassical economics[edit] Main article: Marginalism Equilibrium quantities as a solution to two reaction functions in Cournot duopoly. Each reaction function is expressed as a linear equation dependent upon quantity demanded. 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 her 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. The behavior of every economic actor would be considered on both the production and consumption side. Walras originally presented four separate models of exchange, each recursively included in the next. The solution of the resulting system of equations both linear and non-linear is the general equilibrium. His notation is different from modern notation but can be constructed using more modern summation notation. Walras assumed that in equilibrium, all money would be spent on all goods: Starting from this assumption, Walras could then show that if there were n markets and n-1 markets cleared reached equilibrium conditions that the nth market would clear as well. This is easiest to visualize with two markets considered in most texts as a market for goods and a market for money. If one of two markets has reached an equilibrium state, no additional goods or conversely, money can enter or exit the second market, so it must be in a state of equilibrium as well. Walras used this statement to move toward a proof of existence of solutions to general equilibrium but it is commonly used today to illustrate market clearing in money markets at the undergraduate level. Walras abstracted the marketplace as an auction of goods where the auctioneer would call out prices and market participants would wait until they could each satisfy their personal reservation prices for the quantity desired remembering here that this is an auction on all goods, so everyone has a reservation price for their desired basket of goods. The market would "clear" at that priceâ€”no surplus or shortage would exist. While the process appears dynamic, Walras only presented a static model, as no transactions would occur until all markets were in equilibrium. In practice very few markets operate in this manner. Referred to as the "core" of the economy in modern parlance, there are infinitely many solutions along the curve for economies with two participants [32] Given two individuals, the set of solutions where the both individuals can maximize utility is described by the contract curve on what is now known as an Edgeworth Box. While at the helm of The Economic Journal , he published several articles criticizing the mathematical rigor of rival researchers, including Edwin Robert Anderson Seligman , a noted skeptic of mathematical economics. Edgeworth noticed that a monopoly producing a good that had jointness of supply but not jointness of demand such as first class and economy on an airplane, if the plane flies, both sets of seats fly with it might actually lower the price seen by the consumer for one of the two commodities if a tax were applied. Common sense and more traditional, numerical analysis seemed to indicate that this was preposterous. Seligman insisted that the results Edgeworth achieved were a quirk of his mathematical formulation. He suggested that the assumption of a continuous demand function and an infinitesimal change in the tax resulted in the paradoxical predictions. Harold Hotelling later showed that Edgeworth was correct and that the same result a "diminution of price as a result of the tax" could occur with a discontinuous demand function and large changes in the tax rate.

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