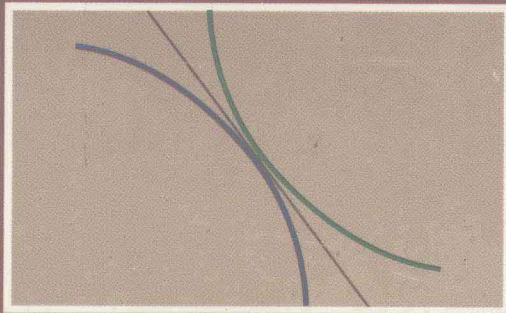


DAVID G. LUENBERGER

MICROECONOMIC THEORY



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David G. Luenberger

Stanford University

McGraw-Hill, Inc.

New York St. Louis San Francisco Auckland Bogotá Caracas
Lisbon London Madrid Mexico City Milan Montreal New Delhi
San Juan Singapore Sydney Tokyo Toronto

This book was set in Lucida Bright by Publication Services, Inc.
The editors were Scott D. Stratford and Lucille H. Sutton;
the production supervisor was Friederich W. Schulte.
The cover was designed by Hermann Strohbach.
Project supervision was done by Publication Services, Inc.
R. R. Donnelley & Sons Company was printer and binder.

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1 2 3 4 5 6 7 8 9 0 DOC DOC 9 0 9 8 7 6 5 4

ISBN 0-07-049313-8

Library of Congress Cataloging-in-Publication Data

Luenberger, David G., (date).

Microeconomic theory / David G. Luenberger.

p. cm.

Includes index.

ISBN 0-07-049313-8

1. Microeconomics. I. Title.

HB172.L945 1995

338.5—dc20

94-40073

INTERNATIONAL EDITION

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McGraw-Hill. The International Edition is not available in North America.

When ordering this title, use ISBN 0-07-113465-4.

MICROECONOMIC THEORY

**To THE MEMORY OF
William K. Linvill**

PREFACE

This book is intended to serve as a basic textbook in microeconomic theory, primarily at the beginning graduate or advanced undergraduate levels. Like any book at this level, this book has several interacting objectives, all of which are important. Most obvious, of course, is the presentation of the broad range of topics that make up the subject of microeconomics, including the theories of production, consumer choice, efficiency and equilibria, externalities, welfare, and uncertainty. This material is extraordinarily rich in conceptual content, making the subject quite exciting and challenging both to teach and to learn. This book has, then, as one objective to present a comprehensive treatment of the basic concepts of the subject as well as to present a sampling of advanced and specialized topics that enrich the field. The book also points to the history of the subject by providing notes and references to important works.

In addition to presenting the vast assortment of economic concepts, a course in microeconomic theory at this level also faces the challenge of having to teach advanced methods of mathematical expression. Frequently, it is in this course that students learn to represent economic concepts using the formalism of sets and mappings, to use global analysis methods, such as convexity and fixed point theorems, to construct proofs, and to sharpen their skills in moving between mathematical expression and economic interpretation. This leap to a new level of scientific and mathematical sophistication is perhaps the most important aspect of a course of this nature. It is this skill that will enable students to continue to absorb and create economic concepts throughout their careers. This text is intended to facilitate this leap.

Another objective of a text in this area is to show how microeconomics can be applied to real situations. However, it is recognized that application occurs in two fundamentally different modes. In one mode, microeconomic concepts are used to gain understanding and to suggest broad outlines of possible policy changes. For example, the fact that a competitive equilibrium is Pareto efficient might suggest that free markets are more desirable than a regulated distribution of goods. The second mode of application is more specific. In this mode one considers a specific situation, such as the problem of a specific firm, and attempts to work out a specific solution, such as a pricing policy. For the first mode of application, an understanding

of concepts is often sufficient. For the second, it is also necessary that one possess a mastery of the techniques for implementing the concepts. For example, one might need to know how to compute an equilibrium as well as know that one exists. This text attempts to teach this aspect of economics by including several examples of both modes.

A final aspect of microeconomics that must be recognized is that microeconomics is a science, and as such its theories must be tested. Sometimes this can be done by direct experimentation. However, the nature of the subject makes it difficult to conduct controlled experiments on a scale large enough to evaluate many aspects of the theory meaningfully. Accordingly, the methods for systematic testing of economic theory make up a large special subject, typically treated in other courses. This text attempts to point out important established results whenever possible, but it does not provide detailed coverage of this aspect.

The text was designed according to a particular weighting of the general objectives outlined above. First priority is given to a mixture of the first two: presentation of the subject itself and development of the skills necessary for students to make the leap in sophistication with respect to rigorous expression of and use of concepts. Once students understand the fundamental principles and make the leap in sophistication, they are prepared to delve deeply into any particular topic, even if it is not included within the text.

A special technical feature of this book is the introduction of the benefit function and related concepts. This material arises in many portions of the book and serves as a kind of unifying theme. This material was in fact not contained in the early versions of the text, for the topic evolved gradually as I worked through the chapters. It seemed clear all along that Pareto efficiency and equilibria should each be related to some general optimization principle. Ultimately, I found that this idea could be expressed as the *zero-maximum* principle and its dual, the *zero-minimum* principle. In various forms these principles actually have roots that go back a long time in economic thought, but I believe that this is the first general textbook that includes significant discussion of them.

The exercises are a major part of the text. Some are versions of standard exercises in texts of this type, but many are original, being developed with the help of many individuals. The exercises emphasize the objectives of the text. Hence they are intended to illustrate the theory, present extensions of the theory, help students develop facility in mathematical expression of economic ideas, and show how the theory can be applied. (A solutions manual is available to instructors.) Several exercises are classroom demonstrations. I have found that inclusion of one or two of these each semester can help make the material come alive—and they are a lot of fun!

Some of the sections, subsections, and exercises are marked with a star (an asterisk *). For sections and subsections a star indicates that the material is rather difficult or perhaps tangential. Generally, it is safe to skip over

starred sections at the first reading. Starred exercises are more difficult than others.

The organization of the book is, I think, relatively standard. The theory of production and of the firm are presented first in Chapters 2 and 3. This material requires relatively few behavioral assumptions, is a good introduction to the kind of mathematical technique that is important, and can be used to address numerous economic applications. Next, in Chapters 4 and 5 the theories of individual preferences and demand are presented. These require somewhat more profound behavioral assumptions, and expand on the mathematical methods (especially those of duality), but they have fewer direct economic applications.

In Chapters 6 and 7 the two previous segments are linked by consideration of overall efficiency and competitive equilibrium. This material is perhaps the heart of modern microeconomic theory, it contains the central theorems relating Pareto efficiency to equilibria and establishing the existence of competitive equilibria.

Chapter 8 is devoted to a fairly brief introduction to game theory. Game theory is a fundamental tool for modern economic analysis, and this chapter develops the tools and concepts that are required for the subsequent chapters.

Chapters 9 and 10 are devoted to externalities and welfare, respectively. Both of these are important topics that go beyond standard competitive analysis, and they are an integral part of any microeconomics course.

Finally, Chapters 11 and 12 discuss uncertainty and information. These are modern topics, for textbooks of a decade or two ago rarely included more than a few sections on uncertainty and information. Now these subjects are considered to be essential to a full course on microeconomics.

The writing of this book spanned approximately 10 years, and the book itself went through several evolutionary stages as I continued to learn new things about economics and as the concepts related to the benefit function developed. It is perhaps obvious that many people contributed to this project, either directly through reading drafts or suggesting exercises or indirectly by providing comments on benefit function theory. I would like especially to thank Kenneth Arrow, Hanan Bell, Pamela Brown, David Cariño, Mark Cronshaw, Darrell Duffie, Stephen Fan, Philip Hanser, Robert Maxfield, Scott McKeon, Maria Luisa Petit, Neal Stoughton, Robert Welch, and Andrew Yates for their comments and help. The final text was improved by the suggestions of the following reviewers: Scott Atkinson, University of Georgia; Gauttam Bhattacharya, University of Kansas; David Card, Princeton University; Kevin Cotter, Wayne State University; Roy Gardner, University of Indiana—Bloomington; Richard Jensen, University of Kentucky; John Pencavel, Stanford University; and Al Slivinski, University of Western Ontario.

My editors, Scott Stratford and Lucille Sutton, had continuing faith in this project and provided every resource possible to complete it in excellent

fashion. Support for much of the research that accompanied this project was provided by the National Science Foundation, to which I am very grateful.

One special person who has been with this project from the beginning to the end, who entered the text in the word processor, corrected the grammar, and kept the manuscript in order through all of its transmutations, is Nancy Florence. I thank her especially. I offer special thanks to my family members, especially my wife, Nancy. This project would not have been accomplished without their understanding of lost weekends and their continuing encouragement and support.

This book is dedicated to the memory of Professor William K. Linvill, who was inspiration, teacher, friend, and colleague to many of us at Stanford and elsewhere. He passionately advanced the vision that analytic methods could contribute significantly to the understanding and solution of a broad assortment of important world problems and issues, and he long ago convinced me that microeconomic theory represents an important class of analytic methods ideally suited for that purpose.

Finally, I want to thank all the students who endured the many early versions of the text. Perhaps these students felt that they were contributing to the welfare of future generations of students, for their suggestions were marked by wonderful enthusiasm and support. I thank them for all they taught me!

David G. Luenberger
Stanford
October 1994

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Chapter 1

INTRODUCTION

1.1 What Is Microeconomics?

It is not easy to give a concise definition of economics, but almost everyone has a general notion of what it is. It is, at least in part, the study of how scarce resources are distributed, including how they are employed for the production of other goods and services and how goods and services are chosen for consumption by individuals. Economics also includes the study of possible institutional mechanisms for facilitating and guiding this distribution, such as various market structures, incentive plans, tax mechanisms, and regulations. Finally, the field of economics studies the relation between individual desires and societal objectives—how these can be reconciled, and how the economy can be structured to be best in some sense. These themes are discussed further in this introduction, and they run throughout the text; but as for any richly complex subject, a list of the main themes can only be an overview, not a real definition of the subject. As one studies the subject, a deeper understanding of its very definition is obtained.

Economic theory is divided into *microeconomics* and *macroeconomics*. The division is a bit arbitrary, since both are concerned with the broad subjects outlined above. Actually, the distinction between the two relates more directly to the methods employed than to a partitioning of the overall sphere of economic problems. Nevertheless, the two methods do lend themselves to different kinds of problems.

Microeconomics describes economic activity at the level of individual agents, such as consumers, investors, or managers of firms. Microeconomic theory is founded on the premise that these individuals behave rationally, making choices that are optimal for themselves. Under this premise, the theory can deduce the choices that would be made in various situations if the choice criteria of an individual or a firm are known.

Microeconomic theory also describes production and trade of elemental commodities, such as bread, automobiles, haircuts, ski trips, and so forth. In a specific analysis, groups of commodities might be aggregated, to reduce dimensionality, but the theory does not rely on such aggregation. At the most general level, microeconomic theory describes production processes