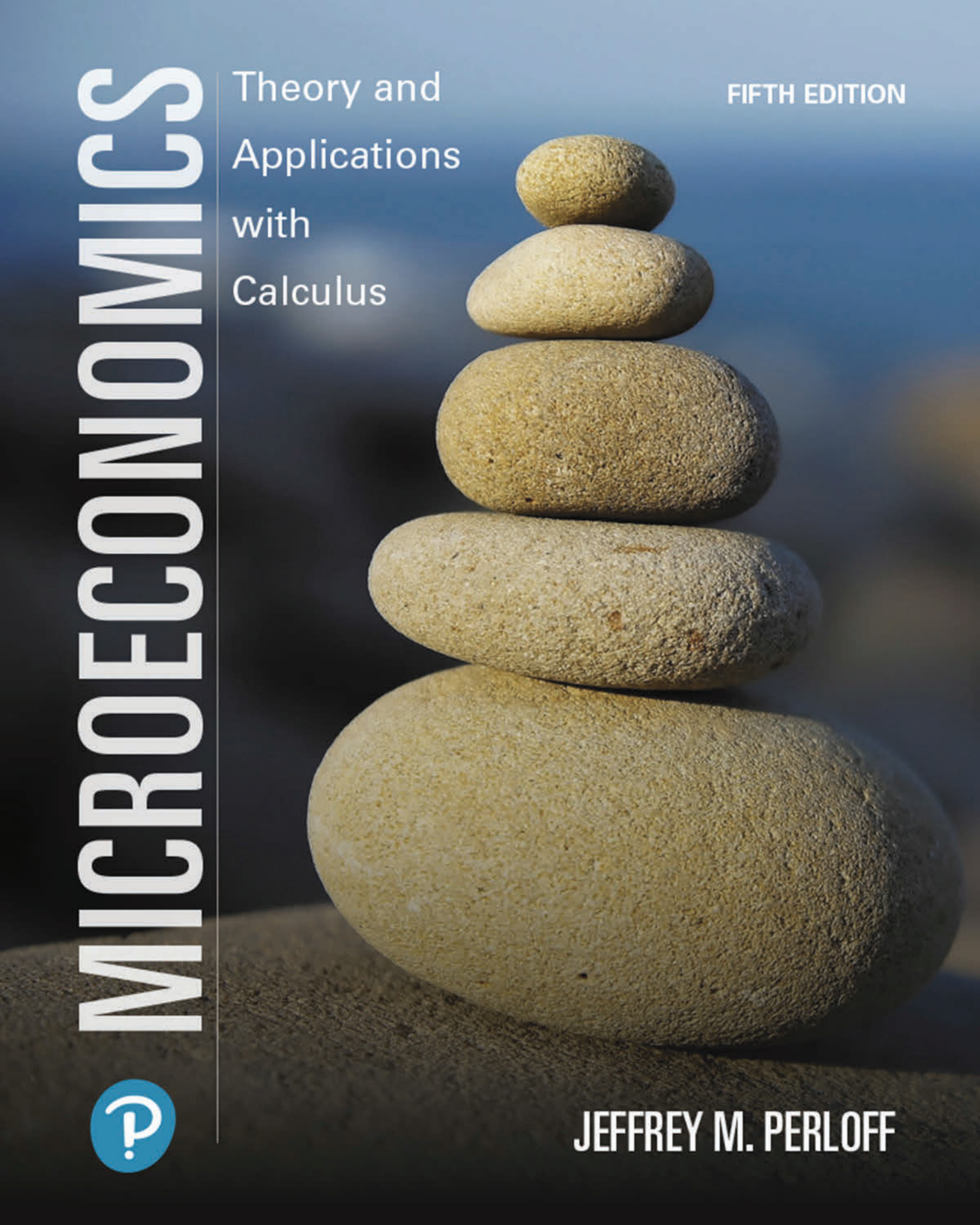
# MICROECONOMICS

## Theory and Applications with Calculus

FIFTH EDITION



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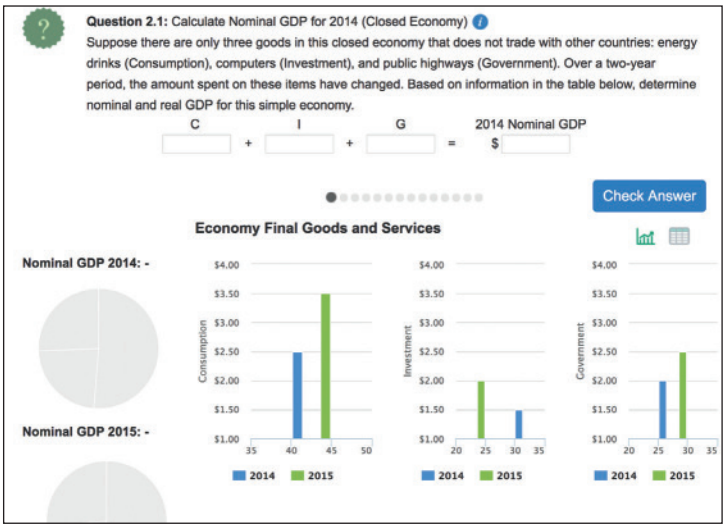


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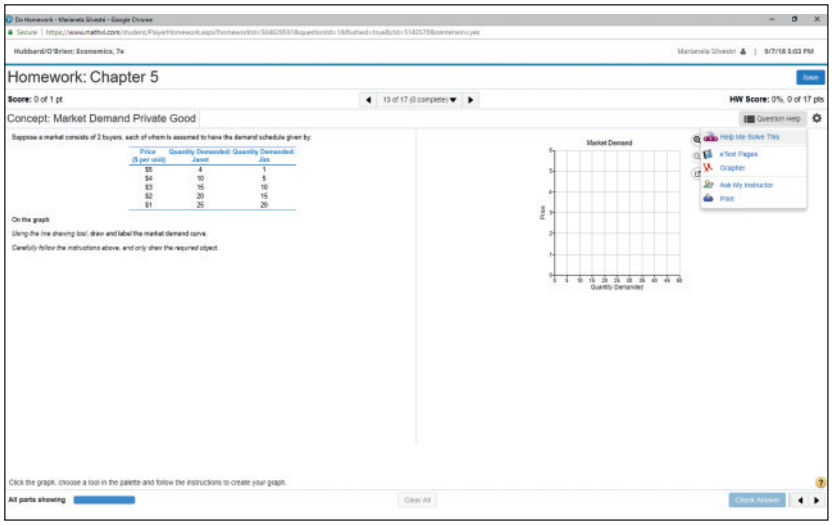


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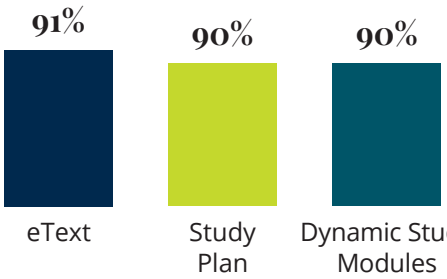


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# MICROECONOMICS

## THEORY AND APPLICATIONS WITH CALCULUS

FIFTH EDITION

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## THEORY AND APPLICATIONS WITH CALCULUS

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**JEFFREY M. PERLOFF**
University of California, Berkeley

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# Preface

This book is a new type of intermediate microeconomics textbook. Previously, the choice was between books that use calculus to present formal theory dryly and with few, if any, applications to the real world and books that include applications but present theory using algebra and graphs only. This book uses calculus, algebra, and graphs to present microeconomic theory based on actual examples and then uses the theory to analyze real-world problems. My purpose is to show that economic theory has practical, problem-solving uses and is not an empty academic exercise.

This book shows how individuals, policymakers, and firms use microeconomic tools to analyze and resolve problems. For example, students learn that:

- individuals can draw on microeconomic theories when deciding whether to invest and whether to sign a contract that pegs prices to the government's measure of inflation;
- policymakers (and voters) can employ microeconomics to predict the impact of taxes, regulations, and other measures before they are enacted;
- lawyers and judges use microeconomics in antitrust, discrimination, and contract cases; and
- firms apply microeconomic principles to produce at least cost and maximize profit, select strategies, decide whether to buy from a market or to produce internally, and write contracts to provide optimal incentives for employees.

My experience in teaching microeconomics for the departments of economics at the Massachusetts Institute of Technology; the University of Pennsylvania; the University of California, Berkeley; the Department of Agricultural and Resource Economics at Berkeley; and the Wharton Business School has convinced me that students prefer this emphasis on real-world issues.

## Changes in the Fifth Edition

This edition is substantially revised:

- It added an extensive Appendix on basic calculus (which was available only online in the previous edition).
- It includes two new features: Common Confusions and Unintended Consequences. Common Confusions describe a widely held belief that economic theory or evidence rejects. Unintended Consequences describe how some policies and other actions have potent side-effects beyond the intended ones.
- All the chapters are moderately to substantially revised and updated, including the many examples embedded in the chapters, Solved Problems, end-of-chapter problems, and other features.

- Of this edition's 128 Applications, 81% are new (26%) or revised (55%). Sixty percent of the Applications are international or concern countries other than the United States. In addition, we've added 23 Applications to MyLab Economics, bringing the total number of additional Applications online to 238.
- Compared to the previous edition, this edition has 7 additional figures (215 total), 2 more photos (52), and 4 new cartoons (22), which I claim illustrate important economic concepts.

## Revised Chapters

Some of the major changes in the presentation of theories in the chapters include:

**Supply and Demand.** Chapter 2 was generally rewritten and has a revised section on taxes.

**Consumer Theory.** The most important changes to Chapters 3–5 include a major revision to the consumer surplus section, an embedded example based on UberX, more details about federal marginal tax rates, and a new Solved Problem.

**Production and Costs.** Chapter 6 has a new discussion of kinked isoquants based on self-driving trucks and a revised discussion of efficiency and a revised Challenge Solution. Chapter 7 also has a revised discussion of efficiency and a revised Challenge Solution.

**Competition.** Chapters 8 and 9 have revised Challenge Solutions and a Solved Problem, a new Solved Problem, a revised section comparing tariffs to quotas, a revised discussion of efficiency and market failures including adding a discussion of allocative inefficiency. This edition now systematically defines deadweight loss as a positive number in this chapter and in subsequent chapters.

**General Equilibrium and Economic Welfare.** Chapter 10 has a revised Solved Problem.

**Monopoly.** Chapter 11 has many changes. The previous section on Network Externalities was replaced with a new section, Internet Monopolies: Network Externalities, Behavioral Economics, and Natural Monopoly, which emphasizes new economic challenges in internet industries. Subsections include new discussions of two-sided markets and disruptive technologies. It includes a revised and a new Solved Problem.

**Pricing and Advertising.** Chapter 12 has many new examples. The key price discrimination analysis now uses Tesla car sales in the United States and in Europe (based on actual data, as always). Its discussions on identifying groups, two-part pricing, the mathematical parts of the Challenge Solution, and several figures are revised. One of the Solved Problems is new.

**Game Theory and Oligopoly.** Chapter 13 on game theory has two new Solved Problems. It uses new examples to illustrate the theory. It has a new two-sided market section. Its section on Dynamic Games is revised. It has new material on limit pricing and double auctions. Chapter 14 has revised discussions of strategic trade and differentiated products and new figures and a table.

**Factor Markets.** Chapter 15 includes a new discussion on the frequency of compounding. The Challenge Solution is revised.

**Uncertainty.** Chapter 16 has a revised section on the risk premium and now formally defines certainty equivalence.

**Externalities and Public Goods.** Chapter 17 has a new Solved Problem. The section on public goods is completely revised including the figure.

**Asymmetric Information.** Chapter 18 has revisions to the sections on Products of Unknown Quality and Universal Coverage. It includes a new section on noisy monopoly.

### Challenges, Solved Problems, and End-of-Chapter Exercises

The Solved Problems (which show students how to answer problems using a step-by-step approach) and Challenges (which combine an Application with a Solved Problem) are very popular with students, so this edition increases the number by 6 to 116. After Chapter 1, each chapter starts with a Challenge (a problem based on an Application) and ends with its solution. In addition, many of the Solved Problems are linked to Applications. Each Solved Problem has at least one similar end-of-chapter exercise, which allows students to demonstrate that they've mastered the concept in the Solved Problem.

This edition has 809 end-of-chapter exercises, which is over 8% more than in the last edition. Of the total, 12% are new or revised and updated. Every end-of-chapter exercise is available in MyLab Economics. Students can click on the end-of-chapter exercise in the eText to go to MyLab Economics to complete the exercise online, get tutorial help, and receive instant feedback.

## How This Book Differs from Others

*Microeconomics: Theory and Applications with Calculus* differs from most other microeconomics texts in four main ways, all of which help professors teach and students learn. First, it uses a mixture of calculus, algebra, and graphs to define economic theory. Second, it integrates estimated, real-world examples throughout the exposition, in addition to offering extended Applications. Third, it places greater emphasis on modern theories—such as industrial organization theories, game theory, transaction cost theory, information theory, contract theory, and behavioral economics—that are useful in analyzing actual markets. Fourth, it employs a step-by-step approach that demonstrates how to use microeconomic theory to solve problems and analyze policy issues.

To improve student results, I recommend pairing the text content with **MyLab Economics**, which is the teaching and learning platform that empowers you to reach every student. By combining trusted author content with digital tools and a flexible platform, MyLab personalizes the learning experience and will help your students learn and retain key course concepts while developing skills that future employers are seeking in their candidates. MyLab Economics allows professors increased

flexibility in designing and teaching their courses. Learn more at www.pearson.com/mylab/economics.

# Solving Teaching and Learning Challenges

In the features of the book and MyLab Economics, I show how to apply theory and analysis learned in the classroom to solving problems and understanding real-world market issues outside of class.

## Using Calculus to Make Theory Clear to Students

Microeconomic theory is primarily the study of maximizing behavior. Calculus is particularly helpful in solving maximization problems, while graphs help illustrate how to maximize. This book combines calculus, algebra, graphs, and verbal arguments to make the theory as clear as possible.

## Real-World Examples and Applications

To convince students that economics is practical and useful—not just a textbook exercise—this book presents theories using examples of real people and real firms based on actual market data rather than artificial examples. These real economic stories are integrated into the formal presentation of many economic theories, discussed in Applications, and analyzed in what-if policy discussions.

**Integrated Real-World Examples.** This book uses real-world examples throughout the narrative to illustrate many basic theories of microeconomics. Students learn the basic model of supply and demand using estimated supply-and-demand curves for corn and coffee. They analyze consumer choice by employing estimated indifference curves between live music and music tracks. They see estimates of the consumer welfare from UberX. They learn about production and cost functions using estimates from a wide variety of firms. Students see monopoly theory applied to a patented pharmaceutical, Botox. They use oligopoly theories to analyze the rivalry between United Airlines and American Airlines on the Chicago–Los Angeles route, and between Coke and Pepsi in the cola industry. They see Apple's monopoly pricing of iPads and learn about multimarket price discrimination through the use of data on how Tesla sets prices across countries.

**Applications.** The text includes many Applications at the end of sections that illustrate the versatility of microeconomic theory. The Applications focus on such diverse topics as:

- the derivation of an isoquant for semiconductors, using actual data;
- how 3D printing affects firms' decisions about scale and its flexibility over time and is undermining movie studios;
- the amount by which recipients value Christmas presents relative to the cost to gift givers;
- why oil companies that use fracking are more likely to shut down;
- whether buying flight insurance makes sense;
- whether going to college pays.

**APPLICATION**

**Welfare Effects of Allowing Fracking**

Technological advances have made hydraulic fracturing—fracking—a practical means to extract natural gas as well as oil from shale formations that previously could not be exploited (see the Application "Fracking and Shutdowns" in Chapter 8). Opponents of fracking fear that it pollutes air and water and triggers earthquakes. Due to their opposition, governments limit or prohibit fracking in parts of the United States and Europe.

Hausman and Kellogg (2015) used estimated natural gas supply and demand curves to calculate the welfare effects of permitting fracking firms to enter the gas market. They found that the rightward shift of the supply curve reduced the U.S. natural gas price by 47% in 2013. As a result, consumer surplus increased substantially, particularly in the south central and midwestern United States, where the industrial and electric power industries use large quantities of gas. This drop in price was sufficient to reduce producer surplus. Hausman and Kellogg concluded that the total surplus increased by $48 billion, but noted that this calculation ignores any possible harmful environmental effects.

**What-If Policy Analysis.** This book uses economic models to probe the likely outcomes of changes in public policies. Students learn how to conduct what-if analyses of policies such as taxes, subsidies, barriers to entry, price floors and ceilings, quotas and tariffs, zoning, pollution controls, and licensing laws. The text analyzes the effects of taxes on virtually every type of market. The book also reveals the limits of economic theory for policy analysis. For example, to illustrate why attention to actual institutions is important, the text uses three different models to show how the effects of minimum wages vary across types of markets and institutions. Similarly, the text illustrates that a minimum wage law that is harmful in a competitive market may be desirable in certain noncompetitive markets.

## Modern Theories

The first half of the book (Chapters 2–10) examines competitive markets and shows that competition has very desirable properties. The rest of the book (Chapters 11–19) concentrates on imperfectly competitive markets—in which firms have market power (the ability to profitably set price above the unit cost of production), firms and consumers are uncertain about the future and have limited information, a market has an externality, or a market fails to provide a public good. This book goes beyond basic microeconomic theory and looks at theories and applications from many important contemporary fields of economics. It extensively covers problems from resource economics, labor economics, international trade, public finance, and industrial organization. The book uses behavioral economics to discuss consumer choice, bandwagon effects on monopoly pricing over time, and the importance of time-varying discounting in explaining procrastination and in avoiding environmental disasters. This book differs from other microeconomics texts by using game theory throughout the second half rather than isolating the topic in a single chapter. The book introduces game theory in Chapter 13, analyzing both static games (such as the prisoners' dilemma) and multi-period games (such as collusion and preventing entry). Special attention is paid to auction strategies. Chapters 14, 16, 17, 18, and 19 employ game theory to analyze oligopoly behavior and many other topics. Unlike most texts,

this book covers pure and mixed strategies and analyzes both normal-form and extensive-form games. The last two chapters draw from modern contract theory to extensively analyze adverse selection and moral hazard, unlike other texts that mention these topics only in passing, if at all. The text covers lemons markets, signaling, shirking prevention, and revealing information (including through contract choice).

## Step-by-Step Problem Solving

Many instructors report that their biggest challenge in teaching microeconomics is helping students learn to solve new problems. This book is based on the belief that the best way to teach this important skill is to demonstrate problem solving repeatedly and then to give students exercises to do on their own. Each chapter (after Chapter 1) provides several Solved Problems that show students how to answer qualitative and quantitative problems using a step-by-step approach. Rather than empty arithmetic exercises demanding no more of students than employing algebra or a memorized mathematical formula, the Solved Problems focus on important economic issues such as analyzing government policies and determining firms' optimal strategies.

One Solved Problem uses game theory to examine why Intel and AMD use different advertising strategies in the central processing unit (CPU) market. Another shows how a monopolistically competitive airline equilibrium would change if fixed costs (such as fees for landing slots) rise. Others examine why firms charge different prices at factory stores than elsewhere and when markets for lemons exist, among many other topics.

The Solved Problems illustrate how to approach the formal end-of-chapter exercises. Students can solve some of the exercises using graphs or verbal arguments, while others require math.

**SOLVED PROBLEM 18.1**

MyLab Economics Solved Problem

Suppose that everyone in our used-car example is risk neutral; potential car buyers value lemons at \$4,000 and good used cars at \$8,000; the reservation price of lemon owners is \$3,000; and the reservation price of owners of high-quality used cars is \$7,000. The share of current owners who have lemons is $\theta$. (In our previous example, the share was $\theta = \frac{1}{2} = 1{,}000/[1{,}000 + 1{,}000]$). For what values of $\theta$ do all the potential sellers sell their used cars? Describe the equilibrium.

**Answer**

1. *Determine how much buyers are willing to pay if all cars are sold.* Because buyers are risk neutral, if they believe that the probability of getting a lemon is $\theta$, the most they are willing to pay for a car of unknown quality is

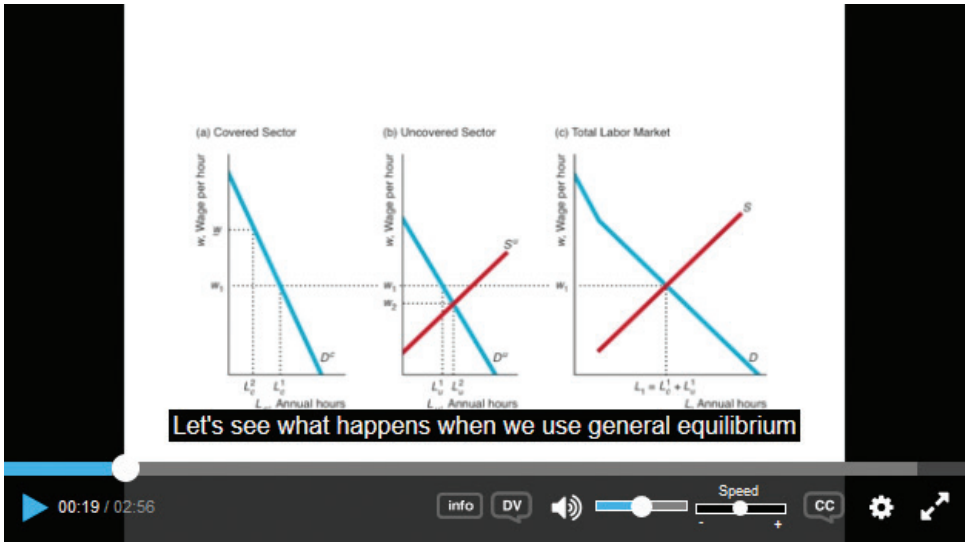
$$p = [\$8{,}000 \times (1 - \theta)] + (\$4{,}000 \times \theta) = \$8{,}000 - (\$4{,}000 \times \theta). \quad (18.1)$$

For example, $p = \$6{,}000$ if $\theta = \frac{1}{2}$ and $p = \$7{,}000$ if $\theta = \frac{1}{4}$.

2. *Solve for the values of $\theta$ such that all the cars are sold, and describe the equilibrium.* All owners will sell if the market price equals or exceeds their reservation price, \$7,000. Using Equation 18.1, we know that the market (equilibrium) price is \$7,000 or more if a quarter or fewer of the used cars are lemons, $\theta \leq \frac{1}{4}$. Thus, for $\theta \leq \frac{1}{4}$, all the cars are sold at the price given in Equation 18.1.

## MyLab Economics Videos

Today's students learn best when they analyze and discuss topics in the text outside of class. To further students' understanding of what they are reading and discussing in the classroom, we provide a set of videos in MyLab Economics. In these videos, Tony Lima presents key figures, tables, and concepts in step-by-step animations with audio explanations that discuss the economics behind each step.




# Developing Career Skills

This book helps you develop valuable career skills. Whether you want to work in business, government, academia, or in other areas, a solid knowledge of economics is invaluable. Employers know that you need economic skills to perform well. They also know that the more rigorous and mathematically based your training, the better you will be at logical thinking.

- Studies show that job seekers with an undergraduate degree who have economics and math training generally receive higher salaries than those with degrees in most other fields. Law schools and MBA programs are more likely to admit students with economics and math training than others, because they know how useful these skills are as well as the training in logic thinking. This training also increases your chances of getting into top graduate programs in economics, agricultural and resource economics, public policy, urban planning, and other similar fields, which is a necessary step for many careers in academia, government, and consulting.
- This book starts by illustrating how to use economic reasoning to analyze and solve a variety of problems. It trains you to use logical analysis based on empirical evidence. You will learn how to apply a variety of verbal, graphical, and mathematical techniques to solve the types of problems that governments, firms, and other potential employers face on a daily basis. In addition to training you in traditional economic analysis, this book shows you how to use game theory, behavioral economics, and other cutting-edge theories to confront modern-day challenges. For example, you'll see how firms develop contracts to motivate workers and executives to perform well, analyze how oligopolistic firms develop strategies; why online platforms (two-sided markets) that bring buyers and sellers together, such as eBay, are highly concentrated; and how disruptive innovations such as 3D printing affect markets.

# Alternative Organizations

Because instructors cover material in many different orders, the text permits maximum flexibility. The most common approach to teaching microeconomics is to cover some or all of the chapters in their given sequence. Common variants include:

- presenting uncertainty (Sections 16.1 through 16.3) immediately after consumer theory;
- covering competitive factor markets (Section 15.1) immediately after competition (Chapters 8 and 9);
- introducing game theory (Chapter 13) early in the course; and
- covering general equilibrium and welfare issues (Chapter 10) at the end of the course instead of immediately after the competitive model.

Instructors can present the material in Chapters 13–19 in various orders, although Section 16.4 should follow Chapter 15, and Chapter 19 should follow Chapter 18 if both are covered.

Many business school courses skip consumer theory (and possibly some aspects of supply and demand) to allow more time for the topics covered in the second half of the book. Business school faculty may want to place particular emphasis on game theory, strategies, oligopoly, and monopolistic competition (Chapters 13 and 14); capital markets (Chapter 15); uncertainty (Chapter 16); and modern contract theory (Chapters 18 and 19).

# Instructor Teaching Resources

This book has a full range of supplementary materials that support teaching and learning. This program comes with the following teaching resources:

| **Supplements available to instructors at www.pearsonhighered.com** | **Features of the Supplement** |
|---|---|
| **Instructor's Manual**<br>Authored by Leonie Stone of SUNY Geneseo | • *Chapter Outlines* include key terminology, teaching notes, and lecture suggestions.<br>• *Teaching Tips* and *Additional Applications* provide tips for alternative ways to cover the material and brief reminders on additional help to provide students.<br>• *Solutions* are provided for all problems in the book. |
| **Test Bank**<br>Authored by Xin Fang of Hawaii Pacific University | • Multiple-choice problems of varying levels of complexity, suitable for homework assignments and exams<br>• Many of these draw on current news and events |
| **Computerized TestGen** | TestGen allows instructors to:<br>• Customize, save, and generate classroom tests<br>• Edit, add, or delete questions from the Test Item Files<br>• Analyze test results<br>• Organize a database of tests and student results. |
| **PowerPoints**<br>Authored by James Dearden of Lehigh University | • Slides include all the graphs, tables, and equations in the textbook, as well as lecture notes.<br>• PowerPoints meet accessibility standards for students with disabilities. Features include, but are not limited to:<br>  • Keyboard and Screen Reader access<br>  • Alternative text for images<br>  • High color contrast between background and foreground colors |

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J.M.P.

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# Introduction 1

*An Economist's Theory of Reincarnation: If you're good, you come back on a higher level. Cats come back as dogs, dogs come back as horses, and people—if they've been really good like George Washington—come back as money.*

If each of us could get all the food, clothing, and toys we want without working, no one would study economics. Unfortunately, most of the good things in life are scarce—we can't all have as much as we want. Thus, scarcity is the mother of economics.

**Microeconomics** is the study of how individuals and firms make themselves as well off as possible in a world of scarcity, and the consequences of those individual decisions for markets and the entire economy. In studying microeconomics, we examine how individual consumers and firms make decisions and how the interaction of many individual decisions affects markets.

Microeconomics is often called *price theory* to emphasize the important role that prices play in determining market outcomes. Microeconomics explains how the actions of all buyers and sellers determine prices, and how prices influence the decisions and actions of individual buyers and sellers.

**In this chapter, we discuss three main topics**

1. **Microeconomics: The Allocation of Scarce Resources.** Microeconomics is the study of the allocation of scarce resources.
2. **Models.** Economists use models to make testable predictions.
3. **Uses of Microeconomic Models in Your Life and Career.** Individuals, governments, and firms use microeconomic models and predictions in decision making.

## 1.1 Microeconomics: The Allocation of Scarce Resources

Individuals and firms allocate their limited resources to make themselves as well off as possible. Consumers select the mix of goods and services that makes them as happy as possible given their limited wealth. Firms decide which goods to produce, where to produce them, how much to produce to maximize their profits, and how to produce those levels of output at the lowest cost by using more or less of various inputs such as labor, capital, materials, and energy. The owners of a depletable natural resource such as oil decide when to use it. Government decision makers decide which goods and services the government will produce and whether to subsidize, tax, or regulate industries and consumers to benefit consumers, firms, or government employees.

## Trade-Offs

People make trade-offs because they can't have everything. A society faces three key trade-offs:

1. **Which goods and services to produce.** If a society produces more cars, it must produce fewer of other goods and services, because it has only a limited amount of *resources*—workers, raw materials, capital, and energy—available to produce goods.
2. **How to produce.** To produce a given level of output, a firm must use more of one input if it uses less of another input. For example, cracker and cookie manufacturers switch between palm oil and coconut oil, depending on which is less expensive.
3. **Who gets the goods and services.** The more of society's goods and services you get, the less someone else gets.

## Who Makes the Decisions

The government may make these three allocation decisions explicitly, or the final decisions may reflect the interaction of independent decisions by many individual consumers and firms. In the former Soviet Union, the government told manufacturers how many cars of each type to make and which inputs to use to make them. The government also decided which consumers would get cars.

In most other countries, how many cars of each type are produced and who gets them are determined by how much it costs to make cars of a particular quality in the least expensive way and how much consumers are willing to pay for them. More consumers would own a handcrafted Rolls-Royce and fewer would buy a mass-produced Toyota Camry if a Rolls were not 14 times more expensive than a Camry.

## How Prices Determine Allocations

Prices link the decisions about *which goods and services to produce*, *how to produce them*, and *who gets them*. Prices influence the decisions of individual consumers and firms, and the interactions of these decisions by consumers, firms, and the government determine price.

Interactions between consumers and firms take place in a **market**, which is an exchange mechanism that allows buyers to trade with sellers. A market may be a town square where people go to trade food and clothing, or it may be an international telecommunications network over which people buy and sell financial securities. Typically, when we talk about a single market, we are referring to trade in a single good or a group of goods that are closely related, such as soft drinks, movies, novels, or automobiles.

*Most of this book concerns how prices are determined within a market*. We show that the organization of the market, especially the number of buyers and sellers in the market and the amount of information they have, helps determine whether the price equals the cost of production. We also show that in the absence of a market (and market price), serious problems, such as high pollution levels, result.

**APPLICATION**

Twinkie Tax

Many government actions affect prices and hence the allocation decisions.

Many U.S., Australian, British, Canadian, New Zealand, and Taiwanese jurisdictions have or are considering imposing a *Twinkie tax* on unhealthful fatty and sweet foods or a tax on sugary soft drinks to reduce obesity and cholesterol problems, particularly among children. A 2017 poll found that 57% of the U.S. public supports "taxing soda and other sugary drinks to raise money for pre-school and children's health programs and help address the problem of obesity."

In recent years, many communities around the world debated and some passed new taxes on sugar-sweetened soft drinks. New beverage taxes went into effect in Mexico in 2014; Cook County, Illinois, in 2016; United Kingdom in 2018; and San Francisco, California, in 2018. At least 34 states differentially tax soft drinks, candy, chewing gum, and snack foods such as potato chips. These taxes affect prices and decisions people make. In addition, many U.S. school districts ban soft drink vending machines. These bans discourage consumption, as would an extremely high tax.

Taxes and bans affect *which foods are produced*, as firms offer new low-fat and low-sugar products, and *how fast-foods are produced*, as manufacturers reformulate their products to lower their tax burden. These taxes also influence *who gets these goods* as consumers, especially children, replace them with relatively less expensive, untaxed products.[1]

## 1.2 Models

*Everything should be made as simple as possible, but not simpler.* —Albert Einstein

To *explain* how individuals and firms allocate resources and how market prices are determined, economists use a **model**: a description of the relationship between two or more variables. Economists also use models to *predict* how a change in one variable will affect another variable.

**APPLICATION**

Income Threshold Model and China

According to an *income threshold model*, people whose incomes are below a threshold do not buy a particular consumer durable, while many people whose income exceeds that threshold buy it.

If this theory is correct, we predict that, as most people's incomes rise above the threshold in lower-income countries, consumer durable purchases will increase from near zero to large numbers virtually overnight. This prediction is consistent with evidence from Malaysia, where the income threshold for buying a car is about $4,000.

In China, incomes have risen rapidly and now exceed the threshold levels for many types of durable goods. In response to higher incomes, Chinese car purchases have taken off. For example, Li Rifu, a 46-year-old Chinese farmer and watch

[1]The sources for Applications are available at the back of this book.

repairman, thought that buying a car would improve the odds that his 22- and 24-year-old sons would find girlfriends, marry, and produce grandchildren. Soon after Mr. Li purchased his Geely King Kong for the equivalent of $9,000, both sons met girlfriends, and his older son got married.

Given the rapid increase in Chinese incomes in the past couple of decades, four-fifths of all new cars sold in China are bought by first-time customers. An influx of first-time buyers was responsible for Chinese car sales increasing by a factor of nearly 18 between 2000 and 2017. In 2005, China produced fewer than half as many cars as the United States. In 2017, China was by far the largest producer of cars in the world, producing one out of every three cars in the world. It produced nearly three times as many cars as the United States—the second largest producer—as well as 39% more than the entire European Union. One out of every three cars is produced in China.

## Simplifications by Assumption

We stated the income threshold model verbally, but we could have presented it graphically or mathematically. Regardless of how the model is described, an economic model is a simplification of reality that contains only reality's most important features. Without simplifications, it is difficult to make predictions because the real world is too complex to analyze fully.

By analogy, if the owner's manual accompanying a new DVD recorder had a diagram showing the relationships among all the parts in the recorder, the diagram would be overwhelming and useless. But a diagram that includes a photo of the buttons on the front of the machine, with labels describing the purpose of each, is useful and informative.

Economists make many *assumptions* to simplify their models.[2] When using the income threshold model to explain car-purchasing behavior in China, we assume that factors other than income, such as the vehicles' color choices, are irrelevant to the decision to buy cars. Therefore, we ignore the color of cars that are sold in China when we describe the relationship between average income and the number of cars that consumers want. If our assumption is correct, we make our auto market analysis simpler without losing important details by ignoring color. If we're wrong and these ignored issues are important, our predictions may be inaccurate.

Throughout this book, we start with strong assumptions to simplify our models. Later, we add complexities. For example, in most of the book, we assume that consumers know each firm's price for a product. In many markets, such as the New York Stock Exchange, this assumption is realistic. However, it is not realistic in other markets, such as the market for used automobiles, in which consumers do not know the prices that each firm charges. To devise an accurate model for markets in which consumers have limited information, in Chapter 16, we add consumer uncertainty about price into the model.

[2]An engineer, an economist, and a physicist are stranded on a deserted island with a can of beans but no can opener. How should they open the can? The engineer proposes hitting the can with a rock. The physicist suggests building a fire under the can to increase pressure and burst it open. The economist thinks for a while and then says, "Assume that we have a can opener. . . ."

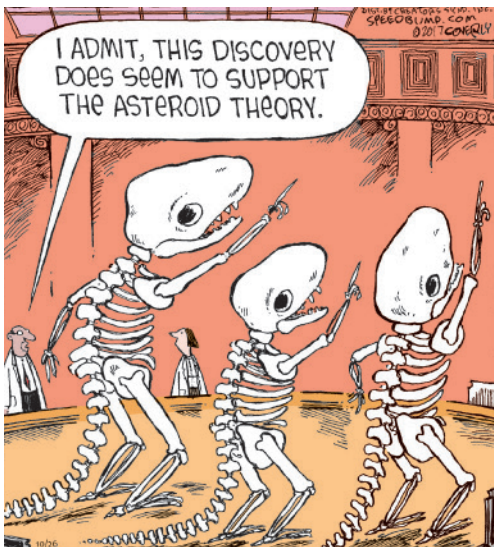
*An alternative theory.*

## Testing Theories

*Blore's Razor: Given a choice between two theories, take the one which is funnier.*

Economic *theory* is the development and use of a model to formulate *hypotheses*, which are predictions about cause and effect. We are interested in models that make clear, testable predictions, such as "If the price rises, the quantity demanded falls." A theory stating that "People's behaviors depend on their tastes, and their tastes change randomly at random intervals" is not very useful because it does not lead to testable predictions.

Economists test theories by checking whether predictions are correct. If a prediction does not come true, economists may reject the theory.[3] Economists use a model until it is refuted by evidence or until a better model is developed.




A good model makes sharp, clear predictions that are consistent with reality. Some very simple models make sharp predictions that are incorrect, and other, more complex models make ambiguous predictions—in which any outcome is possible—that are untestable. The skill in model building is to chart a middle ground.

The purpose of this book is to teach you how to think like an economist, in the sense that you can build testable theories using economic models or apply existing models to new situations. Although economists think alike, in that they develop and use testable models, they often disagree. One may present a logically consistent argument that prices will go up in the next quarter. Another economist, using a different but equally logical theory, may contend that prices will fall in that quarter. If the economists are reasonable, they agree that pure logic alone cannot resolve their dispute. Indeed, they agree that they'll have to use empirical evidence—facts about the real world—to determine which prediction is correct.

## Maximizing Subject to Constraints

Although one economist's model may differ from another's, a key assumption in most microeconomic models is that individuals allocate their scarce resources to make themselves as well off as possible. Of all the affordable combinations of goods,

[3]We can use evidence of whether a theory's predictions are correct to refute the theory but not to prove it. If a model's prediction is inconsistent with what actually happened, the model must be wrong, so we reject it. Even if the model's prediction is consistent with reality, however, the model's prediction may be correct for the wrong reason. Hence, we cannot prove that the model is correct—we can only fail to reject it.

consumers pick the bundle of goods that gives them the most possible enjoyment. Firms try to maximize their profits given limited resources and existing technology. That resources are limited plays a crucial role in these models. Were it not for scarcity, people could consume unlimited amounts of goods and services, and sellers could become rich beyond limit.

As we show throughout this book, the maximizing behavior of individuals and firms determines society's three main allocation decisions: which goods are produced, how they are produced, and who gets them. For example, diamond-studded pocket combs will be sold only if firms find it profitable to sell them. The firms will make and sell these combs only if consumers value the combs at least as much as it costs the firm to produce them. Consumers will buy the combs only if they get more pleasure from the combs than they would from other goods they could buy with the same resources.

Many of the models that we examine are based on maximizing an objective that is subject to a constraint. Consumers maximize their well-being subject to a budget constraint, which says that their resources limit how many goods they can buy. Firms maximize profits subject to technological and other constraints. Governments may try to maximize the welfare of consumers or firms subject to constraints imposed by limited resources and the behavior of consumers and firms. We cover the formal economic analysis of maximizing behavior in Chapters 2 through 19 and review the underlying mathematics in the Calculus Appendix at the end of the book.

## Positive Versus Normative

*Those are my principles. If you don't like them I have others.* —Groucho Marx

Using models of maximizing behavior sometimes leads to predictions that seem harsh or heartless. For instance, a World Bank economist predicted that if an African government used price controls to keep the price of food low during a drought, food shortages would occur and people would starve. The predicted outcome is awful, but the economist was not heartless. The economist was only making a scientific prediction about the relationship between cause and effect: Price controls (cause) lead to food shortages and starvation (effect).

Such a scientific prediction is known as a **positive statement**: a testable hypothesis about matters of fact such as cause-and-effect relations. *Positive* does not mean that we are certain about the truth of our statement; it indicates only that we can test whether it is true.

If the World Bank economist is correct, should the government control prices? If government policymakers believe the economist's predictions, they know that the low prices will help consumers who are able to buy as much food as they want, and hurt both the food sellers and those who are unable to buy as much food as they want, some of whom may die from malnutrition. As a result, the government's decision of whether to use price controls turns on whether the government cares more about the winners or the losers. In other words, to decide on its policy, the government makes a value judgment.

Instead of making a prediction and testing it and then making a value judgment to decide whether to use price controls, government policymakers could make a value judgment directly. The value judgment could be based on the belief that "because people *should* have prepared for the drought, the government should not try to help them by keeping food prices low" or "people should be protected against price gouging during a drought, so the government should use price controls."

These two statements are *not* scientific predictions. Each is a value judgment, or **normative statement**: a conclusion as to whether something is good or bad. A normative statement cannot be tested because a value judgment cannot be refuted by evidence.

It is a prescription rather than a prediction. A normative statement concerns what somebody believes should happen; a positive statement concerns what will happen.

Although a normative conclusion can be drawn without first conducting a positive analysis, a policy debate will be more informed if positive analyses are conducted first.[4] Suppose your normative belief is that the government should help the poor. Should you vote for a candidate who advocates a higher minimum wage (a law that requires firms to pay wages at or above a specified level); a European-style welfare system (guaranteeing health care, housing, and other basic goods and services); an end to our current welfare system; a negative income tax (the less income a person receives, the more that person receives from the government); or job training programs? Positive economic analysis can be used to predict whether these programs will benefit poor people but *not* whether these programs are good or bad. Using these predictions and your value judgment, you decide for whom to vote.

Economists' emphasis on positive analysis has implications for what they study and even their use of language. For example, many economists stress that they study people's *wants* rather than their needs. Although people need certain minimum levels of food, shelter, and clothing to survive, most people in developed economies have enough money to buy goods well in excess of the minimum levels necessary to maintain life. Consequently, calling something a *need* in a wealthy country is often a value judgment. You almost certainly have been told by an elder that "you *need* a college education." That person was probably making a value judgment—"you *should* go to college"—rather than a scientific prediction that you will suffer terrible economic deprivation if you don't go to college. We can't test such value judgments, but we can test hypotheses such as "people with a college education earn substantially more than comparable people with only a high school education."

## New Theories

One of the strengths of economics is that it is continually evolving, for two reasons. First, economists—like physicists, biologists, and other scientists—are always trying to improve their understanding of the world around them.

For example, traditional managerial textbooks presented theories based on the assumptions that decision makers always optimize: They do the best they can with their limited resources. While we cover these traditional theories, we also present another recently developed approach referred to as *behavioral economics*, which is the study of how psychological biases and cognitive limits can prevent managers and others from optimizing.

Second, economic theory evolves out of necessity. Unlike those who work in the physical and biological sciences, economists and managers also have to develop new ways to think about *disruptive innovations*. Although most innovations are incremental, some are sufficiently disruptive to dramatically change the way an industry is structured—or even to create new industries and destroy old ones.

The internet is an example of a disruptive innovation, which led to other disruptions. Online retailing has displaced much traditional brick-and-mortar retailing, online payment systems have largely replaced cash and checks, and online media, especially social media, have changed the way most people acquire and transmit information.

To analyze the economic effects of the internet and other disruptive innovations, economists have extended established theories and developed new ones. For example,

[4]Some economists draw the normative conclusion that, as social scientists, we economists should restrict ourselves to positive analyses. Others argue that we shouldn't give up our right to make value judgments just like the next person (who happens to be biased, prejudiced, and pigheaded, unlike us).

the internet has given rise to many services that allow two groups of users to interact—such as auction services, dating sites, job matching services, and payment services. In response, economists have developed the theory of such *two-sided* markets, which has influenced court decisions and government policy toward such markets. This book describes economic theories of the internet and of two-sided markets, along with other recent developments in economics.

## 1.3 Uses of Microeconomic Models in Your Life and Career

*Have you ever imagined a world without hypothetical situations?*

Because microeconomic models *explain* why economic decisions are made and allow us to make *predictions*, they can be very useful for individuals, governments, and firms in making decisions. Throughout this book, we consider examples of how microeconomics aids in actual decision making. Here, we briefly look at some uses by individuals and governments.

Individuals use microeconomics to make purchasing and other decisions. Examples include considering inflation when choosing whether to rent an apartment (Chapter 4); determining whether going to college is a good investment (Chapter 15); deciding whether to invest in stocks or bonds (Chapter 16); determining whether to buy insurance (Chapter 16); and knowing whether you should pay a lawyer by the hour or a percentage of any award (Chapter 19).

Microeconomics can help citizens make voting decisions based on candidates' views on economic issues. Elected and appointed government officials use economic models in many ways. Recent administrations have placed increased emphasis on economic analysis. Economic and environmental impact studies are required before many projects can commence. The President's Council of Economic Advisers and other federal economists analyze and advise national government agencies on the likely economic effects of all major policies.

Indeed, often governments use microeconomic models to predict the probable impact of a policy. We show how to predict the likely impact of a tax on the tax revenues raised (Chapter 2), the effects of trade policies such as tariffs and quotas on markets (Chapter 9), and the effects on collusion of governments posting the results of bidding (Chapter 14). Governments also use economics to decide how best to prevent pollution and global warming (Chapter 17).

Decisions by firms reflect microeconomic analysis. Firms price discriminate (charge individuals different prices) or bundle goods to increase their profits (Chapter 12). Strategic decisions concerning pricing, setting quantities, advertising, or entering into a market can be predicted using game theory (Chapter 13). An example in an oligopolistic market is the competition between American Airlines and United Airlines on the Chicago–Los Angeles route (Chapter 14). When a mining company should extract ore depends on interest rates (Chapter 15). A firm decides whether to offer employees deferred payments to ensure they work hard (Chapter 19).

Thus, this book will help you develop skills in economic analysis that are crucial in careers such as those in economics, business, law, and many others. Some of you will get jobs that use economic analysis intensively, such as working as an economist or setting prices or assessing financial investment options for firms. Others will use your knowledge of economics in both your work to analyze the likely outcomes from government actions and other events.

## SUMMARY

1. **Microeconomics: The Allocation of Scarce Resources.** Microeconomics is the study of the allocation of scarce resources. Consumers, firms, and governments must make allocation decisions. A society faces three key trade-offs: which goods and services to produce, how to produce them, and who gets them. These decisions are interrelated and depend on the prices that consumers and firms face and on government actions. Market prices affect the decisions of individual consumers and firms, and the interaction of the decisions of individual consumers and firms determines market prices. The organization of the market, especially the number of firms in the market and the information consumers and firms have, plays an important role in determining whether the market price is equal to or higher than the cost of producing an additional unit of output.
2. **Models.** Models based on economic theories are used to answer questions about how some change, such as a tax increase, will affect various sectors of the economy in the future. A good theory is simple to use and makes clear, testable predictions that are not refuted by evidence. Most microeconomic models are based on maximizing behavior. Economists use models to construct *positive* hypotheses concerning how a cause leads to an effect. These positive questions can be tested. In contrast, *normative* statements, which are value judgments, cannot be tested.
3. **Uses of Microeconomic Models in Your Life and Career.** Individuals, governments, and firms use microeconomic models and predictions to make decisions. For example, to maximize its profits, a firm needs to know consumers' decision-making criteria, the trade-offs between various ways of producing and marketing its product, government regulations, and other factors. You can use economic analysis in many different careers, particularly in economics and business.