What Is Economics?

*Economics.* The word conjures up all sorts of images: manic stock traders on Wall Street, an economic summit meeting in a European capital, a somber television news anchor announcing good or bad news about the economy. . . . You probably hear about economics several times each day. What exactly is economics?

First, economics is a *social science,* so it seeks to explain something about *society.* In this sense, it has something in common with psychology, sociology, and political science. But economics is different from these other social sciences because of *what* economists study and *how* they study it. Economists ask different questions, and they answer them using tools that other social scientists find rather exotic.

**ECONOMICS, SCARCITY, AND CHOICE**

A good definition of economics, which stresses the difference between economics and other social sciences, is the following:

*Economics is the study of choice under conditions of scarcity.*

This definition may appear strange to you. Where are the familiar words we ordinarily associate with economics: “money,” “stocks and bonds,” “prices,” “budgets,” . . . ? As you will soon see, economics deals with all of these things and more. But first, let’s take a closer look at two important ideas in this definition: scarcity and choice.

**SCARCITY AND INDIVIDUAL CHOICE**

Think for a moment about your own life. Is there anything you don’t have that you’d *like* to have? Anything you’d like *more* of? If your answer is “no,” congratulations! You are well advanced on the path of Zen self-denial. The rest of us, however, feel the pinch of limits to our material standard of living. This simple truth is at the very core of economics. It can be restated this way: We all face the problem of *scarcity."

At first glance, it may seem that you suffer from an infinite variety of scarcities. There are so many things you might like to have right now—a larger room or apartment, a new car, more clothes . . . the list is endless. But a little reflection suggests
that your limited ability to satisfy these desires is based on two other, more basic limitations: scarce time and scarce spending power.

As individuals, we face a scarcity of time and spending power. Given more of either, we could each have more of the goods and services that we desire.

The scarcity of spending power is no doubt familiar to you. We’ve all wished for higher incomes so that we could afford to buy more of the things we want. But the scarcity of time is equally important. So many of the activities we enjoy—seeing a movie, taking a vacation, making a phone call—require time as well as money. Just as we have limited spending power, we also have a limited number of hours in each day to satisfy our desires.

Because of the scarcities of time and spending power, each of us is forced to make choices. We must allocate our scarce time to different activities: work, play, education, sleep, shopping, and more. We must allocate our scarce spending power among different goods and services: housing, food, furniture, travel, and many others. And each time we choose to buy something or do something, we also choose not to buy or do something else.

Economists study the choices we make as individuals and also the consequences of those choices. For example, over the next decade, the fraction of high school graduates choosing to attend college is expected to rise to record levels. What does this mean for state and federal budgets? What will happen to the wages and salaries of those with college degrees, and those without them? What are the implications for our ability to reform health care, to reduce poverty, and to deal with other problems? Economics is uniquely equipped to analyze these questions.

Economists also study the more subtle and indirect effects of individual choice on our society. Will most Americans continue to live in houses or—like Europeans—will most of us end up in apartments? As the population ages, what will happen to the quality and accessibility of health care for the elderly? Will traffic congestion in our cities continue to worsen or is there relief in sight? These questions hinge, in large part, on the separate decisions of millions of people. To answer them requires an understanding of how individuals make choices under conditions of scarcity.

SCARCITY AND SOCIAL CHOICE

Now let’s think about scarcity and choice from society’s point of view. What are the goals of our society? We want a high standard of living for our citizens, clean air, safe streets, good schools, and more. What is holding us back from accomplishing all of these goals in a way that would satisfy everyone? You already know the answer: scarcity. In society’s case, the problem is a scarcity of resources—the things we use to make goods and services that help us achieve our goals.

The Four Resources

Economists classify resources into four categories:

1. **Labor** is the time human beings spend producing goods and services.
2. **Capital** is a long-lasting tool that we produce to help us make other goods and services.
   - It’s useful to distinguish two different types of capital. **Physical capital** consists of things like machinery and equipment, factory buildings, computers, and

**Resources** The labor, capital, land and natural resources, and entrepreneurship that are used to produce goods and services.

**Labor** The time human beings spend producing goods and services.

**Capital** A long-lasting tool that is used to produce other goods.

**Physical capital** The part of the capital stock consisting of physical goods, such as machinery, equipment, and factories.
even hand tools like hammers and screwdrivers. These are all long-lasting physical goods that are used to make other things.

Human capital consists of the skills and knowledge possessed by workers. These satisfy our definition of capital: They are produced (through education and training), they help us produce other things, and they last for many years, typically through an individual’s working life.¹

Note the word long-lasting in the definition. If something is used up quickly in the production process—like the flour a baker uses to make bread—it is generally not considered capital. A good rule of thumb is that capital should last at least a year, although most types of capital last considerably longer.

The capital stock is the total amount of capital at a nation’s disposal at any point in time. It consists of all the physical and human capital made in previous periods that is still productively useful.

3. Land refers to the physical space on which production takes place, as well as useful materials—natural resources—found under it or on it, such as crude oil, iron, coal, or fertile soil.

4. Entrepreneurship is the ability (and the willingness to use it) to combine the other resources into a productive enterprise. An entrepreneur may be an innovator who comes up with an original idea for a business or a risk taker who provides her own funds or time to nurture a project with uncertain rewards.

Anything produced in the economy comes, ultimately, from some combination of these four resources. Think about the last lecture you attended at your college. You were consuming a service—a college lecture. What went into producing that service? Your instructor was supplying labor. Many types of physical capital were used as well, including desks, chairs, a chalkboard or transparency projector, the classroom building itself, and the computer your instructor may have used to compose lecture notes. There was human capital—your instructor’s specialized knowledge and lecturing skills. There was land—the property on which your classroom building sits, and natural resources like oil or natural gas to heat or cool the building. And some individual or group had to play the role of innovator and risk taker in order to combine the labor, capital, and natural resources needed to create and guide your institution in its formative years. (If you attend a public college or university, this entrepreneurial role was largely filled by the state government, with the state’s taxpayers assuming the risk.)

As a society, our resources—land, labor, capital, and entrepreneurship—are insufficient to produce all the goods and services we might desire. In other words, society faces a scarcity of resources.

This stark fact about the world helps us understand the choices a society must make. Do we want a more educated citizenry? Of course. But that will require more labor—construction workers to build more classrooms and teachers to teach in them. It will require more land for classrooms and lumber to build them. And it will require more capital—bulldozers, cement mixers, trucks, and more. These very same resources, however, could instead be used to produce other things that we find desirable, things

¹ An individual’s human capital is ordinarily supplied along with her labor time. (When your instructor lectures or holds office hours, she is providing both labor time and her skills as an economist and teacher.) Still, it’s often useful to distinguish the time a worker provides (her labor) from any skills or knowledge possessed (human capital).
such as new homes, hospitals, automobiles, or feature films. As a result, every society must have some method of **allocating** its scarce resources—choosing which of our many competing desires will be fulfilled and which will not be.

Many of the big questions of our time center on the different ways in which resources can be allocated. The cataclysmic changes that rocked Eastern Europe and the former Soviet Union during the early 1990s arose from a very simple fact: The method these countries used for decades to allocate resources was not working. Closer to home, the never-ending debates between Democrats and Republicans in the United States about tax rates, government services, and even foreign policy reflect subtle but important differences of opinion about how to allocate resources. Often, these are disputes about whether the private sector can handle a particular issue of resource allocation on its own or whether the government should be involved.

**SCARCITY AND ECONOMICS**

The scarcity of resources—and the choices it forces us to make—is the source of all of the problems you will study in economics. Households have limited incomes for satisfying their desires, so they must choose carefully how they allocate their spending among different goods and services. Business firms want to make the highest possible profit, but they must pay for their resources; so they carefully choose what to produce, how much to produce, and how to produce it. Federal, state, and local government agencies work with limited budgets, so they must carefully choose which goals to pursue. Economists study these decisions made by households, firms, and governments to explain how our economic system operates, to forecast the future of our economy, and to suggest ways to make that future even better.

**THE WORLD OF ECONOMICS**

The field of economics is surprisingly broad. It extends from the mundane—why does a pound of steak cost more than a pound of chicken?—to the personal and profound—how do couples decide how many children to have? With a field this broad, it is useful to have some way of classifying the different types of problems economists study and the different methods they use to analyze them.

**MICROECONOMICS AND MACROECONOMICS**

The field of economics is divided into two major parts: microeconomics and macroeconomics. Microeconomics comes from the Greek word *mikros*, meaning “small.” It takes a close-up view of the economy, as if looking through a microscope. Microeconomics is concerned with the behavior of individual actors on the economic scene—households, business firms, and governments. It looks at the choices they make and how they interact with each other when they come together to trade...
specific goods and services. What will happen to the cost of movie tickets over the next five years? How many management-trainee jobs will open up for college graduates? How would U.S. phone companies be affected by a tax on imported cell phones? These are all microeconomic questions because they analyze individual parts of an economy rather than the whole.

Macroeconomics—from the Greek word makros, meaning “large”—takes an overall view of the economy. Instead of focusing on the production of carrots or computers, macroeconomics lumps all goods and services together and looks at the economy’s total output. Instead of focusing on employment of management trainees or manufacturing workers, it considers total employment in the economy. Instead of asking why credit card loans carry higher interest rates than home mortgage loans, it asks what makes interest rates in general rise or fall. In all of these cases, macroeconomics focuses on the big picture and ignores the fine details.

**POSITIVE AND NORMATIVE ECONOMICS**

The micro versus macro distinction is based on the level of detail we want to consider. Another useful distinction has to do with our purpose in analyzing a problem. Positive economics deals with how the economy works, plain and simple. If someone says, “Recent increases in spending for domestic security have slowed the growth rate of the U.S. economy,” she is making a positive economic statement. A statement need not be accurate or even sensible to be classified as positive. For example, “Government policy has no effect on our standard of living” is a statement that virtually every economist would regard as false. But it is still a positive economic statement. Whether true or not, it’s about how the economy works and its accuracy can be tested by looking at the facts—and just the facts.

Normative economics concerns itself with what should be. It is used to make judgments about the economy and prescribe solutions to economic problems. Rather than limiting its concerns to just “the facts,” it goes on to say what we should do about them and therefore depends on our values.

If an economist says, “We should cut total government spending,” she is engaging in normative economic analysis. Cutting government spending would benefit some citizens and harm others, so the statement rests on a value judgment. A normative statement—like the one about government spending above—cannot be proved or disproved by the facts alone.

Positive and normative economics are intimately related in practice. For one thing, we cannot properly argue about what we should or should not do unless we know certain facts about the world. Every normative analysis is therefore based on an underlying positive analysis. But while a positive analysis can, at least in principle, be conducted without value judgments, a normative analysis is always based, at least in part, on the values of the person conducting it.

Seemingly Positive Statements Be alert to statements that may seem positive but are actually normative. Here’s an example: “If we want to reduce pollution, our society will have to use less gasoline.” This may sound positive, because it seems to refer only to facts about the world. But it’s actually normative. Why? Cutting back on gasoline is just one policy among many that could reduce pollution. To say that we must choose this method makes a value judgment about its superiority to other methods. A purely positive statement on this topic would be, “Using less gasoline—with no other change in living habits—would reduce pollution.”

Similarly, be alert to statements that use vague terms with hidden value judgments. An example: “All else equal, the less gasoline we use, the better our quality of life.” Whether you agree or disagree, this is not a positive statement. Two people who agree about the facts—in this case, the consequences of using less gasoline—might disagree over the meaning of the phrase “quality of life,” how to measure it, and what would make it better. This disagreement could not be resolved just by looking at the facts.
Why Economists Disagree

The distinction between positive and normative economics can help us understand why economists sometimes disagree. Suppose you are watching a television interview in which two economists are asked whether the United States should eliminate all government-imposed barriers to trading with the rest of the world. The first economist says, “Yes, absolutely,” but the other says, “No, definitely not.” Why the sharp disagreement?

The difference of opinion may be positive in nature: The two economists may have different views about what would actually happen if trade barriers were eliminated. Differences like this sometimes arise because our knowledge of the economy is imperfect or because certain facts are in dispute.

In some cases, however, the disagreement will be normative. Economists, like everyone else, have different values. In this case, both economists might agree that opening up international trade would benefit most Americans, but harm some of them. Yet they may still disagree about the policy move because they have different values. The first economist might put more emphasis on benefits to the overall economy, while the second might put more emphasis on preventing harm to a particular group. Here, the two economists have come to the same positive conclusion, but their different values lead them to different normative conclusions.

In the media, economists are rarely given enough time to express the basis for their opinions, so the public hears only the disagreement. People may then conclude that economists cannot agree about how the economy works, even when the real disagreement is over goals and values.

WHY STUDY ECONOMICS?

If you’ve gotten this far into the chapter, chances are you’ve already decided to allocate some of your scarce time to studying economics. We think you’ve made a wise choice. But it’s worth taking a moment to consider what you might gain from this choice.

Why study economics?

TO UNDERSTAND THE WORLD BETTER

Applying the tools of economics can help you understand global and catastrophic events such as wars, famines, epidemics, and depressions. But it can also help you understand much of what happens to you locally and personally—the worsening traffic conditions in your city, the raise you can expect at your job this year, or the long line of people waiting to buy tickets for a popular concert. Economics has the power to help us understand these phenomena because they result, in large part, from the choices we make under conditions of scarcity.

Economics has its limitations, of course. But it is hard to find any aspect of life about which economics does not have something important to say. Economics cannot explain why so many Americans like to watch television, but it can explain how TV networks decide which programs to offer. Economics cannot protect you from a robbery, but it can explain why some people choose to become thieves and why no society has chosen to eradicate crime completely. Economics will not improve your love life, resolve unconscious conflicts from your childhood, or help you overcome a fear of flying, but it can tell us how many skilled therapists, ministers, and counselors are available to help us solve these problems.
Chapter 1: What is Economics?

**TO ACHIEVE SOCIAL CHANGE**

If you are interested in making the world a better place, economics is indispensable. There is no shortage of serious social problems worthy of our attention—unemployment, hunger, poverty, disease, child abuse, drug addiction, violent crime. Economics can help us understand the origins of these problems, explain why previous efforts to solve them haven’t succeeded, and help us to design new, more effective solutions.

**TO HELP PREPARE FOR OTHER CAREERS**

Economics has long been a popular college major for individuals intending to work in business. But it has also been popular among those planning careers in politics, international relations, law, medicine, engineering, psychology, and other professions. This is for good reason: Practitioners in each of these fields often find themselves confronting economic issues. For example, lawyers increasingly face judicial rulings based on the principles of economic efficiency. Doctors will need to understand how new technologies or changes in the structure of health insurance will affect their practices. Industrial psychologists need to understand the economic implications of workplace changes they may advocate, such as flexible scheduling or on-site child care.

**TO BECOME AN ECONOMIST**

Only a tiny minority of this book’s readers will decide to become economists. This is welcome news to the authors, and after you have studied labor markets in your microeconomics course you will understand why. But if you do decide to become an economist—obtaining a master’s degree or even a Ph.D.—you will find many possibilities for employment. The economists with whom you have most likely had personal contact are those who teach and conduct research at colleges and universities. But about equal numbers of economists work outside and inside of academia. Economists are hired by banks to assess the risk of investing abroad; by manufacturing companies to help them determine new methods of producing, marketing, and pricing their products; by government agencies to help design policies to fight crime, disease, poverty, and pollution; by international organizations to help create and reform aid programs for less developed countries; by the media to help the public interpret global, national, and local events; and by nonprofit organizations to provide advice on controlling costs and raising funds more effectively.

**THE METHODS OF ECONOMICS**

One of the first things you will notice as you begin to study economics is the heavy reliance on models.

You’ve no doubt encountered many models in your life. As a child, you played with model trains, model planes, or model people—dolls. You may have also seen architects’ cardboard models of buildings. These are physical models, three-dimensional replicas that you can pick up and hold. Economic models, on the other hand, are built not with cardboard, plastic, or metal but with words, diagrams, and mathematical statements.

What, exactly, is a model?
A model is an abstract representation of reality.

The two key words in this definition are abstract and representation. A model is not supposed to be exactly like reality. Rather, it represents the real world by abstracting or taking from the real world that which will help us understand it. By definition, a model leaves out features of the real world.

**THE ART OF BUILDING ECONOMIC MODELS**

When you build a model, how do you know which real-world details to include and which to leave out? There is no simple answer to this question. The right amount of detail depends on your purpose in building the model in the first place. There is, however, one guiding principle:

*A model should be as simple as possible to accomplish its purpose.*

This means that a model should contain only the necessary details.

To understand this a little better, think about a map. A map is a model that represents a part of the earth’s surface. But it leaves out many details of the real world. First, a map leaves out the third dimension—height—of the real world. Second, maps always ignore small details, such as trees and houses and potholes. But when you buy a map, how much detail do you want it to have?

Let’s say you are in Boston, and you need a map to find the best way to drive from Logan Airport to the downtown convention center. In this case, you would want a very detailed city map, with every street, park, and plaza in Boston clearly illustrated and labeled as in the map on the left in Figure 1. A highway map, which ignores these details, wouldn’t do at all.

But now suppose your purpose is different: to select the best driving route from Boston to Cincinnati. Now you want a highway map such as the one on the right in Figure 1. A map that shows every street between Boston and Cincinnati would have too much detail. All of that extraneous information would only obscure what you really need to see.

The same principle applies in building economic models. The level of detail that would be just right for one purpose will usually be too much or too little for another. When you feel yourself objecting to a model in this text because something has been left out, keep in mind the purpose for which the model is built. In introductory economics, the purpose is entirely educational. The models are designed to help you understand some simple, but powerful, principles about how the economy

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**FIGURE 1**

Maps as Models

*These maps are models. But each would be used for a different purpose.*
operates. Keeping the models simple makes it easier to see these principles at work and remember them later.

Of course, economic models have other purposes besides education. They can help businesses make decisions about pricing and production, help households decide how and where to invest their savings, and help governments and international agencies formulate policies. Models built for these purposes will be much more detailed than the ones in this text, and you will learn about them if you take more advanced courses in economics. But even complex models are built around very simple frameworks—the same frameworks you will be learning here.

**ASSUMPTIONS AND CONCLUSIONS**

Every economic model begins with *assumptions* about the world. There are two types of assumptions in a model: simplifying assumptions and critical assumptions.

A **simplifying assumption** is just what it sounds like—a way of making a model simpler without affecting any of its important conclusions. The purpose of a simplifying assumption is to rid a model of extraneous detail so its essential features can stand out more clearly. A road map, for example, makes the simplifying assumption, “There are no trees” because trees on a map would only get in the way. Similarly, in an economic model, we might assume that there are only two goods that households can choose from or that there are only two nations in the world. We make such assumptions *not* because they are true, but because they make a model easier to follow and do not change any of the important insights we can get from it.

A **critical assumption**, by contrast, is an assumption that affects the conclusions of a model in important ways. When you use a road map, you make the critical assumption, “All of these roads are open.” If that assumption is wrong, your conclusion—the best route to take—might be wrong as well.

In an economic model, there are always one or more critical assumptions. You don’t have to look very hard to find them because economists like to make these assumptions explicit right from the outset. For example, when we study the behavior of business firms, our model will assume that firms try to earn the highest possible profit for their owners. By stating this critical assumption up front, we can see immediately where the model’s conclusions spring from.

**THE THREE-STEP PROCESS**

As you read this textbook, you will learn how economists use economic models to address a wide range of problems. In Chapter 2, for example, you will see how a simple economic model can give us important insights about society’s production choices. And subsequent chapters will present still different models that help us understand the U.S. economy and the global economic environment in which it operates. As you read, it may seem to you that there are a lot of models to learn and remember . . . and, indeed, there are.

But there is an important insight about economics that—once mastered—will make your job easier than you might think. The insight is this: There is a remarkable similarity in the types of models that economists build, the assumptions that underlie those models, and what economists actually do with them. In fact, you will see that economists follow the same three-step process to analyze almost any economic problem. The first two steps explain how economists build an economic model, and the last explains how they use the model.
What are these three steps that underlie the economic approach to almost any problem? Sorry for the suspense, but you'll have to wait a bit (until the end of Chapter 3) for the answer. By that time, you'll have learned a little more about economics, and the three-step process will make more sense to you.

**Math, Jargon, and Other Concerns . . .**

Economists often express their ideas using mathematical concepts and a special vocabulary. Why? Because these tools enable economists to express themselves more precisely than with ordinary language. For example, someone who has never studied economics might say, “When gas is expensive, people don’t buy big, gas-guzzling cars.” That statement might not bother you right now. But once you’ve finished your first economics course, you’ll be saying it something like this: “When the price of gas rises, the demand curve for big, gas-guzzling cars shifts leftward.”

Does the second statement sound strange to you? It should. First, it uses a special term—a demand curve—that you haven’t yet learned. Second, it uses a mathematical concept—a shifting curve—with which you might not be familiar. But while the first statement might mean a number of different things, the second statement—as you will see in Chapter 3—can mean only one thing. By being precise, we can steer clear of unnecessary confusion.

If you are worried about the special vocabulary of economics, you can relax. All of the new terms will be defined and carefully explained as you encounter them. Indeed, this textbook does not assume you have any special knowledge of economics. It is truly meant for a “first course” in the field.

But what about the math? Here, too, you can relax. While professional economists often use sophisticated mathematics to solve problems, only a little math is needed to understand basic economic principles. And virtually all of this math comes from high school algebra and geometry.

Still, if you have forgotten some of your high school math, a little brushing up might be in order. This is why we have included an appendix at the end of this chapter. It covers some of the most basic concepts—such as interpreting graphs, the equation for a straight line, and the concept of a slope—that you will need in this course. You may want to glance at this appendix now, just so you'll know what’s there. Then, from time to time, you'll be reminded about it when you're most likely to need it.

**How to Study Economics**

As you read this book or listen to your instructor, you may find yourself following along and thinking that everything makes perfect sense. Economics may even seem easy. Indeed, it is rather easy to follow economics, since it’s based so heavily on simple logic. But following and learning are two different things. You will eventually discover (preferably before your first exam) that economics must be studied actively, not passively.

If you are reading these words lying back on a comfortable couch, a phone in one hand and a remote control in the other, you are going about it in the wrong way. Active studying means reading with a pencil in your hand and a blank sheet of paper in front of you. It means closing the book periodically and reproducing what you have learned. It means listing the steps in each logical argument, retracing the flow
It does require some work, but the payoff is a good understanding of economics and a better understanding of your own life and the world around you.

**Summary**

*Economics* is the study of choice under conditions of scarcity. As individuals, and as a society, we have unlimited desires for goods and services. Unfortunately, the resources—land, labor, capital, and entrepreneurship—needed to produce those goods and services are scarce. Therefore, we must choose which desires to satisfy and how to satisfy them. Economics provides the tools that explain those choices.

The field of economics is divided into two major areas, *Microeconomics* studies the behavior of individual households, firms, and governments as they interact in specific markets. *Macroeconomics*, by contrast, concerns itself with the behavior of the entire economy. It considers variables such as total output, total employment, and the overall price level.

Economics makes heavy use of *models*—abstract representations of reality. These models are built with words, diagrams, and mathematical statements that help us understand how the economy operates. All models are simplifications, but a good model will have *just enough detail for the purpose at hand*.

When analyzing almost any problem, economists follow a three-step process in building and using economic models. This three-step process will be introduced at the end of Chapter 3.

**Problem Set**  
*Answers to even-numbered Questions and Problems can be found on the text Web site at www.thomsonedu.com/economics/hall.*

1. Discuss whether each statement is an example of positive economics or normative economics or if it contains elements of both:
   a. An increase in the personal income tax will slow the growth rate of the economy.
   b. The goal of any country’s economic policy should be to increase the well-being of its poorest, most vulnerable citizens.
   c. Excess regulation of small business is stifling the economy. Small business has been responsible for most of the growth in employment over the last 10 years, but regulations are putting a severe damper on the ability of small businesses to survive and prosper.
   d. The 1990s were a disastrous decade for the U.S. economy. Income inequality increased to its highest level since before World War II.

2. For each of the following, state whether economists would consider it a *resource*, and if they would, identify which of the four types of resources the item is.
   a. A computer used by an FBI agent to track the whereabouts of suspected criminals.
   b. The office building in which the FBI agent works.
   c. The time that an FBI agent spends on a case.
   d. A farmer’s tractor.
   e. The farmer’s knowledge of how to operate the tractor.
   f. Crude oil.
   g. A package of frozen vegetables.
   h. A food scientist’s knowledge of how to commercially freeze vegetables.
   i. The ability to bring together resources to start a frozen food company.
   j. Plastic bags used by a frozen food company to hold its product.

3. Suppose you are using the second map in Figure 1, which shows main highways only. You’ve reached a conclusion about the fastest way to drive from the Boston city center to an area south of the city. State whether each of the following assumptions of the map would be a *simplifying* or *critical* assumption for your conclusion, and explain briefly. (Don’t worry about whether the assumption is true or not.)
   a. The thicker, numbered lines are major highways without traffic lights.
   b. The earth is two-dimensional.
   c. When two highways cross, you can get from one to the other without going through city traffic.
   d. Distances on the map are proportional to distances in the real world.
TABLES AND GRAPHS

A brief glance at this text will tell you that graphs are important in economics. Graphs provide a convenient way to display information and enable us to immediately see relationships between variables.

Suppose that you’ve just been hired at the advertising department of Len & Harry’s—an up-and-coming manufacturer of high-end ice cream products, located in Texas. You’ve been asked to compile a report on how advertising affects the company’s sales. It turns out that the company’s spending on advertising has changed repeatedly in the past, so you have lots of data on monthly advertising expenditure and monthly sales revenue, both measured in thousands of dollars.

Table A.1 shows a useful way of arranging this data. The company’s advertising expenditure in different months are listed in the left-hand column, while the right-hand column lists total sales revenue (“sales” for short) during the same months. Notice that the data here is organized so that spending on advertising increases as we move down the first column. Often, just looking at a table like this can reveal useful patterns. Here, it’s clear that higher spending on advertising is associated with higher monthly sales. These two variables—advertising and sales—have a positive relationship. A rise in one is associated with a rise in the other. If higher advertising had been associated with lower sales, the two variables would have a negative or inverse relationship: A rise in one would be associated with a fall in the other.

We can be even more specific about the positive relationship between advertising and sales: Logic tells us that the association is very likely causal. We’d expect that sales revenue depends on advertising outlays, so we call sales our dependent variable and advertising our independent variable. Changes in an independent variable cause changes in a dependent variable, but not the other way around.

To explore the relationship further, let’s graph it. As a rule, the independent variable is measured on the horizontal axis and the dependent variable on the vertical axis. In economics, unfortunately, we do not always stick to this rule, but for now we will. In Figure A.1, monthly advertising outlays—our independent variable—are measured on the horizontal axis. If we start at the origin—the corner where the two axes intersect—and move rightward along the horizontal axis, monthly advertising outlays increase from $0 to $1,000 to $2,000 and so on. The vertical axis measures monthly sales—the dependent variable. Along this axis, as we move upward from the origin, sales rise.

The graph in Figure A.1 shows six labeled points, each representing a different pair of numbers from our table. For example, point A—which represents the numbers in the first row of the table—shows us that when the firm spends $2,000 on advertising, sales are $24,000 per month. Point B represents the second row of the table, and so on. Notice that all of these points lie along a straight line.


**Straight-Line Graphs**

You’ll encounter straight-line graphs often in economics, so it’s important to understand one special property they possess: The “rate of change” of one variable compared with the other is always the same. For example, look at what happens as we move from point A to point B: Advertising rises by $1,000 (from $2,000 to $3,000), while sales rise by $3,000 (from $24,000 to $27,000). If you study the graph closely, you’ll see that anywhere along this line, whenever advertising increases by $1,000, sales increase by $3,000. Or, if we define a “unit” as “one thousand dollars,” we can say that every time advertising increases by one unit, sales rise by three units. So the “rate of change” is three units of sales for every one unit of advertising.

The rate of change of the vertically measured variable for a one-unit change in the horizontally measured variable is also called the slope of the line. The slope of the line in Figure A.1 is three, and it remains three no matter where along the line we measure it. For example, make sure you can see that from point C to point D, advertising rises by one unit and sales rise by three units.

What if we had wanted to determine the slope of this line by comparing points D and E, which has advertising rising by four units instead of just one? In that case, we’d have to calculate the rise in one variable per unit rise in the other. To do this, we divide the change in the vertically measured variable by the change in the horizontally measured variable.

\[
\text{Slope of a straight line} = \frac{\text{Change in vertical variable}}{\text{Change in horizontal variable}}.
\]

We can make this formula even simpler by using two shortcuts. First, we can call the variable on the vertical axis “Y” and the variable on the horizontal axis “X.” In our case, Y is sales, while X is advertising outlays. Second, we use the Greek letter \( \Delta \) (“delta”) to denote the words “change in.” Then, our formula becomes:

\[
\text{Slope of straight line} = \frac{\Delta Y}{\Delta X}.
\]

Let’s apply this formula to get the slope as we move from point D to point E, so that advertising \( X \) rises from 7 units to 11 units. This is an increase of 4, so \( \Delta X = 4 \). For this move, sales rise from 39 to 51, an increase of 12, so \( \Delta Y = 12 \). Applying our formula,

\[
\text{Slope} = \frac{\Delta Y}{\Delta X} = \frac{12}{4} = 3.
\]

This is the same value for the slope that we found earlier. Not surprising, since it’s a straight line and a straight line has the same slope everywhere. The particular pair of points we choose for our calculation doesn’t matter.

**Curved Lines**

Although many of the relationships you’ll encounter in economics have straight-line graphs, many others do
not. Figure A.2 shows another possible relationship between advertising and sales that we might have found from a different set of data. As you can see, the line is curved. But as advertising rises, the curve gets flatter and flatter. Here, as before, each time we spend another $1,000 on advertising, sales rise. But now, the rise in sales seems to get smaller and smaller. This means that the slope of the curve is itself changing as we move along this curve. In fact, the slope is getting smaller.

How can we measure the slope of a curve? First, note that since the slope is different at every point along the curve, we aren’t really measuring the slope of “the curve” but the slope of the curve at a specific point along it. How can we do this? By drawing a tangent line—a straight line that touches the curve at just one point and that has the same slope as the curve at that point. For example, in the figure, a tangent line has been drawn for point B. To measure the slope of this tangent line, we can compare any two points on it, say, H and B, and calculate the slope as we would for any straight line. Moving from point H to point B, we are moving from 0 to 3 on the horizontal axis ($\Delta X = 3$) and from 21 to 27 on the vertical axis ($\Delta Y = 6$). Thus, the slope of the tangent line—which is the same as the slope of the curved line at point B—is

$$\frac{\Delta Y}{\Delta X} = \frac{6}{3} = 2.$$  

This says that, at point B, the rate of change is two units of sales for every one unit of advertising. Or, going back to dollars, the rate of change is $2,000 in sales for every $1,000 spent on advertising.

The curve in Figure A.2 slopes everywhere upward, reflecting a positive relationship between the variables. But a curved line can also slope downward to illustrate a negative relationship between variables, or slope first one direction and then the other. You’ll see plenty of examples of each type of curve in later chapters, and you’ll learn how to interpret each one as it’s presented.

**LINEAR EQUATIONS**

Let’s go back to the straight-line relationship between advertising and sales, as shown in Table A.1. What if you need to know how much in sales the firm could expect if it spent $5,000 on advertising next month? What if it spent $8,000, or $9,000? It would be nice to be able to answer questions like this without having to pull out tables and graphs to do it. As it turns out, anytime the relationship you are studying has a straight-line graph, it is easy to figure out an equation for the entire relationship—a linear equation. You then can use the equation to answer any such question that might be put to you.

All straight lines have the same general form. If $Y$ stands for the variable on the vertical axis and $X$ for the
variable on the horizontal axis, every straight line has an equation of the form

$$Y = a + bX,$$

where $a$ stands for some number and $b$ for another number. The number $a$ is called the vertical intercept, because it marks the point where the graph of this equation hits (intercepts) the vertical axis; this occurs when $X$ takes the value zero. (If you plug $X = 0$ into the equation, you will see that, indeed, $Y = a$.) The number $b$ is the slope of the line, telling us how much $Y$ will change every time $X$ changes by one unit. To confirm this, note that as $X$ increases from 0 to 1, $Y$ goes from $a$ to $a + b$. The number $b$ is therefore the change in $Y$ corresponding to a one-unit change in $X$—exactly what the slope of the graph should tell us.

If $b$ is a positive number, a one-unit increase in $X$ causes $Y$ to increase by $b$ units, so the graph of our line would slope upward, as illustrated by the line in the upper left panel of Figure A.3. If $b$ is a negative number, then a one-unit increase in $X$ will cause $Y$ to decrease by
units, so the graph would slope downward, as the line does in the lower left panel. Of course, $b$ could equal zero. If it does, a one-unit increase in $X$ causes no change in $Y$, so the graph of the line is flat, like the line in the middle left panel.

The value of $a$ has no effect on the slope of the graph. Instead, different values of $a$ determine the graph’s position. When $a$ is a positive number, the graph will intercept the vertical $Y$-axis above the origin, as the line does in the upper right panel of Figure A.3. When $a$ is negative, however, the graph will intercept the $Y$-axis below the origin, like the line in the lower right panel. When $a$ is zero, the graph intercepts the $Y$-axis right at the origin, as the line does in the middle right panel.

Let’s see if we can figure out the equation for the relationship depicted in Figure A.1. There, $X$ denotes advertising and $Y$ denotes sales. Earlier, we calculated that the slope of this line, $b$, is 3. But what is $a$, the vertical intercept? In Figure A.1, you can see that when advertising outlays are zero, sales are $18,000. That tells us that $a = 18$. Putting these two observations together, we find that the equation for the line in Figure A.1 is

$$Y = 18 + 3X.$$ 

Now if you need to know how much in sales to expect from a particular expenditure on advertising (both in thousands of dollars), you’d be able to come up with an answer: You’d simply multiply the amount spent on advertising by 3, add 18, and that would be your sales in thousands of dollars. To confirm this, plug in for $X$ in this equation any amount of advertising in dollars from the left-hand column of Table A.1. You’ll see that you get the corresponding amount of sales in the right-hand column.

**HOW STRAIGHT LINES AND CURVES SHIFT**

So far, we’ve focused on relationships where some variable $Y$ depends on a single other variable, $X$. But in many of our theories, we recognize that some variable of interest to us is actually affected by more than just one other variable. When $Y$ is affected by both $X$ and some third variable, changes in that third variable will usually cause a *shift* in the graph of the relationship between $X$ and $Y$. This is because whenever we draw the graph between $X$ and $Y$, we are holding fixed every other variable that might possibly affect $Y$.

A graph between two variables $X$ and $Y$ is only a picture of their relationship when all other variables affecting $Y$ are held constant.

But suppose one of these other variables does change? What happens then?

Think back to the relationship between advertising and sales. Earlier, we supposed sales depend only on advertising. But suppose we make an important discovery: Ice cream sales are also affected by how hot the
weather is. What’s more, all of the data in Table A.1 on which we previously based our analysis turns out to have been from the month of June in different years, when the average temperature in Texas is 80 degrees. What’s going to happen in July, when the average temperature rises to 100 degrees?

In Figure A.4 we’ve redrawn the graph from Figure A.1, this time labeling the line “June.” Often, a good way to determine how a graph will shift is to perform a simple experiment like this: Put your pencil tip anywhere on the graph labeled June—let’s say at point C. Now ask the following question: If I hold advertising constant at $6,000, do I expect to sell more or less ice cream as temperature rises in July? If you expect to sell more, then the amount of sales corresponding to $6,000 of advertising will be above point C, at a point such as C’ (pronounced “C prime”), representing sales of $44,000. From this, we can tell that the graph will shift upward as temperature rises. In September, however, when temperatures fall, the amount of sales corresponding to $6,000 in advertising would be less than it is at point C. It would be shown by a point such as C” (pronounced “C double-prime”). In that case, the graph would shift downward.

The same procedure works well whether the original graph slopes upward or downward and whether it is a straight line or a curved one. Figure A.5 sketches two examples. In panel (a), an increase in some third variable, Z, increases the value of Y for each value of X, so the graph of the relationship between X and Y shifts upward as Z increases. We often phrase it this way: “An increase in Z causes an increase in Y, at any value of X.” In panel (b), an increase in Z decreases the value of Y, at any value of X, so the graph of the relationship between X and Y shifts downward as Z increases.

You’ll notice that in Figures A.4 and A.5, the original line is darker, while the new line after the shift is drawn in a lighter shade. We’ll use this convention—a lighter shade for the new line after a shift—throughout this book.

**Shifts versus Movements Along a Line**

If you look back at Figure A.1, you’ll see that when advertising increases (say, from $2,000 to $3,000), we move along our line, from point A to point B. But you’ve just learned that when average temperature changes, the entire line shifts. This may seem strange to you. After all, in both cases, an independent variable changes (either advertising or temperature). Why should we move along the line in one case and shift it in the other?

The reason for the difference is that in one case (advertising), the independent variable is in our graph, measured along one of the axes. When an independent variable in the graph changes, we simply move along the line. In the other case (temperature), the independent variable does not appear in our graph. Instead, it’s been in the background, being held constant.

Here’s a very simple—but crucial—rule:
Suppose Y is the dependent variable, which is measured on one of the axes in a graph. If the independent variable measured on the other axis changes, we move along the line. But if any other independent variable changes, the entire line shifts.

Be sure you understand the phrase “any other independent variable.” It refers to any variable that actually affects Y but is not measured on either axis in the graph.

This rule applies to straight lines as well as curved lines. And it applies even in more complicated situations, such as when two different lines are drawn in the same graph, and a shift of one causes a movement along the other. (You’ll encounter this situation in Chapter 3.) But for now, make sure you can see how we’ve been applying this rule in our example, where the three variables are total sales, advertising, and temperature.

**SOLVING EQUATIONS**

When we first derived the equation for the relationship between advertising and sales, we wanted to know what level of sales to expect from different amounts of advertising. But what if we’re asked a slightly different question? Suppose, this time, you are told that the sales committee has set an ambitious goal of $42,000 for next month’s sales. The treasurer needs to know how much to budget for advertising, and you have to come up with the answer.

Since we know how advertising and sales are related, we ought to be able to answer this question. One way is just to look at the graph in Figure A.1. There, we could first locate sales of $42,000 on the vertical axis. Then, if we read over to the line and then down, we find the amount of advertising that would be necessary to generate that level of sales. Yet even with that carefully drawn diagram, it is not always easy to see just exactly how much advertising would be required. If we need to be precise, we’d better use the equation for the graph instead.

According to the equation, sales (Y) and advertising (X) are related as follows:

\[ Y = 18 + 3X. \]

In the problem before us, we know the value for sales, and we need to solve for the corresponding amount of advertising. Substituting the sales target of $42, for Y, we need to find that value of X for which

\[ 42 = 18 + 3X. \]

Here, X is the unknown value for which we want to solve.

Whenever we solve an equation for one unknown, say, X, we need to isolate X on one side of the equals sign and everything else on the other side of the equals sign. We do this by performing identical operations on both sides of the equals sign. Here, we can first subtract 18 from both sides, getting

\[ 24 = 3X. \]

We can then divide both sides by 3 and get

\[ 8 = X. \]

This is our answer. If we want to achieve sales of $42,000, we’ll need to spend $8,000 on advertising.

Of course, not all relationships are linear, so this technique will not work in every situation. But no matter what the underlying relationship, the idea remains the same:

To solve for X in any equation, rearrange the equation, following the rules of algebra, so that X appears on one side of the equals sign and everything else in the equation appears on the other side.