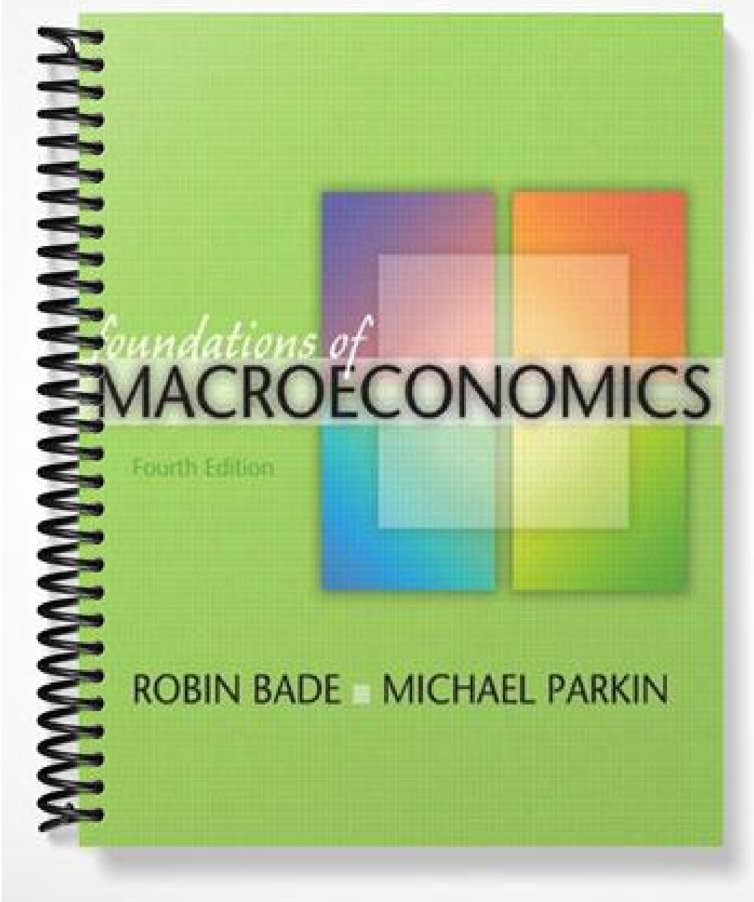
SOLUTIONS MANUAL



Chapter 1

Appendix: Making and Using Graphs

APPENDIX OUTLINE

I. Making and Using Graphs
- A. Basic Idea
- B. Interpreting Data Graphs
  - 1. Scatter Diagram
  - 2. Time-Series Graph
  - 3. Cross-Section Graph
- C. Interpreting Graphs Used in Economic Models
  - 1. Positive (or Direct) Relationship
  - 2. Linear Relationship
  - 3. Negative (or Inverse) Relationship
- D. The Slope of a Relationship
- E. Relationships Among More Than Two Variables
  - 1. *Ceteris Paribus*

APPENDIX ROADMAP

■ What's New in this Edition?
The appendix is an up-dated version of the appendix in the second edition.

■ Where We Are
The appendix to Chapter 1 is a thorough review of the mathematics and geometry used in the text. There are no economic concepts introduced in it, only mathematical concepts.

■ Where We've Been
Chapter 1 introduced economics and presented information about important topics in the course.

■ Where We're Going

Chapter 2 continues presenting background economic material. Chapter 2 uses none of the mathematical concepts covered in this appendix. However, starting in Chapter 3, which presents the production possibilities frontier, most of the remaining chapters use various parts of the review in this appendix.

IN THE CLASSROOM

■ Class Time Needed

Depending on your class's mathematical sophistication, you might decide to make this appendix optional. If you cover it in class, you should spend no more than one class session on it. The topics most likely to need review are the different types of relationships (positive and negative), covered in the third section, and slope, covered in the fourth section. Ideally, you will present these sections together and spend no more than 30 minutes on them.

Classroom Activity: An unfortunate number of students are "afraid" of mathematics. Do your best to convince them that math is a tool for them to use and, as such, it is their friend. Start by telling the students that you are aware of the fact that many of them might have a fear of math, a math phobia. Then tell them that you do not understand why they would have this fear because math is just a tool and no one should have a phobia about a tool. Point out that a pen is a tool and that no one you know has a pen phobia. Take a pen and ask your students what it would be like to have a pen phobia. Start your hand shaking as you hold a pen and point out all the ways that pens can scare people: Some of them must be clicked to work, while others must have a cap removed. And then, the decision must be made as to which end of the pen to use! All in all, a pen is a *lot* more complicated than a pencil (?!) and so it is reasonable to think that some of the students will be deathly afraid of pens, just like some of them fear math! Then conclude by explaining to your students that math is just like a pen: It's a tool to use and there is no more reason to fear it than to fear a pen!

Classroom Activity: Almost all students know how to read graphs. Give them a graph from the newspaper, and they can tell you, oh, yes, voter registrations are rising over time. But put the same chart on the board in economics class, and whatever they knew flies out of their heads. What if you began by reminding them of the *xy* space and ordered pairs they worked with in junior high, then started in with price and quantity relationships, etc.? The idea is to link the skill Miss Chalkdust taught them so long ago to what we're using now. My experience is that students learned math in a vacuum. They did it because they had to, with no understanding that math is a tool for understanding far more important or interesting things. We want to point out to students that what they learned long ago has an additional payoff because it will help them learn an entirely different subject, economics.

CHAPTER LECTURE

■ A1.1 Making and Using Graphs

Basic Idea

- A graph presents a quantity as a distance. The vertical axis is the *y*-axis and horizontal axis is the *x*-axis. The vertical line is the *y*-axis and the horizontal line is the *x*-axis. Where they meet is the origin.

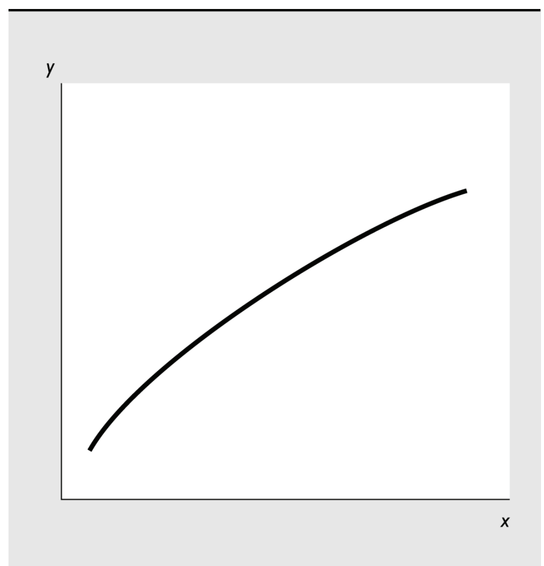
❑ **Land Mine:** Some students have persistent problems reading graphs, despite their exposure to graphs in middle and high school. They seem to fail to connect this basic tool of economics with what they've already learned. It helps to ask them to create their own graphs in xy space using graph paper. You also might use overheads that have light lines on them, and walk through counting across and down, especially in the early weeks of the course. It also seems to help if, at least at first, to label points on the graph as Miss Chalkdust did, that is, "A (5, $10); B (10, $3)." ❑

Interpreting Data Graphs

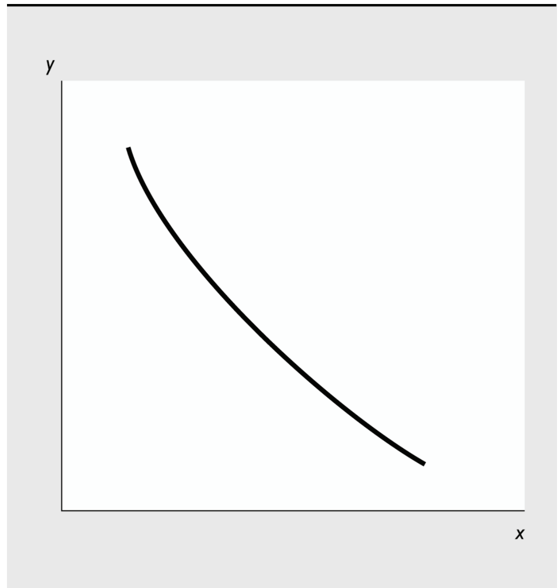
- A **scatter diagram** graphs the value of one variable against the value of another variable.
- A **time-series graph** measures time on the x-axis and the variable or variables of interest on the y-axis.
  - A time-series graph shows whether a variable has a **trend**, the general tendency for the value of the variable to rise or fall.
- A **cross-section graph** shows the values of an economic variable for different groups in a population at a point in time.

Interpreting Graphs Used in Economic Models

- When two variables move in the same direction, they have a **positive,** or **direct relationship,** as illustrated in the figure.
- A linear relationship is a special case of a positive relationship in which the function is graphed as a straight line.



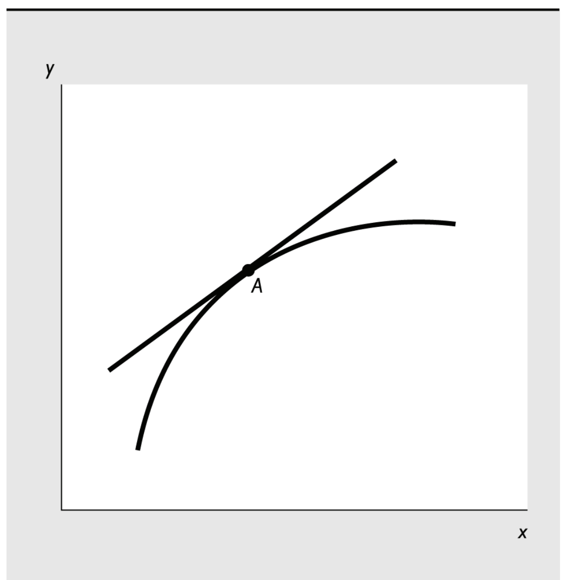
- When two variables move in opposite directions, they have a **negative**, or **inverse relationship**, as illustrated in the figure.
- Some variables have a relationship in which there is a maximum or a minimum point.
- When two variables are unrelated, their graph is either a vertical or a horizontal line.



The Slope of a Relationship

The **slope** of a relationship equals the change in the value of the variable measured on the *y*-axis divided by the change in the value of the variable measured on the *x*-axis or, in terms of a formula, the slope equals $\Delta y \div \Delta x$.

- The slope of a straight line is the same at any point on the line.
- The slope of a curved line at a point equals the slope of a straight line drawn so that it touches the curved line at only that point. In the figure, the slope of the curve at point *A* equals the slope of the straight line that is touching the curve at only point *A*.



❑ **Land Mine**: Slope is a concept that sometimes confuses students. In particular, students can think that slope equals the value of the variable on the y-axis divided by the value of the variable on the x-axis, that is, y ÷ x, rather than the change in the value of the variable on the y-axis divided by the change in the value of the variable on the x-axis, that is, Δy ÷ Δx. Be sure to clearly explain to your students that slope involves changes. One way to stress that slopes are computed using changes is to present the slope as equal to "rise over run" By expressing the slope as rise over the run, the students are reminded that they must calculate the "rise," that is, the change in the value of the variable measured on the y-axis, as well as the "run," the change in the value of the variable measured on the x-axis. ❑

Relationships Among More Than Two Variables

To graph a relationship among more than two variables, we must use the *ceteris paribus* assumption.

- *Ceteris paribus* is the Latin phrase meaning "other things being equal."
- To graph a relationship among more than two variables, select the two of interest and then draw the relationship between the two, assuming that none of the other variables changes (that is, use the ceteris paribus assumption). When one of the other variables changes, the entire graphed relationship shifts.

This might be a good opportunity to explain that unrelated variables and exogenous forces are not depicted in these *xy* graphs. Such a seed planted now may help when students wrestle with the difference between changes in demand (supply) and changes in quantity demanded (supplied) in Chapter 4.