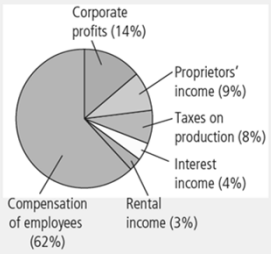
Appendix Graphing: a brief review

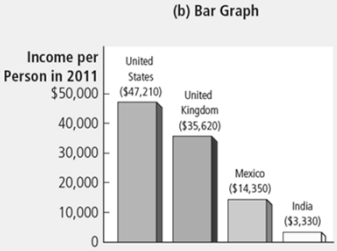
- Graphs' purposes:
  - Visually express ideas that might be less clear if described with equations or words
  - Powerful way of finding and interpreting patterns
- Graphs of a single variable
  - Pie chart
  - Bar graph
  - Time-series graph

Figure A-1
Types of Graphs (a)



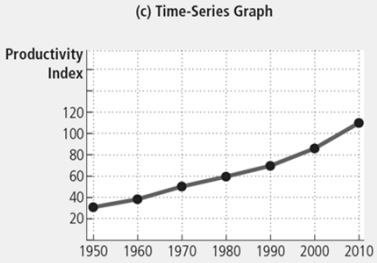
The pie chart in panel (a) shows how the U.S. national income in 2011 was derived from various sources.

Figure A-1
Types of Graphs (b)



The bar graph in panel (b) compares the 2011 average income in four countries.

Figure A-1
Types of Graphs (c)

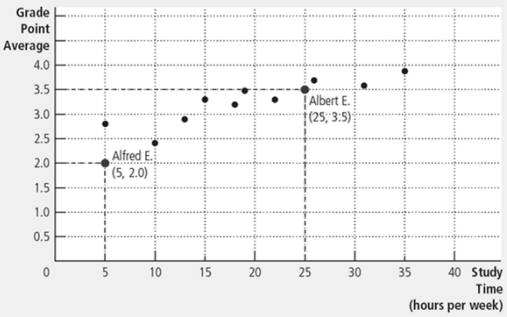


The time-series graph in panel (c) shows the productivity of labor in U.S. businesses from 1950 to 2010.

Appendix Graphing: a brief review

- Graphs of two variables: the coordinate system
  - Display two variables on a single graph
  - Scatterplot
  - Ordered pairs of points
    - x-coordinate
      - Horizontal location
    - y-coordinate
      - Vertical location

Figure A-2
Using the Coordinate System



Grade point average is measured on the vertical axis and study time on the horizontal axis. Albert E., Alfred E., and their classmates are represented by various points. We can see from the graph that students who study more tend to get higher grades.

Appendix Graphing: a brief review

- Curves in the coordinate system
- Data
  - Number of novels purchased
  - Price of novels
  - Income
- Demand curve
  - Effect of a good's price
  - On the quantity of the good consumers want to buy
  - For a given income

Table A-1

Novels Purchased by Emma

Price	For $20,000 Income:	For $30,000 Income:	For $40,000 Income:
$10	2 novels	5 novels	8 novels
9	6	9	12
8	10	13	16
7	14	17	20
6	18	21	24
5	22	25	28
	Demand curve, D_3	Demand curve, D_1	Demand curve, D_2

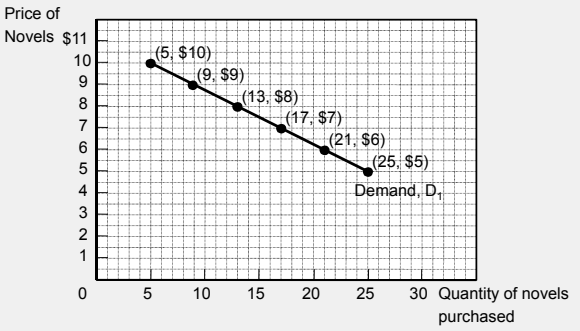
This table shows the number of novels Emma buys at various incomes and prices. For any given level of income, the data on price and quantity demanded can be graphed to produce Emma's demand curve for novels, as shown in Figures A-3 and A-4.

Appendix Graphing: a brief review

- Negatively related variables
  - The two variables move in opposite direction
  - Downward sloping curve
- Positively related variables
  - The two variables move in the same direction
  - Upward sloping curve
- Movement along a curve
- Shifts in a curve

Figure A-3

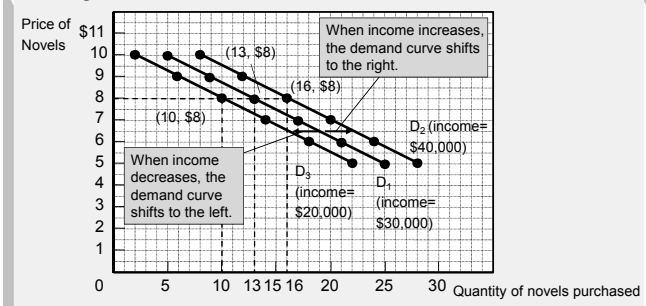
Demand Curve



The line D_1 shows how Emma's purchases of novels depend on the price of novels when her income is held constant. Because the price and the quantity demanded are negatively related, the demand curve slopes downward.

Figure A-4

Shifting Demand Curves



The location of Emma's demand curve for novels depends on how much income she earns. The more she earns, the more novels she will purchase at any given price, and the farther to the right her demand curve will lie. Curve D_1 represents Emma's original demand curve when her income is $30,000 per year. If her income rises to $40,000 per year, her demand curve shifts to D_2. If her income falls to $20,000 per year, her demand curve shifts to D_3.

Appendix Graphing: a brief review

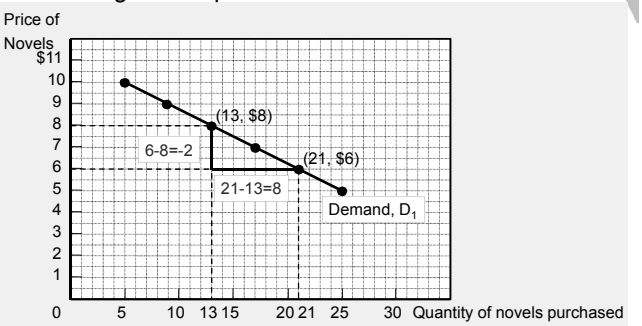
- Slope
  - Ratio of the vertical distance covered
  - To the horizontal distance covered
  - As we move along the line
    - Δ (delta) = change in a variable
    - The "rise" (change in y) divided by the "run" (change in x).

$$Slope = \frac{\Delta y}{\Delta x}$$

Appendix Graphing: a brief review

- Slope
  - Fairly flat upward-sloping line
    - Slope is a small positive number
  - Steep upward-sloping line
    - Slope is a large positive number
  - Downward sloping line
    - Slope is a negative number
  - Horizontal line
    - Slope is zero
  - Vertical line: infinite slope

Figure A-5
Calculating the Slope of a Line

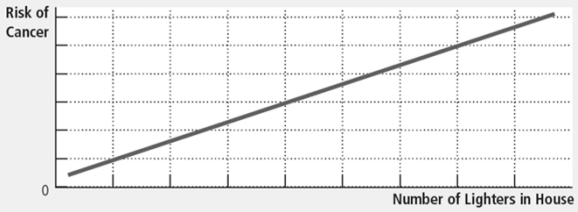


To calculate the slope of the demand curve, we can look at the changes in the x- and y-coordinates as we move from the point (21 novels, $6) to the point (13 novels, $8). The slope of the line is the ratio of the change in the y-coordinate (–2) to the change in the x-coordinate (+8), which equals –1/4.

Appendix Graphing: a brief review

- Cause and effect
  - One set of events
    - Causes another set of events
  - Omitted variables
    - Lead to a deceptive graph

Figure A-6
Graph with an Omitted Variable



The upward-sloping curve shows that members of households with more cigarette lighters are more likely to develop cancer. Yet we should not conclude that ownership of lighters causes cancer because the graph does not take into account the number of cigarettes smoked.

Appendix Graphing: a brief review

- Cause and effect
  - Reverse causality
    - Decide that event A causes event B
    - Facts: event B causes event A

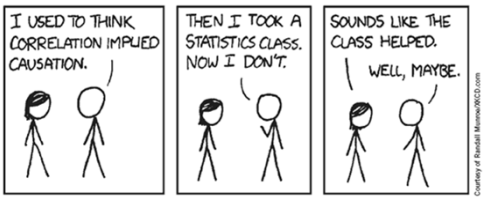
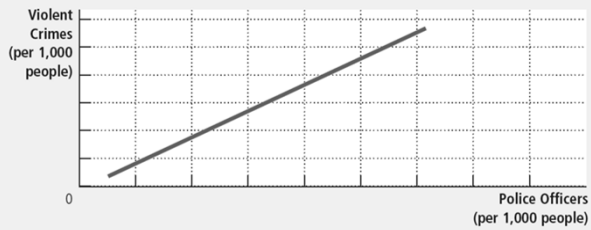


Figure A-7
Graph Suggesting Reverse Causality



The upward-sloping curve shows that cities with a higher concentration of police are more dangerous. Yet the graph does not tell us whether police cause crime or crime-plagued cities hire more police.