1 Reading Graphs

This tutorial covers **how to**:

- read single-variable graphs: pie charts and bar charts
- read two-variable graphs: scatterplots and time plots
- distinguish between a movement along a curve and a shift of a curve

1 Graphing One Variable

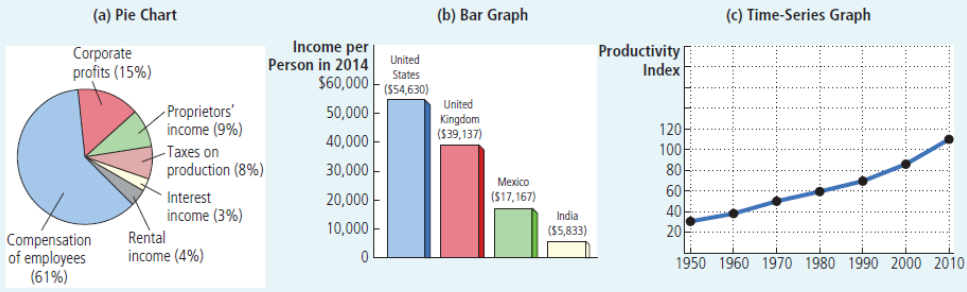
The pie chart and the bar chart (or graph) are two ways to display a single variable.

Mankiw's *Principles of Economics*, 8/e (2018) Figure A–1 presents an example of each type. The left panel (a) shows a **pie chart** of the components of national income in the United States. For each slice of the pie, the percentage in the parenthesis reveals that source's share of national income. For instance, compensation of employees comprises 61% of national income, and 15% of national income comes from corporate profits.

The center panel (b) presents a **bar chart** that compares income per person in 2014 across four countries: Unites States, United Kingdom, Mexico, and India. The length of a country's bar measures its income per person. The tallest bar is for the United States, which had the highest income per person ($54,630) in 2014.

FIGURE A-1
Types of Graphs

The pie chart in panel (a) shows how U.S. national income is derived from various sources. The bar graph in panel (b) compares the average income in four countries. The time-series graph in panel (c) shows the productivity of labor in U.S. businesses over time.



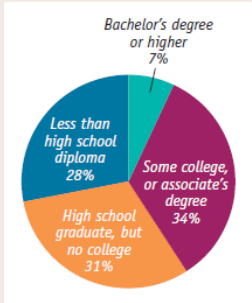
Practice Question

The pie chart in Figure 2A–10 and the bar chart in Figure 2A–11 are from Krugman, Wells, and Graddy's *Essentials of Economics*, 3/e (2014).

(1) Use the pie chart to answer this question: What percentage of workers who were paid at or below the federal minimum wage in 2011 had less than a high school diploma?

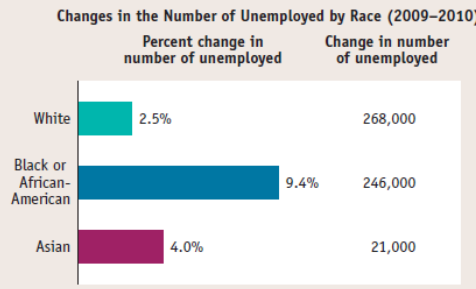
(2) Use the bar chart to answer this question: What was the percentage change in the number of unemployed white workers between 2009 and 2010?

FIGURE 2A-10 Pie Chart



A pie chart shows the percentages of a total amount that can be attributed to various components. This pie chart shows the percentages of workers with given education levels who were paid at or below the federal minimum wage in 2011.
Source: Bureau of Labor Statistics.

FIGURE 2A-11 Bar Graph



A bar graph measures a variable by using bars of various heights or lengths. This bar graph shows the percent change in the number of unemployed workers between 2009 and 2010, separately for White, Black or African-American, and Asian workers.
Source: Bureau of Labor Statistics.

2 Graphing Two Variables

The two most common ways to illustrate two variables are scatterplots and time plots.

Mankiw's (2018) Figure A–2 is an example of a **scatterplot**. The horizontal (or x) axis measures study time (in hours per week). The vertical (or y) axis measures grade point average GPA (on a 4-point scale). Each point or dot on the graph represents a student. For example, Alfred E. studies 5 hours per week, and he has a 2.0 GPA.

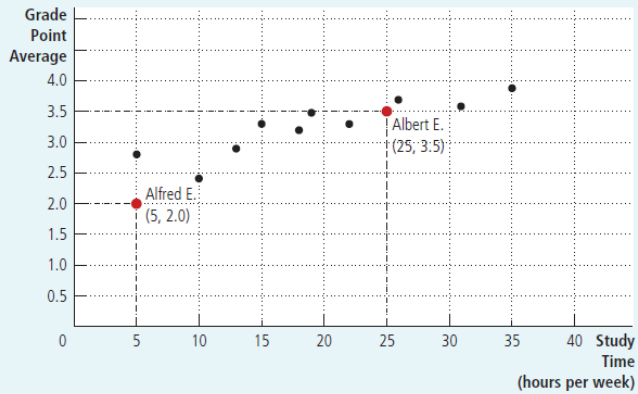
To form a scatterplot, we simply plot the data points, pairs of x and y values in the data. For example, the two numbers in parenthesis under Albert's name, the point $(25, 3.5)$, tell us that Albert spends 25 hours per week studying and his GPA is 3.5. Since this graph measures study

time on the horizontal (or x) axis, 25 measures the distance from the vertical (or y) axis to Albert's data point. Since Albert's GPA is 3.5, his data point lies 3.5 points above the horizontal axis.

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.

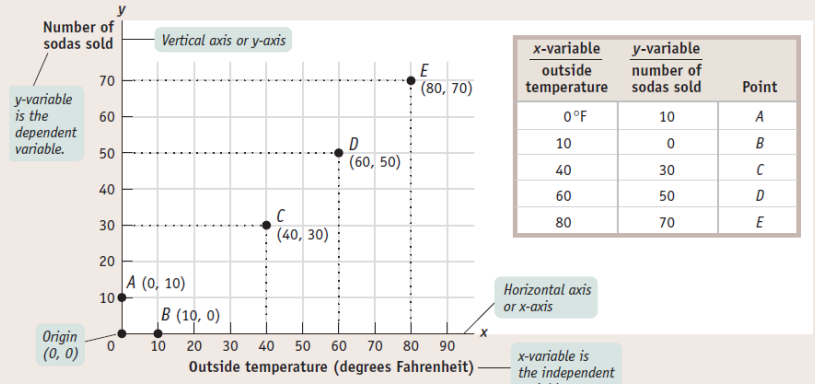


The data points in the scatterplot reveal a positive relationship between study time and GPA: students who spend more time studying tend to have higher GPAs.

Practice Question

Krugman, Wells, and Graddy's (2014) Figure 2A–1 plots combinations of sodas sold and outside temperature. How many sodas are sold if the outside temperature is 60°F?

FIGURE 2A-1 Plotting Points on a Two-Variable Graph



x-variable: outside temperature	y-variable: number of sodas sold	Point
0°F	10	A
10	0	B
40	30	C
60	50	D
80	70	E

The data from the table are plotted where outside temperature (the independent variable) is measured along the horizontal axis and number of sodas sold (the dependent variable) is measured along the vertical axis. Each of the five combinations of temperature and sodas sold is represented by a point: *A*, *B*, *C*, *D*, and *E*. Each point in the graph is identified by a pair of values. For example, point *C* corresponds to the pair (40, 30)—an outside temperature of 40°F (the value of the *x*-variable) and 30 sodas sold (the value of the *y*-variable).

Panel (c) in Mankiw's (2018) Figure A–1 is an example of a **time plot**. The horizontal axis measures time (in years); the vertical axis measures an index of labor productivity. So the figure displays how labor productivity has varied over time in the United States. The data points are pairs of year and labor productivity for the years 1950, 1960, …, 2010.

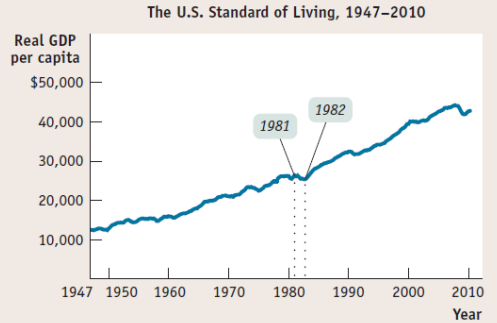
What distinguishes this graph and other time plots from scatter plots is that the data are naturally ordered from earlier to later times. So we connect the points to emphasize the progression from one data point to the next. Here the positive association between labor productivity and time means that labor productivity trended up from 1950 to 2010. In fact, with each 10-year increment, the productivity of U.S. workers increased.

Practice Question

Use the time plot in Figure 2A–8 (Krugman et al. 2014) to answer the following questions: What were the approximate values of real GDP per capita in the United Sates in 1970 and 1990? Was real GDP per capita higher in 1970 or 1990?

FIGURE 2A-8 Time-Series Graph

Time-series graphs show successive dates on the *x*-axis and values for a variable on the *y*-axis. This time-series graph shows real gross domestic product per capita, a measure of a country's standard of living, in the United States from 1947 to late 2010.
Source: Bureau of Economic Analysis.



3 Moving Along a Curve vs. Shifting a Curve

Often in economics, we distinguish between a movement along a curve and a shift of the curve itself. Let's explore the difference between the two changes in the context of demand.

Mankiw's (2018) Figure A–4 displays three downward-sloping curves. Each curve shows how many novels Emma wants to buy at various prices of novels. So each of these curves is Emma's demand curve for novels *given a value for Emma's annual income*. For instance, curve D_1 is Emma's demand curve if her annual income is \$40,000.

Let's compare points along demand curve D_1. If the price of novels is \$8 per book, Emma's quantity demanded of novels is 13 books. If the price of novels falls to \$6 per book, Emma increases her quantity demanded to 21 novels. The point $(21, 6)$ lies on the same demand curve, the blue curve D_1, but it lies southeast of the original point $(13, 8)$. We say that Emma **increases her quantity demanded** of novels as the price of novels falls. That's a movement along demand curve D_1 because her income didn't change when the price of novels fell.

Alternatively, the price of novels remains at \$8, but her annual income rises to \$50,000. She buys 3 more books. Indeed, we graph Emma's new choice by plotting the point $(15, 8)$, which lies 3 books to the right of her choice with the \$40,000 annual income. Her new point is off her demand curve D_1. In fact, it lies another a whole new demand curve D_2.

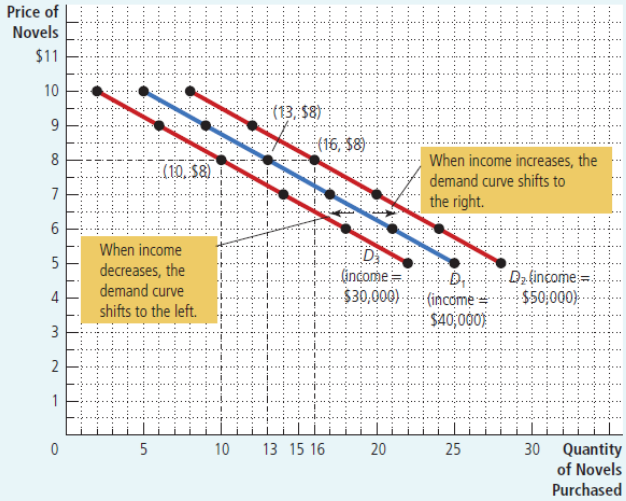


FIGURE A-4

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 $40,000 per year. If her income rises to $50,000 per year, her demand curve shifts to D_2. If her income falls to $30,000 per year, her demand curve shifts to D_3.

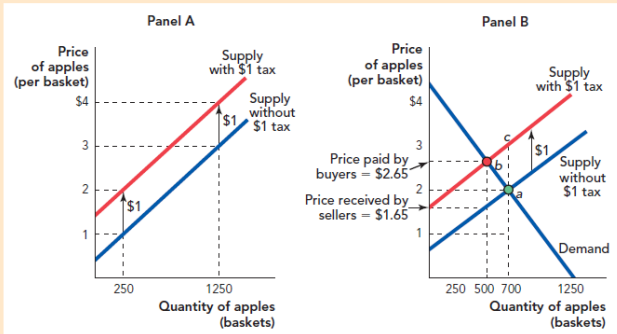
Here's why. Raising her annual income from $40,000 to $50,000 increases the number of novels she wants to buy *no matter what the price of a novel is*. There's nothing special about $8 price of novels. As drawn, at any price of novels, increasing Emma's income by $10,000 increases her quantity demanded of novels by 3. That means, the whole relationship between the number of novels she wants and the price per novel changes. In particular, her demand curve shifts from D_1 to D_2. We call that shift in the whole curve an **increase in demand** for novels.

Economists are careful to distinguish changes in demand from changes in quantity demanded. One concept refers to shifts in the demand curve; the other concept refers to movements along a fixed demand curve. These are clearly two different things, so using one term (e.g., increase in demand) to refer to two distinct concepts (e.g., increasing quantity demanded as a price falls vs. increasing quantity demanded at every price if income rises) would be a recipe for confusion.

Practice Question

Use Figure 6.1 in Cowen and Tabarrok's *Modern Principles of Economics*, 3/e to answer the following questions: Is the change from point a to point b a movement along the demand curve or a shift in the demand curve? Is that change a movement along the supply curve or a shift in the supply curve?

FIGURE 6.1



A Tax on Apple Sellers
Panel A: A $1 tax on apple sellers shifts the supply curve up by $1.
Panel B: A $1 tax on apple sellers shifts the supply curve up by $1, changing the equilibrium from point *a* to point *b*.

References

Cowen, Tyler, and Tabarrok, Alex. *Modern Principles of Economics*, 3/e. Worth Publishers, 2015

Krugman, Paul, Wells, Robin, and Graddy, Kathryn. *Essentials of Economics*. Worth Publishers, 2014.

Mankiw, N. Gregory. *Principles of Economics*, 8/e. Cengage Learning, 2018.

Additional Resources

For questions about this topic, see a **Stat** or **Pre Calc** tutor at the Dolciani Mathematics Learning Center (Hunter East, 7th floor) or any tutor in the Economics Tutoring Center (Hunter West, 15th floor).

The Dolciani Mathematics Learning Center also provides related tutorials on several platforms—CDs, DVDs, and online. Online access is through PLATO. Visit the front desk at the Math Learning Center to create a PLATO account.

Resources at the Dolciani Mathematics Learning Center

Topic	*Situational DVDs*	*Tutorial CDs/DVDs*	PLATO
reading/interpreting charts/tables	SB2, SB4, SB24		Support for Statistics: Statistical Inference & Analysis
reading graphs		C1, V3, W1, Z7, Z8	Support for Statistics: Histograms, Line, Bar, & Circle Graphs
scatter plots	SB8		Support for Statistics: Data Plots & Scatterplots 2017
pie charts	SB2, SB3		Support for Statistics: Histograms, Line, Bar, & Circle Graphs
linear graphs		V3, Z7, Z8	Support for Graphing

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