

Chapter 2

Graphical Representations



Graphs are useful tools in many types of work. They can be used to track profits, expenses, product sales, and many other kinds of data.

2.1

Broken Line Graphs

NEW SKILLS: WORKING WITH BROKEN LINE GRAPHS

broken line graph: a graph that uses points joined by line segments to display data

In the last chapter you used graphs to show slope and rate of change. In this section you will learn about **broken line graphs**. A broken line graph shows information by plotting values and joining them with line segments.

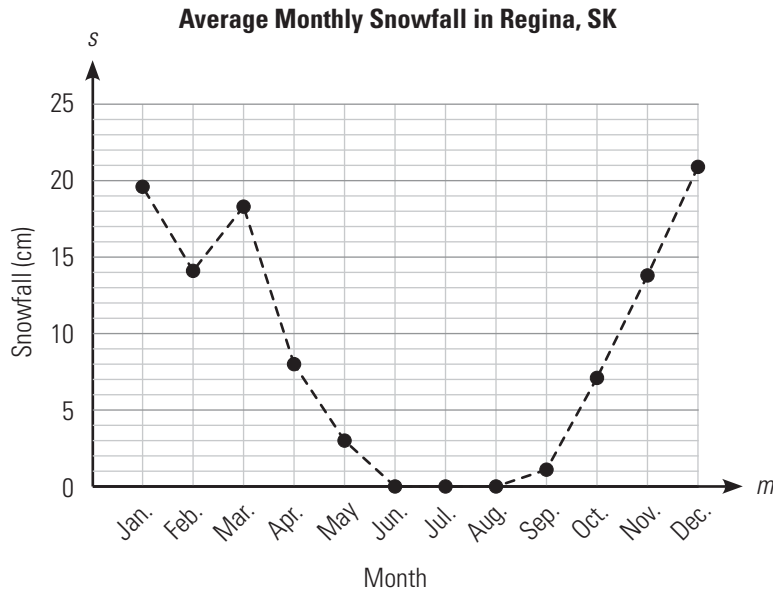
The title of a graph and the labelling of the horizontal and vertical axes tell you about the data shown. If you are drawing the graph, you have to decide what variables to display on each axis, as well as a scale for them. The independent variable goes on the horizontal axis, and the dependent variable goes on the vertical axis.

Broken line graphs are useful for showing a trend over time. They can also be used to compare sets of data, using multiple lines on the same graph.

For more details, see page 56 of *MathWorks 11*.

Example 1

The graph below shows the average snowfall in Regina, Saskatchewan, by month.



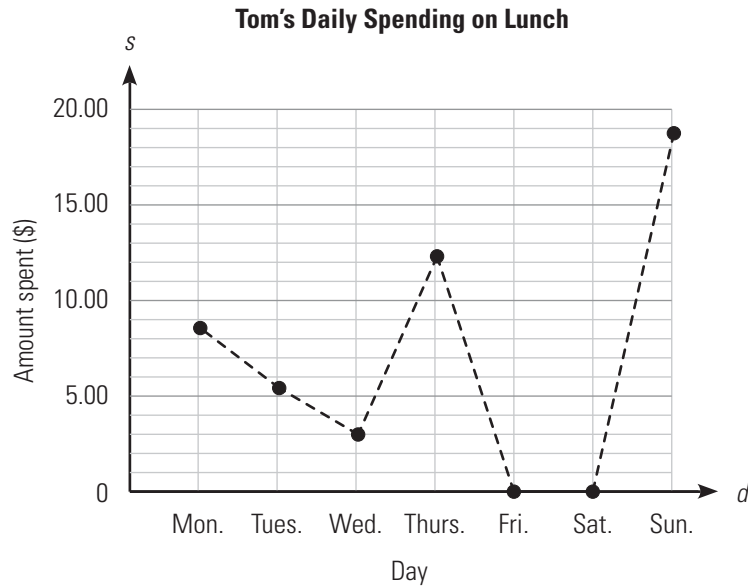
- What month has the highest average snowfall? How much snow fell that month?
- During what three months is there no snowfall in Regina?
- During what month is the average snowfall approximately twice as much as the average October snowfall?

SOLUTION

- December has the highest average snowfall at approximately 21 cm.
- There is no snowfall recorded in June, July, or August.
- Use the graph to find October's average snowfall. It is just over 7 cm, so you need to find what month has approximately double that snowfall, or about 14 cm. February's average snowfall is just over 14 cm.

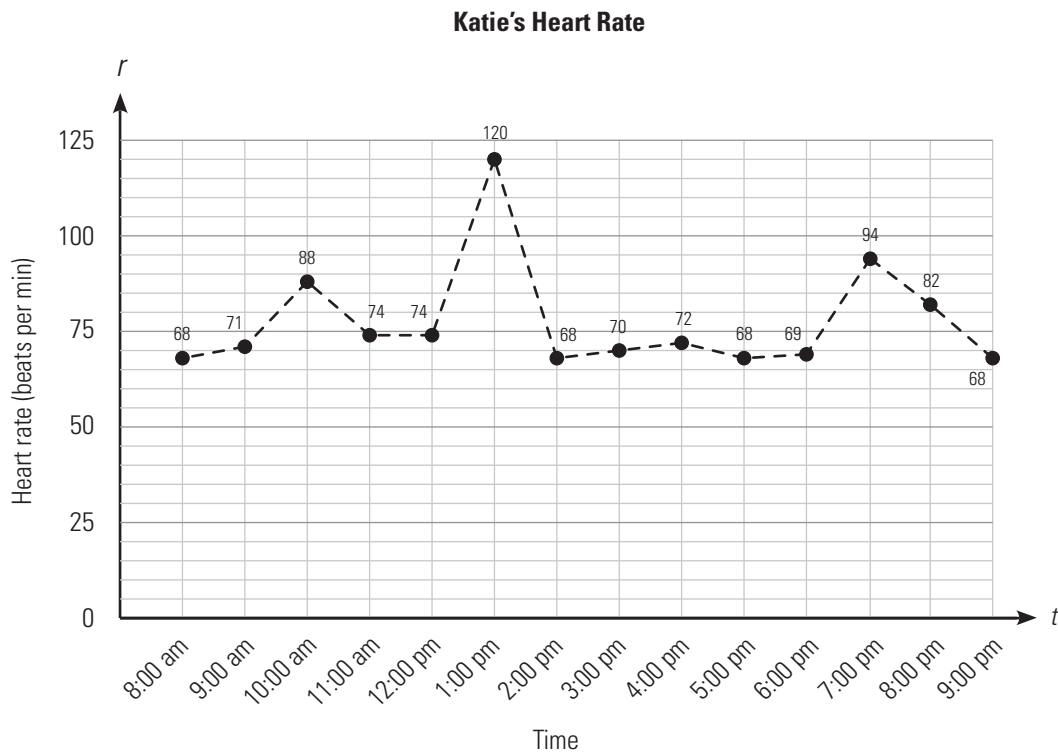
BUILD YOUR SKILLS

1. The following graph shows Tom's spending on lunches for the past week.



- a) How much did he spend on lunch on Wednesday? Friday?
- b) On what day did he spend the most on lunch, and how much was it? Give one possible reason why he might have spent so much that day.

2. Use the graph provided to answer the following questions.

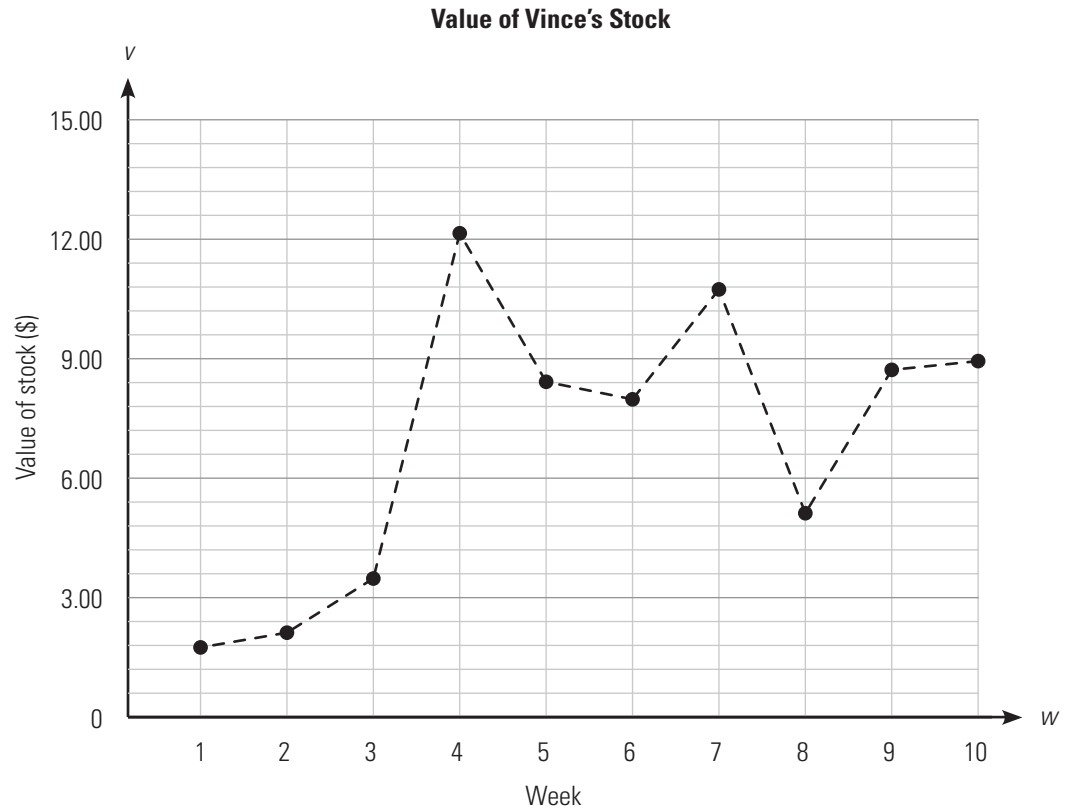


- a) What does the graph show?

- b) When was Katie's heart rate the lowest and what was it?

- c) When was her heart rate the highest? Why might this have been so?

3. The graph below shows the value of a particular stock that Vince bought, over a 10-week period. If Week 1 is when Vince bought the stock, use the graph to answer the following questions.



- a) At what price did Vince buy the stock?
- b) When was the stock worth the most? If Vince had sold it then, what would have been his profit?

Example 2

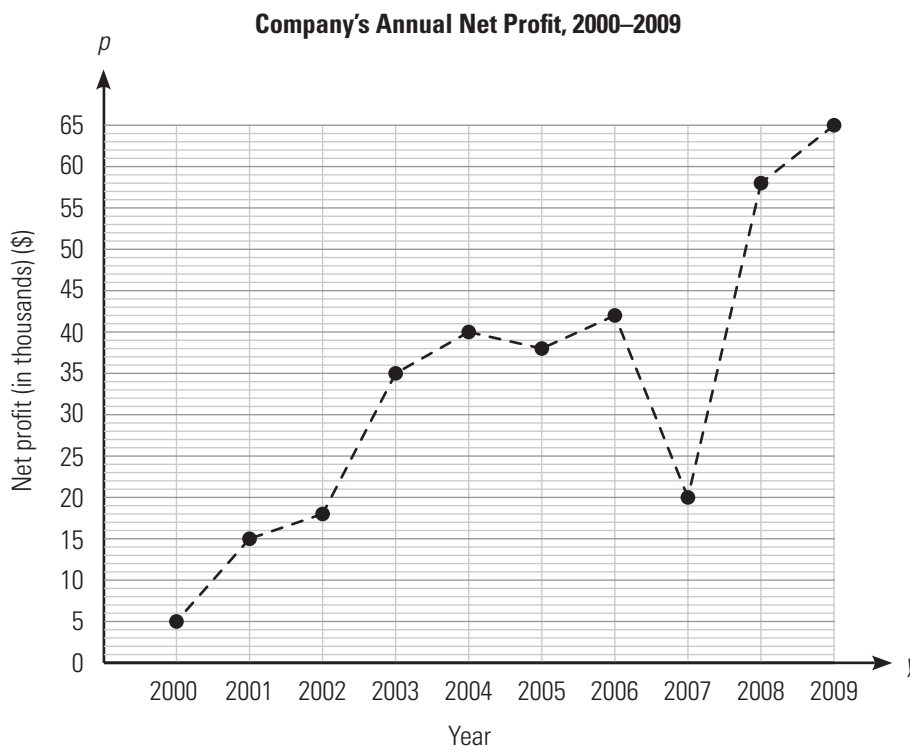
Jacob owns a small appliance repair company. He tracked the company's net profits over a 10-year period. He is examining the data to see if there is a trend and to decide if he can increase the salaries of his employees.

COMPANY'S NET PROFIT, 2000–2009										
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profit (thousands of dollars)	5	15	18	35	40	38	42	20	58	65

- a) Graph the data on a broken line graph.
- b) Is there a general trend in the data? If so, what is it? Are there any exceptions to the trend?

SOLUTION

- a) The year is the independent variable and should be displayed on the horizontal axis. The net profit is the dependent variable and will be along the vertical axis. A suitable choice for scale would be 1 along the horizontal axis and 5 along the vertical axis.



- b) There appears to be a general increase in the company's net profit, although there was a big decline in 2007.

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4. *Canadian Review* magazine is published once a week. The company keeps track of the number of magazines sold from different outlets to determine the market trend. The following data show the number of *Canadian Review* sales at a local store over the past eight weeks.

CANADIAN REVIEW MAGAZINE SALES								
<i>Week</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>
Number of copies sold	20	22	18	15	30	26	32	28

Draw a broken line graph to display the data. Are sales of the magazine increasing or decreasing?

5. Stephanie works in a pediatrician's office. One of her jobs is to track the growth rate of the babies the doctor treats. The table below shows baby Jessica's weight for the first twelve weeks of her life. Draw a broken line graph of the data and discuss the trend.

WEIGHT CHART, JESSICA, WEEKS 0–12													
<i>Age (weeks)</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>
Weight (kg)	2.4	2.2	2.6	2.9	2.9	3.1	3.5	3.6	4.0	4.0	4.2	4.4	5.1

6. A long-distance truck driver recorded the distances he drove each day for two weeks.

DISTANCE DRIVEN PER DAY														
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Distance (km)	450	235	406	0	0	560	325	386	264	453	0	0	356	289

- a) Graph the data using a broken line graph.



Saskatchewan provides 10% of the world's exported wheat. The wheat is delivered to market by truck and train.

- b) Are there any data points that seem unusual? What might have caused them?

- c) Do you think this graph is a good representation of the data?

NEW SKILLS: DISCUSSING TRENDS AND ESTIMATING VALUES

interpolate: to estimate a value between two known values

extrapolate: to estimate a value beyond a known range of values

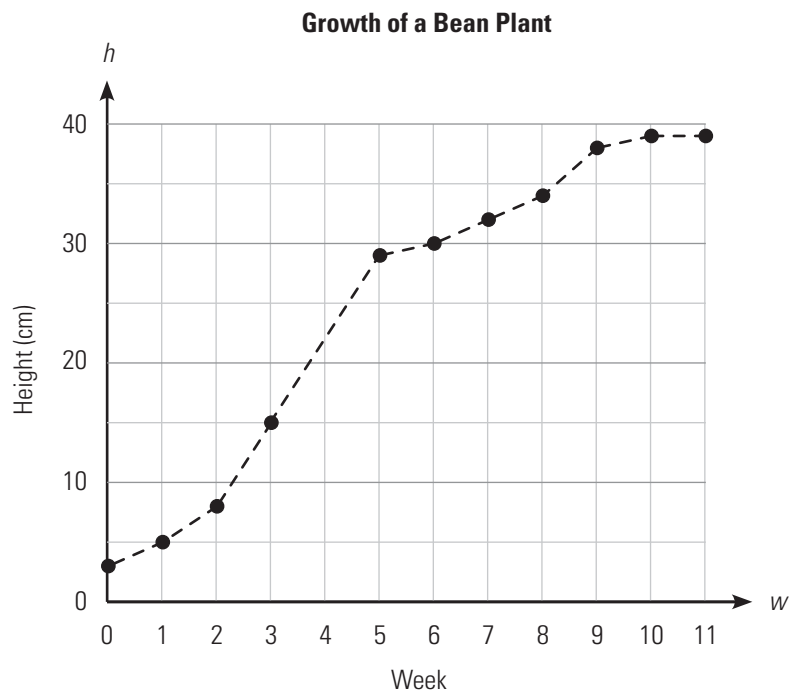
A broken line graph may help you discover a regular pattern in the data. It may show a generally increasing or decreasing trend, which can allow you to **interpolate** or **extrapolate** a value.

Interpolating means to estimate a value between two values shown on the graph. Extrapolating means to predict a value from beyond the given data shown on the graph.

For more details, see page 60 of *MathWorks 11*.

Example 3

The following graph shows the growth rate of a bean plant that David planted in his vegetable garden.



- David forgot to record the height of the bean plant in Week 4. Use the graph to interpolate the height of the plant that week.
- What might the height of the plant be in Week 12?
- Write a statement describing trends in the bean plant's growth rate from Week 0 to Week 11.

SOLUTION

- a) Between Week 2 and Week 5, the bean plant seems to have grown at a fairly steady rate. Its height in Week 4 was probably between the heights in Weeks 3 and 5. Add the heights at Weeks 3 and 5, and divide by 2.

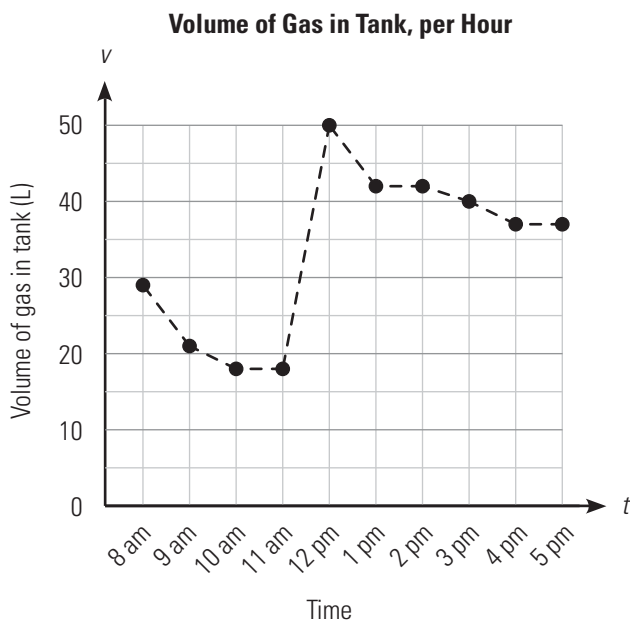
$$(29 + 15) \div 2 = 22$$

The height of the plant in Week 4 was probably around 22 cm.

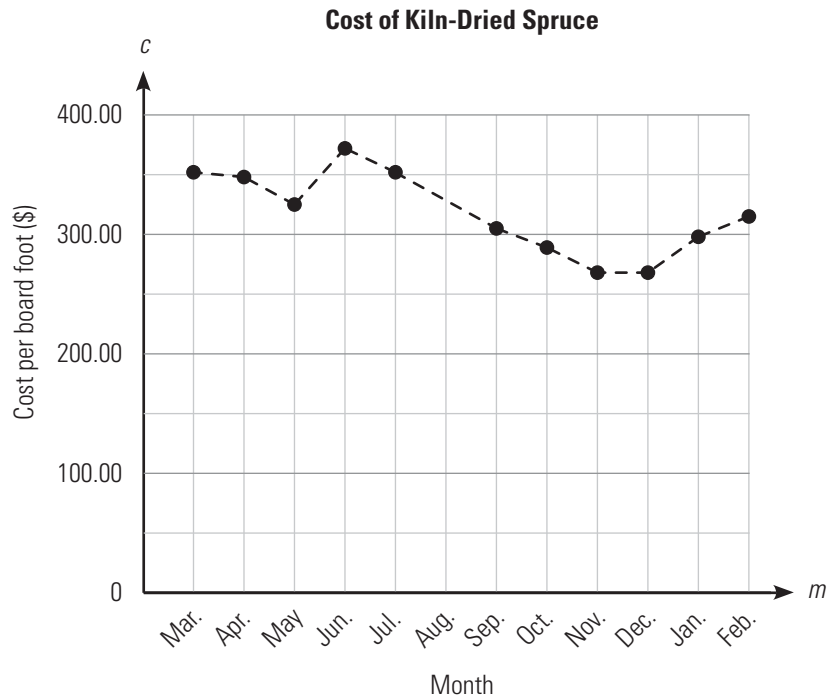
- b) The plant's growth seems to have slowed or stopped in Weeks 9 to 11. It might stay at 39 cm in Week 12, or grow slightly, maybe to about 40 cm.
- c) The plant grew at a fairly steady rate for the first two weeks, and had a rapid growth from Week 2 to Week 5. The growth was then fairly steady until Week 9, when it seemed to stop growing.

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7. Thérèse is on a road trip and is keeping track of her car's fuel consumption. The graph below shows the amount of gas in Thérèse's car at different times of the day. Use the graph to discuss what she may have been doing during the different time frames.



8. Lumber is often priced in board feet. A board foot is a piece of lumber 1 foot long by 1 foot wide by 1 inch thick. The graph below represents the cost per board foot of kiln-dried spruce over a period of one year.



- a) What is the general trend in cost of kiln-dried spruce?
- b) The graph does not show the cost in August. Use the graph to interpolate the cost of kiln-dried spruce that month.
- c) Based on the general trend in the data, what would you estimate the cost of kiln-dried spruce to be the following month, March?

Example 4

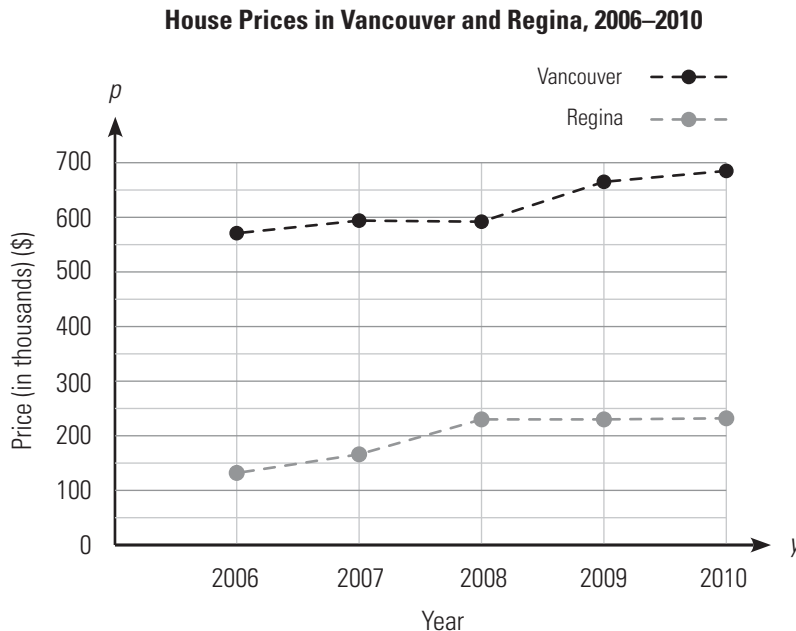
Brett is a real estate agent and is comparing the average listed price for houses in Vancouver to those in Regina from 2006 to 2010.

HOUSE PRICES, REGINA AND VANCOUVER, 2006–2010					
<i>Year</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>
Regina	\$132 000.00	\$166 000.00	\$230 000.00	\$230 000.00	\$232 000.00
Vancouver	\$571 000.00	\$594 000.00	\$592 000.00	\$665 000.00	\$685 000.00

- Display the information on a broken line graph.
- What conclusions can you draw from the table about house prices in the two cities?
- What can you tell from the graph more readily than from the table?

SOLUTION

- Drawing a multiple broken line graph is just like drawing a single one, except that you put two or more lines on the same set of axes. You must also use a legend to indicate which line represents which data.



- From the table, you can tell that house prices in Vancouver are much higher than in Regina.
- From the graph, you can tell that the prices in Regina increased more rapidly than in Vancouver from 2006 to 2008. After 2008, the prices increased more rapidly in Vancouver.

BUILD YOUR SKILLS

9. Raquel is an agent for a cell phone company. The data below indicates the number of cell phones sold to males and females in the last year.

CELL PHONE BUYERS BY GENDER												
<i>Month</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>Jun.</i>	<i>Jul.</i>	<i>Aug.</i>	<i>Sep.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>
Male	53	150	75	238	105	167	102	309	298	76	153	398
Female	21	222	89	174	309	111	76	398	442	123	67	299

- a) Use the data to draw a double line graph.
- b) Write a statement describing the general trend in cell phone purchases over the year.
- c) Does the graph indicate any relationship between the number of cell phones purchased by males compared to females? Why or why not?
- d) Do you think this graph is a useful representation of the data? If so, why? If not, what might be a better way to show trends in cell phone purchases?

10. At the end of every month, Suzanne keeps a record of the price of two stocks she bought.

<i>Month</i>	<i>Jun.</i>	<i>Jul.</i>	<i>Aug.</i>	<i>Sep.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>
Stock A	\$2.75	\$2.95	\$1.43	\$0.89	\$0.76	\$0.98	\$1.14	\$1.28	\$0.65	\$0.45	\$0.76	\$0.53
Stock B	\$1.25	\$1.11	\$1.32	\$1.45	\$1.20	\$1.25	\$1.87	\$1.59	\$1.76	\$1.43	\$1.38	\$1.21

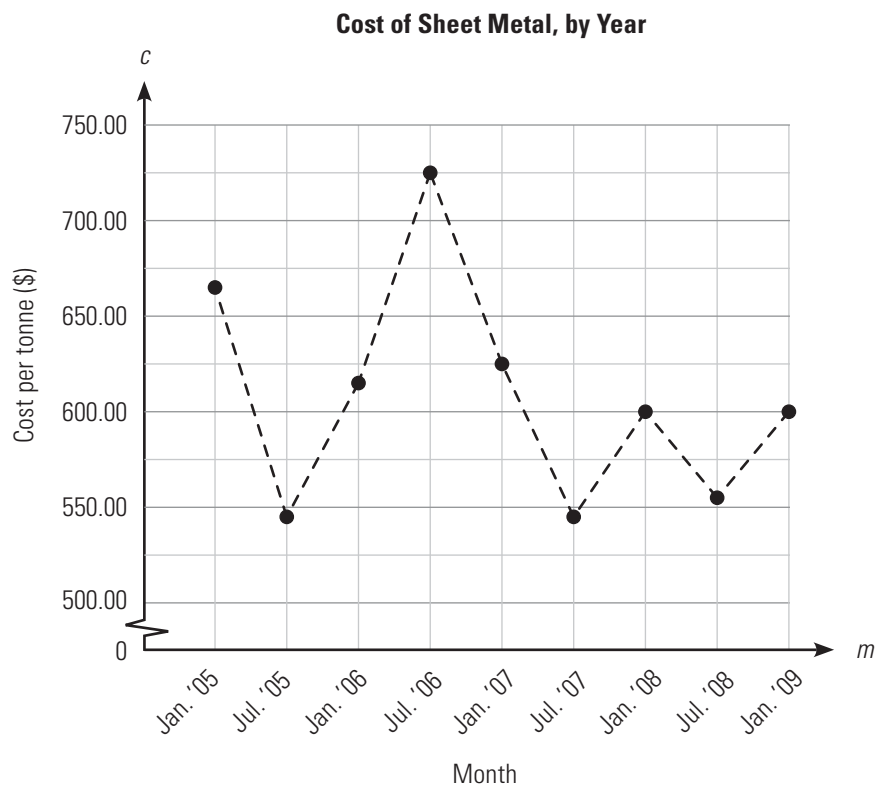
- a) Draw a double broken line graph.
- b) Use the graph to discuss the trends in the prices of the two stocks and how the prices of the two stocks compare.
- c) If Suzanne were to sell one and buy more of the other, which would you suggest she sell? Why?

NEW SKILLS: WORKING WITH MISLEADING GRAPHS

The scale and the size of a graph can influence the way you interpret the data. By changing the scale on an axis or changing the starting point of an axis, you can change how a viewer interprets the graph; while the graph will still be right, you can influence a person's perception of the data.

Example 5

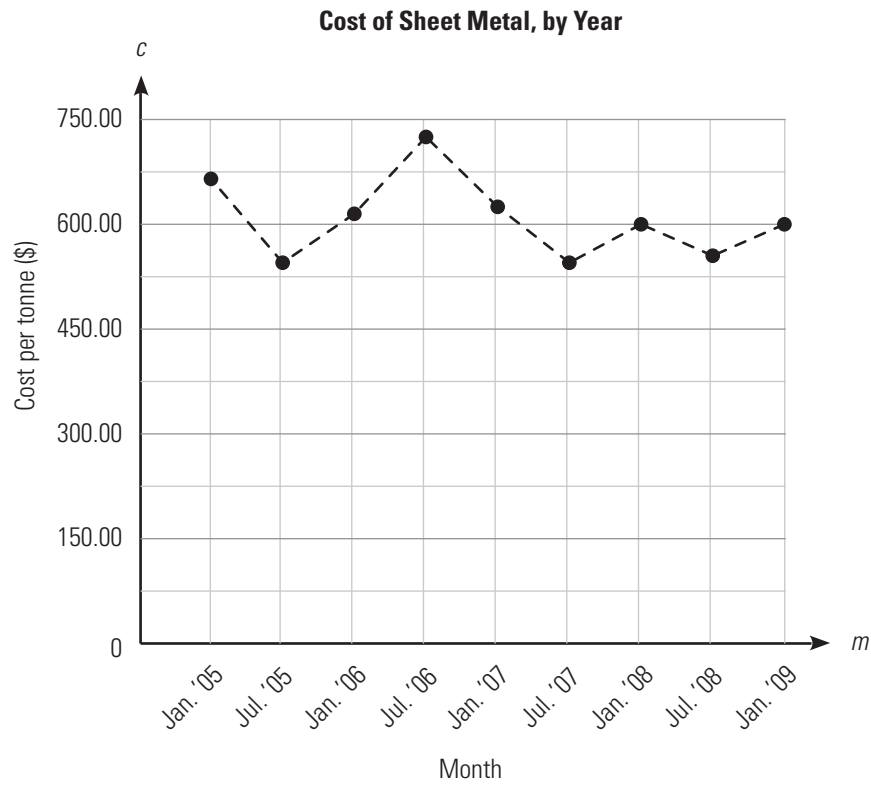
The graph below indicates the approximate cost of sheet metal per tonne over a period of time.



- What does it appear has happened to the price of sheet metal over time?
- What are the scale and starting point of the vertical axis?
- Redraw the graph starting the vertical axis at zero and using the same scale. What does this new graph show about the fluctuation in prices?

SOLUTION

- a) The graph seems to show that there was a lot of fluctuation in the price of sheet metal over time.
- b) The vertical axis begins at 500 and is divided into groups of 50.
- c)

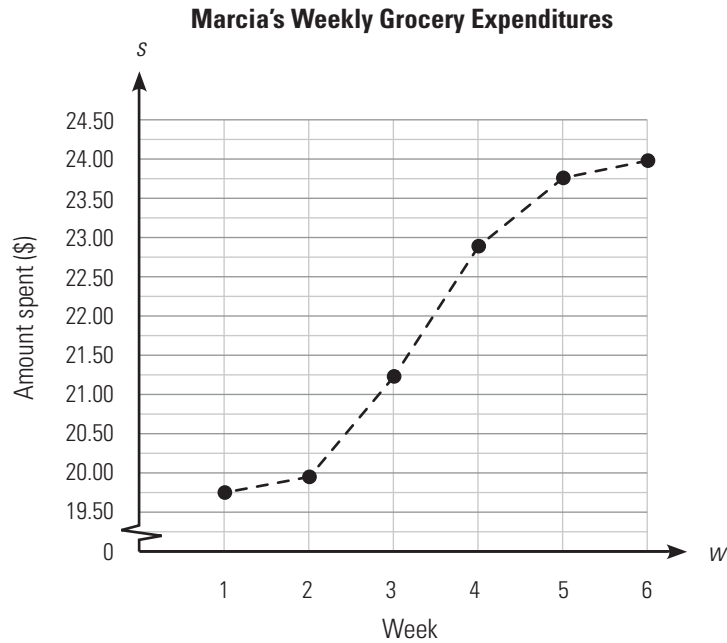


When the vertical axis starts at zero, the fluctuations in price don't look as large.

BUILD YOUR SKILLS

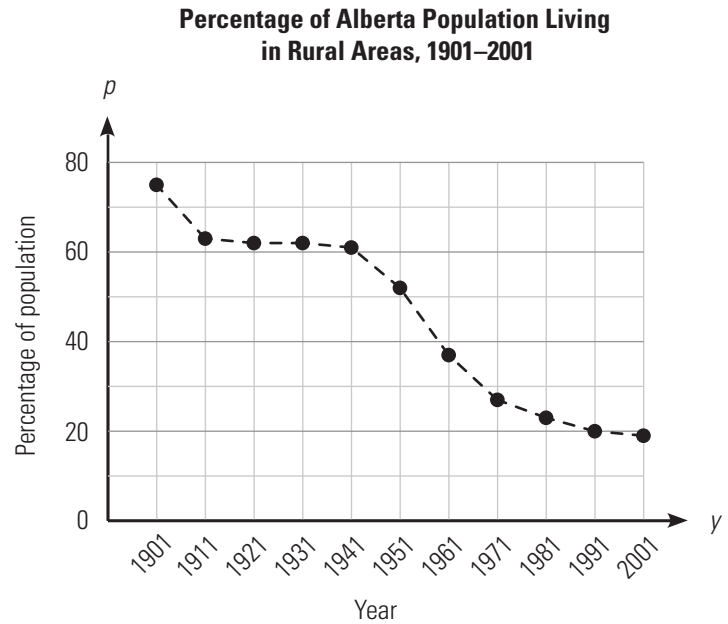
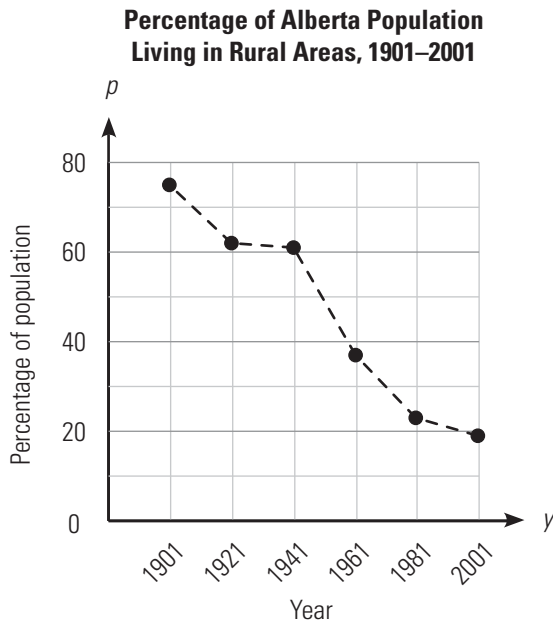
Groceries are a significant weekly expense. If you plan your meals and look for new recipe ideas, you can keep your food costs down.

11. Consider the graph below.



- What does it represent?
- What is the general trend in Marcia's weekly grocery expenditures?
- What is misleading about the graph?
- Draw a graph that better represents her expenditures.

12. Consider the two graphs below that show the percentage of the population of Alberta living in rural areas.



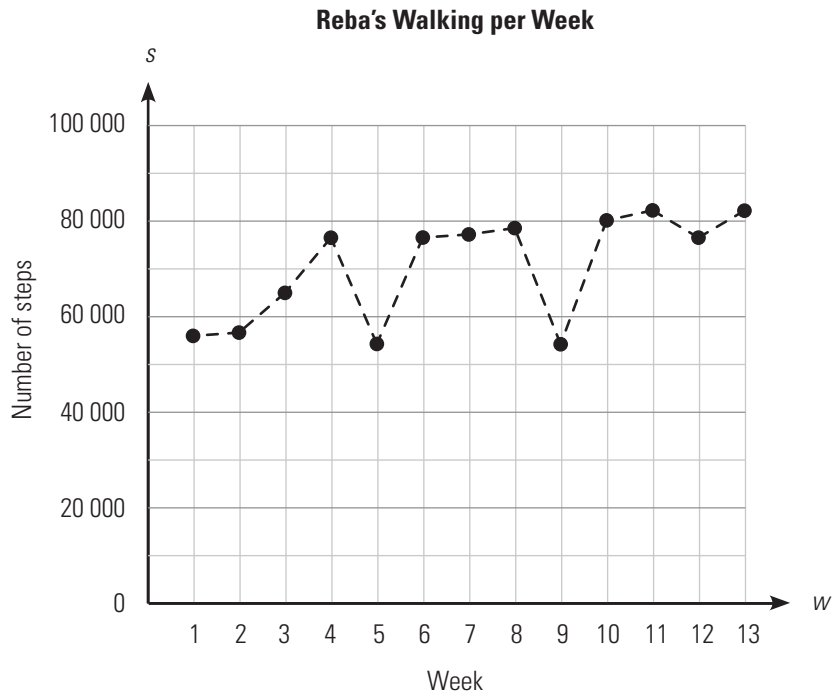
- Which graph makes it appear that the decrease in rural population was more rapid? Why?
- Which graph do you think is a better representation of the actual change in rural population? Why?
- Use the graphs to interpolate what percent of the population was rural in 1916.
- In what year was the population half rural and half urban?
- Use the graph to extrapolate what percent of the population will be rural in 2011.

PRACTISE YOUR NEW SKILLS



Walking can be a great way to get some exercise and spend time with friends.

1. Reba has joined a 13-week walking group. The graph below indicates her total steps per week. Use the graph to answer the following questions.



- a) Approximately how many steps did Reba walk the first week? The last week?

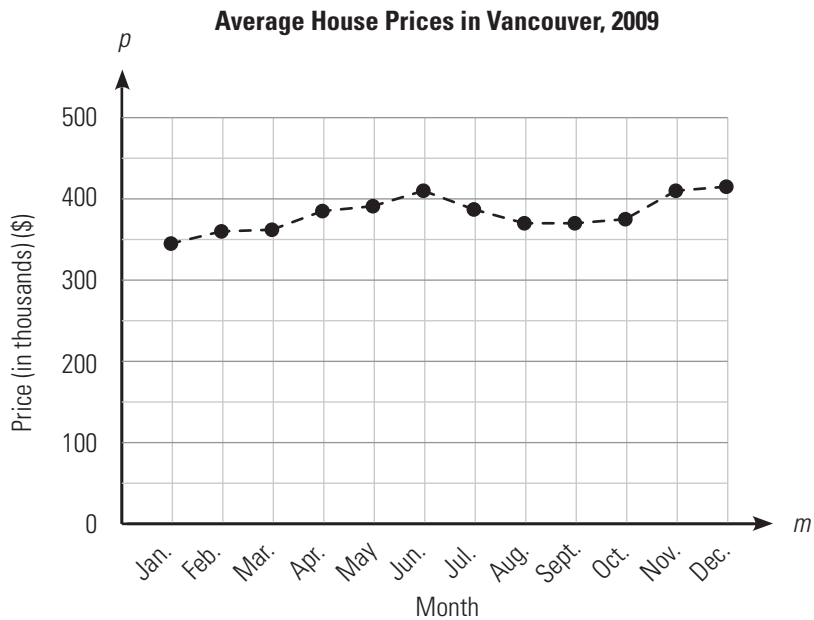
- b) During what week(s) did she take the lowest number of steps? About how many steps did she take?

- c) Is there a general trend in the number of steps she walked per week? If so, what is it?

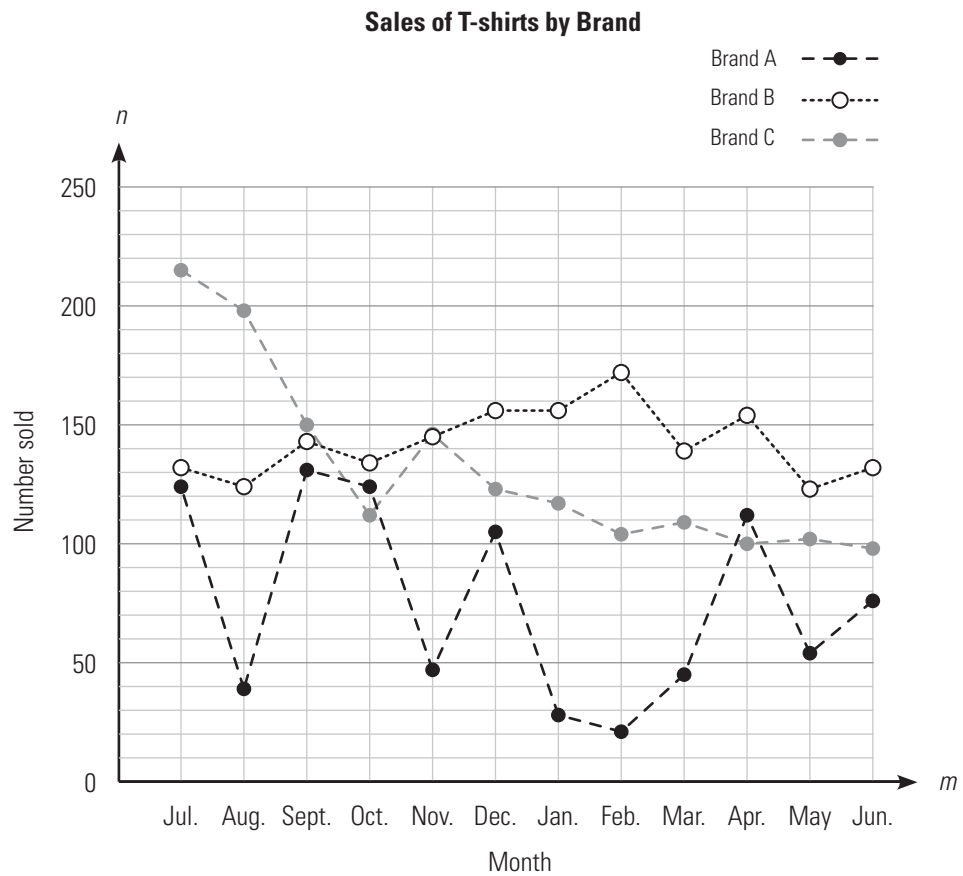
2. The data below indicates the approximate area of forest burned in forest fires in Canada each year from 1999 to 2009. Display the data on a broken line graph and discuss any trends you see in the graph.

AREA OF FOREST BURNED IN CANADA, 1999–2009											
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
No. of hectares burned (in millions)	1.6	0.6	0.6	2.9	1.7	3.3	1.7	2.8	1.6	1.7	0.8

3. The graph below shows the average house price in Vancouver in 2009, by month. Describe the trend in house prices in Vancouver during the year. During what month(s) were the prices highest?



4. Use the multiple broken line graph provided to answer the following questions.



- a) What is the general trend for sales of each brand of T-shirt?
- b) If you were to keep only two of the brands for sale, which two would you keep and why?

5. Each month the librarian does inventory to determine the number of different titles of different genres that are available in the library.

NUMBER OF BOOKS IN THE LIBRARY, BY GENRE								
<i>Month</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>Jun.</i>	<i>Jul.</i>	<i>Aug.</i>
Science fiction	124	132	135	130	145	148	154	150
Historical fiction	128	154	156	150	153	160	162	162
Love stories	123	145	148	145	152	154	159	155

- a) Use the data to draw a multiple line graph showing the number of science fiction, historical fiction, and love stories available each month over an 8-month period.



What types of books do you like to read? Do you visit the local library?

- b) Explain any trends you see in the data. What might a drop in the number of titles available mean?