2.1 Hypotheses and Sources of Data

***Principles of Mathematics 9*, pages 42–47**

A

1. State the opposite of each hypothesis.

a) Most people's favourite colour is blue.

b) Teenagers spend more time listening to rock music than to classical music.

c) Bob's favourite type of ice cream is chocolate.

d) Most students study mathematics.

2. State a hypothesis about a relationship between the variables in each pair. Then, state the opposite of each hypothesis.

a) a father's shoe size and the shoe sizes of his children

b) the cost of a movie ticket and the number of people renting DVDs

c) the altitude of a city and the length of time it takes for water to boil

d) a university student's age and the average of the student's marks

B

3. Which of the following data are primary and which are secondary? Explain.

a) The Student Council President surveys students about a school dance.

b) A student downloads data from a comparison-shopping Web site about the prices of running shoes at sporting goods stores across the country.

c) A researcher interviews 100 people to determine their favourite airline.

d) A teacher finds data on the 2006 Census in a report published by Statistics Canada.

4. Identify each data source as primary or secondary. State one advantage of each source of data.

a) A researcher interviews 100 employees about the length of time they spend travelling to the workplace.

b) An airline company searches on the Internet for data on the places Canadians have travelled recently.

c) A ferry company surveys 800 recent customers about possible changes to the ferry schedule.

d) A volunteer searches reference books at a library to check the values of cars made in 2005.

5. a) Make a hypothesis about whether the students at your school prefer to spend time rollerblading or ice skating in their leisure time.

b) Describe how you could test your hypothesis. Explain whether you would use primary or secondary data.

6. Anoja prepared the following table using data volunteered by eight students in her math class.

Name	Eye Colour	Favourite Subject
Kelvin	brown	History
Dajanth	green	Math
Tanzilah	blue	French
Debbie	blue	English
Tanveer	brown	History
Doug	blue	History
Matt	blue	English
Jamal	blue	Math
Jack	brown	Math
Sanjay	brown	History

a) Is Anoja using primary or secondary data? Explain.

b) Make two hypotheses based on these data.

c) How could you test your hypotheses?

7. Elliot prepared the following table using data collected by a researcher at a company.

Employee's Name	Favourite Colour	Favourite Animal
Sandeep	orange	dog
John	red	horse
Azra	green	cat
Sanjay	blue	dog
Kim	yellow	dog
Anneli	green	cat
Janet	green	dog
Faiza	blue	horse
Freshta	orange	cat
Vidak	blue	dog
Vedrana	purple	dog
Zoë	green	cat
Janet	blue	dog

a) Is Elliot using primary or secondary data? Explain.

b) Make two hypotheses based on these data.

c) How could you test your hypotheses?

C

8. a) Make a hypothesis about the relationship between the resolution of a digital camera and its price.

b) Use an Internet search engine to collect data about digital camera prices. Compare the results when you use the key words "camera stores," "digital camera resolution," and "digital camera prices."

c) Did you conduct primary or secondary research? Explain.

d) Describe another method for gathering data about computer speeds and prices.

9. a) Make a hypothesis about the relationship between the altitude of a mountain and the temperature at the top of the mountain.

b) Use data from a reference book in the library or an on-line source to test your hypothesis.

10. a) Make a hypothesis about how the difference between Olympic records for men and women in the 100-m freestyle swimming race has changed over the years.

b) Use the Internet or other sources to collect data to test your hypothesis.

c) Explain how the data you found prove or disprove your hypothesis.

2.2 Sampling Principles

***Principles of Mathematics 9*, pages 48–55**

A

1. Identify the population in each sample.

a) Generally, girls learn to talk before boys do.

b) As cars age, their value decreases.

c) Most sporting goods stores charge more for ice skates than for hockey sticks.

d) Generally, teenage boys learn to drive cars before teenage girls do.

2. Describe the data required to answer each question. Explain whether you would use a census or a sample to collect each set of data.

a) How are a person's height and weight related?

b) What is the most common colour of car at a car dealership?

c) What is the most common size of painting in an art gallery?

d) Is the mean mark on an exam greater than 70%?

3. Describe how you could choose a random sample to determine each of the following.

a) the type of soft drink preferred by students at a local school

b) Ontario teenagers' favourite radio station

c) countries of origin for citizens of Toronto

d) Ontario residents' favourite TV program

B

4. Identify the type of sample in each situation. Comment on any possible bias in these samples.

a) A business studies class interviews newly qualified Chartered Accountants at a single company to learn about their choices for career specialization.

b) A market research company randomly selects phone numbers from a city directory to survey citizen's opinions on a new brand of toothpaste.

c) Every fourth person entering a provincial park is asked to fill out a questionnaire about the park.

d) Visitors leaving a museum are interviewed to find out what restaurants people like to dine at.

5. List three ways you could divide workers in a company into groups for selecting a stratified random sample.

6. A recording company wants to survey Canadian musicians.

a) Identify the population.

b) Suggest a stratified random sampling technique that the company could use.

7. A health club wants to select 100 of its 415 members for a survey.

a) Identify the population.

b) Describe a systematic random sampling technique that the company could use.

8. The student council at a school wants to survey members of school clubs.

a) Identify the population.

b) Describe a method of randomly selecting 20% of the members of the clubs.

9. This table lists the enrolment at a university.

Year	Number of Students
1	1270
2	1138
3	987
4	880

The university administration wants to interview a random sample of 500 students, stratified by year. How many students should the administration select from each year?

10. Identify the population for each of the following. Then, describe how you would select an appropriate sample of each population.

a) the popularity of various sports teams in your school

b) the popularity of various sports teams in your community

c) the effectiveness of a national campaign to convince people not to drink and drive

d) the spending habits of teenagers in Ontario

e) the quality of photo prints from various digital imaging companies

f) the mean cost of propane in your community

C

11. a) Design and conduct a survey to determine how much sleep students get.

b) Present your results in a table and a graph.

c) Explain your choice of sampling technique.

12. a) Design and conduct a survey to determine

- the percent of students in your school who are taking math at the grade 12 level
- the reasons for their choice

b) Present your data in a table and a bar graph.

c) Explain your choice of sampling technique.

13. In a *voluntary sample*, people choose to answer the survey, rather than being selected by the person doing the survey. For example, a research company could mail out surveys and ask recipients to fill them in and mail them back. Discuss whether this voluntary sample accurately represents a population.

14. A survey selects 10 employees from each department at 200 companies across Ontario.

a) Explain why this sample is not completely random.

b) How does this sampling method bias the results of the survey?

2.3 Use Scatter Plots to Analyse Data

***Principles of Mathematics 9*, pages 56–67**

A

1. Identify the independent and the dependent variable in each pair.

a) physical activity and heart rate

b) cost of postage and mass of a letter

c) age of a tree and height of a tree

d) value of a car and age of a car

2. This table shows the value of an initial investment of $1000 in a mutual fund for 3 years. The values have been rounded to the nearest dollar.

Time (years)	0	1	2	3
Value ($)	1000	1092	1142	1249

a) Make a scatter plot of the data.

b) Describe the relationship between the variables.

3. This table lists the number of hours of driving instruction received by students at a driving school and their driving-test scores.

Instructional Hours	10	15	21	6	18	20	12
Student's Score	78	85	96	75	84	45	82

a) Identify the independent variable and the dependent variable.

b) Make a scatter plot of the data.

c) Describe the relationship between the variables.

d) Are there any outliers? If so, explain how they differ from the rest of the data.

B

4. This table lists data from the monthly sales of T-shirts for a rock band.

Price ($)	Monthly Sales
10	2500
12	2200
15	1600
18	1200
20	800
24	250

a) Identify the independent variable and the dependent variable.

b) Make a scatter plot of the data.

c) Describe the relationship between the variables.

5. This table shows the minimum stopping distances on wet asphalt at various speeds.

Speed (km/h)	Stopping Distance (m)
10	0.9
20	3.2
30	7.3
40	13.0
50	20.1
60	28.6
70	39.1
80	51.3
90	64.8
100	80.0
110	96.5

a) Identify the independent variable and the dependent variable.

b) Make a scatter plot of the data.

c) Describe the relationship between the speed of the car and its stopping distance on wet asphalt.

6. This table shows the average fuel economy of a particular car, in litres per 100 km, at various constant speeds, measured at a test track.

Speed (km/h)	Fuel Economy (L/100 km)
10	14.26
20	12.85
30	11.70
40	10.65
50	10.25
60	10.10
70	10.24
80	10.84
90	11.38
100	12.14
110	14.59
120	15.64
130	16.88
140	19.26
150	22.50

a) Identify the independent variable and the dependent variable.

b) Make a scatter plot of the data.

c) At what speed does this car have the best fuel economy?

7. This table gives the total number of passengers, in thousands, of Canadian air-carriers, every 2 years for the period from 1990 to 1998.

Year	Passengers (1000s)
1990	36 777
1992	37 202
1994	38 868
1996	40 176
1998	42 104

a) Make a scatter plot of the data.

b) Describe the relationship between the year and the total number of passengers.

C

8. a) Make a hypothesis about the relationship between a person's arm length and leg length.

b) Design and carry out an experiment to investigate the relationship. What conclusions can you make from the data you collected?

c) Compare your hypothesis with the results of your experiment.

d) How could you improve your experiment?

9. This table shows the fat and energy content in typical servings of cookies.

Item	Serving Size (g)	Fat (g)	Energy (kJ)
Chocolate Chunk Cookies	31	8.2	670
Butterfly Wing Cookies	19	5.5	420
Digestive Biscuits	40	8.5	830
Pure Butter Shortbreads	33	10	750
Vanilla Wafers	30	7	574

a) Calculate the amount of fat, in milligrams, per gram of each item. Round to the nearest milligram. Then, calculate the energy content per gram of each item. Round to the nearest tenth of a kilojoule. List the results of your calculations in a table.

b) Make a scatter plot of the two sets of data you calculated in part a).

c) Identify and explain any outliers.

d) Describe what you can learn from the scatter plot.

2.4 Trends, Interpolation, and Extrapolation

***Principles of Mathematics 9*, pages 68–76**

A

1. This table shows the mean monthly rent for a three-bedroom house in Sault Ste. Marie, Ontario, from 1998 to 2003.

Year	1998	1999	2000	2001	2002	2003
Rent ($)	900	954	1011	1072	1136	1204

a) Make a bar graph of the data.

b) Describe the trend in rents.

c) Predict the mean rent for a three-bedroom house in Sault Ste. Marie in 2008.

2. This table shows the number of math graduates from a university from 1999 to 2004.

Year	Graduates
1999	152
2000	170
2001	176
2002	183
2003	190
2004	196

a) Make a scatter plot of the data.

b) Describe the trend in the number of math students graduating from the university.

c) Predict the number of math students graduating from the university in 2008.

B

3. This table summarizes data about cell phone and dishwasher use in Canada.

Cell Phone and Dishwasher Use in Canada					
Year	2000	2001	2002	2003	2004
Cell Phone (%)	41.8	47.6	51.6	54	58.9
Dishwasher (%)	51.2	52	54.3	55	56

Adapted from Statistics Canada, Cansim Database, Table 203-0020.

a) Use a graph to compare the trend in cell phone use in Canada with the trend in dishwasher use in Canada.

b) Predict the cell phone use and the dishwasher use in Canada in 2010.

4. This table shows the yearly taxes for a cottage in Sydenham, Ontario, from 2001 to 2005.

Year	2001	2002	2003	2004	2005
Taxes ($)	1400	1600	1800	2000	3000

a) Identify the independent variable and the dependent variable.

b) Make a scatter plot of the data.

c) Describe the trend in taxes.

d) Identify any outliers. Explain whether you would include any of these outliers in the data set.

5. This table shows the population of Ontario from 1990 to 2000.

Year	Population (1000s)
1990	10 299.6
1991	10 472.6
1992	10 570.5
1993	10 690.4
1994	10 827.5
1995	10 964.9
1996	11 100.9
1997	11 249.5
1998	11 384.4
1999	11 513.8
2000	11 669.3

a) Make a scatter plot of the data.

b) Describe the trend in population.

c) Estimate the population of Ontario in 2010.

6. The following table relates mean word length and recommended age level for a set of children's books.

Recommended Age	Mean Word Length
4	3.5
6	5.5
5	4.6
6	5.0
7	5.2
9	6.5
8	6.1
5	4.9

a) Create a scatter plot of the data.

b) Predict the average word length in books for 12-year-olds.

7. This table gives the average annual pet expenses of individuals with certain incomes.

Income ($)	Pet Expenses ($)
15 000	104
25 000	195
35 000	250
45 000	350
55 000	477

a) Identify the independent variable and the dependent variable.

b) Create a scatter plot of the data.

c) Describe the trend in pet expenses. Suggest two reasons to explain this trend.

d) Estimate the pet expenses for an individual with an annual average income of $40 000.

e) Estimate the pet expenses for an individual with an annual average income of $60 000.

f) Estimate the yearly income for a person with average annual pet expenses of $400.

8. This table shows the distance travelled by a car from 0 s to 14 s.

Time (s)	0	2	4	6	8	10	12
Distance (m)	0	6	22	50	90	140	190

a) Make a scatter plot of the data.

b) Use the scatter plot to predict the distance travelled by the car after 9 s.

C

9. An object is thrown straight up into the air. This table shows the height of the object as it ascends.

Time (s)	0	0.2	0.4	0.6	0.8	1.0	1.2
Height (m)	0	1.7	3.0	3.9	4.4	4.5	4.2

a) Make a scatter plot of the data.

b) Use the scatter plot to predict how long the object will be in the air.

10. This table summarizes data about the average weekly earnings in Canada.

Average Weekly Earnings ($)			
Year	Canada	Ontario	Alberta
2001	667.27	712.88	683.49
2002	680.93	726.21	698.85
2003	690.57	734.78	707.31
2004	706.03	748.10	730.81
2005	728.17	768.59	769.13

Adapted from Statistics Canada, CANSIM Database, Table 281-0044

a) Use a graph to compare the trend in average weekly earnings in Canada with the trends in Ontario and Alberta. Summarize the trends in one or two sentences.

b) Estimate the average weekly earnings in Canada, Ontario, and Alberta in 2006.

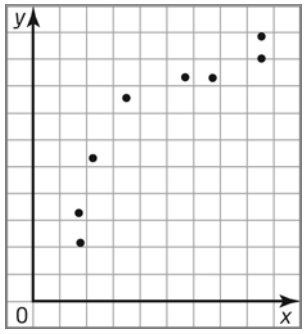
2.5 Linear and Non-Linear Relations

***Principles of Mathematics 9*, pages 77–87**

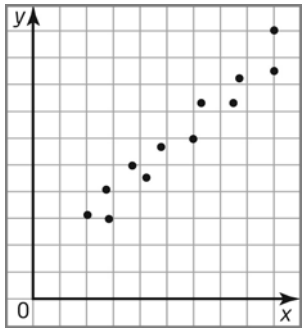
A

1. Does each graph show a linear relationship? Explain.

a)



b)



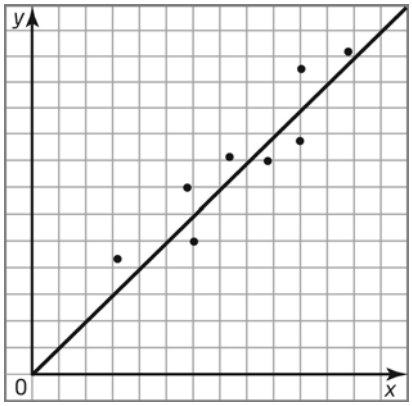
2. Does each set of points have a linear relationship? Justify your answer.

a) (−2, −2), (−2, −1), (−1, −1), (0, 0), (1, 0), (1, 1), (2, 2), (2, 3), (3, 3), (4, 3), (4, 4), (5, 5)

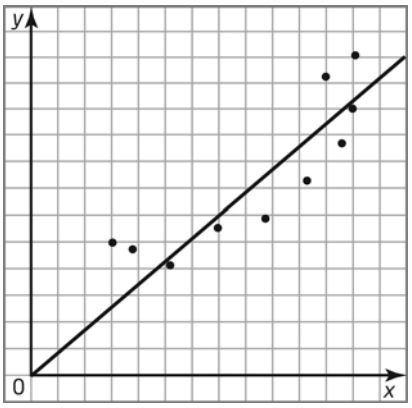
b) (−3, −1), (−2, −1), (−2, −2), (−1, −2), (0, −1), (1, −1), (1, −2), (2, 0), (2, 1), (3, 1), (3, 2), (3, 3)

3. State whether each of these lines of best fit is a good model for the data. Justify your answers.

a)

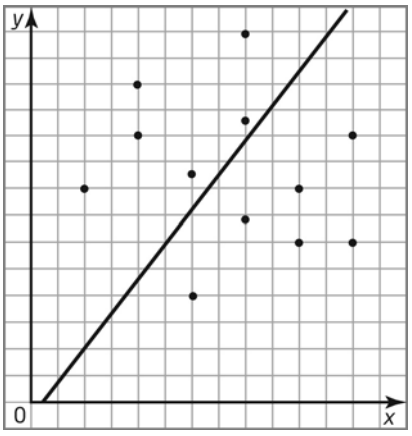


b)

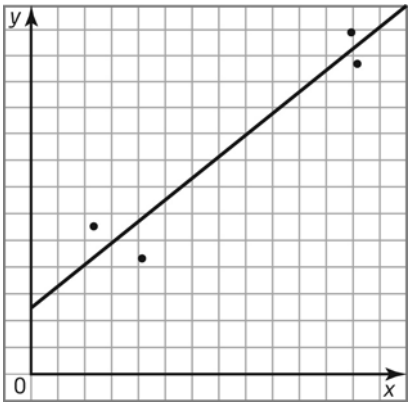


4. State whether each of these lines of best fit is a good model for the data. Justify your answers.

a)



b)



5. Plot each set of points on a grid. If your plot shows a linear relationship, draw a line of best fit. If the relation appears non-linear, sketch a curve of best fit.

a) (−4, −3), (−3, −1), (−2, −1), (−1, −1), (0, 1), (1, 2), (2, 2), (3, 5), (4, 5), (5, 6)

b)

x	4	3	6	5	2	7	1	7
y	1	1	4	3	2	5	3	6

B

6. This table represents the distance that a ball travels when dropped from the top of a 4-m ladder.

Time (s)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Distance (m)	0.05	0.2	0.4	0.8	1.2	1.7	2.4	3.1

a) Make a scatter plot of the data.

b) Draw a line or curve of best fit.

c) Describe the relationship between the variables.

7. This table represents data from a survey to determine the relationship between a student's age and the number of books they have read in the past year.

Age (years)	16	15	18	17	16	15	14	17
Books Read	5	3	8	6	4	4	5	15

a) Make a scatter plot of the data.

b) Describe the relationship between the variables.

c) Are there any outliers? If so, explain how they differ from the rest of the data.

8. This table shows the pressure of salt water at various depths.

Depth (m)	Pressure (kPa)
5	150.385
10	199.315
15	248.425
20	297.458
25	346.491
30	395.525
35	444.558
40	493.591

a) Make a scatter plot of the data.

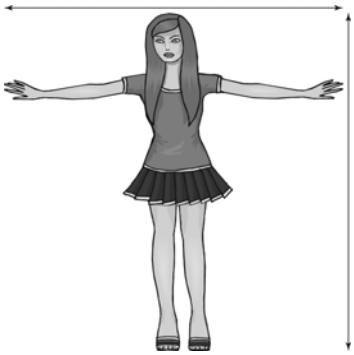
b) Draw a line or curve of best fit.

c) Describe the relationship between the variables.

d) Estimate the water pressure at a depth of 38 m.

e) Extrapolate to estimate the water pressure at a depth of 60 m.

9. Design and carry out an experiment to see if there is a linear relationship between the armspan and height of students in your class.



Write a report on your experiment. This report should include

a) the objective of the experiment

b) your hypothesis

c) a description of your procedure

d) your observations

e) your conclusions

f) an evaluation of the experiment

C

10. Consider each set of data. How can you tell whether the relationship between the variables in each pair is linear without graphing the data?

a)

x	–3	–2	–1	0	1	2	3
y	–4	–2	0	2	4	6	8

b)

t	0	1	2	3	4	5	6
h	–4	–2	–1	4	3	5	7

c)

t	–3	–2	–1	0	1	2	3
d	8	–4	3	0	–3	–4	–5

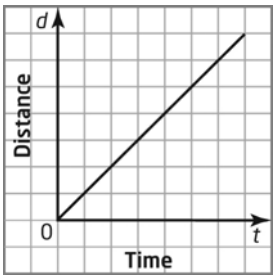
2.6 Distance-Time Graphs

***Principles of Mathematics 9*, pages 88–94**

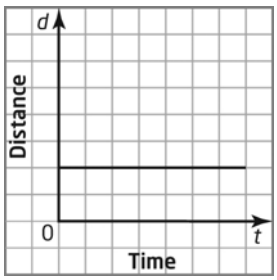
A

1. Describe the motion shown in each distance-time graph.

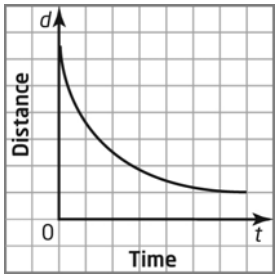
a)



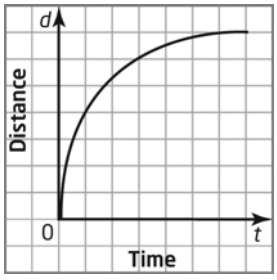
b)



c)

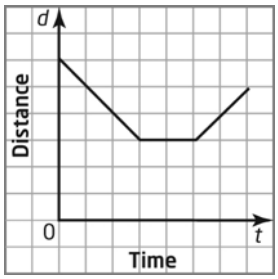


d)

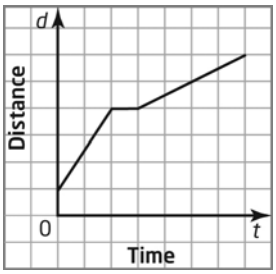


2. Describe a situation that corresponds to each distance-time graph.

a)



b)



B

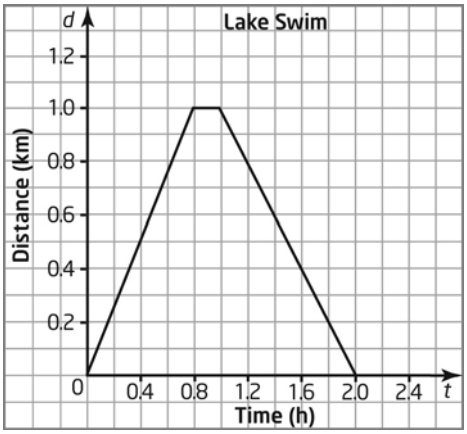
3. Draw a distance-time graph for each situation.

a) A student leaves school at lunch, walking at a decreasing speed. He slows down, and then stops to talk to a friend. He turns around and walks back to school at an increasing speed.

b) A student leaves home, walking at a constant speed. She slows down, and then stops for a few seconds to look in a store window. She turns around and walks back home at a decreasing speed.

4. Sketch a distance-time graph for a cyclist that slowly speeds up after stopping at a stop sign.

5. A swimmer starts out from shore and swims to a dock directly across the lake and back. This graph shows the swimmer's distance from shore during this trip.



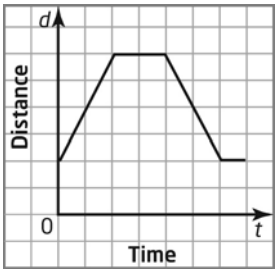
a) How long did this trip take?

b) How far is it to the dock directly across the lake?

c) What does the flat portion of the graph represent?

d) Was the swimmer swimming faster on the way to the dock or on the way back?

6. a) You are holding a rangefinder pointed at a wall. Describe how you would move to match the graph.

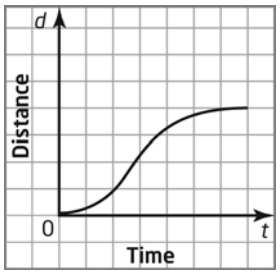


b) How would the distance-time graph change if you walked faster?

c) How would the distance-time graph change if you walked slower?

d) If a rangefinder and graphing calculator are available, use them to check your answers to parts b) and c).

7. This graph shows how far a car has travelled from its starting point.



Describe the car's motion in a few sentences.

C

8. a) Find the speed of the swimmer in question 5 during each of the three segments of the swim.

b) Draw a speed-time graph for the swimmer's swim.

c) How is the speed of the swimmer related to the shape of the distance-time graph?

d) What does negative speed represent in this situation?

9. a) Sketch three distance-time graphs.

b) Describe the motion in each graph.

c) If a rangefinder and graphing calculator are available, use them to check your answer to part b).

Chapter 2 Review

***Principles of Mathematics 9*, pages 95–97**

1. State a hypothesis about a relationship between the variables in each pair. Then, state the opposite hypothesis.

a) the temperature in a city during the winter and the amount of electricity used by the city's residents

b) a person's shoe size and his or her marks in English

2. State the opposite of each hypothesis.

a) Internet use has more than tripled in the past 20 years.

b) The more you practise, the worse you will do in a game.

3. State whether each data source is primary or secondary. Then, explain whether the source is a good choice.

a) To determine the number of each size of T-shirt to buy for student volunteers, a teacher surveyed 100 of the school's students by phone.

b) To find data on the sizes of fish in Ontario, a student searched the Internet.

4. A chain store wishes to survey a representative sample of its employees.

a) Identify the population.

b) Describe a suitable stratified random sample for this survey.

c) Give an example of a non-random sample.

d) Explain why the non-random sample might not be representative of the population.

5. An office manager wants to survey employees' opinions about the working conditions at the office.

a) Identify the population.

b) Describe how the office manager could use a stratified random sample for the survey.

6. A travel company wants to determine how its clients feel about electronic tickets for airlines.

a) Identify the population.

b) Describe how the travel company could use a systematic random sample for its survey.

7. This table shows the lengths of five boats and the number of passengers each one can carry.

Length (feet)	17	19	21	23	25
Capacity (passengers)	6	8	10	11	13

a) Make a scatter plot of the data.

b) Describe the relationship between the length of a boat and its capacity.

c) Estimate the number of passengers that a 20-foot boat could carry.

d) Predict the number of passengers that a 29-foot boat could carry.

8. Graph each set of points on a grid. Then, draw a line or curve of best fit for each set of data. Explain.

a)

x	–3	–1	2	1	–5	–2	0	–4
y	0	2	5	4	–2	1	3	–1

b)

Time (days)	0	1	2	3	4	5
Height (cm)	0.2	0.4	0.8	1.2	2.0	2.6

9. Design and carry out an experiment to see if there is a linear relationship between the height of a pile of quarters and the number of quarters in the pile. This report should include

a) the objective of your experiment

b) your hypothesis

c) a description of your procedure

d) your observations

e) your conclusions

f) an evaluation of the experiment

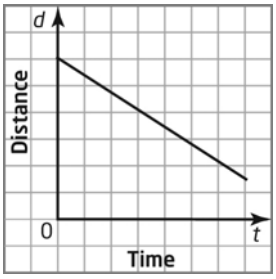
10. Draw a distance-time graph to represent each situation.

a) A student leaves school and walks to a store directly across the street at a speed of 4 m/s for 20 s, stops for 30 s to talk to a friend, and then walks back to the entrance of the school at a speed of 5 m/s for 16 s.

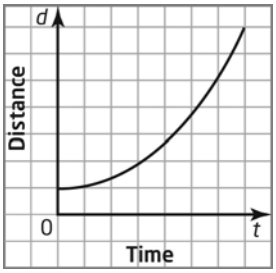
b) A ball dropped from a height of 8 m steadily increases in speed until it hits the ground.

11. Describe the motion in each distance-time graph.

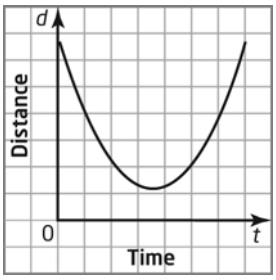
a)



b)



c)



12. Which of the graphs in question 11 show linear functions between distance and time? Justify your answer.