1.2 Conclusions and Issues

"Female students like school more than male students do."

What does the statement above mean? Do you agree with it? How do people make statements like this with confidence?

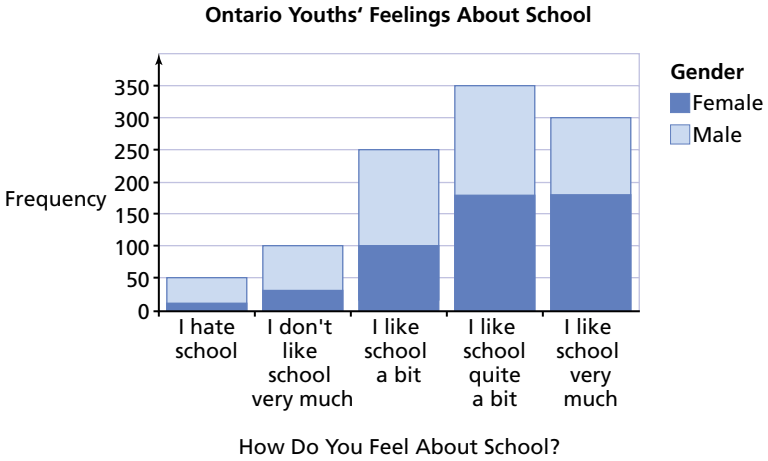
An important step in coming to this conclusion is gathering data. In this case, the data about male and female opinions of school were gathered using a survey and the data were then recorded in a table like the one shown here.

	A	B
1	Ontario Youths	
2	Gender	How do you feel about school?
3	F	3. I like school a bit.
4	F	1. I hate school.
5	F	4. I like school quite a bit.
6	F	5. I like school very much.
7	M	5. I like school very much.
8	F	1. I hate school.
9	M	2. I don't like school very much.
10	M	3. I like school a bit.
11	F	2. I don't like school very much.

Example 1 Do Female Students Like School More Than Male Students Do?

split-bar graph—a visual way of comparing information in which two different quantities are represented by the lengths of bars

What follows is a **split-bar graph** showing the distribution of the responses to the question *How do you feel about school?* with each bar split by gender. Based on these data, do females like school more than males do?



Technolink
The data shown in the split-bar graph and the table above were taken from the full data set on the textbook CD.

Think about
The Graph and the Solution
The analysis used the first and fifth bars to arrive at the conclusion that females like school more than males do. Do the other bars also support this conclusion? Why or why not?

Solution

From the split-bar graph it is clear that

- about three times as many males chose "I hate school" than did females
- more females chose "I like school very much" than did males

Based on this analysis, it seems reasonable to conclude that, compared with males, females like school more.

The conclusion in Example 1, that females like school more than males do, raises some interesting issues. One issue is the possible reasons for the results; that is, why do females like school more than males do?

One theory is that students who hated school often were not doing well in school. The students who were asked whether they liked school were also asked how well they were doing in school. The results were added to the table, which follows.

Project Connection

With any conclusion, it is interesting to ask *Why is this the case?* If in Example 1, the answer for the results is found, then action might be taken to ensure that males and females like school equally as well.

	A	B	C
1	Ontario Youths		
2	Gender	How do you feel about school?	How well are you doing in school?
3	F	3. I like school a bit.	Average
4	F	1. I hate school.	Poorly
5	F	4. I like school quite a bit.	Well
6	F	5. I like school very much.	Very well
7	M	5. I like school very much.	Very well
8	F	1. I hate school.	Average
9	M	2. I don't like school very much.	Average
10	M	3. I like school a bit.	Very well
11	F	2. I don't like school very much.	Average
12	M	3. I like school a bit.	Average
13	F	5. I like school very much.	Well
14	M	5. I like school very much.	Very well
15	M	1. I hate school.	Well
16	F	4. I like school quite a bit.	Well
17	F	5. I like school very much.	Average
18	F	5. I like school very much.	Very well
19	M	4. I like school quite a bit.	Well
20	M	2. I don't like school very much.	Very well
21	M	1. I hate school.	Average
22	F	4. I like school quite a bit.	Well
23	F	5. I like school very much.	Very well
24	M	3. I like school a bit.	Very well
25	F	2. I don't like school very much.	Very well
26	M	5. I like school very much.	Very well
27	F	5. I like school very much.	Very well

Example 2 Performance at School

It seems reasonable to expect that students who are not doing well would not like school. Does the data support this conclusion? How confident are you in the results?

Solution

From the data above, the following observations can be made:

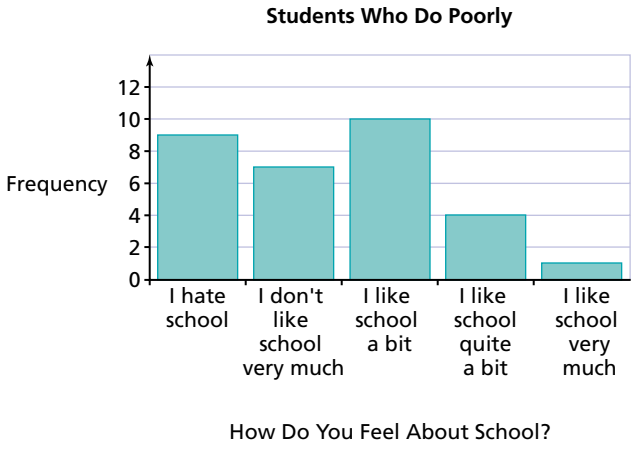
- Most students answered “Very well” when asked how well they were doing in school.
- There is only one student who selected “Poorly” when asked how well she was doing in school.
- Of the four students who answered “I hate school,” one claimed he was doing well.

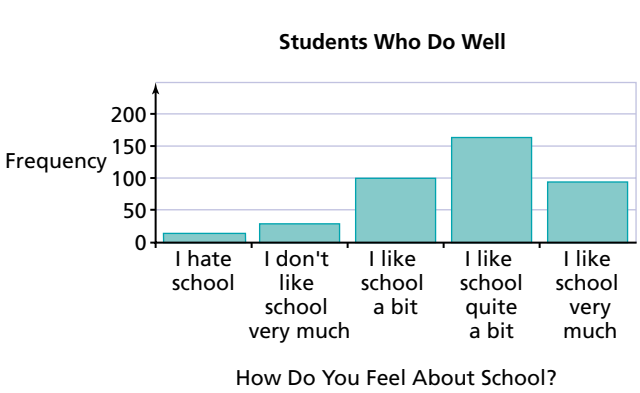
Based on these data, one might conclude that students hate school because they are not doing well. This is, however, a very small sample to say with confidence that a relationship exists between performance at school and feelings about school. More data are needed to draw conclusions with more confidence. (**Note:** There were 1046 students interviewed in this survey and the results are provided on the textbook CD.)

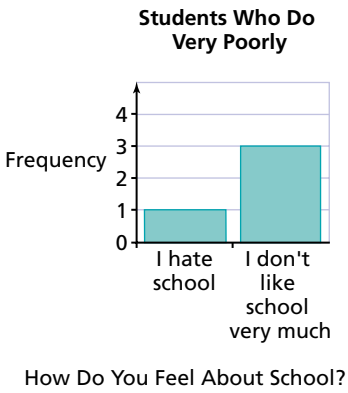
Example 3 Large Amounts of Data to Justify Conclusions: Sample Size

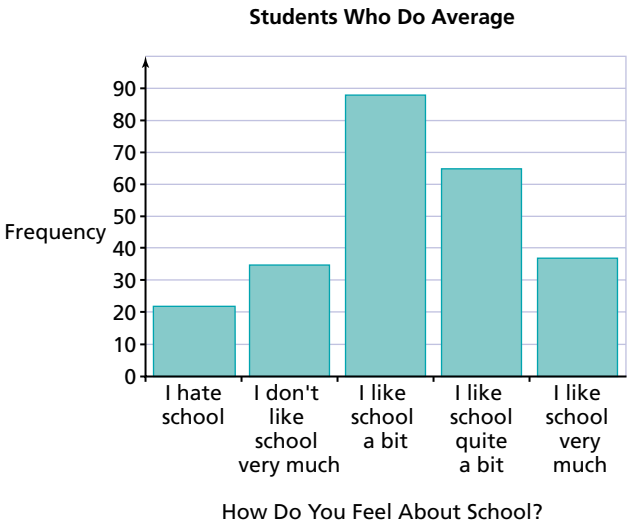
The following graphs were created to show the data from 1046 students. Does the data from the population support the conclusion drawn from the sample?

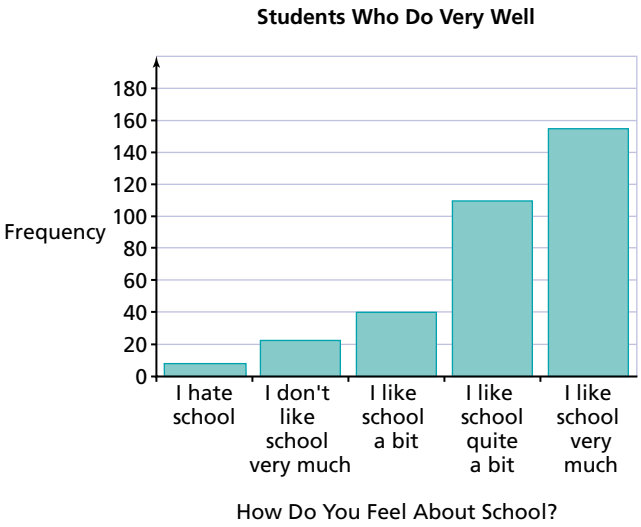
Technolink
For assistance performing this analysis in Fathom™, see Appendix D starting on page 415.











Solution

From the data, the following conclusions can be made:

- All students who responded "Very poorly" also responded "I hate school" or "I don't like school very much."
- A larger proportion of students who responded "Poorly" also responded "I hate school" or "I don't like school very much."

As a result, it seems reasonable to conclude that a relationship exists between a student's performance in school and his or her feelings about school; however, it is not possible to determine if a **causal relationship** exists without further in-depth study.

causal relationship—where one variable directly affects another

Technolink
For more data that imply causal relationships, see pages 388, 391, and 396 of Appendix A.

KEY IDEAS

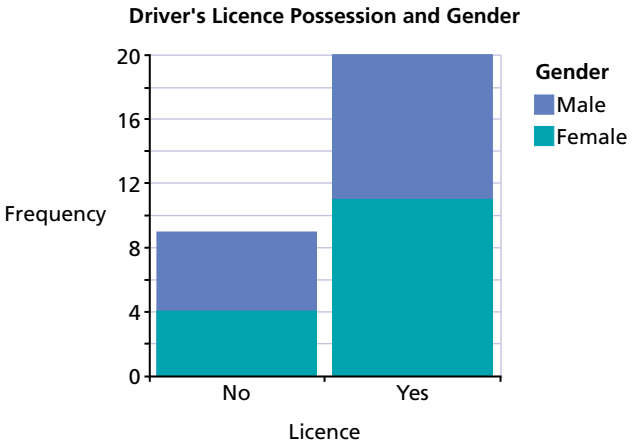
sample—part of a population selected so as to gain information about the whole population

causal relationship—where one variable directly affects another. Proving a causal relationship is the result of an in-depth study.

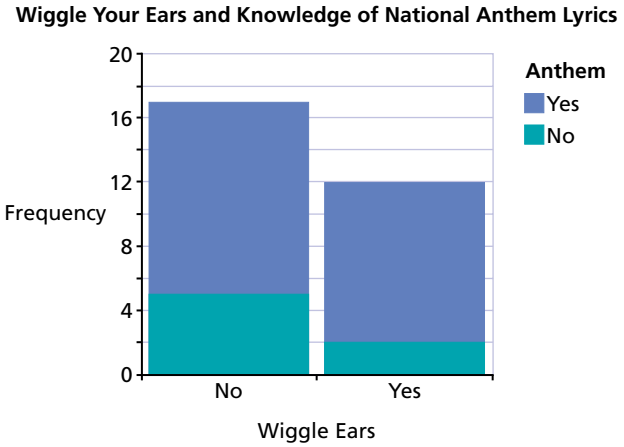
1.2 Exercises

A

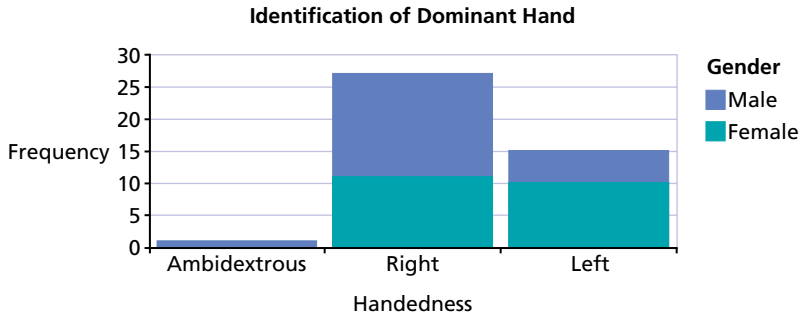
1. **Knowledge and Understanding** Students were asked if they possess a valid driver's licence. The results are shown below, broken down by gender. Does gender have any effect on whether a student has a licence or not? Explain.



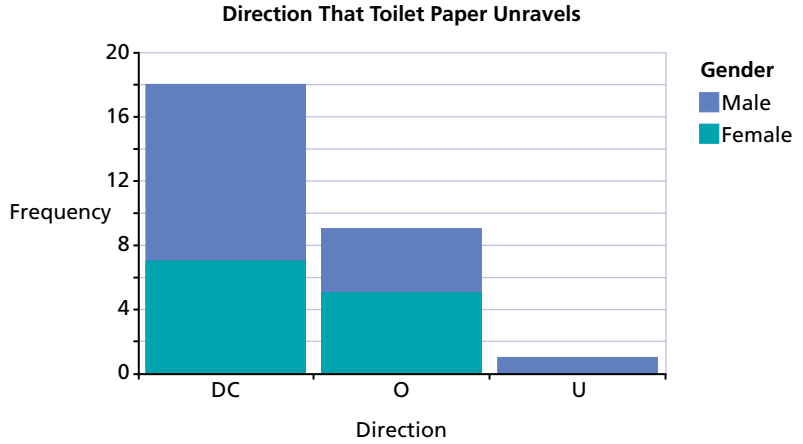
2. Students were asked whether they are able to wiggle their ears as well as whether they know the words to the national anthem. Are students who know the words to the national anthem more likely to be able to wiggle their ears? Explain.



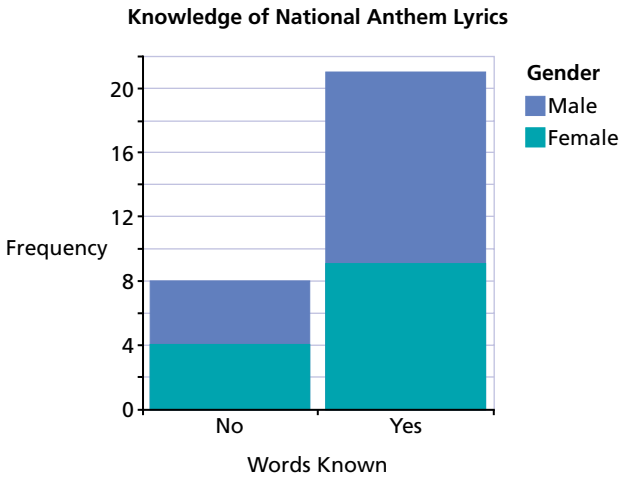
3. Students were asked to identify their dominant hand. Are females or males more likely to be ambidextrous? Explain.



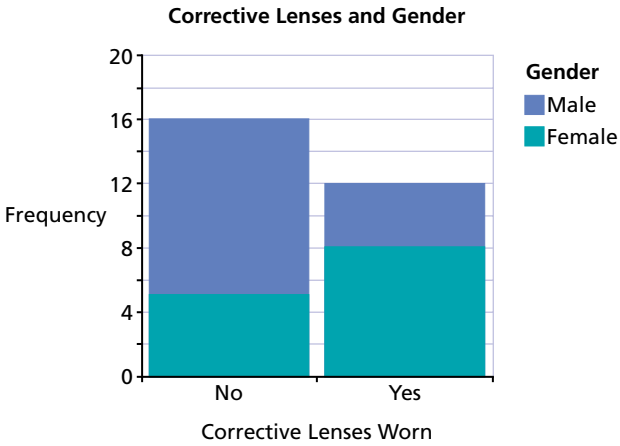
4. Students were asked in which direction they prefer the toilet paper to come off the roll: *don't care* (DC), *over the top of the roll* (O), or *from under the bottom of the roll* (U). The responses are broken down by gender. Do males or females care less about how the paper comes off the roll? Explain.



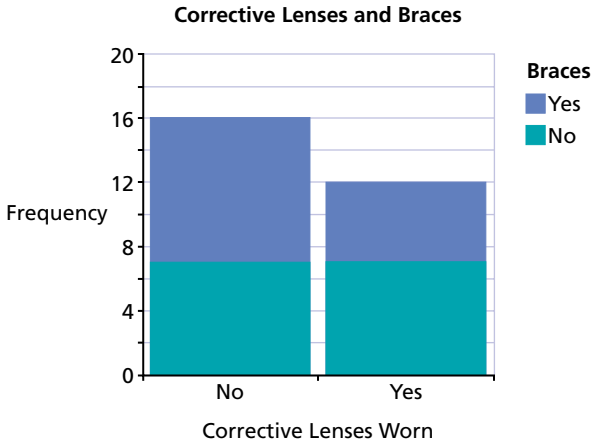
5. Students were asked if they know the words to the national anthem. Do more females than males know the words to the national anthem? Explain.



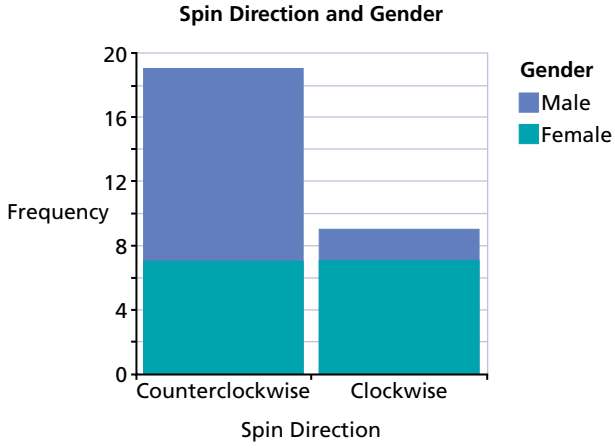
6. Students were asked if they wear corrective lenses. The graph shows the responses. Do more females or more males wear corrective lenses? Explain.



7. In addition to being asked if they wear corrective lenses, students were asked if they had ever worn braces. The graph shows the responses. Do more students who have worn braces wear corrective lenses than students who have not? Explain.



8. Responses to *In which direction does a hurricane spin in Canada?* are shown below, broken down by gender. Do more females or more males know the direction in which a hurricane spins in Canada? Explain.



B

9. **Communication** In a recent poll at a local high school, a sample of 200 students was asked a number of questions. The results of two of the questions are shown below.

How well would you say you get along with your parents/guardians?

	Very Well	Fairly Well	Not At All Well	No Opinion
Males	55%	41%	3%	1%
Females	61%	35%	4%	0%
Overall	58%	38%	4%	0%

How serious do you consider the following offences—shoplifting, cheating on exams, public profanity?

	Very Serious	Somewhat Serious	A Little Serious	Not Serious	No Opinion
Shoplifting	91%	4%	2%	2%	1%
Cheating on Exams	56%	31%	7%	6%	0%
Public Profanity	41%	44%	13%	1%	1%

Write a brief article for the school newspaper summarizing the results of these two questions.

10. You have been asked to conduct a survey to analyze the shopping habits of the people in your community.

(a) Compose 5 to 10 questions that you would ask in the survey.

(b) List the steps that you would follow to choose a sample of the population.

(c) How would you display your results? Give reasons for your answer.

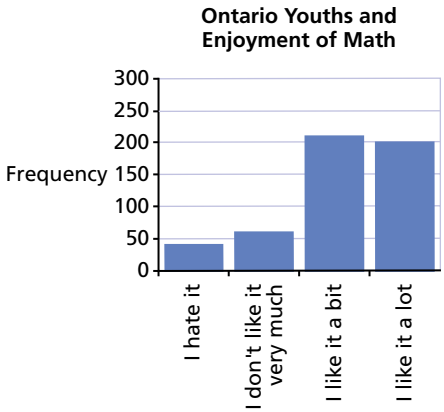
11. The teacher sponsoring this year's ski trip has said that 55% of the student body must be in favour of the trip or it will be cancelled. The student council distributed a questionnaire to a sample of the student body and the results are summarized below.

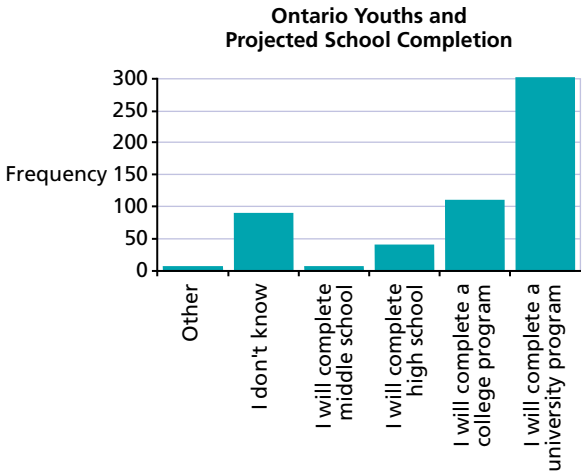
	Number of Students Responded
I definitely will go on the ski trip.	18
I probably will go on the ski trip.	25
I may go on the ski trip.	11
I probably will not go on the ski trip.	4
I definitely will not go on the ski trip.	27

(a) Is there enough interest to hold this year's ski trip? Explain.

(b) To improve the appearance of the results, explain how the student council should present the findings of the questionnaire.

12. A survey of students asked, among other questions, *How much do you enjoy math?* and *What level of school will you complete?* The responses are shown in the graphs below. Consider the conclusion *The level of enjoyment in math will affect the level of education a student will complete.*



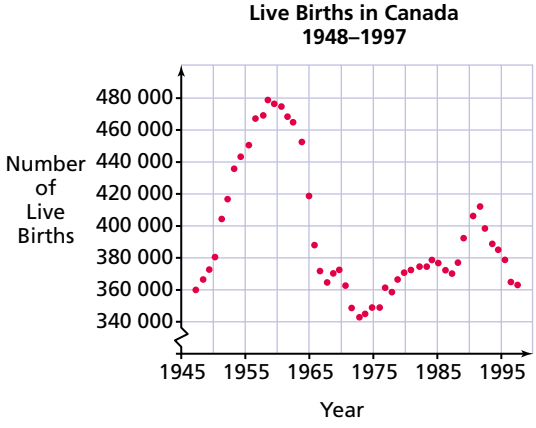


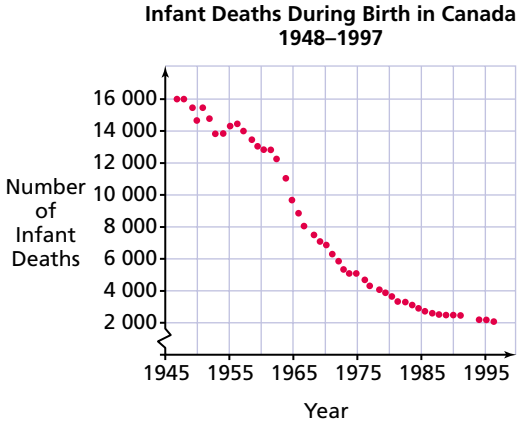
(a) Do the data allow you to support or refute the conclusion? Give reasons for your answer.

(b) Describe how you would organize the data to help you decide whether to accept or reject the hypothesis.

(c) Is there enough data for you to be confident in supporting or refuting the hypothesis? Explain.

13. **Application** The following graphs show Canadian population data from 1948 to 1997.



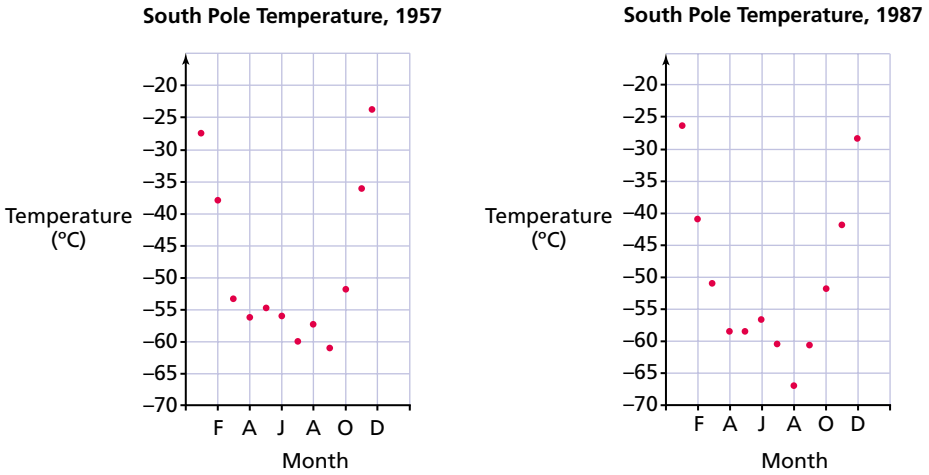


Source: Data have been extracted from Fathom Dynamic Statistics™, Key Curriculum Press.

(a) State a conclusion based on the graphs. Give reasons for your answer.

(b) What issue would require further exploration based on the conclusion you have drawn? Give reasons for your answer.

14. The following graphs were created from temperatures taken at the South Pole in 1957 and 1987.



Source: Data have been extracted from Fathom Dynamic Statistics™, Key Curriculum Press.

(a) State a conclusion based on the graphs. Give reasons for your answer.
(b) What issue would require further exploration based on the conclusion you have drawn? Give reasons for your answer.
(c) What is the relationship between the sample size and the degree of confidence you may have in a conclusion you have drawn based on the sample? Explain.

15. On June 21, 2001, COMPAS Inc. issued a report outlining the results of a survey of Canadians in which participants were asked to respond to 10 questions taken from the citizenship test. Some of the results are shown in the tables that follow.

(a) State a conclusion based on the information in Table 1. Give reasons for your answer.
(b) How would you display the data in Table 2 (on page 26) more clearly?
(c) State a conclusion based on the information in Table 2. Give reasons for your answer.

Table 1: Citizenship Test Report Card

Number of Questions Correctly Answered	0	1	2	3	4	5	6	7	8	9	10
Percent of Respondents	14	14	15	12	15	13	8	4	3	2	0

Source: COMPAS Inc.

Table 2: Correct Response in Percent by Education

	High School	College	University	Post-Grad/ Law/Medicine
What important trade or commerce did the Hudson's Bay Company control during the early settlement of Canada?	60	69	83	90
Which group of people played a major role in physically building the Canadian Pacific Railway across the West?	33	56	55	54
Who are the Métis? From whom are they descended?	34	51	54	56
Parliament created a new territory in Canada's North. What is the name of the new territory?	29	52	58	62
What does one call a law before it is passed?	23	51	49	71
What does one call the Queen's representative in the provinces and territories?	12	28	35	50
Which four provinces first formed the Confederation?	12	16	33	38
Which province is the only bilingual province?	11	18	31	23
When did the British North America Act come into effect?	9	20	23	37
How many electoral districts are there in Canada?	0	4	5	4

Source: COMPAS Inc.

16. **Thinking, Inquiry, Problem Solving** Television networks bid for the right to televise the Olympic games. Using Fathom™ and the data in the Olympics–Cost file on the textbook CD, consider the issue of the cost of hosting the Olympics. Write a report that includes

(a) the part of the issue you have chosen to investigate;
(b) your hypothesis based on the data;
(c) an analysis of how the data supports your hypothesis; and
(d) any modifications you would make to your original hypothesis.

17. With a small group of students, brainstorm some issues that are of interest.

(a) Choose two of the issues from your list and state a hypothesis for each.
(b) Use the Internet, Fathom™, Statistics Canada, and so on, to find data related to your hypothesis.
(c) Does the data support or refute your hypothesis?
(d) What other issues arise from the data?

ADDITIONAL ACHIEVEMENT CHART QUESTIONS

Examples 1, 2, and 3 investigated two possible factors (namely gender and academic performance) that influence students' feelings about school. Another factor that can be explored is unkind treatment by other students. The following data were gathered.

	A	B	C
1	Ontario Youths		
2	Gender	How do you feel about school?	Are you treated unkindly?
3	F	3. I like school a bit.	Never
4	F	1. I hate school.	Some of the time
5	F	4. I like school quite a bit.	Rarely
6	F	5. I like school very much.	Some of the time
7	M	5. I like school very much.	Rarely
8	F	1. I hate school.	Never
9	M	2. I don't like school very much.	Rarely
10	M	3. I like school a bit.	Rarely
11	F	2. I don't like school very much.	Some of the time
12	M	3. I like school a bit.	Rarely
13	F	5. I like school very much.	Never
14	M	5. I like school very much.	Rarely
15	M	1. I hate school.	All the time
16	F	4. I like school quite a bit.	Never
17	F	5. I like school very much.	Never
18	F	5. I like school very much.	Most of the time
19	M	4. I like school quite a bit.	Never
20	M	2. I don't like school very much.	Never
21	M	1. I hate school.	Never
22	F	4. I like school quite a bit.	Never
23	F	5. I like school very much.	Never
24	M	3. I like school a bit.	Some of the time
25	F	2. I don't like school very much.	Some of the time
26	M	5. I like school very much.	Never
27	F	5. I like school very much.	Rarely

Consider the hypothesis: *Unkind treatment by other children causes students to dislike school.*

18. **Knowledge and Understanding**

(a) What is the sample in this study?

(b) What is the population that the sample represents? Explain.

(c) Is there enough data for you to be confident in supporting or refuting the hypothesis? Explain.

19. **Application** Organize the data so that it can be analyzed more easily.

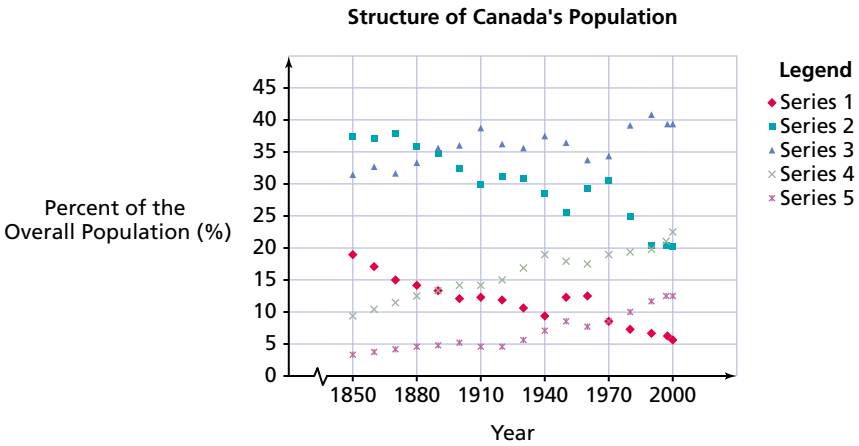
20. **Thinking, Inquiry, Problem Solving** Use the data to support or refute the hypothesis. Give reasons for your answer.

21. **Communication** Describe how you would present these data to convince an audience of your hypothesis.

Chapter Problem

Trends in Canada's Population

Below is a graph of the age classes from the data provided in the table on page 2.



CP3. Identify which series belongs to each age class.

CP4. State a conclusion for each age class based on the graph.

CP5. Identify some issues that would be worth further exploration based on your conclusions. Give reasons for your answer.

CP6. What is the relationship between the sample size and the degree of confidence you may have in a conclusion you have drawn based on these data? Explain.