

2.5 Avoiding Bias

bias—an unintended influence on a data-gathering method

sampling bias—when the chosen sample does not accurately represent the population

non-response bias—when surveys are not returned, thus influencing the result

In collecting data for your course project, the truth is your goal. To avoid distorting the truth, your data-collection methods must be carefully executed. In this section, you will explore how a researcher may unintentionally influence results, and you will develop ways to avoid **bias** in your research.

Example 1 Identifying Bias

You are the campaign manager for your best friend, Rebecca, who is running for student council president. You have been asked to determine the overall level of support for Rebecca among the 1500 students at your school. Design a sampling method that will provide the least **sampling bias**.

Solution

To save time, you have decided that a sample of about 50 students will provide a good picture of the school's political landscape.

Plan A

Students have lunch in periods 2, 3, or 4. By random draw from a hat, you have decided to conduct the survey in the cafeteria during period 4. The first 50 students who enter the cafeteria are given the questionnaire, and you instruct them to fill it out and return it to you before the end of lunch.

What is wrong with this scenario?

A number of possible biases are built into this scenario. Quite often in high schools, lunch hours are populated by one or two grades due to timetabling constraints. This would result in a sampling bias.

The method by which the surveys were to be collected could also lead to a **non-response bias**. It is highly likely that only a few of the people who actually received the questionnaire would return it.

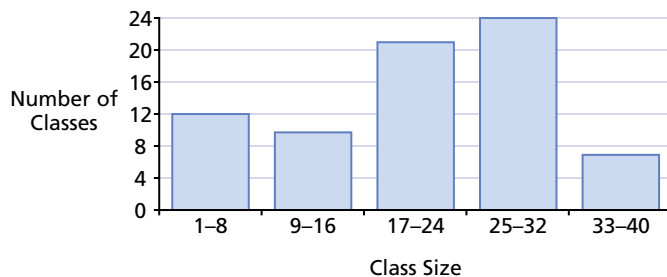
Plan B

To fix the problems with Plan A, you have decided to provide a questionnaire to one person from each homeroom (your sample size is now 73). You can wait until the respondent finishes with the questionnaire to collect it. This will eliminate the non-response bias.

What is wrong with this scenario?

Examine the graph to the left. Whereas 12 students would represent the opinions of, at most,

Classes Categorized by Size



household bias—when one type of respondent is overrepresented because groupings of different sizes are polled equally

96 students (1 student chosen from each of 12 classes consisting of 8 students or less), only 7 students would represent between 231 and 280 students (1 student chosen from each of classes consisting of between 33 and 40 students). Overrepresentation of a particular group of students leads to a **household bias**.

Plan C

A stratified random sampling technique should be used to ensure a suitable survey of the student body. Students in each grade could be assigned a number. The appropriate number of females and males from each grade could then be selected by using a random number generator. The table to the right shows how a sample of 50 students could be selected to ensure that each grade is represented proportionately to its population.

	Females	Males
Grade 9	7	7
Grade 10	7	7
Grade 11	6	6
Grade 12	5	5
Totals	25	25

Interviews with each student selected would eliminate non-response bias.

Example 2 The Questionnaire

Consider the questionnaire developed by Rebecca’s friends.

Identifying the person for whom the survey is being conducted may lead to biased responses.

Bolding Rebecca’s name may lead to an inordinate number of responses in her favour. Remember that you need to obtain a true reflection of opinion.

Who wouldn’t want more fun? This question is not likely to generate any useful information.

Election Survey

Sponsored by the friends for the election of Rebecca committee.

Circle the appropriate response.

Gender: Male Female

Grade: 9 10 11 12

On Election Day, I intended to vote for

Rebecca Zahir Melanie

I want More dances

 More dress-down days

 More holidays

More fun

Students who are taking classes in different grades may be confused by this question and not answer.

response bias—factors in the sampling method that influence the result

The questionnaire developed by Rebecca’s friends shows examples of **response bias**. Poor question design (leading or unclear questions), interviewer tone and attitude, and extraneous information can all lead to response bias. Design a new questionnaire that would eliminate response bias.

Solution

The committee's identity is removed.

Every student has a homeroom designation (even those with spares in the first period).

Candidates are listed alphabetically and without bolding.

An open question is used to elicit unbiased responses.

Election Survey

Circle the appropriate response.

Gender: Male Female

Homeroom #: _____

On Election Day, I intend to vote for

 Melanie Rebecca Zahir

It is my opinion that student council's priorities should be as follows (list up to three priorities):

1. _____
2. _____
3. _____

KEY IDEAS

bias—an unintended influence on a data-gathering method

sampling bias—when the chosen sample does not accurately represent the population

non-response bias—when the results are influenced because surveys are not returned

household bias—when one type of respondent is overrepresented because groupings of different sizes are polled equally

response bias—factors in the sampling method that influence the result

2.5 Exercises



Think about Types of Bias

- sampling bias
- non-response bias
- household bias
- response bias

A

1. **Knowledge and Understanding** Identify the type(s) of bias that might result from each of the following data collection methods.
 - (a) You hand out surveys to your classmates to be returned to you next week.
 - (b) You are interested in the study habits of Grade 12 students, so you interview students from your class.
 - (c) You ask students about their recycling habits on behalf of the Greenteam, the school environment club.
 - (d) You take a random sample of students during the second lunch hour to determine their attitudes toward the new school attendance policy.

2. Which of the following scenarios are examples of household bias? Explain. What type of bias might be shown?
 - (a) polling random shoppers in a grocery store aisle
 - (b) polling classmates about their holiday plans
 - (c) polling random factory workers during shift change about banks
 - (d) mailing surveys to people selected at random from the voters' list
3. Which of the following scenarios are examples of sampling bias? Explain.
 - (a) A researcher selects people off the street for an interview.
 - (b) A researcher randomly selects products off the assembly line for quality-control testing.
 - (c) Traffic volume will be estimated by counting the number of cars travelling through an intersection during the researcher's lunch hour.
 - (d) Books in the library will be tested for mildew by randomly selecting a shelf and taking every book off that shelf.
4. When a phone questionnaire is conducted, many people with call display will not answer their phone. What kind of bias does this represent? What can be done to minimize this kind of bias?
5. Identify examples of response bias in the following questionnaire.

Mega Mall Shopping Survey

Gender: _____ Age: _____ Date: ____/____/____

Which store did you visit today?

Sears	Becker's	Radio Shack	Pet Store
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How much money did you spend?

\$10	\$20	\$30	\$60
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Circle which other types of stores you would like to have in this mall.

Scuba-diving store	Sports shop
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B

6. Modify the questionnaire in Question 5 to eliminate response bias.
7. A Grade 12 class wants to develop a questionnaire to get feedback from the students on what to offer as part of a trip to the Stratford Festival. Create a questionnaire that collects the following data from respondents: their name, grade, and homeroom; whether they can drive and how many people they would be willing to take; the maximum price they would be willing to pay; what plays they would like to see (e.g., *Romeo and Juliet*, *King Lear*, *Pygmalion*); and so on. Remember to make the questions as closed as possible to make analysis easier.
8. A product research firm wishes to gauge public opinion on a new digital TV that it is demonstrating. Create a questionnaire to collect information from randomly selected people at a local shopping mall. Be sure to collect information about the respondent, including TV-watching habits, opinion of the digital TV display, and any other feedback.

9. **Application** A marketing company wanted to find the purchasing habits of Canadian university graduates. It contacted alumni associations to purchase their mailing lists. About 60% of the associations provided lists. The company sent a questionnaire to every person on the lists (approximately 600 000 names). Identify the types of bias that may occur in this survey. In each case, explain your thinking.
10. **Communication** The Canadian census is conducted every five years. The questionnaire provides instructions about when to fill it out and how to mail it back to Statistics Canada. The census representatives visit about 2% of households. Provisions are made to visit those people who are not at home or who may not have a permanent residence such as Aboriginal people living in Baffin Island before they migrate to their summer hunting and fishing camps. There are people who believe that a census is a great waste of money because the results will never be absolutely accurate and biases in the data collection will occur.
- (a) Identify all possible sources of bias in the Canadian census.
- (b) Provide both sides of the argument for a debate based on the following resolution:
- Be it resolved that the Canadian census is inherently inaccurate and costly; therefore, the Canadian government would be better served by gathering data using a carefully designed statistical survey of an appropriately sized sample of the Canadian population.*
11. For each of the following questions,
- (i) state how it is biased
- (ii) write an unbiased version of it
- (a) Given that youth crime in urban areas is on the rise, what should be the top enforcement priority for local police forces?
- | | | | |
|------------------------------|--------------------------|------------------|--------------------------|
| youth crime | <input type="checkbox"/> | illegal drug use | <input type="checkbox"/> |
| car theft | <input type="checkbox"/> | murder | <input type="checkbox"/> |
| other (please specify) _____ | | | |
- (b) Rank the following sports by printing 1 beside the most enjoyable, 2 beside the second most enjoyable, and so on, to 10.
- | | |
|----------------|-----------------|
| ___ baseball | ___ softball |
| ___ fastball | ___ cricket |
| ___ two-pitch | ___ basketball |
| ___ ice hockey | ___ lacrosse |
| ___ shinny | ___ ball hockey |
- (c) You have ordered a brand new SuperDuper Triple Lutz Burger from a local restaurant and they want to know how good it tastes. Please check your rating.
- | | | | |
|--------------------|--------------------------|--------------------|--------------------------|
| Scrumptious | <input type="checkbox"/> | Really Good | <input type="checkbox"/> |
| Decent | <input type="checkbox"/> | Bland | <input type="checkbox"/> |
- (d) Are you perfectly satisfied with your current vehicle? (Y/N)

12. Rewrite this questionnaire eliminating any sources of bias.

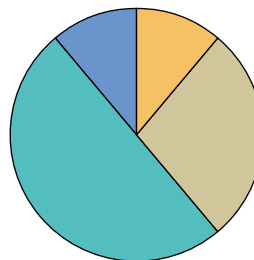
Student Survey of Environmental Support

Sponsored by the Greenteam

1. What is your homeroom? _____
2. On a scale of 1 to 5, to what degree is your homeroom teacher environmentally conscious?
1 2 3 4 5
Sort of Medium Wow
3. When you finish a can of pop in the cafeteria you
 - (a) **put the can in the recycling bin**
 - (b) toss it in the regular garbage
 - (c) deposit it under the table
4. Your family saves water by
 - (a) taking showers instead of baths
 - (b) putting a brick in the toilet tank
 - (c) washing the dishes once a week
5. You want to join the school environment club
 - (a) a whole lot
 - (b) if you had more free time
 - (c) only for the Earth Walk event
6. Environmental topics should be addressed
 - (a) across all curricula
 - (b) especially in Science and Geography
 - (c) in every mathematics course
 - (d) all of the above
7. Your attitude toward improving the environment is
 - (a) highly supportive
 - (b) mostly supportive
 - (c) supportive
8. Canada needs more toxic waste dumps.
☐ Agree ☐ Disagree

9. Based on the graph shown, do you agree that more adults are doing their part for the environment?
☐ Yes ☐ No

Environment Survey



- ☐ Strongly support
- ☐ Support on weekends
- ☐ Detest environmental causes
- ☐ Don't care

Why do you think this is so?

- C** 13. **Thinking, Inquiry, Problem Solving** Do you agree with the following proposition?

A law is proposed to alter the Constitution to establish the Commonwealth of Australia as a Republic with the Queen and Governor General being replaced by a President appointed by a two-thirds majority of members of the Commonwealth Parliament.

This is the question that all citizens of Australia considered on Saturday, November 6, 1999 (voting on a constitutional question is mandatory). If the people of Australia voted *Yes*, they would change their form of government from a constitutional monarchy to a presidential republic. A *No* vote would mean the status quo. Is this question biased? Explain.

ADDITIONAL ACHIEVEMENT CHART QUESTIONS

14. **Knowledge and Understanding** Describe a situation that represents each of the following.
- | | |
|-----------------------|--------------------|
| (a) sampling bias | (b) household bias |
| (c) non-response bias | (d) response bias |
15. **Application** A publishing company wants to conduct a survey of college instructors to determine how many technology references should be included in a new mathematics textbook. Discuss the pros and cons of a voluntary online survey. Suggest another data-collection method.
16. **Thinking, Inquiry, Problem Solving** Bias in the media: fact or fiction? Do some research to find out whether bias affects the manner in which news events are reported both in print and on air (radio and TV). Write a brief report of your findings.
17. **Communication** Discuss the possible sources of bias in answers to each of the following survey questions.
- | |
|--|
| (a) What is your age? |
| (b) What is your annual income? |
| (c) Which party did you vote for in the last election? |
| (d) What is your favourite type of program to watch on television? |



Chapter Problem

Mystery Most Mathematical—Parts V and VI

Subject: Re: Puzzle - Part 5
Date: Thursday 15:37:33 -0700 (EDT)
From: 77777@homework.com
To: jto@coldmail.com

Choose the science area for which you have the greatest interest. Describe in detail the differences between how and what data can be collected from an experiment in this area and the data collected through the Canadian census.

Subject: Re: Puzzle - Part 6
Date: Sunday 19:01:58 -0700 (EDT)
From: 27182818@homework.com
To: jto@coldmail.com

The following questions appeared on a survey:

1. Given the great devastation created by global warming, including soil erosion, coastal flooding, and pestilence, would you support more tax dollars being directed to the ministry of the environment?
2. Good public schooling is critical for our children to become creative, tolerant, and productive adults. Would you support the government making this issue its top priority? Why?

Critique these questions and then rewrite them, if necessary.

jto@coldmail.com aside:

It strikes me as odd that these messages are sent at the strangest times of day. Maybe a pattern will emerge.