MathLinks 9

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MATHEMATICS 9

Chapter 11

Data Analysis

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Chapter 11.1 – Factors Affecting Data Collection

Survey: a _question_ or questions asked of a _portion_ of the population to gather _opinions_ and/or information.

Several influencing factors affect how data is collected or how responses are obtained. These include:

- _bias_ : Does the question show a preference for a specific product?
- _Use of Language_ : Is the question presented in such a way that people understand what is being asked?
- _Ethics_ : Does the question refer to inappropriate behaviour?
- _Cost_ : Does the cost of the study outweigh the benefits?
- _Time and Timing_ : Does the time the data were collected influence the results? Is the timing of the survey appropriate?
- _Privacy_ : Do people have the right to refuse to answer? Are the responses kept confidential?
- _Cultural Sensitivity_ : Might the question offend people from different cultural groups?

Survey questions should be worded so they are free from factors influencing the response.

Why does coke taste better than Pepsi?

→ complicated wording awkward phrasing, big words, etc. Unfamiliar words

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Identify Factors Affecting Data Collection

Example 1:

Helen and Andre are reviewing the data collection methods used by a marketing company. For each situation, help them identify any influencing factors. Explain your reasoning.

a) A sales representative stands in front of a display of different kinds of toothpaste. He asks every person buying toothpaste the following question. **"What is your favorite brand of toothpaste?"**

No Bias

Only surveying people buying toothpaste

b) Free samples of sunscreen are sent to every home in fall and winter. A mail reply card asks people if they would use the product again.

Poor timing - people use sunscreen more in Spring & Summer

c) A grocery store employee conducts a telephone survey of people living within 10 km of the store. To help determine what meat products to sell, she asks what type of red meat people prefer.

Bias - it assumes all people eat red meat

Culturally Insensitive - certain religions/cultures don't eat red meat

d) A sales representative conducts a telephone survey. As she poses the question, a person receiving the call says, "I am not interested, thank you." The sales representative responds, "Why not? Your input provides useful information." She begins to repeat the survey question.

Right to Refusal

e) Your school is under construction and is quite dusty and dirty. A survey is conducted about the environmental health of your school. The survey is done every four years.

Poor timing - it's gross right now

f) A sales representative sets up an online survey. The survey offers a free MP3 file of a song that was downloaded from the Internet to everyone who completes the survey. The company has not bought the rights to the song.

Ethically wrong

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Example 2:
A marketing firm displayed two sports shirts at a grades 7 to 12 school with 800 students. The first ten grade 12 students who entered the school were asked the following question. **"Which one of these two sports shirts would you buy?"**

A week later, the firm gave this flyer to the student council.

What factors might have affected the data collected and the company's conclusions? Explain.

Over 78% of students at Central High will buy Shirt B.

A: $29.95   B: $49.95

- brand names   - colour
- looks nicer   - only gr.12 responded
- more expensive   - only 10 students

Write Survey Questions Free of Influencing Factors
Example 3:
A steel milling company conducts a survey.
a) Does the survey question influence the results? Explain.

- # of jobs   "forward-thinking" in the question.
- only positives describing steel mill

The proposed mill will produce 250 jobs and economic benefits for your community. Are you in favour of having a forward-thinking steel mill in your community? YES   NO

b) Rewrite the question so that it is free of influencing factors.

Are you in favour of a steel mill in your community? YES   NO

Example 4:
For each situation, explain whether the question has influencing factors. If it does, rewrite the question.
a) Daniel is studying the population of polar bears in eastern Hudson Bay. He drafts the following question.
Do you think the senseless slaughter of polar bears should be stopped? YES   NO

Biased

b) A recent study shows that 45% of Canadians are using the Internet to shop. Amy develops the following question for a class survey.
What kinds of products and services do you buy online?
you shop online?
Assumes everyone online shops.

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Chapter 11.2 – Collecting Data

Population - all of the individuals in the group being studied. It is not always cost effective or practical to survey everyone in a large population.
Ex: the population in a federal election is all eligible voters.
Ex: the population in the SRC election is all current Gr. 9, Gr. 10, and Gr. 11 students.

Sample - any group of individuals selected from the population
Ex: a sample of the population in a federal election might be 100 people chosen from each province or territory.
Ex: a sample of the population in an SRC election might be 30 students chosen from each grade. (Gr. 9, Gr. 10, and Gr. 11.)

Types of Samples:

Convenience **sample**- created by choosing individuals from the population who are easy to access.

Voluntary **sample** - created by inviting the whole population to participate.

Random **sample** - created by choosing a specific number of individuals randomly from the whole population. Everyone has an equal chance of being selected. This is likely to represent the whole population. The information can be used to make predictions about the population. It can be one of two types: stratified or systematic.

- **Stratified** **sample** - created by dividing the whole population into distinct groups, and then choosing the same fraction of members from each group

- **Systematic** **sample** - created by choosing individuals at fixed intervals from an ordered list of the whole population

Identify the Population
Example 1:
Identify the population for each situation. Then, state whether you would survey the population or a sample of the population. Explain your reasoning.
a) A bicycle store owner wants to know which brand of mountain bike her customers prefer.

Population

Cyclist   } Sample

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b) The school board wants to know how many hours of homework students do each day.

Sample
↳ stratified } various schools
various grades

c) A candle manufacturer wants to know how many of its candles are made with flaws.

Population — all candle owners
Sample — systematic → check every 10th candle

Example 2:
For each scenario, identify the population. Then, indicate whether you would survey the population or a sample. Explain your reasoning.

a) The Royal Garden restaurant needs to know which main dish its customers favourite.

Population — customers
Sample — small → everybody // big → Systematic

b) Stephan wants to find out if teachers in Canada prefer to wear glasses or contact lenses.

Population — teachers w/ poor vision
Random ← Stratified — voluntary

c) A junior hockey team wants to find out why some people who bought season tickets last year are not buying them this year.

Pop — not renewed Season ticket holders
Sample — voluntary
— systematic (every 5th person)

Identify a Sample
Example 3:
For each situation, describe how the sample could be selected. Identify the type of sample.

a) A teacher wishes to get feedback from her class about the school dance. She plans to survey 5 students out of a class of 30.

Random — draw from a hat

b) A telephone company wants to determine whether a fitness centre would be well used by its 3000 employees. The company plans to survey 300 employees.

Systematic — every 10th person from pay roll list $\frac{3000}{300} = 10$

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c) A chain store is trying to decide whether to open a store in Camrose, Alberta. The company decides to survey people in Camrose and three nearby towns. The population of each location is shown in the table.

Location	Population
Camrose	16 000
Bashaw	825
Tofield	1 876
Daysland	876

$(0.1) = 1600$
$(0.1) = 83$
$(0.1) = 188$
$(0.1) = 88$

Sample – 10% of each
Systematic

d) A marketing research company mails surveys to all of the adult residents in a town. The survey asks about brands of consumer products. The residents are asked to mail their responses in a prepaid envelope.

Population – all adults
Sample – voluntary

e) A restaurant owner wants to know the favourite pizza topping of his customers. He plans to survey every customer who orders a pizza in his restaurant between 5:00 p.m. and 10:00 p.m. one evening.

Population – pizza customers
– convience – everyone who orders pizza on Friday

Example 4:
For each scenario, what type of sample would you use? How would you select the sample?
• A marketing firm plans to conduct a telephone survey in a city of 800 000 people. The survey asks whether there is interest in a new art gallery.

Sample: every n^{th} person
random list

• A student wants to know the most popular cell phone provider that grade 9 students use.

Sample: 10% / Systematic / convience sample

Example 5:
In each case, identify the type of sample.
• A coach puts the names of all of the basketball players into a hat and draws one name for a free basketball.

RANDOM

• A questionnaire is sent to every ninth person on an alphabetical list of a store's credit card customers.

SYSTEMATIC

• The student council invites all students to provide ideas for activities.

VOLUNTARY

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Chapter 11.3 – Probability in Society

ASSUME

an assumption is something taken for granted as if it were true.

Biased Sample does not represent the population and can make survey results inaccurate.

Examples of biased samples:

- Survey seniors at a fitness centre to determine overall fitness level of all seniors, (_those are probably the fit ones ~~those~~_).
- Survey college students to determine young adults' favorite music, (_not a representative sample - not all y.a. go to college, not all college students are young adults_).
- Survey asking teen girls…What kind of magazines teens prefer to read: fashion or mechanics (_not all teens are girls - boys should be surveyed too_).

Use a Sample to Make a Prediction about the Population
Example 1:
Ruth wants to determine the most common eye colour of students. All grade 12 students in five of seven high schools in a city recorded their eye colour. A total of 2300 students were surveyed. The results are shown in the table.

Eye Colour	Total
Brown	1656
Blue	483
Green	115
Other	46

a) From the results, predict how many of the 7200 students at the local college will have brown eyes?

$$\frac{1656}{2300} = 0.72 \quad 72\%$$

$$7200 \times 0.72 = 5184$$

b) Is your prediction reasonable? Explain why or why not.

No - universities have a more diverse student population potentially

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c) Predict how many college students will have blue eyes or green eyes.

+ add blue + green $483 + 115 = 598$

+ find percentage $\dfrac{598}{2300} = \dfrac{0.26}{26\%}$ $(0.26)(7200)$

+ multiply by the percent $= 1872$

d) Can you generalize the results from the sample to the local college population? Explain.

You could if people were the same at both places.

e) What limitation might you include to make your prediction more accurate?

You could add, " if the student population at the college and high school are similar"

Avoid Making a False Prediction
Example 2:
Mr. Krutz gave an assignment worth 30 marks. After marking the first five papers, he was concerned that the students did not understand the assignment. He predicted most students would not do well. Results are shown in the diagram.

a) Based on Mr. Krutz's sample, predict the "average" mark for the whole class on the assignment as a percent. Another name for "average" is called
_____mean_____.

(add them all up; then divide by the number of things)

$$\dfrac{20 + 15 + 18 + 19 + 18}{5} = \dfrac{90}{5} = 18$$

$$\dfrac{18}{30} = 0.6 \times 100 = 60\%$$

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Tuesday, April 14, 2015   9:23 AM

b) The scores for all 30 students in the class are: ~60%

20	15	18	19	18	16	17	23	24	30
22	24	21	20	24	25	19	24	15	28
27	28	22	24	19	13	28	22	24	20

Why does Mr. Krutz's sample lead him to make a false prediction?

$$\frac{13 + 28 + 20 + 24 + 20}{5} = \frac{107}{5} = \frac{21.4}{30} = 71\%$$

$$\frac{649}{30} = 21.6/_{30} = 72\%$$

↑ # tests

marks

The first ones were slightly worse than the rest

c) What if Mr. Krutz had marked the last five papers first?

The results would have looked different.
The average of the last 5 was 71% , which is more accurate. ☺

d) Do these results give a more reasonable prediction of the class average? Explain.

No — the sample size is too small.

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Make a Decision Based on Probability

Probability - the likelihood or chance of an event occurring. Probability can be expressed as a ratio, fraction, or percent.

- **2 types of probability**
  - ➢ _Theoretical_ **probability** - the expected probability of an event occurring. The ratio of the number of expected favourable outcomes to the total number of possible outcomes for an event.
  - ➢ _Experimental_ **probability** - the probability of an event occurring based on experimental results.

Example 3:

A youth association surveys its 400 members about their preferred activity. There are 100 members in each of four groups. The activities were chosen from a youth activities resource. The table displays the survey results.

Group	Swimming	Rock Climbing	Watching Movies	Bowling	Total
Red	14	9	40	37	100
Blue	11	19	59	11	100
Green	27	12	57	4	100
Yellow	13	24	44	19	100

a) What is the probability that a member of any group will choose rock climbing?
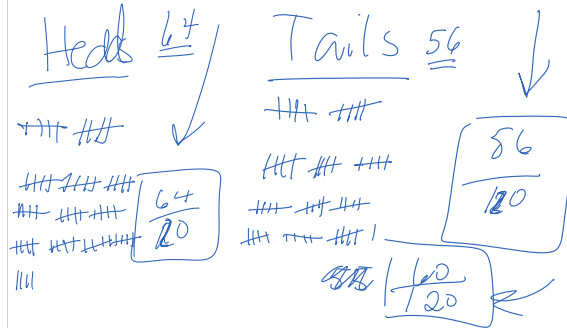
$$P(rock) = \frac{1}{4}$$

b) Based on your results from 'a', predict how many of the 400 members will choose rock climbing

$$\left(\frac{1}{4}\right)(400) = 100$$

c) What assumptions did you make?

There will be an equal amount of activity lovers.

50% H
50% T

Heads 64   Tails 56

$\frac{64}{120}$ $\frac{56}{120}$

$\frac{120}{120}$

d) Based on the survey results, predict the probability that a member will choose rock climbing.

Add: $9 + 19 + 12 + 24 = 64$

Divide : $\dfrac{64}{400} = \underline{16\%}$

e) Compare your answers for parts 'a' and 'd'. Explain any differences.

$\dfrac{1}{4}$ or 25% vs 16%

→ Some people might be afraid of heights.
→ The bigger your sample size, the closer you should get to your theoretical probability

f) Based on the survey results, what is the probability that a member will choose watching movies? Bowling?

Movies

$40 + 59 + 57 + 44$
$= 200$

$\dfrac{200}{400} = 50\%$

Bowling

$37 + 11 + 4 + 19$
$= 71$

$\dfrac{71}{400} = 18\%$

g) If you were the coordinator planning the activities, how would you determine the favourite activity? Explain.

The one w/ the highest percent interest