

9.1 – Probability in Society

Focus: Explain how probability is used outside the classroom.

Investigate

From the statements below, identify the different probabilities that Jean-Guy considers in a day. List an assumption associated with each statement. Explain how the situation would change if that assumption were not true.

- Jean-Guy noticed that, in the last month, 70% of the time the bus was 3 minutes late. So, he takes his time with breakfast today.

- Lately, Jean-Guy's math teacher checks homework 4 days a week. So, Jean-Guy makes sure he has time to complete his homework today.

- At school, Jean-Guy and his friends agree that their lacrosse team has a 95% chance of making the finals.

- In health class, Jean-Guy's teacher reads a magazine that claims 172 out of 1000 male smokers develop lung cancer, but only 13 out of 1000 males who do not smoke develop lung cancer.

Vocabulary:

Probability:

Theoretical Probability:

Experimental Probability:

Subjective Judgement:

Probabilities can be expressed as a fraction, decimal or as a percent.

By collecting and analyzing data, predictions can be made about the probability that a certain event will occur in the future.

Identifying Decisions Based on Probabilities and Judgments

Ex. 1: Explain how each decision is based on theoretical probability, experimental probability, subjective judgment, or any combination of these.

- a) It is Ausma's experience that 4 out of 5 times the prize in the cereal box is found at the bottom of the box. So, Ausma opens the bottom of the cereal box to find her prize.

- b) Two friends are rolling a die. Out of eight rolls made, a "4" came up 7 times. Amith predicts the next roll will likely not be a "4," since each number has an equal chance of being rolled. Maria decides the die is unfair since 7 out of 8 rolls revealed a "4."

Explaining How Assumptions Affect a Probability

Ex. 2: In past baseball games, Alice made 2 hits for every 5 times she went up to bat.

- a) In the next game, suppose Alice goes up to bat. What is the probability that she will get a hit? What assumptions are you making?



- b) For each assumption, explain how the predicted outcomes might change if the assumption changes.

Using a Probability to Support Opposing Views

Ex. 3: Jon wants to learn how to snowboard but does not want to take lessons. His mother insists that Jon take lessons. Jon and his mother find an article that claims:



68% of snowboarding injuries
occur during beginner lessons

Explain how both Jon and his mother can use this statistic to support their opinions.

9.2 – Potential Problems with Collecting Data

Focus: Describe how the collection of data may be adversely affected.

Vocabulary: There are several factors that might lead to problems with data collection.

| Potential Problem | What it means | Example |
|-----------------------------|---|--|
| <i>Bias</i> | The question influences responses in favour of, or against the topic of the data collection. | Suppose a person asks: <i>Don't you think the price of a movie ticket is too high?</i> This person has a bias against the current ticket price, and the bias influences how the survey question is written. |
| <i>Use of Language</i> | The use of language in a question could lead people to give a particular answer. | If you ask: <i>Don't you think the price of a movie ticket is too high?</i> The question may lead people to answer yes. A better question would be: <i>Do you think the price of a movie ticket is too high, too low, or fair?</i> |
| <i>Timing</i> | When the data are collected could lead to particular results. | A survey is conducted to find opinions on the need for a vehicle to have winter tires. The results may be different if the survey is conducted in August instead of February. |
| <i>Privacy</i> | If the topic of the data collection is personal, a person may not want to participate or may give an untrue answer on purpose. Anonymous surveys may help. | People may not want to participate in a study on weight if it means stepping on a scale in front of other people. |
| <i>Cultural Sensitivity</i> | Cultural sensitivity means that you are aware of other cultures. You must avoid being offensive and asking questions that do not apply to that culture. | Suppose you wanted to know the favourite method of cooking ham, and you asked: <i>Please circle your favourite method:</i> <i>BBQ Bake Fry</i> This question does not apply to everyone because many people do not eat ham. A better question would be: <i>If you eat ham, name your favourite method of cooking it.</i> |
| <i>Ethics</i> | Ethics dictate that collected data must not be used for purposes other than those told to the participants. Otherwise, your actions are considered unethical. | Suppose you tell your classmates that you want to know their favourite snacks to help you plan your birthday party. If you then use the information to try to sell your classmates their favourite snacks between classes, your actions would be unethical. |
| <i>Cost</i> | The cost of collecting data must be taken into account. | If you need to pay for printing the questionnaires, or to pay people to collect the data, the cost may be more than you can afford. |
| <i>Time</i> | The time needed for collecting the data must be considered. | A survey that takes an hour to complete may be too long for most people. This would limit the number of people willing to participate. |

Identifying and Eliminating Potential Problems

Ex. 1: For each survey question, explain why a problem may occur and the effect it would have on the results. Suggest how each problem could be avoided.

- a) A survey is conducted to find out if citizens think the local government should provide more money for youth activities. The question asked was:

“Would you support an increase in taxes to create more skate parks?”

- b) A survey is conducted to find out the level of school spirit. Students are polled about their level of school spirit after the soccer team wins the championship.

Analyzing Data Collection for Problems

Ex. 2: Kublu and Irniq plan to open a shop in Saskatoon that would sell traditional Inuit crafts. To ensure Saskatoon is the best place for their business, they want to survey residents to find out how popular Inuit crafts are. Kublu knows that they would get the most accurate results if each household in Saskatoon is surveyed, but Irniq points out that this is problematic. Explain why.

Overcoming Potential Problems of Data Collection

Ex. 3: Antonia wants to find out if there is a relationship between household income and how much people spent on Christmas presents. Identify potential problems Antonia may encounter, and explain how she could deal with the problems

9.3 – Using Samples and Populations to collect Data

Focus: Select and defend the choice of using a population or a sample.

Vocabulary:

Population:

Census:

A census can be costly, time consuming, and difficult or impossible to complete. So, a census is only used when an issue is important or when the population is small.

Sample:

Valid Conclusion:

Care must be taken when determining the appropriate size of the sample. If the sample is large, the data collection could be costly or time consuming. If the sample is small, then it may not be representative of the population.

Explaining Why Data Are Collected from Populations

Ex. 1: In each case, explain why a population was surveyed instead of a sample.

- a) To determine the average number of siblings of his classmates, Carlos surveyed each person in the class.

- b) Every 5 years, Statistics Canada conducts a census. One question in the survey is used to determine the ages of the people in each household.

Reasoning Why and When Samples Should Be Used

Ex. 2: The student leadership team is planning a school dance. To attract grade 9 students to the dance, the team decided to collect data about the preferred music of the grade 9 students. The team set up in the hallway to collect the data. By the end of the day it had surveyed 72% of the grade 9 students.

a) Why do you think the data were collected from a sample instead of the entire population?

b) Will the opinions of the sample likely reflect those of the population? Explain.

Identifying and Critiquing the Use of Samples

Ex. 3: In each case, identify if data were collected from a sample or a population. Wherever a sample was used, explain if you think the conclusion would be valid.

a) A province considers banning cell phones in all of its schools. To determine the opinions of students on this issue, you poll each student in your school.

b) To determine which politician is expected to win the municipal election, every person over 18 and who is eligible to vote in the election is polled.

c) To determine the average lifetime of a type of light bulb, 150 light bulbs were selected randomly from the production line and tested.

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Quiz next class on 9.1 to 9.3

Mid-Unit Review

9.1

1. Before a security company hires someone, that person must pass a lie-detector test. Suppose that a lie detector has a 0.9 probability of identifying a lie. A person being tested thinks that if he lies 10 times, 9 of those lies will be detected.
 - a) Name one assumption the person is making.
 - b) Explain how the predicted outcome might change if the assumption changes.



2. Due to global warming, the West Antarctic Ice Sheet (WAIS) could melt and raise sea levels. Some scientists think there is a 1 in 20 chance that WAIS will collapse in the next 200 years. Explain how this statistic could be used to support opposing positions about the effects of global warming.

9.2

3. Ca Bol surveys a group of people to find out how they feel about students listening to music while studying.
 - a) Write a question Ca Bol could use to influence:
 - i) the responses in favour of students listening to music while studying
 - ii) the responses to oppose students listening to music while studying
 - b) Write a question that does not show a bias. Explain how this question is more suitable than the questions in part a.

9.3

4. Suppose your teacher conducts a survey in class about student smoking.
 - a) What problems might arise?
 - b) How would these problems affect the data collected?
5. Ahmed wanted to find out if a person's years of post-secondary education is related to how much the person earns.
 - a) Describe problems Ahmed might have to overcome related to:
 - i) privacy
 - ii) cultural sensitivity
 - iii) use of language
 - iv) cost and time
 - b) Describe the effect each problem may have on Ahmed's results.
6. Describe a situation where the timing of a question may influence the responses.
7. Which students in your school would you survey for their opinions on each topic?
 - a) the quality of cafeteria service
 - b) the cost of a gym uniform
 - c) the number of student parking spaces
 - d) the school spirit at football games
8. For each situation, explain why data were not collected by a census.
 - a) the number of Canadian families with internet access
 - b) the average cost of DVD players
 - c) the average mass of a Northern pike in Misaw Lake, Saskatchewan
9. For each topic, would you collect data using a census or a sample? Justify your choice.
 - a) to determine the average height of a grade 9 student in your class
 - b) to determine the reaction to new traffic laws in your province or territory

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1.
 - a) 90% of a person's lies will be detected, not 1 out of 10 people will be able to lie undetected.
 - b) His reaction to the test will be different from most other people's.
2. 1 in 20 is a fairly small chance, so we probably don't need to worry about the WAIS collapsing. However, 1 in 20 is far from impossible, and considering the gravity of the situation if WAIS were to collapse, we should do everything possible to avoid it.
3.
 - a)
 - i) Do you find listening to music helps you relax while studying?
 - ii) Do you find listening to music distracting when you're trying to study?
 - b) Do you support listening to music while studying?
4.
 - a) Privacy: The survey is not anonymous.
 - b) Many student smokers would lie and claim that they do not smoke, thus skewing the results toward a low number of student smokers.
5.
 - a)
 - i) People may refuse to disclose how much they earn.
 - ii) Well-educated parents who choose to stay home with children may resent the question.
 - iii) Change "years of post-secondary education" to levels of education, or number of courses at each level.
 - iv) Surveying a very large sample would take a lot of time and would be costly.
 - b)
 - i) People may lie about the amount of money they make.
 - ii) People may be reluctant to answer or may answer dishonestly.
 - iii) People's answers may not reflect their true situations if the questions are unclear.
 - iv) Ahmed may not get as many results as he hopes for.
6. Asking students on a Monday morning if they enjoy going to school
7.
 - a) Students who regularly eat at the cafeteria
 - b) Students who are enrolled in phys-ed classes
 - c) Students who drive to school
 - d) Students who go to or participate in football games
8.
 - a) Too time-consuming
 - b) Too many DVD players to conduct a census; moreover, DVD player prices change often.
 - c) It is probably impossible to catch all the northern pike in Misaw Lake, and doing so could devastate the local ecosystem.
9.
 - a) Census
 - b) Sample

9.4 – Selecting a Sample

Focus: Understand and choose an appropriate sample.

| Method | What it means | Example |
|--|---|--|
| <i>Simple random sampling</i> | Each member of the population has an equal chance of being selected. | To select a random sample of 5 students from your math class, each student is assigned a number and 5 numbers are drawn from a hat. |
| <i>Self-selected sampling</i> | Only members who are interested and volunteer will participate. | If a radio station conducts a telephone survey, only people who are interested will call. |
| <i>Systematic or interval sampling</i> | Every n th member of the population is selected. This method is often used in manufacturing | Every 20th product in an assembly line is tested for quality. If the item is destroyed or unusable after being sampled, then the sample is a <i>destructive sample</i> . |
| <i>Convenience sampling</i> | Only members of the population who are convenient to include are selected. | For a survey about grocery shopping habits, people in a grocery store are approached and questioned. |
| <i>Cluster sampling</i> | Every member of each randomly chosen group of the population is selected. | Each grade represents a group of the school population. One grade in your school is chosen randomly, and all students in that grade are selected. |
| <i>Stratified random sampling</i> | Some members from each group of the population are randomly selected. | 5 randomly chosen students from each grade in a school could be selected, even if each grade has a different number of students. |

Identifying Appropriate Samples

Ex. 1: The student leadership team wants to find out if students would like the cafeteria to have longer hours. Several sampling methods were suggested. Identify the sampling method and explain whether each sample is appropriate.

a) Every student's name is put into a box, and 100 names are selected randomly to be surveyed.

b) Every 5th person entering the school is selected.

c) Each person on the leadership team asks her or his friends.

d) An announcement is made asking anyone who wishes to participate to fill in a ballot.

Choosing Appropriate Samples

Ex. 2: A company packages boxes of granola bars. The quality-control manager inspects the first 5 boxes each morning to ensure that each has the same number and types of granola bars.

a) Is this a good way of ensuring quality control? Explain.

b) Suggest 2 other methods of sampling that would be appropriate. Explain why each is appropriate.

9.5 – Designing a Project Plan

Focus: Develop a project plan for data collection.

Using Spreadsheets and Graphs to Display Data

You can use a graph to display your data in a way that is clear and easy to understand.

Spreadsheet software can be used to record and graph data.

These data come from the *Census at School* website:

Which method do you use most often to communicate with friends?

| Method of communication | Girls | Boys | All students |
|-------------------------|-------|-------|--------------|
| | % | | |
| Internet chat or MSN | 36.11 | 35.26 | 35.7 |
| In person | 30.02 | 35.51 | 32.65 |
| Telephone (land line) | 15.61 | 13.5 | 14.6 |
| Cell phone | 8.91 | 7.66 | 8.31 |
| Text messaging | 6.59 | 3.77 | 5.23 |
| E-mail | 1.73 | 2.20 | 1.96 |
| Other | 1.03 | 2.11 | 1.55 |

Notes: Secondary students only.

Methods of communication appear in order of frequency for all students.

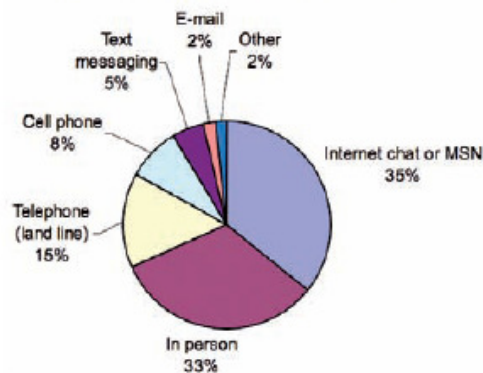
Source: Statistics Canada, Census at School, 2006/2007.

1. Enter the *Method of communication* and the percent of *All students* into columns and rows.
2. Highlight the data including the column heads. Click the graph/chart icon. Select the circle graph, which is sometimes called a pie chart. Label the graph and all sectors of the circle.

Your graph might look like this:

| Method of communication | All students |
|-------------------------|--------------|
| Internet chat or MSN | 35.7 |
| In person | 32.65 |
| Telephone (land line) | 14.6 |
| Cell phone | 8.31 |
| Text messaging | 5.23 |
| E-mail | 1.96 |
| Other | 1.55 |

Method of communication - All students



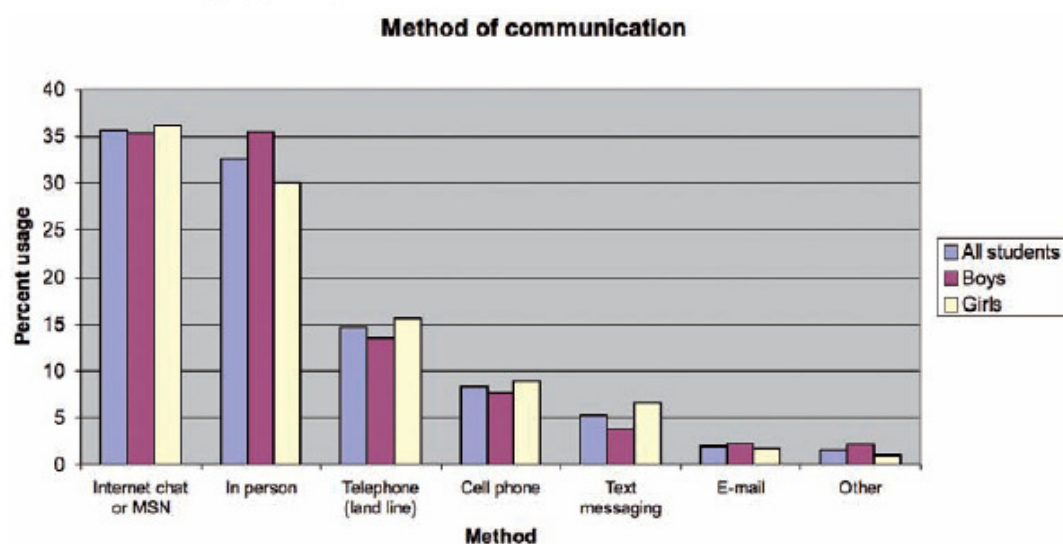
3. You can also display the data using a bar graph. Create a *Vertical bar graph*, sometimes called a *Column graph* for the data. Label the graph and axes. Experiment with the scale of each axis to most clearly display the data.

4. To display the data for *Boys*, *Girls*, and *All students*, you can make a multiple bar graph.

Enter the data for *Boys* and *Girls* into the next two columns of the spreadsheet. Now highlight all the data and create a bar graph.

Your finished graph might look like this:

| Method of communication | All students | Boys | Girls |
|-------------------------|--------------|-------|-------|
| Internet chat or MSN | 35.7 | 35.26 | 36.11 |
| In person | 32.65 | 35.51 | 30.02 |
| Telephone (land line) | 14.6 | 13.5 | 15.61 |
| Cell phone | 8.31 | 7.66 | 8.91 |
| Text messaging | 5.23 | 3.77 | 6.59 |
| E-mail | 1.96 | 2.2 | 1.73 |
| Other | 1.55 | 2.11 | 1.03 |



Check

- List one advantage and one disadvantage of displaying data using each type of graph above.
- These data are from *Census at School*:

How long does it usually take you to travel to school?

| Minutes | Elementary | Secondary |
|--------------|------------|-----------|
| | % | |
| Less than 10 | 38.36 | 18.96 |
| 10 to 19 | 31.83 | 31.92 |
| 20 to 29 | 12.55 | 17.96 |
| 30 to 44 | 10.65 | 16.83 |
| 45 to 59 | 4.16 | 7.71 |
| 60 or more | 2.44 | 6.61 |

Source: Statistics Canada, *Census at School*, 2006/2007.

Use an appropriate graph to display the results for all students. Justify your choice of graph.

**Start
Where You
Are**

How Can I Assess My Work?

I can design a **rubric**. A rubric helps me to see how well I understood the task and how good I am at communicating what I know. It lists the content and quality needed for a task; these are called the *criteria* of the task.

My first step to create a rubric is to determine the criteria of the task. Suppose I have to write an article for my school newspaper.

The criteria I would look for in the article are:

- Accurate information
- Well organized
- An eye-catching title
- Correct spelling and grammar

I then assess each criterion using one of 4 *levels of achievement*:

- Not yet adequate
- Adequate
- Proficient
- Excellent



I create a grid:

| | Not yet adequate | Adequate | Proficient | Excellent |
|------------------------------|------------------|----------|------------|-----------|
| Accurate information | | | | |
| Correct spelling and grammar | | | | |
| Well organized | | | | |
| Eye-catching title | | | | |

I then include what I think needs to be done to achieve each level.

| | Not yet adequate | Adequate | Proficient | Excellent |
|------------------------------|---|--|---|--|
| Accurate information | uses few facts that are not enough to explain the topic (1-2 facts) | uses some facts to explain the topic (3-4 facts) | uses most of the available facts to explain the topic (5-7 facts) | uses all the available facts to explain the topic (8 facts) |
| Correct spelling and grammar | | has some spelling and grammatical errors (4-6 errors) | has few spelling and grammatical errors (1-3 errors) | has no spelling or grammatical errors (0 errors) |
| Well organized | ideas are not in an order that makes sense | ideas are partly in an order that makes sense | | all ideas are in an order that makes sense |
| Eye-catching title | attempts to write a title, but it is not clear and will not attract readers | writes a title that is clear, but may not attract many readers | writes a title that is clear and effective at attracting many readers | writes a title that is very clear and is outstanding at attracting all readers |

Check

1. What descriptions might go in the grey areas?

Apply

2. a) Create a rubric to evaluate your day at school. Use the criteria below.

| | Not yet adequate | Adequate | Proficient | Excellent |
|---------------------|------------------|----------|------------|-----------|
| Homework was done | | | | |
| On time for classes | | | | |
| Paid attention | | | | |
| Helped others | | | | |

- b) Trade rubrics with a classmate. Suggest how to improve your classmate's rubric.

Here are 5 possible steps to consider when you design a plan for data collection:

1. Prepare a question.

The wording should avoid biases, and be culturally sensitive. If the survey question is personal, the participants should be anonymous.

2. Identify the population, and possibly choose a sample.

If you select a sample, ensure it represents the population. Consider the time and cost involved in collecting data from your population or sample.

3. Collect the data.

Consider the timing of your data collection: does it avoid potential problems?

4. Analyze and display the data.

Choose an appropriate display for the data, such as a table, circle graph, bar graph, or line graph.

5. Design a rubric.

This should help you evaluate the important components of your project.

Designing a Project Plan

Ex. 1: Suppose a frozen yogurt company considers adding a new flavour to its menu. Decide how to conduct a survey to determine whether the new flavour should be added to the menu.

Study Guide

Probability

- ▶ Probability is the likelihood an event will occur. For example, a weather forecast says that the probability of rain is 60%. This assumes that the predicted weather conditions do not change. If they do change, then the likelihood of rain may also change.
- ▶ Decisions based on probabilities may be a combination of theoretical probability, experimental probability, and subjective judgment. People may make different decisions based on one probability. For example, one person may consider a 60% probability of rain as being too high, and cancel a planned outdoor event. Another person may say that a 40% probability it will not rain is good enough to proceed with the event.



Collecting data

- ▶ Problems may arise if a person does not consider:
 - bias
 - use of language
 - ethics
 - cost and time
 - timing
 - privacy
 - cultural sensitivity
- ▶ The population is the group from which you are getting information.
- ▶ When a census is conducted, data are collected from the entire population.
- ▶ When data are collected from only part of the population, a *sample* is used. This sample must be representative of the population.
- ▶ Valid conclusions are obtained when the sample results represent those of the population.

HW Assignment

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