2.3 Sampling Techniques

1. Identify the population for each of the following questions.
- **a)** Who is your favourite teacher?
- **b)** Who is the favourite teacher in your school?
- **c)** Which team should win the Stanley Cup?
- **d)** What is your favourite novel?

2. Classify the sampling method used in each scenario.
- **a)** The student council president randomly asks students their opinions on the school's attendance policy.

- **b)** To generate statistics on householders, 10 Canadian cities are selected, then 10 neighbourhoods in each city, and then 1 household in each neighbourhood.

- **c)** Six baseball teams from a league are selected to answer a survey.

- **d)** An Internet site requests people to send e-mails stating their opinions regarding the latest political scandal.

- **e)** Customs inspectors stop every 10th person passing through customs.

- **f)** A marketing company randomly selects people to participate in a survey such that the number of people in each income group is proportional to the size of the groups.

3. What type(s) of sample would be appropriate for each of the following?
- **a)** determining the most popular spreadsheet program

- **b)** contacting employees of a company relative to the size of their departments

- **c)** taking a national poll on a current issue in Parliament

4. A market research company wishes to determine the opinions of people of various age groups regarding a new theatre opening in their neighbourhood. Describe how this company might organize a stratified sample survey.

5. The police are running an anti-drinking-and-driving campaign by stopping every fifth car on a main highway.
- **a)** What type of sampling is being used?
- **b)** Suggest a better method of sampling. Explain your choice.

6. Describe the reasons why a voluntary-response survey is not considered to be accurate.

2.4 Bias in Surveys

1. Classify the bias in each of the following scenarios.

a) Students are asked by their teacher whether they had ever cheated on a test.

b) A fast-food franchiser uses a cluster survey to find out about employer-employee relations.

c) A survey asks the question: "Are you in favour of holding the Olympics in Toronto, even though your taxes may increase?"

d) A radio station asks listeners to call in to voice their opinions on whether a Canadian figure skater should have won a gold medal.

2. Reword each of the following survey questions to eliminate bias.

a) A random sample of residents of a city with high traffic congestion is asked: "Are you in favour of widening the main street to reduce congestion?"

b) During an election campaign, voters are asked: "Do you agree that, because they have reduced taxes to a postwar low, the current government should be re-elected to continue their great work?"

c) A marketing firm hired by a movie company asks: "Which of the following movies should be named Movie of the Year?"

d) A government pollster asks: "Unemployment is at an extremely high level. Are you in favour of government policies to spend money to create jobs in your community?"

3. **a)** Write an example of a biased question regarding officiating in your favourite sport.

b) Identify the type of bias you used.

c) Write an unbiased version of your question.

4. A survey contained the following set of instructions and questions for parents of honour-roll students:

Wearing school uniforms helps keep trespassers from causing problems in the school.

- Would you be in favour of changing the school dress code to introduce uniforms for all students so that proper discipline can be enforced?
- Other dress code changes may or may not have positive effects on student discipline. Do you have any other suggestions for dress code changes?
  Please enter your name and phone number:_____

a) Identify the types of bias in the survey.

b) What types of answers is the author of this survey attempting to elicit?

c) Suggest improvements to eliminate bias.

2.5 Measures of Central Tendency

You are encouraged to use a spreadsheet to answer any of these questions, or a graphing calculator

1. The masses of 5-kg boxes of nails labelled with a mass of 5 kg were checked by finding the masses of 200 boxes. The results are shown at the right.

a) Calculate the mean, median, and mode mass.

b) A customer says that the average box is underweight. Can the manufacturer legitimately dispute this? Why or why not?

Mass (kg)	Frequency
4.6–4.7	15
4.7–4.8	37
4.8–4.9	24
4.9–5.0	49
5.0–5.1	72
5.1–5.2	3

2. Kamran earned a term mark of 85%. The term is worth 70% and the exam is worth 30% of his report card remark. What percent mark will Kamran require on his exam to earn an 80% report card mark?

3. The data in the chart at the right represent the salary distribution in a company.

a) Calculate the mean, median, and mode salaries.

b) Which measure of central tendency best describes these data? Why?

Salary (× $1000)	Number of Employees
15.5–25.5	3
25.5–35.5	12
35.5–45.5	24
45.5–55.5	21
55.5–65.5	10
65.5–75.5	2
75.5–85.5	0
85.5–95.5	0
95.5–105.5	0
105.5–115.5	1

4. Candidacy to be a school ambassador is to be granted to the student who scores highest in four weighted categories. The criteria and their weightings are provided in the table, along with the candidates' scores in each category.

Criterion	Weighting	Sang Hee	Mario	Melissa
Grades	3	3	3	5
Extra-Curricular Involvement	2	4	1	5
Teacher Recommendation	4	2	5	3
Personal Interview	5	3	5	2

Based on their weighted means, who should win the candidacy?

5. **a)** Describe what is meant by "outliers" in a set of data.

b) What effects do outliers have on each measure of central tendency?

2.6 Measures of Spread

1. A list of total points in 25 basketball games is given in the table at the right:
Calculate the mean and population standard deviation.

145	198	154	166	159
163	120	169	199	152
176	168	144	177	205
181	180	162	138	165
169	128	174	166	160

Hint: For Question #2, it is probably easier to list the full data set out in a spreadsheet. Calculating standard deviation from a frequency table is very difficult. Copy and paste 1.97 eight times, copy and paste 1.98 fifteen times, etc. and then calculate the mean and standard deviation.

2. The mass of a 2-kg box of chocolates was checked by finding the masses of 150 boxes.
The results are shown in the table at the right.

a) Calculate the mean and the range.

b) Calculate the population standard deviation.

c) The company has decided that a sample that is within 2 standard deviations of the mean would be acceptable. A random sample was taken and the mass was 1.97 kg. Would this be an acceptable sample?

Mass (kg)	Frequency
1.97	8
1.98	15
1.99	19
2.00	35
2.01	33
2.02	22
2.03	14
2.04	4

3. On a recent grade 11 mathematics contest, the mean score was 57.9 with a standard deviation of 11.6. On the grade 10 mathematics contest written at the same time, the mean score was 61.2 with a standard deviation of 11.9. Pang scored 84.3 on the grade 11 contest and his sister, Ming, scored 86.2 on the grade 10 contest. Make an argument in favour of Pang's results being better than those of his sister.

ANSWERS

2.3 Sampling Techniques

1. **a)** all students
b) all students in your school
c) all NHL fans or experts
d) all novel readers

2. **a)** simple random **b)** multi-stage
c) cluster **d)** voluntary-response
e) systematic **f)** stratified

3. **b)** stratified **c)** multi-stage

4. Randomly select people in numbers proportional to the sizes of their age groups

5. **a)** systematic **b)** Use a cluster sample by selecting a few bars and stop all drivers near bars

6. Those people who have strong opinions may be more likely to respond, thereby skewing the results.

2.4 Bias in Surveys

1. **a)** response bias **b)** sampling bias
c) measurement bias **d)** sampling bias

2. **a)** Are you or are you not in favour of widening the main street?
b) Should the current government be re-elected?
c) What movie do you think should be named Movie of the Year?
d) Should the gov. spend money on job creation?

4. **a)** Sampling bias – only asked of parents of honour-roll students
Measurement bias – wearing school uniforms
Measurement bias –other dress code …
Non-response bias – Please enter your name & #
b) answers in favour of wearing uniforms
c)Give the survey to a cross section of parents. Provide arguments on both sides of the issue. Do not ask parents to identify themselves.

2.5 Measures of Central Tendency

1. **a)**mean = 4.9175 kg, median = 4.95 kg, mode = 5.05 kg.
b) No. Only the mode is above 5.0 kg.

2. 68.3%

3. **a)** mean = $45.4315 thousand
median = $40.5 thousand mode = $40.5 thousand
b) Median because it represents the middle value and is not affected by the outlier.

4. Mario, with a weighted mean of 4 (old answer - 3.36)

5. **a)** An outlier is a measurement that is distant from the rest of the data.
b) Outliers affect the mean by making it somewhat greater or less than the median.

2.6 Measures of Spread

1. **a)** mean = 164.72 points, population standard deviation = 20.04 points

2. **a)** mean is 2.004 kg. Range is 0.07 kg
c) 0.017 kg **d)** Yes

3. **Take question up in class**