Alberta's Program of Studies (Curriculum) - Mathematics - Statistics and Probability (Strand and Sub-strands with Achievement Outcomes)

Note: These strands are not intended to be discrete units of instruction. The integration of outcomes across trands makes mathematical experiences meaningful. Students should make the connection between concepts both within and across strands.

PROGRESSION IS HIGHLIGHTED IN THE FOLLOWING DOCUMENT VIA **BOLDED TEXT**.

MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and embrace lifelong learning in mathematics.

MATHEMATICAL PROCESS	Communication [C]	Connections [CN]	Mental Mathematics and Estimation [ME]	Problem Solving [PS]	Reasoning [R]	Technology [T]	Visualization [V]
Students are expected to	communicate in order to learn and express their understanding	connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines	demonstrate fluency with mental mathematics and estimation	develop and apply new mathematical knowledge through problem solving	develop mathematical reasoning	select and use technologies as tools for learning and for solving problems	develop visualization skills to assist in processing information, making connections and solving problems

Sub-strand: Data Analysis

General Outcome: Collect, display and analyze data to solve problems.

Kindergarten	Grade 1	Grade 2		Grade 3		Grade 4		Grade 5	
Specific Outcome *It is expected that students will:*	**Specific Outcome** *It is expected that students will:*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
N/A	N/A	**1. Gather and record data about self and others to answer questions.** [C, CN, PS, V] [ICT: C4–1.3, C7–1.1]	* Formulate a question that can be answered by gathering information about self and others. * Organize data as it is collected, using concrete objects, tallies, check marks, charts or lists. * Answer questions, using collected data.	1. Collect **first-hand** data and organize it using: **• tally marks** **• line plots** **• charts** **• lists** to answer questions. [C, CN, PS, V] [ICT: C4–1.3]	* Record the number of objects in a given set, using tally marks. * Determine the common attributes of line plots by comparing line plots in a given set. * Organize a given set of data, using tally marks, line plots, charts or lists. * Collect and organize data, using tally marks, line plots, charts and lists. * Answer questions arising from a given line plot, chart or list. * Answer questions using collected data.	1. **Demonstrate an understanding of many-to-one correspondence**. [C, R, T, V] [ICT: C6–2.2, C6–2.3]	* Compare graphs in which the same data has been displayed using one-to-one and many-to-one correspondences, and explain how they are the same and different. * Explain why many-to-one correspondence is sometimes used rather than one-to-one correspondence. * Find examples of graphs in print and electronic media, such as newspapers, magazines and the Internet, in which many-to-one correspondence is used; and describe the correspondence used.	1. **Differentiate between** first-hand and **second-hand** data. [C, R, T, V] [ICT: C1–2.2, P5–2.3]	* Explain the difference between first-hand and second-hand data. * Formulate a question that can best be answered using first-hand data, and explain why. * Formulate a question that can best be answered using second-hand data, and explain why. * Find examples of second-hand data in print and electronic media, such as newspapers, magazines and the Internet.
		2. Construct and interpret concrete graphs and pictographs to solve problems. [C, CN, PS, R, V] [ICT: C7–1.3]	* Determine the common attributes of concrete graphs by comparing a given set of concrete graphs. * Determine the common attributes of pictographs by comparing a given set of pictographs. * Answer questions pertaining to a given concrete graph or pictograph. * Create a concrete graph to display a given set of data, and draw conclusions. * Create a pictograph to represent a given set of data, using one-to-one correspondence. * Solve a given problem by constructing and interpreting a concrete graph or pictograph.	2. Construct, **label** and interpret **bar** graphs to solve problems. [C, PS, R, V] [ICT: C4–1.3, C7–1.3, C7–1.4]	* Determine the common attributes, titles and axes of bar graphs by comparing bar graphs in a given set. * Create a bar graph, labelling the title and axes, to represent a given set of data. * Draw conclusions from a given bar graph to solve problems. * Solve problems by constructing and interpreting a bar graph.	2. Construct and interpret pictographs and bar graphs **involving many-to-one correspondence** to **draw conclusions**. [C, PS, R, V]	* Identify an interval and correspondence for displaying a given set of data in a graph, and justify the choice. * Create and label (with categories, title and legend) a pictograph to display a given set of data, using many-to-one correspondence, and justify the choice of correspondence used. * Create and label (with axes and title) a bar graph to display a given set of data, using many-to-one correspondence, and justify the choice of interval used. * Answer a given question, using a given graph in which data is displayed using many-to-one correspondence.	2. Construct and interpret **double** bar graphs to draw conclusions. [C, PS, R, T, V] [ICT: C6–2.2, P5–2.3]	* Determine the attributes (title, axes, intervals and legend) of double bar graphs by comparing a given set of double bar graphs. * Represent a given set of data by creating a double bar graph, label the title and axes, and create a legend without the use of technology. * Draw conclusions from a given double bar graph to answer questions. * Provide examples of double bar graphs used in a variety of print and electronic media, such as newspapers, magazines and the Internet. * Solve a given problem by constructing and interpreting a double bar graph.

Sub-strand: Data Analysis

General Outcome: N/A	General Outcome: N/A							General Outcome: Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.	
Specific Outcome	**Specific Outcome**	**Specific Outcome**	**Achievement Indicators**	**Specific Outcome**	**Achievement Indicators**	**Specific Outcome**	**Achievement Indicators**	**Specific Outcome**	**Achievement Indicators**
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3. Describe **the likelihood of a single outcome occurring,using words such as:** **• impossible** **• possible** **• certain.** [C, CN, PS, R]	* Provide examples of events from personal contexts that are impossible, possible or certain. * Classify the likelihood of a single outcome occurring in a probability experiment as impossible, possible or certain. * Design and conduct a probability experiment in which the likelihood of a single outcome occurring is impossible, possible or certain. * Conduct a given probability experiment a number of times, record the outcomes, and explain the results.
								4. **Compare the likelihood of two possible outcomes occurring, using words such as:** **• less likely** **• equally likely** **• more likely**. [C, CN, PS, R]	* Identify outcomes from a given probability experiment that are less likely, equally likely or more likely to occur than other outcomes. * Design and conduct a probability experiment in which one outcome is less likely to occur than the other outcome. * Design and conduct a probability experiment in which one outcome is equally likely to occur as the other outcome. * Design and conduct a probability experiment in which one outcome is more likely to occur than the other outcome.

Alberta's Program of Studies (Curriculum) - Mathematics - Statistics and Probability (Strand and Sub-strands with Achievement Outcomes)

Note: These strands are not intended to be discrete units of instruction. The integration of outcomes across trands makes mathematical experiences meaningful. Students should make the connection between concepts both within and across strands.

PROGRESSION IS HIGHLIGHTED IN THE FOLLOWING DOCUMENT VIA **BOLDED TEXT**.

MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and embrace lifelong learning in mathematics.

MATHEMATICAL PROCESS	Communication [C]	Connections [CN]	Mental Mathematics and Estimation [ME]	Problem Solving [PS]	Reasoning [R]	Technology [T]	Visualization [V]
Students are expected to	communicate in order to learn and express their understanding	connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines	demonstrate fluency with mental mathematics and estimation	develop and apply new mathematical knowledge through problem solving	develop mathematical reasoning	select and use technologies as tools for learning and for solving problems	develop visualization skills to assist in processing information, making connections and solving problems

Sub-strand: Data Analysis

General Outcome: Collect, display and analyze data to solve problems.

Grade 6		Grade 7		Grade 8		Grade 9	
Specific Outcome *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*	**Specific Outcome** *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
Select, justify and use appropriate methods of collecting data, including: • **questionnaires** • **experiments** • **databases** • **electronic media**. [C, CN, PS, R, T] [ICT: C4–2.2, C6–2.2, C7–2.1, P2–2.1, P2–2.2]	* Select a method for collecting data to answer a given question, and justify the choice. * Design and administer a questionnaire for collecting data to answer a given question, and record the results. * Answer a given question by performing an experiment, recording the results and drawing a conclusion. * Explain when it is appropriate to use a database as a source of data. * Gather data for a given question by using electronic media, including selecting data from databases.	**1. Demonstrate an understanding of central tendency and range by:** **• determining the measures of central tendency (mean, median, mode) and range** **• determining the most appropriate measures of central tendency to report findings.** [C, PS, R, T] [ICT: P2–3.4]	* Determine mean, median and mode for a given set of data, and explain why these values may be the same or different. * Determine the range for a given set of data. * Provide a context in which the mean, median or mode is the most appropriate measure of central tendency to use when reporting findings. * Solve a given problem involving the measures of central tendency.	**1. Critique ways in which** data is presented in circle graphs, line graphs, bar graphs and pictographs. [C, R, T, V] [ICT: C7–3.1, C7–3.2, F4–3.3]	* Compare information provided for the same data set by a given set of graphs, including circle graphs, line graphs, bar graphs and pictographs, to determine the strengths and limitations of each graph. * Identify the advantages and disadvantages of different graphs, including circle graphs, line graphs, bar graphs and pictographs, in representing a given set of data. * Justify the choice of a graphical representation for a given situation and its corresponding data set. * Explain how the format of a given graph, such as the size of the intervals, the width of the bars and the visual representation, may lead to misinterpretation of the data. * Explain how a given formatting choice could misrepresent the data. * Identify conclusions that are inconsistent with a given data set or graph, and explain the misinterpretation.	**1. Describe the effect of:** **• bias** **• use of language** **• ethics** **• cost** **• time and timing** **• privacy** **• cultural sensitivity** **on** the collection of data. [C, CN, R, T] [ICT: F4–3.2, F4–3.3]	* Analyze a given case study of data collection; and identify potential problems related to bias, use of language, ethics, cost, time and timing, privacy or cultural sensitivity. * Provide examples to illustrate how bias, use of language, ethics, cost, time and timing, privacy or cultural sensitivity may influence data.
1. Create, label and interpret **line** graphs to draw conclusions. [C, CN, PS, R, V]	* Determine the common attributes (title, axes and intervals) of line graphs by comparing a given set of line graphs. * Determine whether a given set of data can be represented by a line graph (continuous data) or a series of points (discrete data), and explain why. * Create a line graph from a given table of values or a given set of data. * Interpret a given line graph to draw conclusions.	**2. Determine the effect on the mean, median and mode when an outlier is included in a data set.** [C, CN, PS, R]	* Analyze a given set of data to identify any outliers. * Explain the effect of outliers on the measures of central tendency for a given data set. * Identify outliers in a given set of data, and justify whether or not they are to be included in reporting the measures of central tendency. * Provide examples of situations in which outliers would and would not be used in reporting the measures of central tendency.			**2. Select and defend the choice of using either a population or a sample of a population** to answer a question. [C, CN, PS, R]	* Identify whether a given situation represents the use of a sample or a population. * Provide an example of a situation in which a population may be used to answer a question, and justify the choice. * Provide an example of a question where a limitation precludes the use of a population; and describe the limitation, e.g., too costly, not enough time, limited resources. * Identify and critique a given example in which a generalization from a sample of a population may or may not be valid for the population. * Provide an example to demonstrate the significance of sample size in interpreting data.
3. Graph collected data, and **analyze** the graph to solve problems. [C, CN, PS, R, T] [ICT: C6–2.5, C7–2.1, P2–2.1, P2–2.2]	* Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph. * Solve a given problem by graphing data and interpreting the resulting graph.	**3.** Construct, label and interpret **circle** graphs to solve problems. [C, CN, PS, R, T, V] [ICT: P2–3.3]	* Identify common attributes of circle graphs, such as: • title, label or legend • the sum of the central angles is 360o • the data is reported as a percent of the total, and the sum of the percents is equal to 100%. * Create and label a circle graph, with and without technology, to display a given set of data. * Find and compare circle graphs in a variety of print and electronic media, such as newspapers, magazines and the Internet. * Translate percentages displayed in a circle graph into quantities to solve a given problem. * Interpret a given circle graph to answer questions.			**3. Develop and implement a project plan for the** collection, display and analysis of data by: • **formulating** a question **for investigation** • **choosing** a data collection method **that includes social considerations** • **selecting a population or a sample** • collecting the data • displaying the collected data **in an appropriate manner** • drawing conclusions **to** answer **the** question. [C, PS, R, T, V] [ICT: C1–3.5, C4–3.1, C6–3.1, C6–3.2, C7–3.1, C7–3.2, P1–3.4, P2–3.1]	* Create a rubric to assess a project that includes the assessment of: • a question for investigation • the choice of a data collection method that includes social considerations • the selection of a population or a sample and the justification for the selection • the display of collected data • the conclusions to answer the question. * Develop a project plan that describes: • a question for investigation • the method of data collection that includes social considerations • the method for selecting a population or a sample • the methods for display and analysis of data. * Complete the project according to the plan, draw conclusions, and communicate findings to an audience. * Self-assess the completed project by applying the rubric.

Sub-strand: Data Analysis

General Outcome: Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.

Specific Outcome	Achievement Indicators	Specific Outcome	Achievement Indicators	Specific Outcome	Achievement Indicators	Specific Outcome	Achievement Indicators
4. Demonstrate an understanding of probability by: **• identifying all possible outcomes of a probability experiment** **• differentiating between experimental and theoretical probability** **• determining the theoretical probability of outcomes in a probability experiment** **• determining the experimental probability of outcomes in a probability experiment** **• comparing experimental results with the theoretical probability for an experiment.** [C, ME, PS, T] [ICT: C6–2.1, C6–2.4]	* List the possible outcomes of a probability experiment, such as: • tossing a coin • rolling a die with a given number of sides • spinning a spinner with a given number of sectors. * Determine the theoretical probability of an outcome occurring for a given probability experiment. * Predict the probability of a given outcome occurring for a given probability experiment by using theoretical probability. * Conduct a probability experiment, with or without technology, and compare the experimental results with the theoretical probability. * Explain that as the number of trials in a probability experiment increases, the experimental probability approaches theoretical probability of a particular outcome. * Distinguish between theoretical probability and experimental probability, and explain the differences.	**4. Express** probabilities **as ratios, fractions and percents.** [C, CN, R, T, V] [ICT: P2–3.4]	* Determine the probability of a given outcome occurring for a given probability experiment, and express it as a ratio, fraction and percent. * Provide an example of an event with a probability of 0 or 0% (impossible) and an example of an event with a probability of 1 or 100% (certain).	**2.** Solve problems involving the probability of independent events. [C, CN, PS, T] [ICT: P2–3.4]	* Determine the probability of two given independent events; and verify the probability, using a different strategy. * Generalize and apply a rule for determining the probability of independent events. * Solve a given problem that involves determining the probability of independent events.	**4.** Demonstrate an understanding of **the role of** probability **in society**. [C, CN, R, T] [ICT: F4–3.3]	* Provide an example from print and electronic media, e.g., newspapers, the Internet, where probability is used. * Identify the assumptions associated with a given probability, and explain the limitations of each assumption. * Explain how a single probability can be used to support opposing positions. * Explain, using examples, how decisions may be based on a combination of theoretical probability, experimental probability and subjective judgement.
		5. Identify the sample space (where the combined sample space has 36 or fewer elements) for a probability experiment involving **two independent events**. [C, ME, PS]	* Provide an example of two independent events, such as: • spinning a four section spinner and an eight-sided die • tossing a coin and rolling a twelve-sided die • tossing two coins • rolling two dice and explain why they are independent. * Identify the sample space (all possible outcomes) for each of two independent events, using a tree diagram, table or other graphic organizer.				
		6. Conduct a probability experiment **to compare** the theoretical probability **(determined using a tree diagram, table or other graphic organizer)** and experimental probability **of two independent events**. [C, PS, R, T] [ICT: C7–3.2, P2–3.4]	* Determine the theoretical probability of a given outcome involving two independent events. * Conduct a probability experiment for an outcome involving two independent events, with and without technology, to compare the experimental probability with the theoretical probability. * Solve a given probability problem involving two independent events.				