MDM4U
Mathematics of Data Management
University Preparation

Mathematics of Data Management: Content and Reporting Targets

Mathematical Processes across all strands: *Problem Solving, Reasoning and Proving, Reflecting, Selecting Tools and Computational Strategies, Connecting, Representing, and Communicating.*

Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Counting and Probability • Introducing Probability vocabulary and notation in contexts involving simple counting • Counting permutations and combinations • Using mathematical notation to describe the number of permutations and combinations • Solving counting problems • Solving probability problems using counting principles	**Organization of Data for Analysis** • Connecting questions and the data needed to answer them • Understanding data concepts	**Statistics** • Single-variable data • Two-variable data • Evaluating validity	**Probability Distributions** • Discrete random variables	**Modeling Continuous Data** • Continuous random variables
Culminating Projects and Investigations **A: Permutations, Combinations, Probabilities; B: Statistics; C: Probability Distributions**				
Counting Stories Project • Choosing or creating a nursery rhyme or piece of literature that provides the potential for posing and answering connected problems that involve permutations, combinations, and probabilities • Posing and solving the connected problems	**Culminating Investigation** • Retrieving/gathering data from various sources (e.g., e-Stat) • Dealing with/organizing various forms of data • Fine-tuning their research question • Learning to use data-analysis tools (e.g., Fathom)	**Culminating Investigation** • Interpreting, analysing, and interpreting the data • Drawing conclusions from the analysis of data • Compiling report, presenting multimedia summary to audience, and answering questions • Posing probing questions of presenters • Critiquing work of others	**Games Fair Project** • Creating a game of chance that has an expected value > 0 for the game provider, and that encourages people to play the game • Calculating the probability distribution for the game and the expected values • Hosting the game and gathering experimental data • Comparing the theoretical probability distribution and the experimental data • Critiquing work of others	**Culminating Investigation** • Identifying area of interest and connecting it to probability • Posing a problem of interest, finding sources of data, determining relevance of data • Designing a plan to study the problem of interest, formulating a research question

Rationale

Starting with Probability and Counting

- Helps students understand that this course requires new ways of thinking mathematically that is less algebraic than earlier courses.
- Due to new pathways producing a more diverse group of students, starting with Probability and Counting will begin to train students to use more complex mathematical processes.
- Builds on prior experiences with and knowledge of probability to use a more formal mathematical approach, including its vocabulary and notation.
- Separates the establishment of this formal approach from the introduction to permutations and combinations.
- Offers an opportunity for success early in the course to students who may not have excelled in more algebraic approaches.
- Establishes this course as a university-preparation course
- Provides the opportunity to introduce concepts of variability.
- Prepares students for statistical analysis and probability distributions.

Organization of Data for Analysis (in Unit 2)

- Providing students with tools for working with data prepares them to begin work on Culminating Investigation B early in the course.

Probability Distributions(later in the course)

- Students benefit from seeing data distributions before applying those concepts to probability distributions

Culminating Projects and Investigations (addressed in all units)

- Provides time for students to develop quality projects and investigations.
- Provides time for students to incorporate feedback on Project A into Project and Investigation C
- Provides time for students to incorporate feedback on various stages of Investigation B into their presentation.
- Addresses all curriculum expectations through projects and investigations, thereby eliminating the need for an examination.
- Provides more opportunities for feedback and interactions.

Mathematics of Data Management
Year Outline – Planning Tool

P Number of pre-planned lessons (including instruction, diagnostic and formative assessments, summative assessments other than summative performance tasks)

J Number of jazz days of time (instructional or assessment)

T Total number of days

SP Summative performance task (see Assessment – Grade 9 Applied)

Unit	Cluster of Curriculum Expectations	Overall and Specific Expectations	P	J	T	SP
1	Counting and Probability Introducing Probability vocabulary (e.g. sample space, outcomes, events, trials, discrete, continuous, theoretical probability, experimental probability, mutually exclusive, random number generator, Venn diagram, independent and dependent events, conditional probability, complement, simulation) and notation (e.g., P(~A), P(A and B), P(A or B), P(A | B)) in contexts involving simple counting (e.g. where the sample space is given) Distinguish between and make connections between situations involving the use of permutations and combinations Develop, through investigation the number of permutations and combinations Using mathematical notation (e.g., $n!, P(n,r), \binom{n}{r}$) to count Solving counting problems using counting principles – additive, multiplicative Solving probability problems using counting principles Culminating Investigation – identifying area of interest and connecting it to probability	**A1** solve problems involving the probability of an event or a combination of events for discrete sample spaces **A2** solve problems involving the application of permutations and combinations to determine the probability of an event **E1** design culminating investigation that requires the integration and application of the knowledge and skills related to the expectations of this course **E2** communicate the findings of a culminating investigation and provide constructive critiques of the investigations of others	16	2	19	2

Unit	Cluster of Curriculum Expectations	Overall and Specific Expectations	P	J	T	SP
2	Organization of Data for Analysis Demonstrate an understanding of the role of data in statistical studies Describe the characteristics of a good sample and compare sampling techniques Design an effective survey and collect data Understand how data is organized Find sources of data, refine topic of interest and design a plan in preparation for the Culminating Investigation	**C1** demonstrate an understanding of the role of data in statistical studies and the variability inherent in data, and distinguish different types of data **C2** describe the characteristics of a good sample, some sampling techniques, and principles of primary data collection, and collect and organize data to solve a problem **E1** design culminating investigation that requires the integration and application of the knowledge and skills related to the expectations of this course	10	1	11	
3	Statistics Explore, analyse, interpret, and draw conclusions from one-variable data Explore, analyse, interpret, and draw conclusions from two-variable data Investigate and evaluate validity of statistical summaries Culminating Investigation Analyse, interpret, draw conclusions and write a report of their research Present summary of findings Critique presentations of their peers	**D1** analyse, interpret, and draw conclusions from one-variable data using numerical and graphical summaries **D2** analyse, interpret, and draw conclusions from two-variable data using numerical, graphical, and algebraic summaries **D3** demonstrate an understanding of the applications of data management used by the media and the advertising industry and used in various occupations **E1** design and carry out a culminating investigation that requires the integration and application of the knowledge and skills related to the expectations of this course **E2** communicate the findings of a culminating investigation and provide constructive critiques of the investigations of others	18	2	20	10

Unit	Cluster of Curriculum Expectations	Overall and Specific Expectations	P	J	T	SP
4	Probability Distributions Understand probability distributions for discrete random variables Explore and connect Binomial and Hypergeometric distributions Recognize that the differences between a probability histogram and a frequency histogram may be the result of variability Complete a Games Fair culminating project	**B3** demonstrate an understanding of discrete probability distributions, represent them numerically, graphically, and algebraically, determine expected values, and solve related problems from a variety of applications; **E1** design and carry out a culminating investigation that requires the integration and application of the knowledge and skills related to the expectations of this course **E2** communicate the findings of a culminating investigation and provide constructive critiques of the investigations of others	10	1	11	2
5	Modelling Continuous Data Describe the shapes of distributions of continuous data Extend the concept of a discrete probability distribution to a continuous probability distribution Understand the features of the normal distribution Apply normal distributions to real-world situations recognizing the role of variability	**D1** analyse, interpret, and draw conclusions from one-variable data using numerical and graphical summaries; **B2** demonstrate an understanding of continuous probability distributions, make connections to discrete probability distributions, determine standard deviations, describe key features of the normal distribution, and solve related problems from a variety of applications.	10	1	11	
	Summative Performance Tasks					14
	Total Days		64	7	72	85

The number of prepared lessons represents the lessons that could be planned ahead based on the range of student readiness, interests, and learning profiles that can be expected in a class. The extra time available for "instructional jazz" can be taken a few minutes at a time within a pre-planned lesson or taken a whole class at a time, as informed by teachers' observations of student needs.

The reference numbers are intended to indicate which lessons are planned to precede and follow each other. Actual day numbers for particular lessons and separations between terms will need to be adjusted by teachers.

Unit 1: Counting and Probability

Grade 12

Lesson Outline

Big Picture

Students will:

- solve problems involving probability of distinct events;
- solve problems using counting techniques of distinct items;
- apply counting principles to calculating probabilities;
- explore variability in experiments;
- demonstrate understanding of counting and probability problems and solutions by adapting/creating a children's story/nursery rhyme in a Counting Stories project;
- explore a significant problem of interest in preparation for the Culminating Investigation.

Day	Lesson Title	Math Learning Goals	Expectations
1–2	Mathematical Probability	• Investigate probabilities generated from experiments (e.g., spinners, sampling, numbered cubes, coins, cards) and use mathematical vocabulary (e.g., sample space, outcomes, events, trials, theoretical probability, experimental probability, mutually exclusive, non-mutually exclusive, independent and dependent events, complement) and notation (e.g., *P(A), P(~A), P(A* and *B), P(A* or *B), P(A | B))* in contexts involving simple counting (e.g. where the sample space is given) and tools (e.g. tree diagrams, organized lists, Venn diagram). • Determine whether 2 events are independent or dependent and whether one event is conditional on another. • Recognize that the sum of the probabilities of all possible outcomes in the sample space is 1.	A1.1, A1.2, A1.3, A1.5, A1.6
3	Counting Stories Project	• Introduce and understand one culminating project, Counting Stories Project (e.g. student select children's story/nursery rhyme to rewrite using counting and probability problems and solutions as per Strand A). • Create a class critique to be used during the culminating presentation.	E2.3 E2.4
4–5	Using Simulations to Show Variability	• Determine, through investigation using class-generated data and technology-based simulation models, the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases. • Graph the experimental probability versus the number of trials, and describe any trend.	A1.4
6	Counting Arrangements and Selections	• Solve problems that progress from small sets to more complex sets using lists, tree diagram, role play to establish the need for a more formal strategy. • See examples where some of the *distinct* objects are used and where all the *distinct* objects are used. • Discuss how counting when order is important is different from when order is not important to distinguish between situations that involve, the use of permutations and those that involve the use of combinations.	A2.1

Day	Lesson Title	Math Learning Goals	Expectations
7	Counting Permutations	• Develop, based on previous investigations, a method to calculate the number of permutations of all the objects in a set of *distinct* objects and some of the objects in a set of *distinct* objects. • Use mathematical notation (e.g., *n!, P(n, r)*) to count.	A2.1, A2.2
8	Counting Combinations	• Develop, based on previous investigations, a method to calculate the number of combinations of some of the objects in a set of *distinct* objects. • Make connection between the number of combinations and the number of permutations. • Use mathematical notation (e.g., $\binom{n}{r}$) to count • Ascribe meaning to $\binom{n}{n}, \binom{n}{1}, \binom{n}{0}$. • Solve simple problems using techniques for counting permutations and combinations, where all objects are distinct.	A2.1, A2.2
9	Counting Stories Project	• Use counting and probability problems and solutions to create first draft of Counting Stories Project.	A1.1, A1.3, A1.5, A1.6, A2.1, A2.2, A2.3

Day	Lesson Title	Math Learning Goals	Expectations
10–11	Pascal's Triangle	• Investigate patterns in Pascal's triangle and the relationship to combinations, establish counting principles and use them to solve simple problems involving numerical values for n and r. • There is only one way to choose all of the elements (i.e., $\binom{n}{n} = 1$). • There is only way to choose none of the elements (i.e., $\binom{n}{0} = 1$). • There are n ways to choose one element from n elements (i.e., $\binom{n}{1} = 1$). • Choosing r elements from n elements is the same as choosing $n–r$ elements from n elements (i.e., $\binom{n}{n} = \binom{n}{n-r}$) (e.g., Choosing 3 girls from 8 girls for a committee is the same as choosing 5 girls not to be on the committee). • The number of collections of any size from n elements is 2^n. (i.e., $\binom{n}{0} + \binom{n}{1} + \binom{n}{2} + \ldots + \binom{n}{n-1} + \binom{n}{n} = 2^n$) (e.g., the number of different playlists selected from 10 tunes is 2^{10}). • The total number of selections of r elements from n elements is made up of selections that either include a particular element or not (i.e., $\binom{n}{r} = \binom{n-1}{r-1} + \binom{n-1}{r}$) (e.g., the number of unordered playlists with 5 tunes chosen from 10 tunes either includes a specific tune or not. If it includes it, there are $\binom{9}{4}$ ways of choosing the remaining tunes. If it doesn't include it, there are $\binom{9}{5}$ ways of choosing the five tunes. So $\binom{9}{4} + \binom{9}{5}$ is the number of ways of choosing 5 tunes from 10, which is $\binom{10}{5}$.). • Investigate pathway problems.	A2.4
12	Mixed Counting Problems	• Distinguish between and make connections between situations involving the use of permutations and combinations of distinct items. • Solve counting problems using counting principles – additive, multiplicative.	A2.3

Day	Lesson Title	Math Learning Goals	Expectations
13	Probability	• Solve probability problems using counting principles involving equally likely outcomes, e.g., two cards are drawn randomly from a standard 52-card deck. What is the probability that the two cards are both aces if the first card is replaced? If the first card is not replaced?	A2.5
14	Counting Stories Project	• Complete final version of Counting Stories Project.	A1.1, A1.3, A1.5, A1.6, A2.1, A2.2, A2.3, A2.4, A2.5, F2.4
15	Culminating Investigation	• Identify a significant problem of interest for Culminating Investigation. • Brainstorm ideas, e.g., mind mapping, for organization and analysis of data related to a related significant problem.	E1.1
16–17	Jazz/Summative		

Unit 1: Counting and Probability

Grade 12

Lesson Outline

Big Picture

Students will:

- solve problems involving probability of distinct events;
- solve problems using counting techniques of distinct items;
- apply counting principles to calculating probabilities;
- explore variability in experiments;
- demonstrate understanding of counting and probability problems and solutions by adapting/creating a children's story/nursery rhyme in a Counting Stories project;
- explore a significant problem of interest in preparation for the Culminating Investigation.

Day	Lesson Title	Math Learning Goals	Expectations
1–2	Mathematical Probability	• Investigate probabilities generated from experiments (e.g., spinners, sampling, numbered cubes, coins, cards) and use mathematical vocabulary (e.g., sample space, outcomes, events, trials, theoretical probability, experimental probability, mutually exclusive, non-mutually exclusive, independent and dependent events, complement) and notation (e.g., *P(A), P(~A), P(A* and *B), P(A* or *B), P(A | B))* in contexts involving simple counting (e.g. where the sample space is given) and tools (e.g. tree diagrams, organized lists, Venn diagram). • Determine whether 2 events are independent or dependent and whether one event is conditional on another. • Recognize that the sum of the probabilities of all possible outcomes in the sample space is 1.	CP1.1, CP1.2, CP1.3, CP1.5, CP1.6
3	Counting Stories Project	• Introduce and understand one culminating project, Counting Stories Project (e.g. student select children's story/nursery rhyme to rewrite using counting and probability problems and solutions as per Strand A). • Create a class critique to be used during the culminating presentation.	E2.3, E2.4
4–5	Using Simulations to Show Variability	• Determine, through investigation using class-generated data and technology-based simulation models, the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases (Sample problem: Calculate the theoretical probability of rolling a 2 on a number cube. Simulate rolling a number cube, and use the simulation to calculate the experimental probability of rolling a 2 after 10, 20, 30, …, 200 trials. • Graph the experimental probability versus the number of trials, and describe any trend.	CP1.4
6	Counting Arrangements and Selections	• Solve problems that progress from small sets to more unwieldy sets using lists, tree diagram, role play to motivate the need for a more formal treatment. • See examples where some of the *distinct* objects are used and where all the *distinct* objects are used. • Discuss how counting when order is important is different from when order is not important to distinguish between situations that involve, the use of permutations and those that involve the use of combinations.	CP2.1

Day	Lesson Title	Math Learning Goals	Expectations
7	Counting Permutations	• Develop, based on previous investigations, a method to calculate the number of permutations of all the objects in a set of *distinct* objects and some of the objects in a set of *distinct* objects. • Use mathematical notation (e.g., *n!, P(n, r)*) to count.	CP2.1, CP2.2
8	Counting Combinations	• Develop, based on previous investigations, a method to calculate the number of combinations of some of the objects in a set of *distinct* objects. • Make connection between the number of combinations and the number of permutations. • Use mathematical notation (e.g., $\binom{n}{r}$) to count • Ascribe meaning to $\binom{n}{n}, \binom{n}{1}, \binom{n}{0}$. • Solve simple problems using techniques for counting permutations and combinations, where all objects are distinct.	CP2.1, CP2.2
9	Counting Stories Project	• Use counting and probability problems and solutions to create first draft of Counting Stories Project.	CP1.1, CP1.3, CP1.5, CP1.6, CP2.1, CP2.2, CP2.3

Day	Lesson Title	Math Learning Goals	Expectations
10–11	Pascal's Triangle	• Investigate patterns in Pascal's triangle and the relationship to combinations, establish counting principles and use them to solve simple problems involving numerical values for *n* and *r*. • There is only one way to choose all of the elements (i.e., $\binom{n}{n} = 1$). • Choose none of the elements can be done in only one way (i.e., $\binom{n}{0} = 1$). • There are n ways to choose one element from n elements (i.e., $\binom{n}{1} = 1$). • Choose *r* elements from n elements is the same as choosing *n-r* to ignore (i.e., $\binom{n}{n} = \binom{n}{n-r}$) (e.g., Choosing 3 girls from 8 girls for a committee is the same as choosing 5 girls not to be on the committee). • The number of collections of any size from n elements is 2^n. (i.e.) $\binom{n}{r} + \binom{n}{1} + \binom{n}{2} + \ldots + \binom{n}{n-1} + \binom{n}{n} = 2^n$ (e.g., the number of different playlists selected from 10 tunes is 2^{10}). • The total number of selections of r elements from n elements is made up selections that either include a particular element or not (i.e.,) $\binom{n}{r} = \binom{n-1}{r-1} + \binom{n-1}{r}$ (e.g., the number of unordered playlists with 5 tunes chosen from 10 tunes either includes a specific tune or not. If it includes it, there are $\binom{9}{4}$ ways of choosing the remaining tunes. If it doesn't include it, there are $\binom{9}{5}$ ways of choosing the five tunes. So $\binom{9}{4} + \binom{9}{5}$ is the number of ways of choosing 5 tunes from 10, which is $\binom{10}{5}$). • Investigate pathway problems.	CP2.4
12	Mixed Counting Problems	• Distinguish between and make connections between situations involving the use of permutations and combinations of distinct items. • Solve counting problems using counting principles – additive, multiplicative.	CP2.3

Day	Lesson Title	Math Learning Goals	Expectations
13	Probability	• Solve probability problems using counting principles involving equally likely outcomes, e.g., two cards are drawn randomly from a standard 52-card deck. What is the probability that the two cards are both aces if the first card is replaced? If the first card is not replaced?	CP2.5
14	Counting Stories Project	• Complete final version of Counting Stories Project.	CP1.1, CP1.3, CP1.5, CP1.6, CP2.1, CP2.2, CP2.3, CP2.4, CP2.5, F2.4
15	Culminating Investigation	• Identify area of interest for Culminating Investigation • Brainstorm ideas, e.g., mind mapping, for organization and analysis of data related to a related significant problem.	CI1.1
16–17	Jazz/Summative		

Unit 1: Day 3: Counting Stories Project

Grade 12

75 min

Math Learning Goals

- Introduce and understand one culminating project, Counting Stories Project (e.g., student select children's story/nursery rhyme to rewrite using counting and probability problems and solutions as per Strand A)
- Create a class critique to be used during the culminating presentation

Materials

- BLM 1.3.1–1.3.5
- Notebook 1.3.1
- ppt 1.3.1

Assessment Opportunities

Minds On…

Whole Class → Webbing Ideas

Lead students in a brainstorming session to generate a list of probability terms introduced thus far in the unit. Refer to Sample Mathematical Terminology Web (BLM 1.3.1).

Students construct a class mind map to make visual connections amongst the various terms, using Interactive White Board software, SMART Ideas™ or chart paper and markers.

Students make connections between terms, concepts and principles of probability and counting using a Mind Map (*Think Literacy, Cross-Curricular Approaches, Mathematics*, Gr.7–12, p. 77)

SMART Ideas™ software is available to teachers as a free download.

Whole Class → Introduction of Project

Read a children's story that illustrates a different perspective or has used mathematical terms. (e.g., *The True Story of the 3 Little Pigs*, by Jon Scieszka (ISBN 0-670-82759-2), *Fractured Math Fairy Tales* (ISBN 0-439-51900-4))

Using BLM 1.3.2, introduce the project to students, and discuss the description of the task and the assessment rubric.

Action!

Whole Class → Counting Story Development

Using the SMART™ Notebook file, PowerPoint files, or BLM 1.3.3, or BLM 1.3.5 develop the counting story exemplar with student input. At the end of the presentation, model writing a component of the story with student input.

As students write portions of the story, be attentive to the appropriateness of the story line. Encourage Character Education Traits, e.g., the wolf is not portrayed as a bully.

Small Groups → Further Development of Counting Story

In small groups, students complete an additional component of the story (e.g., independent events, dependent events, mutually exclusive events, non-mutually exclusive events or complementary events). Ensure that each group completes a different missing component, including mathematical justification.

BLM 1.3.5 is an example of an extension to the story.

The Math Processes/Observation/Checkbric: Observe students as they use a variety of computational strategies, make connections, and communicate their reasoning to complete components of the story; prompt students as necessary.

The Counting Story Project could be a multi-disciplinary (e.g., Math/English, Math/Art) project.

Consolidate Debrief

Whole Class → Gallery Walk

Each group shares their completed component of the story in a gallery walk. (Each group's work is displayed and students walk around to read each other's component parts).

Think/Pair/Share → Brainstorming

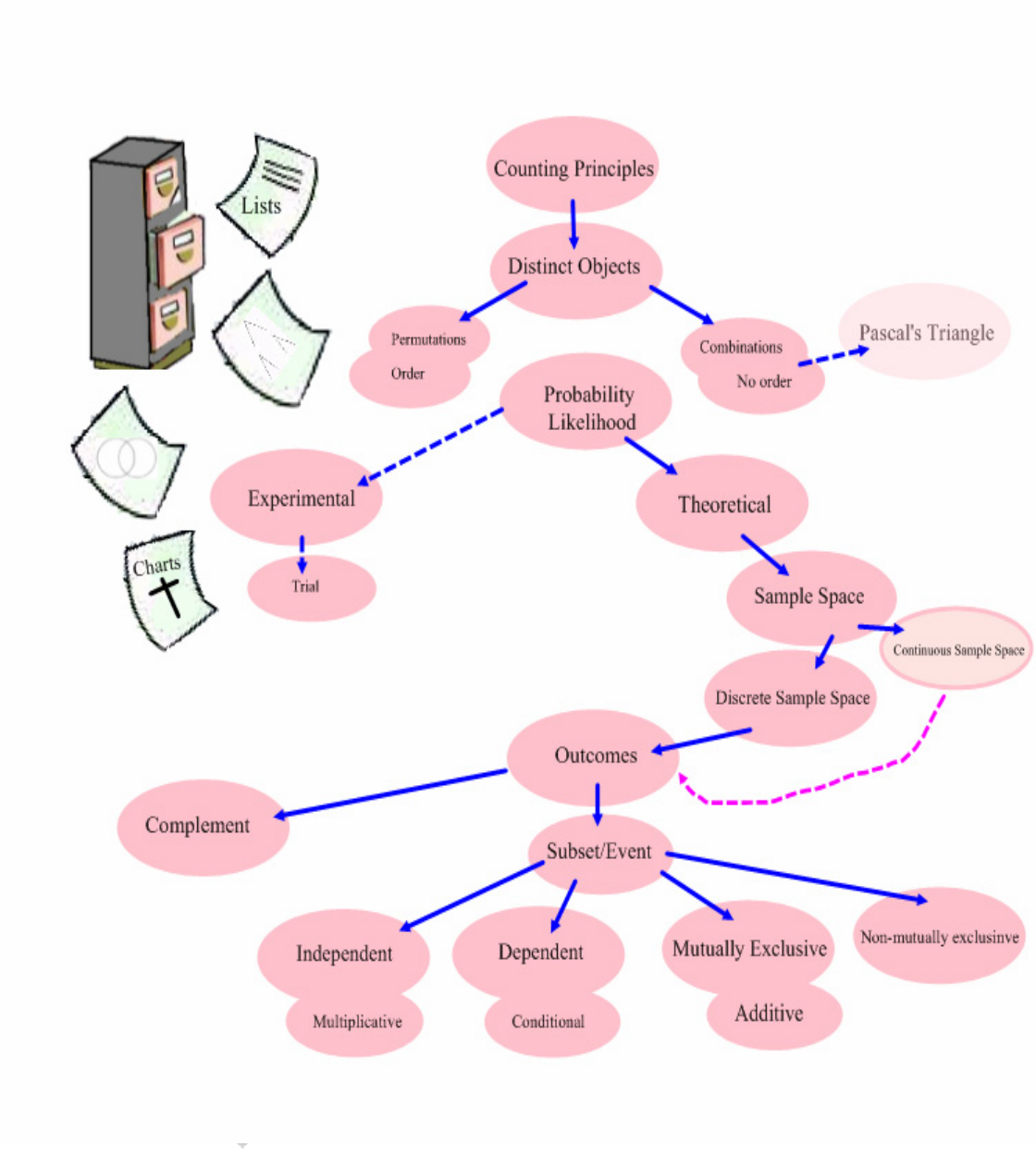
Students generate criteria for critiquing stories during the final presentation gallery walk, e.g., math content matches story, story is engaging, illustration help with understanding. Create a class critique for the presentations, using the criteria agreed on.

Home Activity or Further Classroom Consolidation

Select or create a story to begin your Counting Story Project. Begin to integrate mathematical components of the story already discussed in this unit.

Students continue to add to this project as they learn new concepts.

1.3.1: Counting Stories Project
Mathematical Terminology Web



1.3.2: Counting Stories Project

You will re-write or create a children's story, fairy tale, nursery rhyme, or song so that it includes probability and counting concepts and principles. The mathematics you introduce in the story must connect to the context of the story, and provide opportunities for decision making on the part of the characters within the story. The mathematics may be complex but try to keep the story simple. The assessment of this assignment will focus on the mathematics within the story line and the integration of narrative and mathematical forms in the story.

The following criteria will be assessed:

1. At least 12 of the following 19 concepts/principles are used to describe the decisions that the character(s) are asked to make.

    - Additive Principle
    - Complementary Events
    - Counting Techniques
    - Events
    - Independent Events
    - Mutually Exclusive Events
    - Outcomes
    - Permutations (order)
    - Subset
    - Trials
    - Combinations (no order)
    - Conditional Probability
    - Dependent Events
    - Experimental Probability
    - Multiplicative Principle
    - Non-Mutually Exclusive Events
    - Pascal's Triangle
    - Sample Space
    - Theoretical Probability

2. Appropriate organizational tools (e.g., Venn diagram, Charts, Lists, Tree diagrams) are used and illustrated.

3. Diagrams, words, and pictures illustrate the tools and computational strategies used and the choices available to the character(s).

Feedback on this assignment will include:

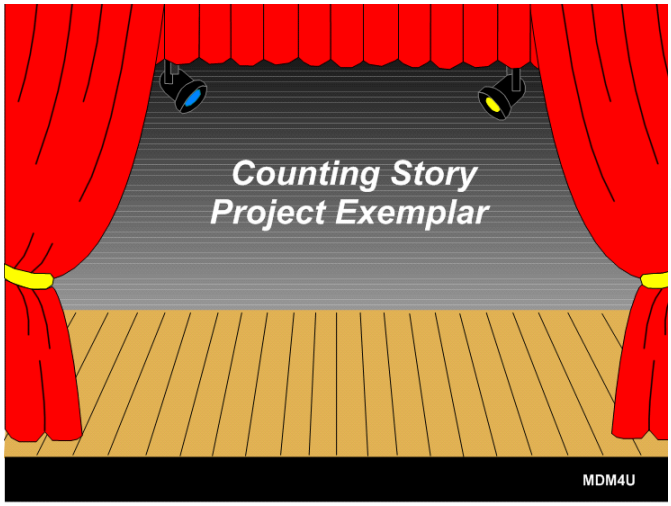
- Peer critiques of your story
- A level for each of the criteria in the Counting Stories Rubric

You will read the stories of others during a class gallery walk. Using the critiques developed by the class, each student critiques two of the stories of others, selected by random draw. These critiques provide peer feedback to the author of the story.

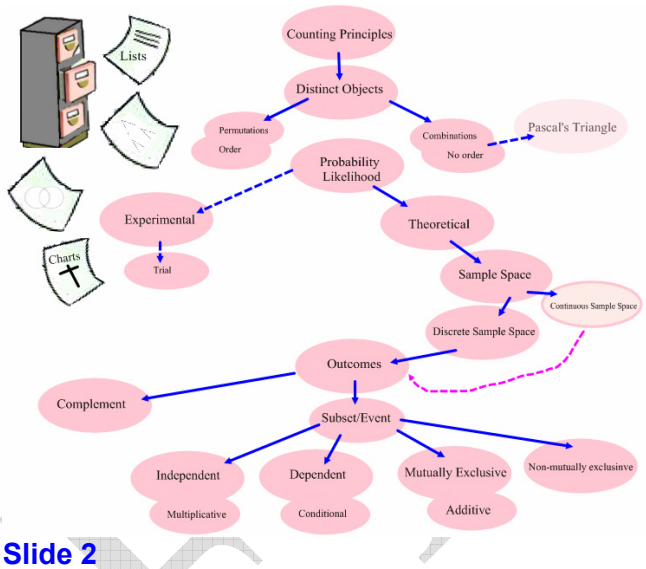
1.3.2: Counting Stories Project Rubric

Problem Solving				
Criteria	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Applying mathematical processes and procedures correctly to solve the problems in the story.	– correctly applies some of the mathematical processes and procedures with major errors	– correctly applies many of the mathematical processes and procedures with some errors	– correctly applies the mathematical processes and procedures with few errors	– correctly applies the mathematical processes and procedures with precision and accuracy
Selecting Tools and Computational Strategies				
Selecting and using tools and strategies to organize the mathematics presented in the story.	– selects and applies the counting organizers (Venn diagram, charts, lists, tree diagrams) with major errors or omissions	– selects and applies the counting organizers (Venn diagram, charts, lists, tree diagrams) with minor errors or omissions	– selects and applies the counting organizers (Venn diagram, charts, lists, tree diagrams) accurately	– selects and applies the most appropriate counting organizers (Venn diagram, charts, lists, tree diagrams) accurately
Connecting				
Connecting the concepts/principles of counting and probability to the story line.	– incorporates permutations, combinations, and probability with weak connections to the story line	– incorporates permutations, combinations, and probability with simple connections to the story line	– incorporates permutations, combinations, and probability with appropriate connections to the story line	– incorporates permutations, combinations, and probability with strong connections to the story line
Representing				
Creating an appropriate variety of mathematical representations within the story.	– few representations are embedded in the story	– some representations are embedded in the story	– an adequate variety of representations are embedded in the story	– an extensive variety of representations are embedded in the story
Communicating				
Using mathematical symbols, labels, units and conventions related to counting and probability correctly across a range of media.	– sometimes uses mathematical symbols, labels and conventions related to counting and probability correctly within the story	– usually uses mathematical symbols, labels and conventions related to counting and probability correctly within the story	– consistently uses mathematical symbols, labels and conventions related to counting and probability correctly within the story	– consistently and meticulously uses mathematical symbols, labels, and conventions related to counting and probability correctly and in novel ways within the story
Integrating narrative and mathematical forms of communication in the story.	– either mathematical or narrative form is present in the story but not both	– both mathematical and narrative forms are present in the story but the forms are not integrated	– both mathematical and narrative forms are present and integrated in the story	– a variety of mathematical and narrative forms are present and integrated in the story and are well chosen

1.3.3: Counting Stories Project Presentation File



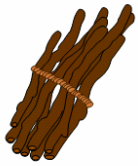
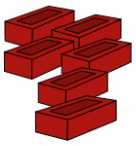
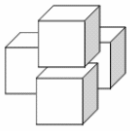
Slide 1



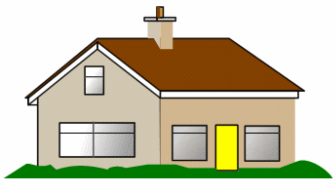
Slide 2

Slide 3

Slide 4

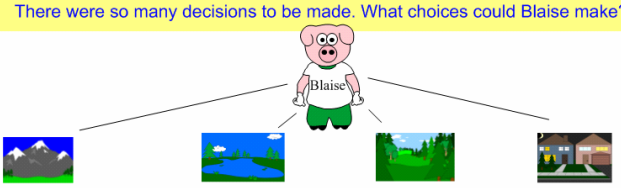
The house could be built with either wood, brick or snow.




The house could have one or two levels.

Slide 5

There were so many decisions to be made. What choices could Blaise make?

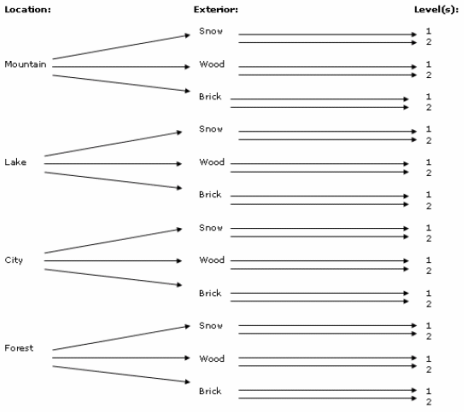


Slide 6

The total number of possible choices (_____) for Blaise is __.

This collection of all possible choices is called the _____.

* Boxes can be moved to show answe

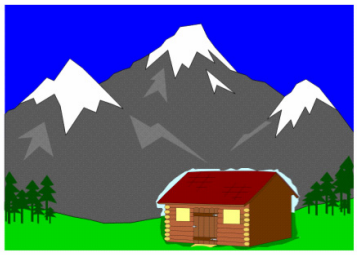


Slide 7

The first little pig, Blaise didn't want to have the same type of house as the second little pig, Pierre. He really wanted a one level wooden house in the mountains. He decided t was alright because the likelihood of Pierre choosing this particular house was not gre

The probability that Pierre made this choice was only __, approximately __%.

* Boxes can be moved to show ans

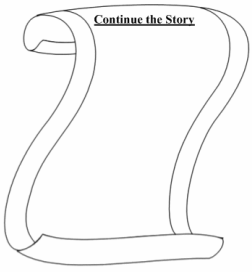


Slide 8

Unfortunately, Pierre had already decided on a one level wooden house in the mountains. So, Blaise and Pierre decided to toss a coin 10 times to decide who would acquire this house. Blaise called heads on each toss.

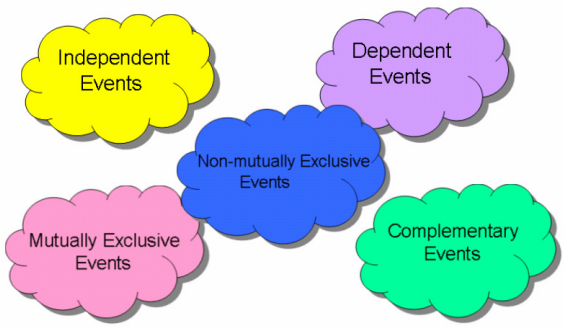
Make a prediction: Who do you think will get the house?

Heads	Tails



Slide 9

In groups of three continue the story including one of these concepts:



Slide 10

1.3.5: Sample Stories Extensions

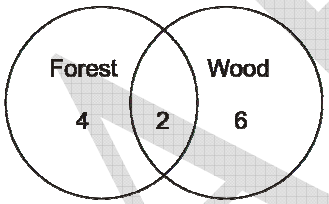
Non-Mutually Exclusive Events

The third little pig, Sasha knows she will be happy with a house that is either in the forest or built of wood. How many possible houses can she have?

Her choice is far more likely to happen. The number of houses satisfying her event criteria was 12.

$$\begin{aligned} n(\textit{forest or wood}) &= n(\textit{forest}) + n(\textit{wood}) - n(\textit{forest and wood}) \\ &= 6 + 8 - 2 \\ &= 12 \end{aligned}$$

Using the additive principle Sasha observes that building a house in the forest made of wood are non-mutually exclusive events since the subset of building of wood in the forest is not empty.



Independent Events

The probability that Sasha chooses a house in the forest built of wood is $\frac{12}{24} = \frac{1}{2}$. The probability that Pierre chooses his one level house in the mountains is $\frac{1}{24}$. According to the **multiplicative principle**, the probability of Sasha's choice and Pierre's choice occurring together is $\frac{1}{48}$ since they are **independent events**.

$$\begin{aligned} P(\textit{Sasha and Pierre}) &= P(\textit{Sasha} \times P(\textit{Pierre}) \\ &= \frac{1}{2} \times \frac{1}{24} \\ &= \frac{1}{48} \end{aligned}$$

Unit 2: Organization of Data for Analysis Grade 12

Lesson Outline

Big Picture

Students will:

- demonstrate an understanding of the role of data in statistical studies;
- describe the characteristics of a good sample and compare sampling techniques;
- design an effective survey and collect data;
- understand how data is organized;
- find sources of data, refine topic of interest, and design a plan in preparation for the Culminating Investigation.

Day	Lesson Title	Math Learning Goals	Expectations
1	Brainstorming	• Use prepared data to: – recognize and describe the role of data in statistical studies; – describe examples of applications of statistical studies; – recognize that conclusions drawn from statistical studies of the same relationship may disagree, and explain why.	C1.1, C1.2
2	Distinguishing Types of Data	• Use prepared data to distinguish different types of statistical data that is discrete from continuous; qualitative from quantitative; categorical from numerical; nominal from ordinal; primary from secondary; experimental from observational; micro data from aggregate data.	C1.3
3	Sampling Jigsaw	• Describe and compare sampling techniques i.e., simple random; systematic, stratified, convenience, voluntary. • Describe principles of primary data collection. • Demonstrate an understanding of the difference between population and sample.	C2.2
4	Data Validity	• Describe the characteristics of a good sample, i.e., bias free, random, representative. • Distinguish between population and sample, and understand why sampling is necessary. • Understand how using random samples with a bias or non random samples can affect the results of a study.	C2.1, C2.2, C2.3
5	Surveys	• Describe the characteristics of an effective survey. • Collect data from primary sources, through experimentation, organize data with one or more attributes.	C2.4, C2.5
6	Census of school, collecting data	• Design questionnaires.	C 2.4
7	Culminating Investigation Searching for data *(lesson not included)*	• Collect data from secondary sources, e.g., by using the internet to access reliable data from a well-organized database such as e-stat; by using print sources such as newspapers and magazines.	C2.5,

Day	Lesson Title	Math Learning Goals	Expectations
8	Demographics and Beverage Consumptions	• Collect data from secondary sources (e.g., by using the internet to access reliable data from a well-organized database such as e-stat; by using print sources such as newspapers and magazines). • (Beer demographics activity available at http://www.statcan.ca/english/edu/mathmodel.htm).	C2.5
9	Project Day	• Find sources of data in preparation for the Culminating Investigation. • Refine topic of interest for Culminating Investigation. • Design a plan to investigate topic.	C2.5 E1.1, E1.2, E1.3
10–11	Jazz/Summative		

Unit 2: Day 1: Brainstorming

Grade 12

75 min

Math Learning Goals

- Use prepared data to do the following
  - recognize and describe the role of data in statistical studies
  - describe examples of applications of statistical studies
  - recognize that conclusions drawn from statistical studies of the same relationship may disagree, and explain why

Materials

- BLM 2.1.1
- •Internet access or printed articles
- Smart Ideas™

Assessment Opportunities

Minds On…

Small Groups → Place Mat

Introduce the purpose of the Culminating Investigation which takes place over the next two units. Explain that the purpose is to pose a significant problem of interest, and design and carryout a culminating investigation that requires the tools of this course. Brainstorm and record ideas using Placemats. Placemats should have different central ideas such as: Health, Sports, Environment, Issues Facing Teens, Social Issues, but not necessarily limited to these topics. Small groups identify related topics or subcategories concerning the central idea.

Think Literacy –Cross Curricular Approaches , Grades 7-12, Place Mat, p. 162

Small Group → Presentation

Using the Smart Ideas™ file: Brainstorm Topics.ipr as a starting point, students present their subtopics for each of the central ideas. Focus on diabetes as one of the Health topics.

Visit http://teacherweb.com/on/statistics/math Click on Project Supports and Examplars This site provides ways introduce the project, ideas on how to access Statistics Canada data and examples of studen projects.

Action!

Pairs → Research

Diabetes Exemplar: Students access articles related to Diabetes. Students complete BLM 2.1.3 after reading of the article in preparation for the group discussion. Assign pairs to record some of their answers on chart paper.

Whole Group → Sharing

Discuss the role of data in statistical studies. Point out that conclusions drawn from statistical studies about the same relationships may disagree. Refer to the questions on BLM 2.1.3.

Project Connection: Inform students that information collected from articles should become part of the background information for their culminating project.

Sources of articles: http://www.who.int/diabetes/facts/en/diabcare0504.pdf

http://www.who.int/diabetes/actionnow/en/mapdiabprev.pdf

http://www.ohqc.ca/en/yearlyreport.php

Extracted pp. 77–82

Learning Skills/Teamwork/Mental Note:

Mathematical Process Focus: Reasoning and Proving

Consolidate Debrief

Whole Group → Mindmap

Create a mind map for the "Diabetes Exemplar Project." See BLM 2.1.2 Diabetes Mind map as an example.

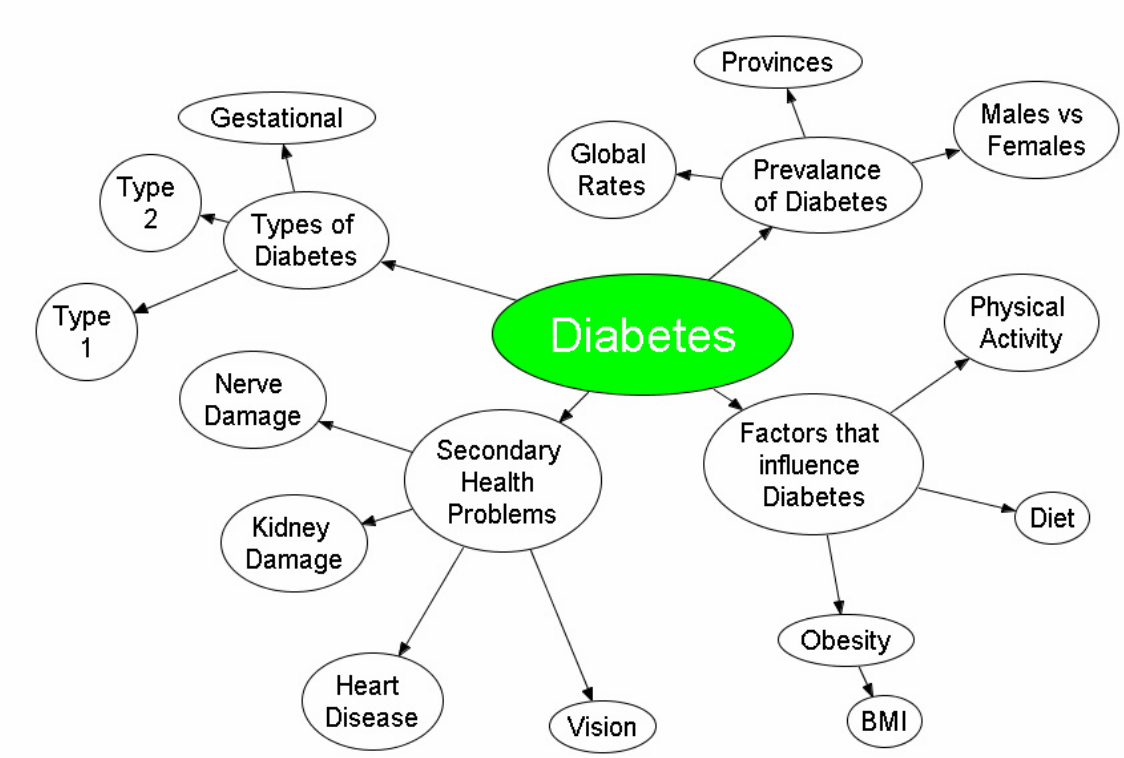
Brainstorm and list ten potential topics for further investigation.

Home Activity or Further Classroom Consolidation

Find five different examples of graphs taken from the Internet or other sources related to the topics brainstormed.

Prepare some graphs for students who are absent or unable to complete the home activity.

2.1.2: Diabetes Mind Map Exemplar (Teacher)



2.1.3: Searching for the Data in Diabetes

For the article you were assigned, focus only on the information related to Diabetes. You may not be able to answer all of the following questions.

Guiding Questions

1. What is the title of the article and who is the author? Why is it important to know who wrote the article?

2. If your article contains a graph or table related to diabetes, what does the graph or table tell you?

3. How is the data in the article presented? (numbers, percentages, graphs, etc…) What are the claims being made?

4. Does your article offer an opinion? If so, what is the stance the article has taken?

5. Does the article make any predictions? If so, what claims are being made?

6. Does the article give information regarding the source of the data?

7. Does the article give information on the reliability of the data? If so, how is it presented?

8. There are many factors that may influence the rate of diabetes, what factors are mentioned in the article? Think of other factors that may be important to examine.

9. Do the conclusions in the articles agree with the statistics presented or disagree? Explain.

10. Is there any other important information presented in your article that you believe would be required for a statistical study on diabetes.

2.1.3: Searching for the Data in Diabetes (continued)

Other Diabetes Articles

Articles showing analysis of the diabetes data from this survey 2.1
http://www.statcan.ca/bsolc/english/bsolc?catno=82-621-X20060029224

This article presents diabetes prevalence by age, sex, and province or territory for the population aged 12 and over, using data from the 2005 Canadian Community Health Survey. The article also examines questions related to specific health care received by individuals who have been diagnosed with diabetes. These questions are part of a module introduced in the survey to respond to a lack of data in regards to detailed information on health care required to the prevention of serious complications resulting from diabetes.

Smoking and Diabetes Care: Results from the CCHS Cycle 3.1 (2005)
http://www.statcan.ca/bsolc/english/bsolc?catno=82-621-X2006002

This issue examines smoking trends from 2000/01 to 2005 for the population aged 12 or older, using data from the Canadian Community Health Survey. This issue also presents diabetes prevalence by age, sex, and province or territory for the population aged 12 and over, using data from the 2005 Canadian Community Health Survey.

Health State Descriptions for Canadians: Diabetes
http://www.statcan.ca/bsolc/english/bsolc?catno=82-619-M2005002

This document examines the functional limitations-physical, emotional and social-related to the most common types of diabetes and the conditions that result from the disease. These functional limitations are described and classified using the Classification and Measurement System of Functional Health (CLAMES).

These descriptions and classifications are the first step in a new approach to measuring the health of Canadians that examines what factors are adversely affecting population health and how to address them. This document also provides health professionals, advocacy groups, and individual Canadians with an overview of how living with diabetes affects day-to-day functioning.

Health Indicators
http://www.statcan.ca/bsolc/english/bsolc?catno=82-221-X

Over 80 indicators (including data on diabetes) measure the health of the Canadian population and the effectiveness of the health care system. Designed to provide comparable information at the health region and provincial/territorial levels, these data are produced from a wide range of the most recently available sources. This Internet publication is produced by Statistics Canada and the Canadian Institute for Health Information.

Unit 2: Day 2: Distinguishing Types of Data

Grade 12

75 min

Math Learning Goals

- Use prepared data to distinguish different types of statistical data (i.e., discrete from continuous; qualitative from quantitative; categorical from numerical; nominal from ordinal; primary from secondary; experimental from observational; microdata from aggregate data)

Materials

- BLM 2.2.1 on card stock for each small group
- TIP 2.2.1

Assessment Opportunities

Minds On…

Whole Class → Inside Outside Circle

Using the graphs they collected from previous day's Home Activity, students share one or two key ideas from their graphs.

Summarize features of graphs (e.g., numerical or categorical information) and discuss the how the axes may represent different sets of data or one set of data.

Inside Outside Circle see TIPS for Teachers, TIP 13, p. 14

Provide graphs for students, as necessary.

Action!

Small Groups → Sorting

Students sort the data cards on BLM 2.2.1 into groups and explain their sorting method. They can also sort the graphs from the Home Activity.

Explain the meaning of terms in pairs (e.g., discrete vs. continuous) and have students resort cards based on new terminology. Repeat for other pairs of terms. See <<TOOLKIT 2.2.1 or TIP >>

Note: Some graphs are a combination of different types of data, for example, the Favourite Ice Cream Flavours has categorical nominal data on the horizontal axis and numerical discrete data on the vertical axis.

Word Wall:

- numerical data
- categorical data
- discrete data
- continuous data
- qualitative data
- quantitative data
- nominal data
- ordinal data
- primary data
- secondary data
- experimental data
- observational data
- micro data
- aggregate data

Whole Class → Sharing

Groups justify how their data sets demonstrate categorical, ordinal, and quantitative data.

Learning Skills/Teamwork/Mental Note:

Mathematical Process Focus: Communication:

Electronic resources (web site, power point, data sets) may help provide more examples.

Consolidate Debrief

Whole Group → Notetaking

Using the graphs, sort the cards into appropriate groupings to distinguish between the pairs of definitions. Create notes to summarize concepts.

Keep the collection of student graphs for future use.

Use an interactive whiteboard for students to demonstrate their sorting method.

Home Activity or Further Classroom Consolidation

For the graphs you found, identify types of data displayed.

2.2.1: Sorting Data

Ontario Mother Tongues

	AreaName	Total	English	French	Other
1	Algoma District	122800	113860	4935	4005
2	Brant County	111540	106790	240	4510
3	Bruce County	64665	63715	125	825
4	Cochrane District	89345	52905	34510	1930
5	Dufferin County	45005	44190	125	690
6	Durham Regional ...	450410	429680	2935	17795
7	Elgin County	77025	72090	90	4845
8	Essex County	338350	299850	4715	33785
9	Frontenac County	131225	124550	2050	4625
10	Grey County	86100	84615	130	1355
11	Haldimand-Norfolk...	100685	96610	240	3835
12	Haliburton County	15160	15045	15	100
13	Halton Regional M...	333100	313720	2395	16985
14	Hamilton-Wentw o...	452120	399720	1600	50800
15	Hastings County	116565	113405	1300	1860

Eye Colour

Snack of Choice

Apples: 10
Oranges: 7
Bananas: 6
Nutrition Bar: 16

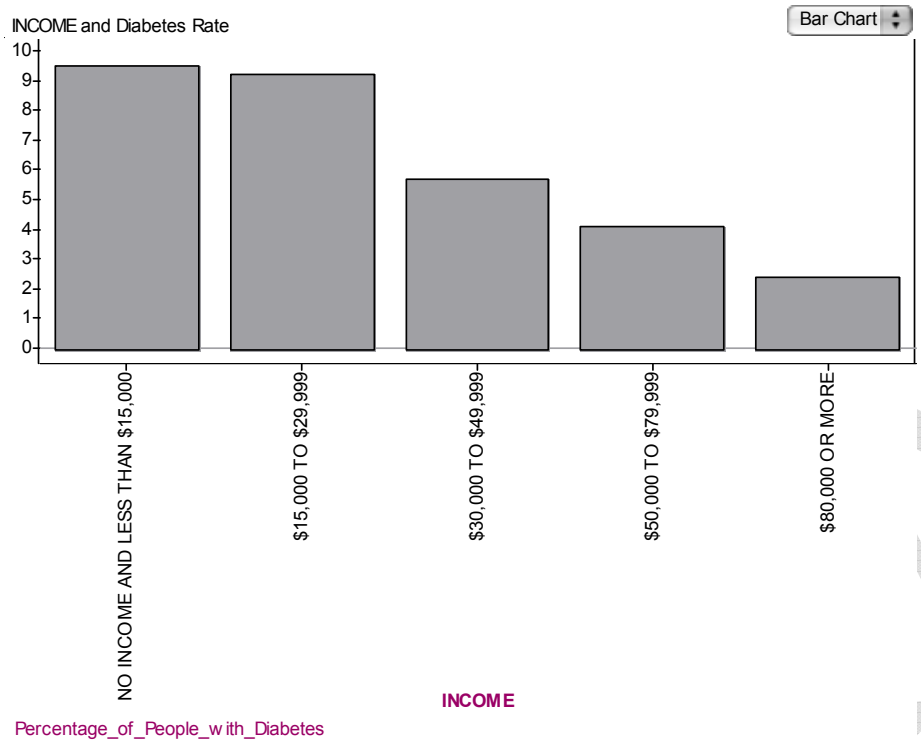
Favourite Colour

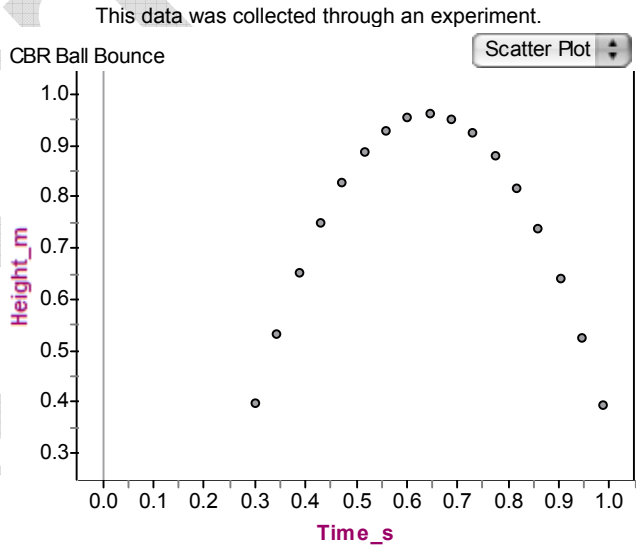
Survey 5 people and record below:

What is your favourite colour?

_____, _____, _____, _____, _____

2.2.1: Sorting Data (continued)





SUN	MON	TUES	WED	THURS	FRI	SAT
	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

It is the 18th of the month

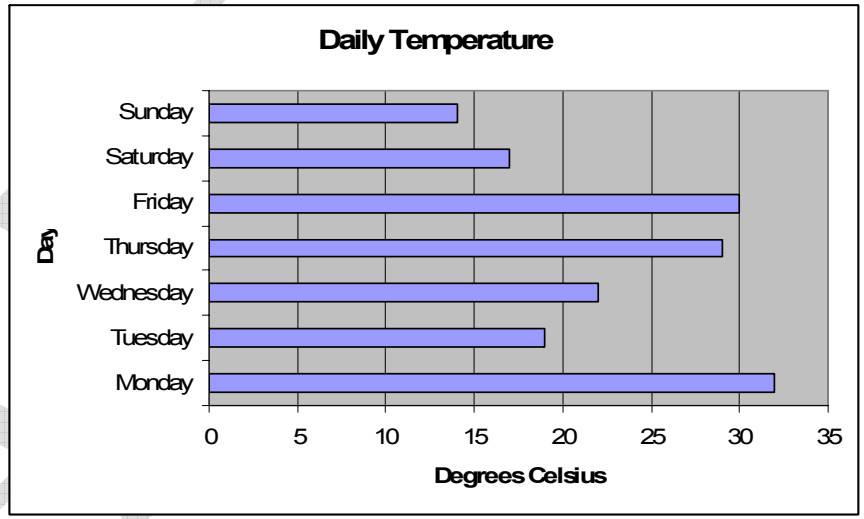
In a race a cheetah came in first, the fox came in second and the cow didn't mooooooove.

2.2.1: Sorting Data (continued)

Student	Lates	Absences
Sasha	**6**	**1**
Blaise	**30**	**9**
Pierre	**0**	**0**
Wolf	**8**	**2**

At a high school, there are consequences for being late.

Number of Lates	Consequence
5	Detention
8	Phone Call Home
10	Meeting with Principal



Student Name	Mark
Sasha	75
Bliase	54
Pierre	67
Wolf	86

Age of first year university students

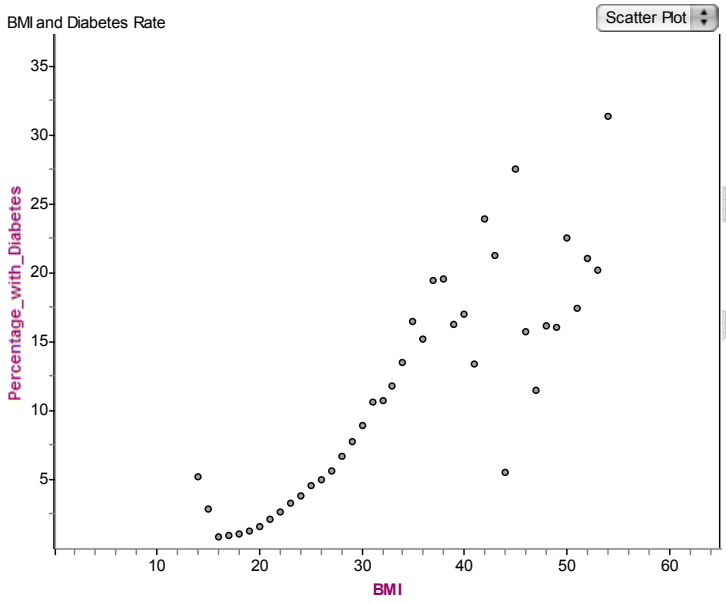
23 21 34 56 32 17 14 18 19 20 21 18 18 65 18 19 17

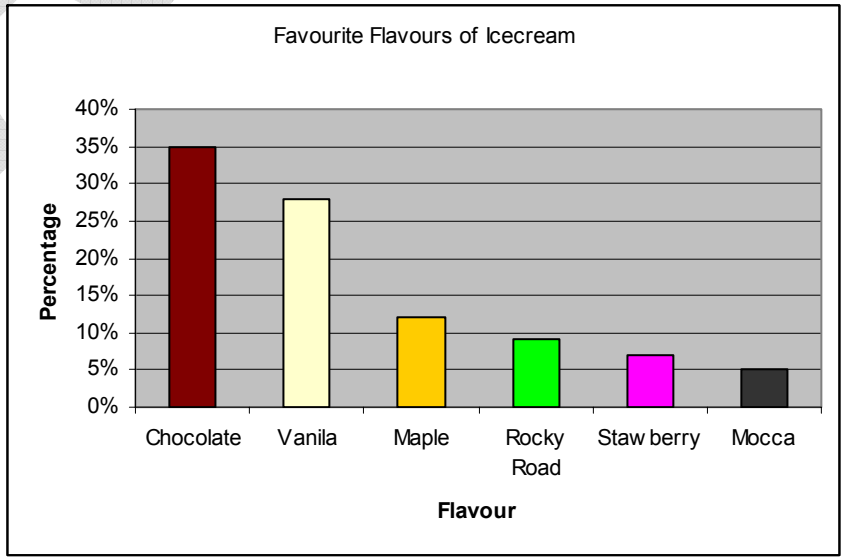
26 17 18 17 28 39 32 21 23 75 18 18 18 16 17 21 22 32

2.2.1: Sorting Data (continued)

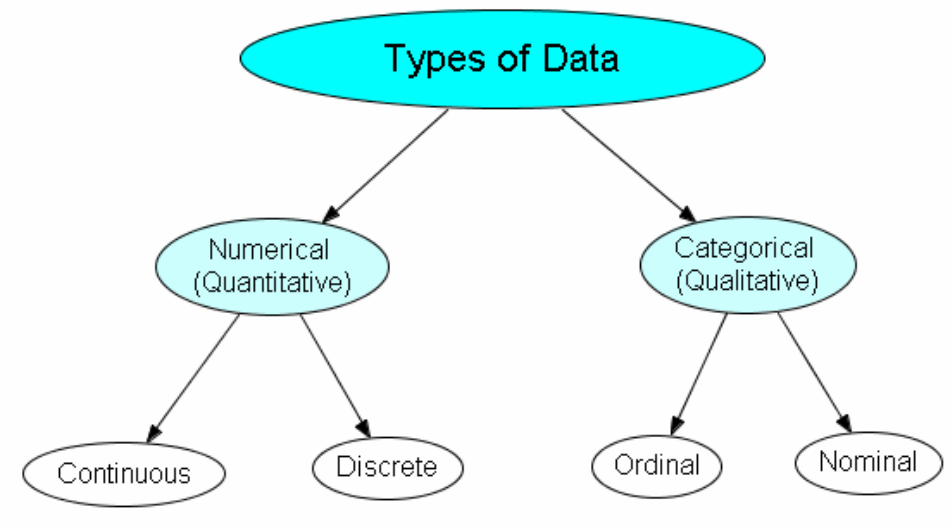
Ontario Youths

	Sex	How_do_you_feel_about_school	Children_say_mean_things_to_you	How_well_are_you_doing_in_school
1	F	3. I like school a bit	Never	Average
2	F	1. I hate school	Some of the time	Poorly
3	F	4. I like school quite a bit	Rarely	Well
4	F	5. I like school very much	Some of the time	Very well
5	M	5. I like school very much	Rarely	Very well
6	F	1. I hate school	Never	Average
7	M	2. I don-t like school very much	Rarely	Average
8	M	3. I like school a bit	Rarely	Very well
9	F	2. I don-t like school very much	Some of the time	Average
10	M	3. I like school a bit	Rarely	Average





TOOLKIT Unit 2 (Lesson 2.2.1: Data Definitions)



Aggregate Data	Data that is organized or grouped such as finding the sum over a given period or time, for example, monthly or quarterly. Data can be organized into any grouping such as geographic area. The data is not individual records.
Categorical Data	Consists of data that can be grouped by specific categories (also known as qualitative variables). Categorical variables may have categories that are naturally ordered (ordinal variables) or have no natural order (nominal variables). For example, the variable "height" is ordinal because it contains the categories "short," "average," and "tall" which are naturally ordered according to ascending height. On the other hand, variables such as "sex" and "hair colour," which have no natural category order, are examples of nominal variables.
Continuous Variable	A numeric variable which can assume an infinite number of real values. For example, age, distance and temperature are considered continuous variables because an individual can walk 3.642531...km.
Discrete Variable	A numeric variable that takes only a finite number of real values (e.g., *X* can equal only 1, 3, 5, and 1,000).
Experimental Data	Data gathered through experimentation.
Microdata	Non-aggregated data about the population sampled. For surveys of individuals, micro data contain records for each individual interviewed; for surveys of organizations, the micro data contain records for each organization
Nominal Variable	Type of categorical variable that describes a name, label, or category with no natural order. For example, there is no natural order in listing different types of school subjects: "History" does not have to follow "Biology." These subjects can be placed in any order.
Numeric Variable	A quantitative variable that describes a numerically measured value (e.g., age or number of people in a household). These variables can be either continuous or discrete.

Observational Data	Data gathered by observation of the "subject." For example, the subject is recorded then the behaviours are noted on a period of time.
Ordinal Variable	A type of categorical variable: an ordinal variable is one that has a natural ordering of its possible values, but the distances between the values are undefined. Ordinal variables usually have categorical scales. For example, when asking people to choose between Excellent, Good, Fair and Poor to rate something, the answer is only a category but there is a natural ordering in those categories.
Primary Data	Data gathered directly by the researcher in the act of conducting research or an experiment. Data can be gathered by surveys or through experimentation.
Secondary Data	Data gathered by someone other than the researcher.

Definition Bibliography

www.statcan.ca/english/edu/power/glossary/gloss.htm

www.ccny.cuny.edu/bbpsy/modules/recording_obs_data.htm.

www.ils.unc.edu/~ohjs/stats/tutorial_BasicConcepts.html

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www.nyskwic.org/u_data/data_terms.cfm

www.en.wikibooks.org/wiki/statistics:Different_Types_of_Data/Quatitative_and_Qualitative_Data

Unit 2: Day 3: Sampling Jigsaw

Grade 12

75 min

Math Learning Goals

- describe and compare sampling techniques (i.e., simple random; systematic, stratified, convenience, voluntary)
- describe principles of primary data collection
- demonstrate an understanding of the difference between population and sample

Materials

- 10 or more Decks of Cards
- Graphing Calculators
- BLM 2.3.1, 2.3.2

Assessment Opportunities

Minds On…

Whole Class → Demonstration

Demonstrate how to collect a simple random sample using a graphing calculator and using a deck of cards. Have the class list some real-life examples of simple random sampling such as playing a game of Bingo. Demonstrate how expert groups are to complete information for their sampling type (BLM 2.3.1).

Discuss population and sample.

Think Literacy – Cross Curricular Approaches , Grades 7–12, Jigsaw, p. 170

Word Wall Words

- Population
- Sample
- Multistage Random Sample
- Destructive Sample
- Convenience Sample
- Voluntary Sample
- If home groups consist of only 4 members assign Non-Random Sampling- Convenience and Voluntary Sampling following the procedure used in BLM 2.3.2

Action!

Home Groups → Jigsaw

Review how to create a seed value and generate random numbers using a graphic calculator.

Expert Groups → Jigsaw

Students use materials provided to complete the sampling method assigned and record their findings under the headings: Description, Example, Solution, and Demonstration (deck of cards). They practice the sampling method using both the deck of cards and the graphing calculator random number generator.

Learning Skills/Teamwork/Checkbric:

Consolidate Debrief

Home Groups → Jigsaw

Students return to their home group and share their knowledge from their expert groups and demonstrate how to use the sampling method using cards.

Diabetes Exemplar: Examine the source of the diabetes data

Taken from http://cybrary.uwinnipeg.ca

If Home groups consist of only 4 members assign Non-Random Sampling - Convenience and Voluntary Sampling following the procedure used in BLM 2.3.2

Home Activity or Further Classroom Consolidation

Application
Concept Practice
Differentiated
Exploration
Reflection
Skill Drill

2.3.1: Collecting Samples

Example

Type of Sampling	Simple Random Sampling
Description	• every member of the population has an equal chance of being selected • the selection of any particular individual does not affect the chances of any other individual being chosen • a sample could be selected by drawing names randomly • use a random number generator to select a individual
Example and solution	A restaurant owner is interested in determining if his patrons are satisfied with the quality of service on a particular evening at his restaurant. It is impractical for the owner to survey every person, so he chooses to do a simple random sample. * There are 52 reservations at the restaurant. * The owner decides to sample 13 using a random number generator. **GRAPHING CALCULATOR RANDOM NUMBER GENERATOR** Press MATH ▷ ▷ ▷ to use the **PRB** menu and select **5: randInt** Enter (Lower value , Upper value, number of random numbers) He will survey reservation numbers:
Demonstration using a deck of cards	Shuffle a standard deck of cards, then randomly draw 13 cards

2.3.1: Collecting Samples (continued)

Type of Sampling	
Description	
Example and solution	
Demonstration using a deck of cards	

2.2.2: Collecting Samples Jigsaw Instructions

To choose HOME groups:

Use a deck of cards with appropriate sets of 4 cards to create groups of 4. (To make groups of 5 use jokers; students with jokers can choose to join any group of 4). For example all the ACES belong to the same home group.

Home Group

Each home group will have up to 5 members that will become Aexperts@ on a specific type of sampling method. Your card type will be used to assign which expert group you belong to. After the expert groups meet to understand and explain how their sampling method works, experts return to home groups to present their findings to each other. Each member of the home group is responsible for creating their own note on each of the sampling methods described.

To choose EXPERT groups:

♥ Systematic Random Sampling
♦ Stratified Random Sampling
♣ Cluster Random Sampling
♠ Multi-stage Random Sampling
☺ Non-Random Sampling - Convenience and Voluntary Sampling (Jokers if used)

EXPERT GROUPS

Expert groups meet together in order to learn about one method of sampling.
Use textbooks or any other available resources. Each expert is responsible to report the following to their home group:

- Type of Sampling
- Description of Sampling Method
- An example of how this sampling method is used in practical terms
- Demonstration of your method of sampling using a deck of cards

Note: if Home groups consist of only 4 members assign Non-Random Sampling - Convenience and Voluntary Sampling for **Home Activity**

TIP 2.3.1: Definitions

Simple Random Sampling
The sample is chosen from the entire population using a random number generator. Each member of the population has an ***equal chance of being selected***. The selection of any particular individual does not affect the chances of any other individual being chosen.

Systematic Random Sampling
A random starting point is chosen using a random number generator. The sample is chosen by going through the population sequentially; the members of the sample are selected at ***regular intervals***. (e.g., every fifth person is selected)

Stratified Random Sampling
The population is divided into groups that share a common characteristic. From each group a simple random sample of the members is taken. The size of each sample from each group is ***proportional*** to the size of each group.

Cluster Random Sampling
The population is divided into groups. A random sample of groups is chosen. ***All members*** from the chosen group are surveyed.

Multi-stage Random Sampling
The population is organized into groups. A random sample of groups is chosen. From each group a random sample is chosen. This method ***uses several levels*** of random sampling.

Destructive Sampling
A random sample is taken; each sample is ***destroyed*** during the process of testing. (e.g., testing life of light bulbs)

Voluntary Sampling
The researcher invites members of the population to participate in the survey on a ***voluntary basis***.

Convenience Sampling
The researcher selects members of the population that are easily accessible.

Unit 2: Day 4: Data Validity

Grade 12

75 min

Math Learning Goals

- describe the characteristics of a good sample (i.e., bias free, random, representative)
- distinguish between population and sample, and understand why sampling is necessary
- understand how using random samples with a bias or non random samples can affect the results of a study

Materials

- Internet
- BLM 2.4.1, 2.4.2, 2.4.3, 2.4.4, 2.4.5, 2.4.6

Assessment Opportunities

Minds On…

Whole Class → Discussion

Look at the website links from the previous day's assignment and discuss whether the information on these sites is valid. Discuss the importance of having reliable sources of data.

Word Wall Words
Sampling Bias
Non-Response Bias
Response Bias
Measurement Bias

Action!

Pairs → Research

Students complete BLM 2.4.1: Evaluating Websites to create their own checklist for evaluating websites. BLM 2.4.2 and 2.4.3 contain the articles required for the research.

http://cybrary.uwinnipeg.ca

Other evaluation websites
http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/Evaluate.html

Whole Class → Instructions

Introduce the task :Bias Seek and Destroy (BLM 2.4.4-BLM2.4.6)
Review various types of bias.

Pairs → Investigation

Each pair of students identifies the type of bias present in a bias example (BLM 2.4.6) They justify their answer, and explain how the source of bias could be removed.

Consolidate Debrief

Pairs → Presentation

Pairs present their example to the class orally.

Mathematical Process/Reasoning and Proving/Rubric: Evaluate the students' oral presentation focusing on their justification.

Application
Concept Practice
Differentiated
Exploration
Reflection
Skill Drill

Home Activity or Further Classroom Consolidation

Complete Part 2 – (Worksheet)

2.4.1: Evaluating Websites

PART 1 – Internet Articles

Note: The information was obtained from the University of Winnipeg. It is part of a tutorial that helps to determine if a website is credible.

Answer the following questions in **your own words**, using the information given:

1. Why is print material considered more credible than Internet material?

2. What tip does Robert Harris offer to determine if a source is reliable/credible?

3. Summarize the CARS checklist. Include important questions that you must ask yourself and indicators of poor information when evaluating an Internet site.

4. Does the web address itself give you any information? Explain.

5. Do “links” on a website tell you anything about the quality of the information? Explain.

PART 2 – Creating a Checklist

Make a checklist for evaluating websites.

Use Robert Harris’ article “Evaluating Internet Research Sources” and the “Evaluation – The Weakest Link,” to create your own checklist for evaluating an Internet site. Your checklist should be user friendly and useful for evaluating the reliability of websites. You will be using your checklist to evaluate the websites you use in your project.

2.4.2: Evaluation – The Weakest Link

Evaluating something you find on the Internet isn't much different than evaluating information in books, magazines and other sources. The main difference is that print material has usually been vetted by an editor, and internet information may not have been.

Also important is your own informational need, for example, if you are using the internet to find a recipe for pasta sauce the information is evaluated differently than if you are using the internet to consider if you should have laser eye surgery.

Your informational needs in University will often focus on scholarly issues, which are covered in the chapter in eManual on Information Gaps.
A good article about evaluating web resources is written by Robert Harris.

> Harris, Robert. "Evaluating Internet Research Sources." VirtualSalt.
> 17 Nov 1997. 15 Sep 2001. (Article Attached)

Harris presents an evaluation model called CARS, for Credibility, Accuracy, Reasonableness, Support.
One way of approaching any information (but especially internet resources) is by asking the following questions.

Why is the information being provided?

There are many motivations for publishing on the Web: to attract users and therefore advertisers, to sell something, to enhance a service, to advocate a personal position, or to disseminate research.

Web pages can be divided into the following groups (as with all classifications, sometimes sites will be a combination of more than one type):

1. **Advocacy Web Pages** (for example Lifesite Canada).
2. **Business/Marketing Pages** (for example Michie Creek Mushing)
3. **Information Web Pages** (for example Strategis)
4. **News/EJournals** (for example http://www.canoe.com/Canoe/home.html).
5. **Personal Home Pages** (for example Geneology Page of John Blythe Dobson).
6. **Entertainment** (for example Sponge Bob).

You can tell a little about the motivation and source of a document by the address. Common domain name suffixes are: .com (for a commercial enterprise); .gov (for government - U.S. only); .org (for organization). Canadian domain names often end in .ca, but do not necessarily have to end in .ca.

Credibility

- What is the author's training or experience with the topic?
- Is the author a recognized authority on the topic of the document?
- Is the author affiliated with an educational institution, research laboratory, governmental agency, or other reputable organization related to the topic of the document?

2.4.2: Evaluation – The Weakest Link (continued)

Interactivity

One feature that separates the Internet from traditional resources is the internet's amazing ability to create communities.

- Does the site allow open comments and feedback?
- Can you view and comment on what other people are saying?

Relevance and Scope of Content

The quality of the information within a document is related to your needs.

- Is the information sufficiently current?
- Does the document provide any new information on the topic?
- Are there obvious gaps or omissions in the coverage of the topic?

Content Validity

- Is the methodology used to develop the resource described and appropriate to the content?
- Has the document been linked to or referenced by recognized authorities? (for example, does the document show up on more than one list of resources on the topic?). You can check who has linked to a site by using Google, AltaVista, or Profusion (for example, search for link:www.snopes.com to see who else has linked to the *Urban Legends Reference* Page).
- Can you find a review of the document in quality web directories such as the Scout Report Signpost, or Librarian's Index to the Internet.
- Is the document a primary (original, unfiltered material) or secondary (modified, selected, or rearranged information about primary materials) source?
- Does the information provided contradict or confirm information from other sources?
- Does the author provide references or links to confirm the accuracy of the information?
- Does the author provide verifiable statistics to support conclusions?

Accuracy and Balance of Content

- Are all sides of controversial issues presented, or is it necessary to seek alternative views?
- If the document deals with controversial issues, is the bias of the author clearly identified?
- Are there indications of careless or hasty preparation, such as spelling or grammatical errors?

Quality of the Links

- Are the links visible and understandable?
- Are links annotated?
- Are links provided primarily to resources rather than a list of resources?
- How reliable are the links?

2.4.2: Evaluation – The Weakest Link (continued)

More Information

- Thinking Critically about World Wide Web Resources by Esther Grassian, UCLA College Library.
- Links to Additional Sites with Web Evaluation Materials
  by Jan Alexander & Marsha Ann Tate, Wolfgram Memorial Library, Widener University.
- The Urban Legends Reference Page by The San Fernando Valley Folklore Society. (Not a site on evaluation per se, but an excellent resource for identifying urban legends and hoaxes).

Source of the Article

http://cybrary.uwinnipeg.ca
➔Learn
➔Information Research Guide
➔Evaluation: The Weakest Link
➔Evaluation Criteria

2.4.3: Evaluating Internet Research Sources

Robert Harris
Version Date: November 17, 1997

"The central work of life is interpretation." – Proverb

Introduction: The Diversity of Information

Information is a Commodity Available in Many Flavors

Think about the magazine section in your local grocery store. If you reach out with your eyes closed and grab the first magazine you touch, you are about as likely to get a supermarket tabloid as you are a respected journal (actually more likely, since many respected journals don't fare well in grocery stores). Now imagine that your grocer is so accommodating that he lets anyone in town print up a magazine and put it in the magazine section. Now if you reach out blindly, you might get the *Elvis Lives with Aliens Gazette* just as easily as *Atlantic Monthly* or *Time.*

Welcome to the Internet. As I hope my analogy makes clear, there is an extremely wide variety of material on the Internet, ranging in its accuracy, reliability, and value. Unlike most traditional information media (books, magazines, organizational documents), no one has to approve the content before it is made public. It's your job as a searcher, then, to evaluate what you locate, in order to determine whether it suits your needs.

Information Exists on a Continuum of Reliability and Quality

Information is everywhere on the Internet, existing in large quantities and continuously being created and revised. This information exists in a large variety of kinds (facts, opinions, stories, interpretations, statistics) and is created for many purposes (to inform, to persuade, to sell, to present a viewpoint, and to create or change an attitude or belief). For each of these various kinds and purposes, information exists on many levels of quality or reliability. It ranges from very good to very bad and includes every shade in between.

2.4.3: Evaluating Internet Research Sources (continued)

Getting Started: Screening Information

Pre-evaluation

The first stage of evaluating your sources takes place before you do any searching. Take a minute to ask yourself what exactly you are looking for. Do you want facts, opinions (authoritative or just anyone's), reasoned arguments, statistics, narratives, eyewitness reports, descriptions? Is the purpose of your research to get new ideas, to find either factual or reasoned support for a position, to survey opinion, or something else? Once you decide on this, you will be able to screen sources much more quickly by testing them against your research goal. If, for example, you are writing a research paper, and if you are looking for both facts and well-argued opinions to support or challenge a position, you will know which sources can be quickly passed by and which deserve a second look, simply by asking whether each source appears to offer facts and well-argued opinions, or just unsupported claims.

Select Sources Likely to be Reliable

Becoming proficient at this will require experience, of course, but even a beginning researcher can take a few minutes to ask, "What source or what kind of source would be the most credible for providing information in this particular case?" Which sources are likely to be fair, objective, lacking hidden motives, showing quality control? It is important to keep these considerations in mind, so that you will not simply take the opinion of the first source or two you can locate. By thinking about these issues while searching, you will be able to identify suspicious or questionable sources more readily. With so many sources to choose from in a typical search, there is no reason to settle for unreliable material.

Source Selection Tip:

Try to select sources that offer as much of the following information as possible:

Author's Name
Author's Title or Position
Author's Organizational Affiliation
Date of Page Creation or Version
Author's Contact Information
Some of the Indicators of Information Quality (listed below)

2.4.3: Evaluating Internet Research Sources (continued)

Evaluating Information: The Tests of Information Quality

Reliable Information is Power

You may have heard that "knowledge is power," or that information, the raw material of knowledge, is power. But the truth is that only some information is power: reliable information. Information serves as the basis for beliefs, decisions, choices, and understanding our world. If we make a decision based on wrong or unreliable information, we do not have power--we have defeat. If we eat something harmful that we believe to be safe, we can become ill; if we avoid something good that we believe to be harmful, we have needlessly restricted the enjoyment of our lives. The same thing applies to every decision to travel, purchase, or act, and every attempt to understand.

Source Evaluation is an Art

Source evaluation--the determination of information quality--is something of an art. That is, there is no single perfect indicator of reliability, truthfulness, or value. Instead, you must make an inference from a collection of clues or indicators, based on the use you plan to make of your source. If, for example, what you need is a reasoned argument, then a source with a clear, well-argued position can stand on its own, without the need for a prestigious author to support it. On the other hand, if you need a judgment to support (or rebut) some position, then that judgment will be strengthened if it comes from a respected source. If you want reliable facts, then using facts from a source that meets certain criteria of quality will help assure the probability that those facts are indeed reliable.

The **CARS** Checklist

The CARS Checklist (Credibility, Accuracy, Reasonableness, Support) is designed for ease of learning and use. Few sources will meet every criterion in the list, and even those that do may not possess the highest level of quality possible. But if you learn to use the criteria in this list, you will be much more likely to separate the high quality information from the poor quality information.

2.4.3: Evaluating Internet Research Sources (continued)

Credibility

Because people have always made important decisions based on information, evidence of authenticity and reliability--or credibility, believability--has always been important. If you read an article saying that the area where you live will experience a major earthquake in the next six months, it is important that you should know whether or not to believe the information. Some questions you might ask would include, What about this source makes it believable (or not)? How does this source know this information? Why should I believe this source over another? As you can see, the key to credibility is the question of trust. There are several tests you can apply to a source to help you judge how credible and useful it will be:

Author's Credentials

The author or source of the information should show some evidence of being knowledgeable, reliable, and truthful. Here are some clues:

- Author's education, training, and/or experience in a field relevant to the information. Look for biographical information, the author's title or position of employment
- Author provides contact information (email or snail mail address, phone number)
- Organizational authorship from a known and respected organization (corporate, governmental, or non-profit)
- Author's reputation or standing among peers.
- Author's position (job function, title)

Evidence of Quality Control

Most scholarly journal articles pass through a peer review process, whereby several readers must examine and approve content before it is published. Statements issued in the name of an organization have almost always been seen and approved by several people. (But note the difference between, “Allan Thornton, employee of the National Oceanographic and Atmospheric Agency, says that a new ice age is near,” and “The National Oceanographic and Atmospheric Agency said today that a new ice age is near.” The employee is speaking for himself, whereas a statement in the name of NOAA represents the official position of NOAA.)

Evidence of quality control of Internet material includes these items:

- Information presented on organizational web sites
- On-line journals that use refereeing (peer review) by editors or others
- Postings of information taken from books or journals that have a quality control process

2.4.3: Evaluating Internet Research Sources (continued)

Metainformation

Metainformation is information about information. Information workers (sometimes called knowledge workers) all over the world are constantly poring over, processing, and evaluating information--and making notes. As the challenges produced by the increasing quantity of information continue, access to high quality metainformation will become increasingly important. Metainformation can take many forms, but there are two basic types, summary and evaluative.

Summary metainformation includes all the shortened forms of information, such as abstracts, content summaries, or even tables of contents. This type of metainformation gives us a quick glance at what a work is about and allows us to consider many different sources without having to go through them completely. Evaluative metainformation includes all the types that provide some judgment or analysis of content. This type includes recommendations, ratings, reviews, and commentaries. And, of course, these two types can be combined, resulting in the best form of metainformation, providing us with a quick overview and some evaluation of the value. An example would be a World Wide Web yellow pages or directory which describes each selected site and provides evaluations of its content.

Indicators of Lack of Credibility

You can sometimes tell by the tone, style, or competence of the writing whether or not the information is suspect. Here are a few clues:

Anonymity

Lack of Quality Control

Negative Metainformation. If all the reviews are critical, be careful.

Bad grammar or misspelled words. Most educated people use grammar fairly well and check their work for spelling errors. An occasional split infinitive or comma in the wrong place is not unusual, but more than two or three spelling or grammar errors is cause for caution, at least. Whether the errors come from carelessness or ignorance, neither puts the information or the writer in a favorable light.

2.4.3: Evaluating Internet Research Sources (continued)

Accuracy

The goal of the accuracy test is to assure that the information is actually correct: up to date, factual, detailed, exact, and comprehensive. For example, even though a very credible writer said something that was correct twenty years ago, it may not be correct today. Similarly, a reputable source might be giving up-to-date information, but the information may be only partial, and not give the full story. Here are some concepts related to accuracy:

Timeliness

Some work is timeless, like the classic novels and stories, or like the thought provoking philosophical work of Aristotle and Plato. Other work has a limited useful life because of advances in the discipline (psychological theory, for example), and some work is outdated very quickly (like technology news). You must therefore be careful to note when the information you find was created, and then decide whether it is still of value (and how much value). You may need information within the past ten years, five years, or even two weeks. But old is not necessarily bad: nineteenth-century American history books or literary anthologies can be highly educational because they can function as comparisons with what is being written or anthologized now. In many cases, though, you want accurate, up-to-date information.

An important idea connected with timeliness is the dynamic, fluid nature of information and the fact that constant change means constant changes in timeliness. The facts we learn today may be timely now, but tomorrow will not be. Especially in technology, science, medicine, business, and other fields always in flux, we must remember to check and re-check our data from time to time, and realize that we will always need to update our facts.

Comprehensiveness

Any source that presents conclusions or that claims (explicitly or implicitly) to give a full and rounded story, should reflect the intentions of completeness and accuracy. In other words, the information should be comprehensive. Some writers argue that researchers should be sure that they have “complete” information before making a decision or that information must be complete. But with the advent of the information age, such a goal is impossible, if by “complete” we mean all possible information. No one can read 20,000 articles on the same subject before coming to a conclusion or making a decision. And no single piece of information will offer the truly complete story--that's why we rely on more than one source. On the other hand, an information source that deliberately leaves out important facts, qualifications, consequences, or alternatives, may be misleading or even intentionally deceptive.

2.4.3: Evaluating Internet Research Sources (continued)

Audience and Purpose

For whom is this source intended and for what purpose? If, for example, you find an article, "How Plants Grow," and children are the intended audience, then the material may be too simplified for your college botany paper. More important to the evaluation of information is the purpose for which the information was created. For example, an article titled, "Should You Buy or Lease a Car?" might have been written with the purpose of being an objective analysis, but it may instead have been written with the intention of persuading you that leasing a car is better than buying. In such a case, the information will most likely be highly biased or distorted. Such information is not useless, but the bias must be taken into consideration when interpreting and using the information. (In some cases, you may need to find the truth by using only biased sources, some biased in one direction and some biased in the other.) Be sure, then, that the intended audience and purpose of the article are appropriate to your requirements or at least clearly in evidence so that you may take them into account. *Information pretending to objectivity but possessing a hidden agenda of persuasion or a hidden bias is among the most common kind of information in our culture.*

Indicators of a Lack of Accuracy

In addition to an obvious tone or style that reveals a carelessness with detail or accuracy, there are several indicators that may mean the source is inaccurate, either in whole or in part:

- No date on the document
- Vague or sweeping generalizations
- Old date on information known to change rapidly
- Very one sided view that does not acknowledge opposing views or respond to them

2.4.3: Evaluating Internet Research Sources (continued)

Reasonableness The test of reasonableness involves examining the information for fairness, objectivity, moderateness, and consistency.

Fairness Fairness includes offering a balanced, reasoned argument, not selected or slanted. Even ideas or claims made by the source's opponents should be presented in an accurate manner. Pretending that the opponent has wild, irrational ideas or arguments no one could accept is to commit the straw man fallacy. A good information source will also possess a calm, reasoned tone, arguing or presenting material thoughtfully and without attempting to get you emotionally worked up. Pay attention to the tone and be cautious of highly emotional writing. Angry, hateful, critical, spiteful tones often betray an irrational and unfair attack underway rather than a reasoned argument. And writing that attempts to inflame your feelings to prevent you from thinking clearly is also unfair and manipulative.

Objectivity There is no such thing as pure objectivity, but a good writer should be able to control his or her biases. Be aware that some organizations are naturally not neutral. For example, a professional anti-business group will find, say, that some company or industry is overcharging for widgets. The industry trade association, on the other hand, can be expected to find that no such overcharging is taking place. Be on the lookout for slanted, biased, politically distorted work.
One of the biggest hindrances to objectivity is conflict of interest. Sometimes an information source will benefit in some way (usually financially, but sometimes politically or even emotionally or psychologically) if that source can get you to accept certain information rather than the pure and objective truth. For example, many sites that sell “natural” products (cosmetics, vitamins, clothes) often criticize their competitors for selling bad, unhealthy or dangerous products. The criticism may be just, but because the messenger will gain financially if you believe the message, you should be very careful--and check somewhere else before spending money or believing the tale.

Moderateness Moderateness is a test of the information against how the world really is. Use your knowledge and experience to ask if the information is really likely, possible, or probable. Most truths are ordinary. If a claim being made is surprising or hard to believe, use caution and demand more evidence than you might require for a lesser claim. Claims that seem to run against established natural laws also require more evidence. In other words, do a reality check. Is the information believable? Does it make sense? Or do the claims lack face validity? That is, do they seem to conflict with what you already know in your experience, or do they seem too exaggerated to be true? “Half of all Americans have had their cars stolen.” Does that pass the face validity test? Have half of your friends had their cars stolen? Is the subject on the news regularly (as we might assume it would be if such a level of theft were the case)?
It is important, of course, to remember that some truths are spectacular and immoderate. A few years back, a performer with the stage name of

Mr. Mange Tout (French for “eats everything”) actually ate, over a period of a few years, several bicycles, TV sets, and a small airplane by first having them ground into a fine powder and sprinkling a few teaspoonfuls on his breakfast cereal each morning. So do not automatically reject a claim or source simply because it is astonishing. Just be extra careful about checking it out.

Consistency

The consistency test simply requires that the argument or information does not contradict itself. Sometimes when people spin falsehoods or distort the truth, inconsistencies or even contradictions show up. These are evidence of unreasonableness.

World View

A writer's view of the world (political, economic, religious--including anti-religious--and philosophical) often influences his or her writing profoundly, from the subjects chosen to the slant, the issues raised, issues ignored, fairness to opponents, kinds of examples, and so forth. World view can be an evaluative test because some world views in some people cause quite a distortion in their view of reality or their world view permits them to fabricate evidence or falsify the positions of others. For some writers, political agendas take precedence over truth. If you are looking for truth, such sources are not the best.

Indicators of a Lack of Reasonableness

Writers who put themselves in the way of the argument, either emotionally or because of self interest, often reveal their lack of reasonableness. If, for example, you find a writer reviewing a book he opposes by asserting that “the entire book is completely worthless claptrap,” you might suspect there is more than a reasoned disagreement at work. Here are some clues to a lack of reasonableness:

- Intemperate tone or language (“stupid jerks,” “shrill cries of my extremist opponents”)
- Overclaims (“Thousands of children are murdered every day in the United States.”)
- Sweeping statements of excessive significance (“This is the most important idea ever conceived!”)
- Conflict of Interest (“Welcome to the Old Stogie Tobacco Company Home Page. To read our report, ‘Cigarettes Make You Live Longer,' click here.” or “The products our competitors make are dangerous and bad for your health.”)

Support

The area of support is concerned with the source and corroboration of the information. Much information, especially statistics and claims of fact, comes from other sources. Citing sources strengthens the credibility of the information. (Remember this when you write a research paper.)

Source Documentation or Bibliography

Where did this information come from? What sources did the information creator use? Are the sources listed? Is there a bibliography or other documentation? Does the author provide contact information in case you wish to discuss an issue or request further clarification? What kind of support for the information is given? How does the writer know this? It is especially important for statistics to be documented. Otherwise, someone may be just making up numbers. Note that some information from corporate sites consists of descriptions of products, techniques, technologies, or processes with which the corporation is involved. If you are careful to distinguish between facts ("We mix X and Y together to get Z") and advertising ("This protocol is the best in the industry"), then such descriptions should be reliable.

Corroboration

See if other sources support this source. Corroboration or confirmability is an important test of truth. And even in areas of judgment or opinion, if an argument is sound, there will probably be a number of people who adhere to it or who are in some general agreement with parts of it. Whether you're looking for a fact (like the lyrics to a song or the date of an event), an opinion (like whether paper or plastic is the more environmentally friendly choice), or some advice (like how to grow bromeliads), it is a good idea to triangulate your findings: that is, find at least three sources that agree. If the sources do not agree, do further research to find out the range of opinion or disagreement before you draw your conclusions.

What you are doing with corroboration, then, is using information to test information. Use one source, fact, point of view, or interpretation to test another. Find other information to support and reconfirm (or to challenge or rebut) information you have found.

Corroboration is especially important when you find dramatic or surprising information (information failing the moderateness test, above). For example, the claim that a commonly used food additive is harmful should be viewed with scepticism until it can be confirmed (or rebutted) by further research. The claim may be true, but it seems unlikely that both government and consumer organizations would let the additive go unchallenged if indeed it were harmful.

External Consistency

While the test of corroboration involves finding out whether other sources contain the same new information as the source being evaluated, the test of external consistency compares what is familiar in the new source with what is familiar in other sources. That is, information is usually a mixture of old and new, some things you already know and some things you do not. The test of external consistency asks, Where this source discusses facts or ideas I already know something about, does the source agree or harmonize or does it conflict, exaggerate, or distort? The reasoning is that if a source is faulty

where it discusses something you already know, it is likely to be faulty in areas where you do not yet know, and you should therefore be cautious and sceptical about trusting it.

Indicators of a Lack of Support

As you can readily guess, the lack of supporting evidence provides the best indication that there is indeed no available support. Be careful, then, when a source shows problems like these:

- Numbers or statistics presented without an identified source for them
- Absence of source documentation when the discussion clearly needs such documentation
- You cannot find any other sources that present the same information or acknowledge that the same information exists (lack of corroboration)

2.4.3: Evaluating Internet Research Sources (continued)

Summary of The CARS Checklist for Research Source Evaluation

Credibility	trustworthy source, author's credentials, evidence of quality control, known or respected authority, organizational support. Goal: an authoritative source, a source that supplies some good evidence that allows you to trust it.
Accuracy	up to date, factual, detailed, exact, comprehensive, audience and purpose reflect intentions of completeness and accuracy. Goal: a source that is correct today (not yesterday), a source that gives the whole truth.
Reasonableness	fair, balanced, objective, reasoned, no conflict of interest, absence of fallacies or slanted tone. Goal: a source that engages the subject thoughtfully and reasonably, concerned with the truth.
Support	listed sources, contact information, available corroboration, claims supported, documentation supplied. Goal: a source that provides convincing evidence for the claims made, a source you can triangulate (find at least two other sources that support it).

Living with Information: The CAFÉ Advice

Here is one last piece of advice to help you live well in the world of information: Take your information to the Café (Challenge, Adapt, File, Evaluate).

Challenge Challenge information and demand accountability. Stand right up to the information and ask questions. Who says so? Why do they say so? Why was this information created? Why should I believe it? Why should I trust this source? How is it known to be true? Is it the whole truth? Is the argument reasonable? Who supports it?

Adapt Adapt your scepticisms and requirements for quality to fit the importance of the information and what is being claimed. Require more credibility and evidence for stronger claims. You are right to be a little sceptical of dramatic information or information that conflicts with commonly accepted ideas. The new information may be true, but you should require a robust amount of evidence from highly credible sources.

File File new information in your mind rather than immediately believing or disbelieving it. Avoid premature closure. Do not jump to a conclusion or come to a decision too quickly. It is fine simply to remember that someone claims XYZ to be the case. You need not worry about believing or disbelieving the claim right away. Wait until more information comes in, you have time to think about the issue, and you gain more general knowledge.

Evaluate Evaluate and re-evaluate regularly. New information or changing circumstances will affect the accuracy and hence your evaluation of previous information. Recognize the dynamic, fluid nature of information. The saying, "Change is the only constant," applies to much information, especially in technology, science, medicine, and business.

2.4.4: Statistical Bias-Definitions

Statistical Bias

- any factor that favours certain outcomes or responses
- any factor that may skew results
- factors that lead to bias may be unintentional

❶ Sampling bias

- sample does not reflect the characteristics of the population

Problem: The sampling method itself is the cause of the problem

❷ Non-**response** bias

- when a particular group is under-represented in a survey because they choose not to participate or they don't return the survey

Problem: Lack of participation

❸ **Response** bias

- when participants in a survey deliberately give false or misleading answers
- respondents may want to influence the results
- respondents may be afraid or embarrassed to answer sensitive questions honestly

Problem: Respondents purposefully alter their response

❹ **Measurement** bias

- data collection method that consistently either under- or over-estimates a characteristic of the population
- the result of the data collection process that affects the variable it is measuring
- survey questions themselves can be "loaded" or lead the respondents

Problem: Researchers have problems with the survey itself or with how the data is collected.

2.4.6: BIAS – Seek and Decide

- Identify the type of bias.
- Give an explanation as to why the scenario is biased.
- Create a solution that will avoid the bias.
- Record your findings under the headings-Type of Bias, Explanation, and Solution.

a) A survey asked students at a high school basketball game whether a fund for extra-curricular activities should be used to buy new equipment for the basketball team or instruments for the school band.

b) A social science class asks every tenth student entering the cafeteria to answer a survey on environmental issues. Less than half complete the questionnaire. The completed questionnaires show that a high proportion of the respondents are concerned about the environment and about environmental issues.

c) A civil engineer suggests that a cost-effective way to survey traffic speeds on a highway would be to have a police officer patrol the highway and record the speed of the traffic every half hour.

d) An aid agency in a developing country wants to know what proportion of households have at least one personal computer. One of the agency's staff members conducts the survey by calling household randomly selected from the telephone directory.

e) The following questionnaire was developed by Sarah's friends:

Election Survey

Sponsored by the friends for the election of Sarah committee.

Circle the appropriate response.

Gender:	Male		Female	
Grade:	9	10	11	12
On election day, I intend to vote for				
	Sarah	Zahir		Melanie
I want more:	dances	hat days	holidays	fun

f) **One** student from each home room is surveyed about which new menu choices they would prefer in the cafeteria. Below is information about the number of people in each home room:

8 Home rooms with 1–12 students

42 Home rooms with 13–24 students

20 Home rooms with 25–36 students

g) A teacher finishes explaining a new concept to the class and wants to check that all the students have grasped the concept. The teacher asks those who do not understand to raise their hands.

2.4.6: BIAS – Seek and Decide

h) As part of a survey of the "Greatest Hits of All Time," a radio station asks its listeners: Which was the best Elvis song?

Blue Suede Shoes
Hound Dog
Heartbreak Hotel
All Shook Up
Suspicious Minds

i) Members of a golf and country club are polled regarding the construction of a highway interchange on part of their golf course.

j) A group of candidates running for the position of Prime Minister are asked whether they have ever taken part in an illegal protest.

k) A random poll asks the following question: "The proposed nuclear power plant will produce a number of jobs and economic activity in and around your community. Are you in favour of this forward-thinking initiative?"

l) A survey uses a cluster sample of Toronto residents to determine public opinion on whether the provincial government should increase funding on public transit.

m) A researcher appears on a talk-show and conducts an on-air survey about re-instituting capital punishment in Canada.

n) Parents of high school students were asked: "Do you think that students should be released from school an hour early on Friday, free to run around and get into trouble?"

o) Audience members at an investment workshop are asked to raise their hands if they have been late with a bill payment within the last six months.

75 min

Math Learning Goals

- describe the characteristics of an effective survey
- collect data from primary sources, through experimentation, organize data with one or more attributes

Materials

- Internet
- BLM 2.5.1, 2.5.2

Assessment Opportunities

Minds On…

Pairs → Think/Pair/Share

Individually students complete the survey and identify problems with it (BLM).

Pairs compare the problems they found.

Students describe for the class what is wrong with the survey (e.g., Which questions "lead" the respondent? Which questions employ jargon? Which questions are stated using negatives?)

Think/Pair/Share: Think Literacy, p. 152

Action!

Pair → Brainstorm

Students skim the teacher-prepared survey to look for characteristics of a good survey. They compare this survey to the survey in **Minds On…**.

Students brainstorm characteristics of an effective survey.

Other surveys and data can be found at the support site: http://teacherweb.com/on/statistics/math/ Choose the link: MDM Datasets and surveys

http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=4450&lang=en&db=IMDB&dbg=f&adm=8&dis=2

Individual → Survey

Students complete the selected number of questions from the National Longitudinal Study of Children and Youth (NLSCY) to demonstrate the attributes of a non-biased survey. This data corresponds to the Fathom file: Ontario Youth.

Whole Class → Four Corners Plus One

Students move to one of the four corners or to the middle of the room depending on their response to two questions chosen from the survey:

1. Choose a question whose response is
   - Not important at all
   - Not very important
   - Somewhat important (middle)
   - Important
   - Very Important
2. Choose a question where the response is one of 5 categories

Record the number of responses at each location.

While in their corners students discuss why they chose that location. In a class discussion, a representative from each location summarise the group's thinking.

Four Corners: Think Literacy p. 182 (This version is modified to include 5 locations)

Learning Skills/Teamwork/Checkbric:

Consolidate Debrief

Whole Class → Discussion

Compile the data of the class responses to compare with the 1040 cases from the province. (Data could be collected from students using electronic clickers, a spreadsheet, or by hand)

Prompting questions:

1. Which survey questions generate categorical data? numerical data?
2. When comparing class data to the Ontario Youths what conclusions we can make?
3. How does sample size affect the results of a survey?
4. Is our class a representative sample?

Whole Class → T-Chart Summary

On chart paper, summarize the characteristics of a good survey vs. a bad survey or questionnaire, including ideas about sample size, bias, and good questioning.

Application
Concept Practice
Differentiated
Exploration
Reflection
Skill Drill

Home Activity or Further Classroom Consolidation

2.5.1: Teacher

A Silly Survey – Sample Survey

Create a survey that breaks all the following rules:

- uses jargon
- uses abbreviations
- uses negatives (e.g., From the list below, indicate which books you wouldn't recommend to parents)
- uses leading questions
- includes questions that are insensitive
- will creates response bias
- uses changes in font (to highlight or lead)
- uses language that is unclear or complex rather than simple

Unit 3: Statistics

Grade 12

Lesson Outline

Big Picture

Students will:

- explore, analyse, interpret, and draw conclusions from one-variable data;.
- explore, analyse, interpret, and draw conclusions from two-variable data;
- investigate and evaluate validity of statistical summaries;
- culminating Investigation;
- analyse, interpret, draw conclusions, and write a report of their research;
- present summary of finding;
- critique presentations of their peers.

Day	Lesson Title	Math Learning Goals	Expectations
1–2	Summary Statistics	• Recognize that the analysis of one-variable data involves the frequency of one attribute, and determine, using technology, the relevant numerical summaries (mean, median, mode, range, variance, and standard deviation). • Determine the positions of individual data points within a one-variable data set using quartiles, percentiles, and *z*-scores; use the normal distribution to model one-variable data sets, and recognize these processes as strategies for one-variable data analysis.	D1.1, D1.2
3–4	Graphical displays of data	• Generate, using technology, the relevant graphical displays of one-variable data based on the type of data provided. • Explore types of data, e.g., categorical, ordinal, and quantitative.	D1.3
5	Culminating Investigation	• Interpret, analyse, and summarize data related to the study of the problem. • Draw conclusions from the analysis of the data, evaluate the strengths of the evidence, specify limitations, suggest follow-up problems or investigations. • Focus on one-variable analysis.	E1.4, E1.5
6–7	Interpreting Data Using Summary Statistics and Graphs	• Interpret and compare two related one-variable prepared data sets. • Formulate and critique conclusions. • Communicate conclusions orally and in writing make connections to the culminating investigation.	D1.5, E 1.4, E1.5
8–9	Analysing Two Variable Data	• Graph two numerical variables on a scatter plot. • Determine the appropriateness of a linear model to describe the relationship between two numerical attributes. • Recognize the meaning of the correlation coefficient, using a prepared investigation. • Compare a quantitative and a categorical variable (e.g., gender vs. Income) using appropriate displays, e.g., stacked box plots. • Compare two categorical variables, e.g., gender vs. Colour-blindness, using a contingency or summary table and computing proportions.	D2.1, D2.3

Day	Lesson Title	Math Learning Goals	Expectations
10–11	Understanding Correlation	• Explore different types of relationships between two variables, e.g., The cause-and-effect relationship between the age of a tree and its diameter; the common-cause relationship between ice cream sales and forest fires over the course of a year; the accidental relationship between your age and the number of known planets in the universe. • Interpret statistical summaries to describe and compare the characteristics of two variable statistics.	D2.2, D2.5, E1.4, E1.5
12–13	Interpreting and Making Inferences	• Perform linear regression using technology to determine information about the correlation between variables. • Determine the effectiveness of a linear model on two variable statistics. • Investigate how statistical summaries can be used to misrepresent data. • Make inferences and justify conclusions from statistical summaries or case studies. • Communicate orally and in writing, using convincing arguments.	D2.2, D2.4, D2.5, E1.4, E1.5
14	Culminating Investigation	• Interpret, analyse, and summarize data related to the study of the problem. • Draw conclusions from the analysis of the data, evaluate the strengths of the evidence, specify limitations, suggest follow-up problems or investigations. • Focus on two-variable analysis.	E1.4, E1.5
15	Assess Validity	• Interpret and assess statistics presented in the media, e.g., Promote a certain point of view, advertising, including how they are used or misused to present a certain point of view. • Investigate interpretation by the media based on lack of knowledge of statistics, e.g., drug testing, false positives. • Examine data collection techniques and analysis in the media, e.g., sample size, bias, law of large numbers. • Scrapbook of statistical observations from the media.	D3.1, D3.2, E1.5
16–17	Culminating Investigation related to occupations	• Use journalism as an example to demonstrate applications of data management in an occupation. • Gather, interpret, and describe how the information collected in their project relates to an occupation, e.g., insurance, sports statistician, business analyst, medical researcher. • From their projects identify university programs that explore the applications.	D3.3, E1.3
18	Culminating Investigation	• Edit and compile a report that interpret, analyses, and summarizes data related to the study of the problem. • Draw conclusions from the analysis of the data, evaluate the strengths of the evidence, specify limitations, suggest follow-up problems or investigations.	E1.4, E1.5, E2.1
19–20	Jazz/Summative	•	
Reserve time 10 days	Culminating Investigation	• Present a summary of the culminating investigation to an audience of their peers. • Answer questions about the culminating investigation and respond to critiques. • Critique the mathematical work of others in a constructive manner.	E2.2, E2.3, E2.4

75 min

Math Learning Goals

- Explore different type of relationships between two variables, e.g., the cause-and-effect relationship between the age of a tree and its diameter; the common-cause relationship between ice cream sales and forest fires over the course of a year; the accidental relationship between your age and the number of known planets in the universe.
- Interpret statistical summaries to describe and compare the characteristics of two variable statistics.

Materials

- BLM 3.11.1
- CCHS two variable datafile

Assessment Opportunities

Minds On…

Whole Class → Discussion

Lead a discussion to consolidate the variables associated with the prevalence of Diabetes. (See Day ? Unit 2.)

Action!

Individual → Anticipation Guide

Students complete the "**Before**" column of the Anticipation Guide BLM 3.11.1

Pairs → Investigation

Pairs explore and investigate the relationships between having diabetes and other variables, e.g., BMI, income, lifestyle, in order to verify or refute the statements in the Anticipation Guide.

They determine if a relationship exists between the prevalence of Diabetes and the given variables, identify the type of relationship, e.g., cause-and-effect, and connect the findings to the statements in the Anticipation Guide.

They prepare a one-page summary of their findings explaining and justifying their position for each statement including evidence, e.g., graphs, statistical summaries, correlation.

To Learn more about Japanese lessons and Bansho:

http://www.criced.tsukuba.ac.jp/math/sympo_2006/takahashi.pdf

For more information on Ontario Bansho: www.curriculum.org to see webcast, Making Math Accessible for All Students

Consolidate Debrief

Whole Class → Sharing/Reflecting

Post student responses organized under each Anticipation Guide statement. (Bansho) Review the evidence shown by the posted reports.

Students complete the After column of the Anticipation Guide.

Summarize the variety of techniques used by the class to analyse two variable data.

Post chart paper summary and add to it as students discover more techniques.

Application
Differentiated
Exploration

Home Activity or Further Classroom Consolidation

Use one of the other variables provided, and determine if there is a relationship, e.g., Diabetes rates vs. Age.

3.11.1: Anticipation Guide Two Variable Exploration

Instructions

- Check **Agree** or **Disagree**, in ink, in the **Before** category beside each statement before you start the Diabetes Exploration task.
- Compare your choice with your partner.
- Revisit your choices at the end of the investigation.

Before		Statement	After	
Agree	Disagree		Agree	Disagree
		1. An individual's BMI has no effect on their chance of getting diabetes.		
		2. People in higher income brackets are more likely to have diabetes.		
		3. Diabetes rates in Ontario have stabilized over the last ten years.		
		4. Being more active decreases your chances of having diabetes.		

Unit 4: Probability Distributions of Discrete Random Variables

Grade 12

Lesson Outline

Big Picture

Students will:

- Understand probability distributions for discrete random variables.
- Explore and connect binomial and hypergeometric distributions.
- Recognize that the differences between a probability histogram and a frequency histogram may be the result of variability.
- Complete a Games Fair culminating project.

Day	Lesson Title	Math Learning Goals	Expectations
1–2	Formalizing Discrete Random Variables Relating Probability Histograms and Frequency Histograms	• Recognize and identify a discrete random variable. • Calculate the probabilities associated with all values of a random variable, with and without technology. • Generate, tabulate, and graph a probability distribution. • Compare a probability histogram to the frequency histogram of a related experiment conducted previously in the course. • Make connections between the frequency histogram and the probability histogram.	B1.1, B1.3
3	Spin and Win	• Calculate, interpret, and apply expected value. • Construct and analyse simple fair and unfair games, e.g., using familiar examples from Unit 1.	B1.2
4	Are You Game?	• Calculate, interpret, and apply expected value. • Make connections between the expected value and the weighted mean of the values of the discrete random variable. • Introduce the Games Fair project and its connection to experimental and theoretical probability. • Develop a critique for peer assessment for the Games Fair project.	E1, E2, B1.2

Day	Lesson Title	Math Learning Goals	Expectations
5–7	The Binomial Distribution	• Recognize and identify situations resulting in a binomial discrete random variable. • Calculate the probabilities associated with all values of a binomial random variable. • Compare binomial probability histograms to frequency histograms of related experiments conducted previously in the course. • Recognize that the differences between a probability histogram and a frequency histogram may be the result of variability and/or other factors (e.g., when tossing a coin 10 times and recording the number of heads, the frequency distribution should have some of the features of the probability distribution but will not match it exactly due to variability. As well, the model may not be correct due to bias such as an unfair coin or poor experimental technique or that independence is not a good assumption). • Investigate how increasing the number of independent trials makes the frequency histogram better match the probability histogram. • Generalize the algebraic representation of the binomial probability distribution. • Calculate, interpret, and apply expected value. • Compare the expected value of a binomial random variable to the mean of an experimental data set.	B1.4, B1.6, B1.1, B1.2, B1.3
8–9	The Hypergeometric Distribution	• Recognize and identify situations resulting in a hypergeometric random variable. • Calculate the probabilities associated with all values of a random variable. • Compare hypergeometric probability histograms to frequency histograms of related experiments conducted previously in the course. • Calculate, interpret, and apply expected value. • Compare the expected value of a hypergeometric random variable to the mean of an experimental data set. • Investigate how changing the probability of "success" affects the shape of the probability histogram.	B1.5, B1.6, B1.1, B1.2, B1.3
9–10	Solve Problems	• Solve problems involving uniform, binomial, and hypergeometric distributions. • Apply probability distributions to real-world situations. • Solve problems related to the design of a game for the Games Fair project, (ensure that the expected value of the winnings falls within a given range).	B1.7, E1, E2
11-12	Games Fair Project data collection and presentation	• Present games and collect data. • Organize the data. • Compare the probability model to the data gathered at the *Games Fair*. • Interpret, analyse, and summarize the data. • Communicate findings.	E1, E2
13	Jazz		

75 min

Math Learning Goals

- Calculate, interpret, and apply Expected Value.
- Construct and analyse simple fair and unfair games, e.g., using familiar examples from Unit 1.

Materials

- simulation manipulatives (e.g., dice, counters, graphing calculator)
- BLM 4.3.1, 4.3.2

Assessment Opportunities

Minds On…

Think/Pair/Share → Exploration

Use an acetate of BLM 4.3.1 to introduce the Spin & Win game.

Individual students complete the Anticipation Guide "before" section (BLM 4.3.2.).

In pairs, students discuss the questions from the Anticipation Guide.

Pairs select from a variety of manipulatives and explore the game using a simulation of the game.

Engage students in a discussion of the difference of "chance" and "skill" highlighting that theoretical probabilities can be calculated for games of "chance" but not for games of "skill."

Playing the spinner game can be simulated, e.g., using a 6-sided number cube, a probability simulator.

Action!

Pairs → Experiment

Students determine experimentally the average winnings per game by:

- playing a specified number of trials (e.g., 25 trials), collecting data for each outcome, and determining average winnings per game;
- determining the average class winnings per game, showing calculations (post some strategies so that students will know how to do this).

Whole Group → Guided Discussion

Introduce the concept of Expected Value.

Students construct and complete the chart to determine the Expected Value of the Spin & Win Game:

Outcome	Theoretical Probability	Outcome × *P*(Outcome Occurs)

Summarize Expected Value [$E(x) = \sum$(outcome × P(outcome occurs)), or $E(x) = \sum(x \times P(X = x))$] and compare this value to the average winnings per game obtained experimentally.

Pairs → Explore

Students select What If… statements from a list provided by the teacher, e.g., What if …it costs $2 to play, is it a fair game? …the $5 prize increases to $6? …the $1 prize becomes "game over"? …the expected value must be between $1.40–$1.50?, and determine the effect on the expected value.

Process Expectations/Communicating/Observation: Observe pairs as they make changes to the game and connect results to expected value. Listen to discussions and ideas looking for items that students can share with others during the **Consolidate Debrief.**

Consolidate Debrief

Whole Class → Discussion

Develop a class definition of a Fair Game.

Individual → Self Assessment

Students complete the After section of the Anticipation Guide (BLM 4.3.2).

Application
Differentiated
Reflection

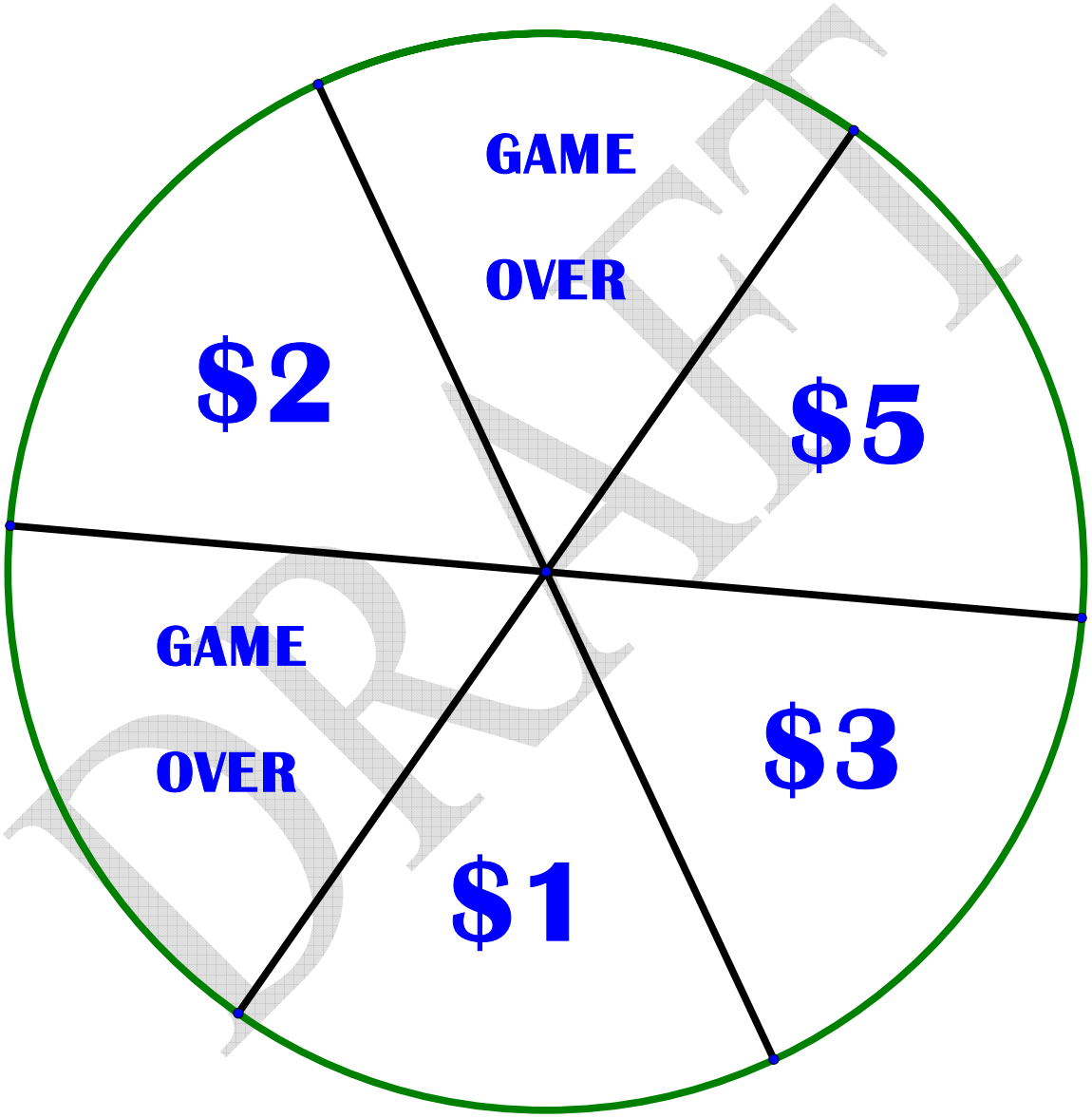
Home Activity or Further Classroom Consolidation

Create a new Spin & Win game that does not have 6 sections, determine the cost to play and the values for each outcome that will lead to an expected value in a set range. In your journal, discuss if the game is fair, with justification.

4.3.1: Spin & Win

Instructions

- one game costs $2 to play
- spin and win the amount shown

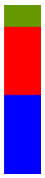


4.3.2: Anticipation Guide for Spin & Win

Instructions

- Check **Agree** or **Disagree**, in ink, in the **Before** category beside each statement before you start to play the Spin and Win game.
- Compare your choice with your partner.
- Revisit your choices at the end of the investigation.

Before		Statement	After	
Agree	**Disagree**		**Agree**	**Disagree**
		1. Playing this game requires skill.		
		2. You'll usually win when you play this game.		
		3. Every time you play this game, you have the same chance of losing.		
		4. This is a fair game.		


75 min

Math Learning Goals
- Calculate, interpret, and apply Expected Value.
- Develop a critique for peer assessment for the Games Fair.
- Make connections between the expected value and the weighted mean of the values of the discrete random variable.
- Introduce the Games Fair project and its connection to experimental and theoretical probability.

Materials
- Coins, dice, cards
- BLM 4.4.1

Assessment Opportunities

Minds On…

Whole Class → Inside Outside Circle
Students discuss the strategies they used in the homework activity from Day 3.

Whole Class → Discussion
Summarize and post the key strategies for altering the Expected Value of a game (e.g., change the dollar value or the probability of the outcome) and for determining the fairness of the game (e.g., the cost to play).

Inside Outside Circle see TIPS for Teachers, TIP 13, p. 14

Action!

Whole Class → Activity Instruction
Introduce the Lucky Aces game using the following chart:

Winning Amount ($)	Roll of 6 Sided Number Cube	Coin Toss	Card Draw
2	1 or 2	Heads	Red
4	3 or 4	Tails	Spades
6	5 or 6	Heads	Ace

All other combinations result in $0.
(The game involves rolling a die, flipping a coin and drawing a card from a standard deck).

Using a game in this way connects the concepts: tree diagrams, graphing probability distributions, and the Expected Value as they are related to the Games Fair project.

Later in the unit, introduce examples of games involving binomial and hypergeometric distributions so that students have examples of these distributions to guide them.

Pairs → Experiment
Students play the Lucky Aces game 20 times and collect data for the four possible outcomes in a tally chart.

Whole Class → Discussion
Students collate their results, record the experimental probabilities for each outcome, and construct the graph of the experimental probability distribution. Students calculate the theoretical probability of each outcome, using a probability tree diagram, graph the theoretical probability distribution, and calculate the Expected Value for this game.

Students dialogue about the differences between the experimental and theoretical probability distributions and explain their reasoning.

Learning Skills/Teamwork/Checkbric: Observe students as they play the game and record results. Note any areas of difficulty so they can be discussed during **Consolidate Debrief**.

Critique handouts could be provided to students ahead of the Games Fair. Feedback from peers may be used in the report to inform how the game might be improved.

Consolidate Debrief

Whole Class → Discussion
Introduce Games Fair (BLM 4.4.1).

Students assess the games Spin & Win BLM 4.3.1 and Lucky Aces using the criteria from Games Fair Assessment BLM 4.4.1 and discuss why Lucky Aces does not meet the criteria. Students identify any difficulties encountered in the Lucky Aces activity.

Brainstorm criteria for critiquing peers' games that will be used during the Games Fair. (e.g., clear instructions, inviting display, appears to be within the Expected Value range). Agree on approximately 5 that will be used for the critique.

Application *Exploration*	**Home Activity or Further Classroom Consolidation** Generate ideas for the design of your own game and produce an informal plan for a game for the Fair.	Students work on their game throughout the remainder of the unit.

4.4.1: Games Fair

To apply what you have learned about permutations, combinations, probability, and discrete probability distributions we are going to have a Games Fair! The high stakes Games Fair will take place over two classes.

Your task is to create an original, interesting, easy-to-play, and profitable game involving dice, spinners, cards, or any other reasonable item that introduces an element of chance. The game will require the participant to pay one or two 'Data Dollars' and all prizes must be payable in full 'Data Dollars.'

The expected value is dependent on the cost to play as identified in the chart:

Cost to Play One Game	Expected Value Range
$1	$0.60–$0.80
$2	$1.60–$1.80

On the first day of the Games Fair, half of the class are players, and the other half operate the games that they have created. On the second day, the roles are reversed. On Games Fair days, each player and each operator receives thirty 'Data Dollars.'

Operators

As an operator, create a tally chart for tracking all possible outcomes. If an operator or player no longer has enough ' Data Dollars ' to award a prize or continue playing, bankruptcy is declared and $30 is borrowed from the 'Data Bank.' At the end of each day of Games Fair, the player and the operator with the most 'Data Dollars' are declared "winners." Bankrupt players and/or operators are not eligible for a prize.

Players

On the day you are playing, you draw the names of three games. You must play each of these games a minimum of 5 times and provide a peer critique for each.
Each player must play every game at least twice.

After the Games Fair, you submit a report that includes:

- playing instructions and items required to play
- critiques from peers
- the theoretical probability of all possible game outcomes
- a graph of the theoretical distribution of all possible game outcomes
- a player's theoretical Expected Value
- a tally chart with the collected experimental results
- the experimental probability of all possible game outcomes
- a graph of the experimental distribution of all possible game outcomes
- a player's experimental return per game

In the report, analyse, and provide reasons for differences between the experimental and theoretical results for all the components of your game; address feedback shared in the critiques and provide suggested modifications to make your game "better." Make connections between your Game Fair experience and real world contexts.

4.4.1: Games Fair Assessment

Problem Solving				
Criteria	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Appling mathematical processes and procedures correctly to determine accurate theoretical and experimental results for the components of the game	– correctly applies some of the mathematical processes and procedures with major errors	– correctly applies many of the mathematical processes and procedures with some errors	– correctly applies the mathematical processes and procedures with few errors	– correctly applies the mathematical processes and procedures with precision and accuracy
Connecting				
Relating the mathematical ideas of the Games Fair to real contexts	– makes weak connections between experimental and theoretical results to real contexts	– makes simple connections between experimental and theoretical results to real contexts	– makes appropriate connections between experimental and theoretical results to real contexts	– makes strong connections between experimental and theoretical results to real contexts
Reasoning and Proving				
Interpreting the mathematical results from the Games Fair and making relevant statements	– misinterprets a major part of the results from the games fair, but carries on to make some otherwise reasonable statements	– misinterprets a minor part of the results from the games fair, but carries on to make some otherwise reasonable statements	– correctly interprets the results from the games fair and makes reasonable statements	– correctly interprets the results from the games fair and makes insightful statements
Making inferences, conclusions and justifications when comparing theoretical and experimental results	– differences between theoretical and experimental results are not justified	– some differences between theoretical and experimental results are justified	– differences between theoretical and experimental results are justified	– differences between theoretical and experimental results are highly justified
Reflecting				
Using metacognitive strategies to suggest improvements for a better game	– applies metacognitive strategies to suggest improvements for a better game with limited insightfulness	– applies metacognitive strategies to suggest improvements for a better game with some insightfulness	– applies metacognitive strategies to suggest improvements for a better game with insightfulness	– applies metacognitive strategies to suggest improvements for a better game with a high degree of insightfulness
Communicating				
Integrating narrative and mathematical forms of communication in the report	– either mathematical or narrative form is present in the report, but not both	– both mathematical and narrative forms are present in the report, but the forms are not integrated	– both mathematical and narrative forms are present and integrated in the report	– a variety of mathematical and narrative forms are present, integrated in the report, and well chosen

4.4.1: Games Fair Assessment (continued)

The report includes:

- ☐ playing instructions, items required to play, and peer critiques
- ☐ theoretical probability of each possible game outcome
- ☐ a graph of the theoretical distribution of all possible game outcomes
- ☐ a player's theoretical Expected Value (within range)
- ☐ a tally chart with collected experimental results
- ☐ experimental probability of each possible game outcome
- ☐ a graph of the experimental distribution of all possible game outcomes
- ☐ a player's experimental return per game
- ☐ suggestions to improve the game
- ☐ connecting between the Games Fair and real contexts

4.4.1: Games Fair (continued)

DATA BANK

$1

ONE DATA DOLLAR

DATA BANK

$1

ONE DATA DOLLAR

DATA BANK

$1

ONE DATA DOLLAR

DATA BANK

$1

ONE DATA DOLLAR

DATA BANK

$1

ONE DATA DOLLAR

DATA BANK

$1

ONE DATA DOLLAR

4.4.1: Games Fair (continued)

DATA BANK $2 TWO DATA DOLLARS	DATA BANK $2 TWO DATA DOLLARS
DATA BANK $2 TWO DATA DOLLARS	DATA BANK $2 TWO DATA DOLLARS
DATA BANK $2 TWO DATA DOLLARS	DATA BANK $2 TWO DATA DOLLARS

Unit 5: Modelling Continuous Data

Grade 12

Lesson Outline

Big Picture

Students will:

- describe the shapes of distributions of continuous data;
- extend the concept of a discrete probability distribution to a continuous probability distribution;
- understand the features of the normal distribution;
- apply normal distributions to real-world situations recognizing the role of variability.

Day	Lesson Title	Math Learning Goals	Expectations
1–2	Look At Continuous Data	• Identify a continuous random variable. • Distinguish between situations that result in discreet vs. continuous frequency distribution. • Recognize standard deviation as a measure of the spread of a distribution. • Determine the mean and standard deviation of a sample of values, with and without technology. • Recognize the need for mathematical models to represent continuous frequency distributions. • Use intervals to represent a sample of values of continuous random variables numerically (frequency table) and graphically (frequency histogram and polygon). • Use technology to compare the effectiveness of the frequency polygon as an approximation of the frequency distribution. • Recognize that the probability of a continuous random variable taking any *specific* value is zero.	B2.1, B2.2, B2.3, B2.4, B2.5
3–5	Normal Distributions	• Recognize important features of a normally distributed data, e.g., bell-shaped, the percentages of data values within one, two, and three standard deviations of the mean. • Recognize and describe situations that might be normally distributed. • Investigate the conditions under which the shape of a binomial distribution approaches a normal distribution, i.e., as the number of trials increases and/or the probability of "success" gets closer to one-half. • Investigate the conditions under which the shape of a hypergeometric distribution approaches a normal distribution, i.e., as the number of dependent trials increases and/or the probability of "success" gets closer to one-half. • Use a discrete probability distribution to approximate the probability that a normal random variable takes on a specific range of values. • Recognize that a continuous probability distribution is used to calculate the probability that a random variable takes on a range of values.	B2.5, B2.6, B2.7

Day	Lesson Title	Math Learning Goals	Expectations
6–7	Probabilities In A Normal Distribution	• Define and calculate *z*-scores.	D1.2, B2.8
8–9	Solving Problems Using The Normal Distribution	• Use the normal distribution to model one-variable data sets after determining that such a model might be suitable. • Interpret, for a normally distributed population, the meaning of a statistic qualified by a statement describing the margin of error. Recognize that this is one way to account for variability. • Solve probability problems involving normal distribution using a variety of tools and strategies. • Apply normal distributions to real-world situations.	D1.4, B2.8
10–11	Summative, Jazz		