Mathematics of Data Management, Grade 12, University Preparation

Course Title: Mathematics of Data Management
Course Code: MDM4U
Grade: 12
Course Type: University Preparation
Credit Value: 1.0
Prerequisites: MCF3M (Functions and Applications), or MCR3U (Functions)

Curriculum Document: Mathematics, The Ontario Curriculum, Grades 11 and 12, 2007 (Revised)
Developed By: Sarah McKercher
Department: Mathematics
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Teacher(s):

Priscilla Chan B.A. Hons. Quantitative Analysis for Business, M.Ed., OCT

Course Description:

This course broadens students' understanding of mathematics as it relates to managing data. Students will apply methods for organizing and analysing large amounts of information; apply counting techniques, probability, and statistics in modelling and solving problems; and carry out a data management investigation that integrates the expectations of the course and encourages perseverance and independence. Students planning to pursue university programs in business, the social sciences, or the humanities will find this course of particular interest.

Unit Title and Description	Time Allocated
Tools for Data Management Data Management comprises all the disciplines related to managing data as a valuable resource. Tools for managing data will be explored and used, as we lay the foundation for a structure that allows us to use data meaningfully and wisely to make decisions. In this course we will be using spreadsheets and graphing software to perform complex calculations and link, search, sort and graph data. Among other assignments students are introduced in this unit to the Statistics Canada website where they will learn methods of data retrieval and the creation of graphs using CANSIM. This course involves a data management investigative (DMI) that stretches over the first four units. In this unit, students will formulate and submit their hypothesis.	12 Hours
Collecting Data To summarize data and recognize the trends, we use tables and graphs. In this unit, students will demonstrate an understanding of the role of data in statistical studies	12 Hours

and the variability inherent in data, and distinguish different types of data. Students will also 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. Finally, students will demonstrate an understanding of the applications of data management used by the media and the advertising industry and in various occupations. The DMI continues in this unit and students use statistical skills to appropriately collect and record information.	
One Variable Statistics This unit will focus on the analysis and presentation of one-variable data. Students will process raw data and develop the skills to summarize it in terms of central tendency, spread, and distribution. Students will analyze, interpret, and draw conclusions from one-variable data using numerical and graphical summaries and explore methods of describing a single piece of data in the context of a wider data set. Students use a variety of different software to analyze the presentation of data that has been collected and processed by others. They develop the critical thinking skills necessary to interpret and assess the validity of secondary data and conclusions drawn from it, maintaining an awareness of the possibility of bias and misrepresentation, either deliberate or accidental. Students submit the third part of their DMI where they process and analyse their individual data sets.	17.5 Hours
Two Variable Statistics Two-variable statistics are the basis for many decisions personally and as a society. Although most two-variable statistical tests are beyond the scope of secondary school math, this unit will examine some of the basic topics in two-variable statistics. Two-variable statistics provide methods for detecting relationships between variables and for developing mathematics of these relationships. The visual pattern in a graph or plot can often reveal the nature of the relationship between two variables. In this unit students will analyse, interpret, and draw conclusions from two-variable data using numerical, graphical, and algebraic summaries. Students complete the last part of their DMI where they perform analysis of the relationship between the sets of their information, and use critical thinking skills to formulate a final conclusion relating to their initial hypothesis.	18 Hours
Combinatorics Combinatorics is the branch of mathematics dealing with ideas and methods for counting, especially in complex situations. The techniques and mathematical logic for counting possible arrangements or outcomes are useful for a wide variety of applications. A computer programmer writing software for a game or industrial process would use these techniques, as would a basketball coach planning potential line-ups for a game, or a school board trying to make the most efficient use of its buses. Students will investigate the concepts of combinations and permutations. They will consider situations in which each should be used, and develop the skills to be able to determine which is most appropriate.	16 Hours
Probability Probability was first studied mathematically in the 17th century when Pierre de Fermat and Blaise Pascal attempted to analyze problems associated with gambling. Modern probability theory grew from their correspondence. In this unit students will solve problems involving the probability of an event or a combination of events for discrete sample spaces. Students will solve problems involving the application of	16 Hours

permutations and combinations to determine the probability of an event, and demonstrate an understanding of discrete probability distributions, representing them numerically, graphically, and algebraically. Students will also determine expected values, and solve related problems from a variety of applications.	
The Normal Distribution Students will gain an understanding of continuous distributions, and will investigate different shapes of distribution, considering situations that may generate them. Students will explore the normal distribution in detail, and investigate its many applications. They will make comparisons between the normal and binomial distributions. They will form an understanding of the conditions in which they might be used interchangeably, and develop the skills that will allow them to decide how and when to make use of these properties.	16 Hours
Final Assessment The final assessment for this course consists of a final exam that is worth 30% of a student's overall grade.	2.5 Hours

Overall Curriculum Expectations
Counting and Probability 1. solve problems involving the probability of an event or a combination of events for discrete sample spaces; 2. solve problems involving the application of permutations and combinations to determine the probability of an event
Probability and Distributions 1. 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; 2. 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.
Organization of Data for Analysis 1. demonstrate an understanding of the role of data in statistical studies and the variability inherent in data, and distinguish different types of data; 2. 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.
Statistical Analysis 1. analyse, interpret, and draw conclusions from one-variable data using numerical and graphical summaries; 2. analyse, interpret, and draw conclusions from two-variable data using numerical, graphical, and algebraic summaries; 3. demonstrate an understanding of the applications of data management used by the media and the advertising industry and in various occupations.
Culminating Data management Investigation

1. 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;
2. communicate the findings of a culminating investigation and provide constructive critiques of the investigations of others.

Resources Required:

This course is entirely online and does not require nor rely on any textbook. The materials required for the course are:

- A scanner, smart phone camera, or similar device to digitize handwritten or hand-drawn work,
- A non-programmable, non-graphing, scientific calculator.
- Spreadsheet software
- Word processing software

Teaching and Learning Strategies:

The overriding aim of this course is to help students use the language of mathematics skillfully, confidently, and flexibly. A wide variety of instructional strategies are used to provide learning opportunities to accommodate a variety of learning styles, interests, and ability levels. The following mathematical processes are used throughout the course as strategies for teaching and learning the concepts presented:

- *Problem solving*: This course scaffolds learning by building off of skills learned in each unit. Students will work on a single project across multiple units, applying what they have learned in each unit to further analyze the data they have collected. The course guides students toward recognizing opportunities to apply knowledge they have gained to solve problems.
- *Representing*: Through the use of examples, practice problems, and solution videos, the course models various ways to demonstrate understanding, poses questions that require students to use different representations as they are working at each level of conceptual development – concrete, visual or symbolic, and allows individual students the time they need to solidify their understanding at each conceptual stage.
- *Connecting*: Students will connect concepts learned in this course to real-world applications of statistics and probability through investigations and assignments.
- *Self-Assessment*: Through the use of interactive activities (e.g. multiple choice quizzes, and drag-and-drop activities) students receive instantaneous feedback and are able to self-assess their understanding of concepts.

Assessment and Evaluation Strategies

Every student attending Christian Virtual School is unique. We believe each student must have the opportunities to achieve success according to their own interests, abilities, and goals. Like the

Ministry of Education, we have defined high expectations and standards for graduation, while introducing a range of options that allow students to learn in ways that suit them best and enable them to earn their diplomas. Christian Virtual School's Assessment, Evaluation, and Reporting Policy is based on seven fundamental principles, as outlined in the Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools document.

When these seven principles are fully understood and observed by all teachers, they guide the collection of meaningful information that helps inform instructional decisions, promote student engagement, and improve student learning. At Christian Virtual School, teachers use practices and procedures that:

- are fair, transparent, and equitable for all students;
- support all students, including those with special education needs, those who are learning English, and those who are First Nation, Métis, or Inuit;
- are carefully planned to relate to the curriculum expectations and learning goals and, as much as possible, to the interests, learning styles and preferences, needs, and experiences of all students;
- are communicated clearly to students and parents or guardians at the beginning of the school year or course and at other appropriate points throughout the school year or course;
- are ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning;
- provide ongoing descriptive feedback that is clear, specific, meaningful, and timely to support improved learning and achievement; and
- develop students' self-assessment skills to enable them to access their own learning, set specific goals, and plan next steps for their learning.

For more information on Christian Virtual School's general assessment and evaluation strategies, you can refer to our Assessment, Evaluation, and Reporting Policy.

To ensure that we are meeting the principles of *Growing Success*, we carefully plan all the assessments within our courses.

First and foremost, they are designed as opportunities for students to improve their learning. Assessment for the purpose of improving student learning is seen as both "assessment for learning" and "assessment as learning," according to *Growing Success*. As part of assessment for learning, teachers provide students with descriptive feedback and coaching for improvement. Teachers engage in assessment as learning by helping all students develop their capacity to be independent, autonomous learners who can set individual goals, monitor their own progress, determine next steps, and reflect on their thinking and learning. Examples of these types of assessments in this course include:

Assessment for Learning	Assessment as Learning
Discussion activities	Reflection activities
Practice quizzes	Self-directed exercises
Practice assignments	

Second, we focus on a balance between assessing students' acquisition of knowledge as well as their skills of thinking, communication, and application of subject-specific material. In this course, you can expect assessment to be divided into the following balance:

Percentage	Skill
20	Knowledge and Understanding: Subject-specific content acquired and the comprehension of its meaning and significance
30	Thinking/Inquiry: The use of critical and creative thinking skills and/or processes
20	Communication: The conveying of meaning through various forms
30	Application: The use of knowledge and skills to make connections within and between various contexts

Lastly, the assessments are designed so that teachers have an opportunity to gain an understanding of a student's learning through direct observation of students, one-on-one conversations with students, and evaluating products that students submit. Examples of these methods in this course include:

Observation	Conversation	Product
Practice assignments	Interaction through emails	Unit tests
Practice quizzes	Teacher-student discussions	Problem sets

Program Planning Considerations

Each of our courses have been designed by a team of educators to create an environment infused with creativity, flexibility, choice, and variety, with the goal to help every student succeed. We also take into consideration several topics that span disciplines and ensure we incorporate these into each of our courses.

Program Planning Considerations
Students with Special Needs Christian Virtual School is committed to ensuring that all students are provided with the learning opportunities and supports they require to succeed. Our courses are made to offer flexible, personalized learning experiences. By maintaining an asynchronous model, students can move through their courses at their own pace, ensuring they are able to take the time they need to understand concepts or work with their teacher if they hit roadblocks. Christian Virtual School courses also incorporate choice, allowing students to submit work in a variety of mediums or formats to communicate their ideas. In addition to the flexibility built into the courses, Christian Virtual School will implement the accommodations that are listed in a student's Individual Education Plan (IEP) that are applicable to the online learning environment. In these cases, the learning expectations will be the same as or similar to the expectations outlined in the curriculum document but supports will be provided to help students achieve those expectations. Common accommodations in the environment are reducing the workload, simplifying

tasks and materials, providing extra time for tests and exams, allowing scribing or the use of specialized equipment, and not deducting marks for spelling.

English Language Learners

Although all our courses are only offered in English at this time, Christian Virtual School welcomes students learning the English language. Students do need to meet a baseline proficiency level to access the content, but Christian Virtual School teachers are responsible for helping students develop their English literacy skills no matter the course they are enrolled in.

Upon enrollment, students are asked if they would like to provide information about their English language background, and this information is used by our teachers to help them adjust their instruction and suggest accommodations within the courses. English language learners are encouraged to reach out to their teacher or the Christian Virtual School administration to talk about the accommodation options in their courses so that the appropriate opportunities are given to everyone.

Environmental Education

Christian Virtual School operates with 5 cores values: responsibility, perseverance, integrity, compassion, and community. These core values determine our business operations, as well as exemplify what we, as educations, want to instill in our students. Environmental education, among other causes, are important to us as a school and we strive to promote learning about these issues and solutions within our courses. We work to educate students on the environment, its threats, and the importance of sustainability. We also work to inspire students to make an impact within their community and identify an alignment between their passions and the local, or global, needs.

Environmental education is woven throughout our course content, across all disciplines. Depending on the course and subject matter, this education can be subtle or explicit, but the goal is to ensure that students have the opportunity to acquire the knowledge, skills, perspective and practices needed to become an environmentally literate citizen.

Equity and Inclusive Education

Christian Virtual School stands on the belief that every person is unique and, regardless of ancestry, culture, ethnicity, sex, physical or intellectual ability, race, religion, sexual orientation, socio-economic status, or other similar factor, they are to be welcomed, included, accepted, treated fairly, and respected. As a school, we teach students about multiple worldviews, how to identify and acknowledge similarities and differences, and how to communicate with others in an inclusive, kind, loving, and compassionate way.

Diversity is valued at Christian Virtual School, and it is our goal to ensure all members of the community feel safe, comfortable, and accepted. Our courses are written to draw attention to the contributions of men and woman alike, the different perspectives of various cultural, religious, and racial communities, and the beliefs and practices of First Nations, Métis, and Inuit peoples, to showcase a wide range of backgrounds and allow all of our students to see themselves reflected in the curriculum.

As a school, we see and recognize the diversity of families, children, and people in the world in need of Christ's love. We work every day to spread the love and acceptance of Christ.

Financial Literacy Education

Whenever possible, Christian Virtual School emphasizes the importance of financial literacy. Making financial decisions has become an increasingly complex task, and students need to have knowledge in many areas and a wide range of skills in order to make informed decisions about financial matters. In addition to the concrete skills of numeracy and finances from a mathematical point of view, students need to develop an understanding of the economic forces and ways in which they can respond to those influences.

Lessons that promote skill building in problem solving, inquiry, research, decision making, reflection, and critical thinking are present throughout Christian Virtual School courses. The goal is to help students acquire the knowledge and skills required to understand their own finances, as well as to develop an understanding of local and global effects of world economic forces and the social, environmental, and ethical implications of their own choices.

The Role of Information and Communication Technology

Technology is rapidly changing, and the requirements for literacy in technology is growing just as quickly. Students entering the workforce are expected to have a firm grasp of information and communication technologies and be skilled their use.

Due to the nature of Christian Virtual School courses, students are exposed to a wide range of technologies to both facilitate and communicate their learning. As a result, students will develop transferable skills through their experience with word processing, information processing, internet research, presentation software, communication tools, and more.

Career Education

Opportunities are present throughout Christian Virtual School courses to explore careers related to the different disciplines and subject areas. Students are exposed to a wide variety of modern careers, fields of study, and employment opportunities.

In addition, teachers are available to help the student prepare for employment in a number of diverse areas. With the help of teachers, students will learn to set and achieve goals and gain experience in making meaningful decisions concerning career choices. The skills, knowledge, and creativity that students acquire through our course are essential for a wide range of careers.

Health and Safety

In order to provide a suitable learning environment for the Christian Virtual School staff and students, it is critical that the courses and the learning environment complies with relevant federal, provincial, and municipal health and safety legislation and by-laws, including, but not limited to, the Workplace Safety and Insurance Act, the Workplace Hazardous Materials Information System (WHMIS), the Food and Drug Act, the Health Protection and Promotion Act, the Ontario Building Code, and the Occupational Health and Safety Act (OHSA).

Consideration of students' health and safety is taken when planning activities, investigations, and experiments for our courses to ensure that proper safety precautions are communicated to and attainable for students.