Insight Academy of Canada

Course Outline

Course Title	Mathematics of Data Management, Grade 12, University Preparation (MDM4U)
Grade	12
Course Type	University
Course Code	MDM4U
Credit Value	1.0
Curriculum Policy Documents	The Ontario Curriculum, Grades 11 and 12: Mathematics, 2007 (revised) Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, 2010
Prerequisite(s)	Functions, Grade 11, University Preparation (MCR3U), or Functions and Applications, Grade 11, University/College Preparation (MCF3M)

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; solve problems involving probability and statistics; and carry out a culminating investigation that integrates statistical concepts and skills. Students will also refine their use of the mathematical processes necessary for success in senior mathematics. Students planning to enter university programs in business, the social sciences, and the humanities will find this course of particular interest.

Overall Curriculum Expectations

A. Counting and Probability By the end of this course, students will:	
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.
B. Probability Distributions By the end of this course, students will:	
B1	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;
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.
C. Organization of Data for Analysis By the end of this course, students will:	
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.
D. Statistical Analysis By the end of this course, students will:	
D1	Analyze, interpret, and draw conclusions from one-variable data using numerical and graphical summaries;
D2	Analyze, 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 in various occupations.

	E. Culminating Data Management Investigation By the end of this course, students will:		
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.		

Outline of Course Content

Unit No.	Unit Title	Instructional Time	Overall Expectations
1	Introduction to Probability	12 hours	A1
2	Permutations	12 hours	A2
3	Combinations	12 hours	A2
4	Probability Distributions for Discrete Variables	12 hours	A1, B1
5	Organization of Data for Analysis	12 hours	C1, C2, D3
6	One-Variable Data Analysis	12 hours	D1, D3, E1
7	Probability Distributions for Continuous Variables	12 hours	B2, D1, D2
8	Two-Variable Data Analysis	12 hours	D2, D3
9	Culminating Investigation	14 hours	E1, E2
Total Instructional Time		110 HOURS	
10	Final Exam	2 hours	All

Unit Descriptions
The entire course is delivered online

Unit 1: Introduction to Probability

In this unit, students will be introduced to the basic concepts that define probability theory. Students will be exposed to basic probability distributions, binomial distributions and hypergeometric distributions. Probability Distributions will be created in a Table then graphed into a histogram to analyze the probability of each event happening. Students will apply the Binomial Distribution, and Hypergeometric Distribution formulae

This unit introduces 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 in contexts involving simple counting (e.g. where the sample space is given)

This unit helps students understand that this course requires new ways of thinking mathematically that is less algebraic than earlier courses.

Beginning the course 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.

Specific Expectations: A1.1, A1.2, A1.3, A1.4 A1.5, A1.6, A2.1, A2.3, A2.5

Unit 2: Permutations

In this unit, students will be expected to:
- make connections between situations involving the use of permutations,
- develop, through investigation the number of permutations and to use mathematical notation to count, solving counting problems using counting principles – additive, multiplicative
- solve probability problems using counting principles

Specific Expectations: A2.1, A2.2, C1.1, C1.2, C1.3, C1.5, C1.6

Unit 3: Combinatorics

Combinatorics is the branch of mathematics dealing with ideas and methods for counting, especially in complex situations. 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.

Specific Expectations: A2.1, A2.2, A2.4, A2.5

Unit 4: Probability Distributions for Discrete Variables

Students will be introduced to the concept of a discrete variable distribution and be introduced to: the Binomial probability distribution, Hypergeometric probability distributions, Multinomial probability distributions and, Negative binomial distributions

Specific Expectations: A1.1, A1.3, A1.4, A1.5, A1.6, B1.1, B1.2, B1.3, B1.4, B1.5, B1.6, B1.7

Unit 5: Organization of Data for Analysis

In this unit, students will demonstrate an understanding of the role of data in statistical studies, describe the characteristics of a good sample and compare sampling techniques. They will design an effective survey and collect data displaying an understanding of how data is organized
At the end of the unit students will locate sources of data, refine topic of interest and design a plan in preparation for the Culminating Investigation

Specific Expectations: C1.1, C1.2, C1.3, C2.1. C2.1, C2.3, C2.4, C2.5, E1.1, E1.2

Unit 6: One-Variable Data Analysis

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.

Specific Expectations: D1.2, D3, E1.1, E1.2, E1.3

Unit 7: Probability Distributions for Continuous Variables

If probability distributions can be classified as discrete probability distributions or as continuous probability distributions, depending on whether they define probabilities associated with discrete variables or continuous variables. In this unit, students will develop and understanding and apply the equation used to describe a continuous probability distribution - the **probability density function**. Sometimes, it is referred to as a **density function**, a **PDF**, or a **pdf**.

Specific Expectations: B2.1, B2.2, B2.3, B2.4, B2.5, B2.6, B2.8, D1.1, D1.2, D1.3, D1.4, D1.5, D2.1, D2.2, D2.3, D2.5, D2.6, E1

Unit 8: Two-Variable Data Analysis

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.

Specific Expectations: D2.1, D2.2, D2.3, D2.5, D3.1, 3.2, D3.3, E1.1, E1.2, E1.3, E1.5

Unit 9: Culminating Investigation

In this unit, student will 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. Students then communicate the findings of a culminating investigation and provide constructive critiques of the investigations of others.

Specific Expectations: E1.6, E2.1, E2.2, E2.3, E2.4

Teaching and Learning Strategies

Effective instruction is key to student success and students learn best when they are engaged in a variety of ways of learning. Teachers at Insight Academy of Canada (IAC) provide numerous opportunities and use a variety of instructional, assessment, and evaluation strategies to help students develop skills of inquiry, problem solving, and communication as they investigate and learn fundamental concepts. The activities offered enable students not only to make connections among these concepts throughout the course but also to relate and apply them to relevant societal, environmental, and economic contexts. Opportunities to relate knowledge and skills to these wider contexts will motivate students to learn and to become lifelong learners.

The following seven mathematical process expectations describe a set of skills that support lifelong learning in mathematics and that students need to develop on an ongoing basis, as they work to achieve the expectations outlined within the course.
- Problem Solving: develop, select, apply, compare, and adapt a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- Reasoning and Proving: develop and apply reasoning skills to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments;
- Reflecting: demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem;
- Selecting Tools and Computational Strategies: select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- Connecting: make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts;
- Representing: create a variety of representations of mathematical ideas, connect and compare them, and select and apply the appropriate representations to solve problems;
- Communicating: communicate mathematical thinking orally, visually, and in writing, using precise mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

Each unit of the course contains a Unit Overview, a number of lessons, a Unit Review Assignment, a Unit Quiz, a Unit Test, and a Unit Exit Card. Lessons are delivered through the following format.
- Mind on. Students are introduced to the content through a variety of exploratory and instructional strategies including watching online videos.
- Actions. Students practice and apply their new learning through worked examples, investigation, and exploration. Students are actively engaged in their assessment process as they monitor their own learning to determine their next steps and set individual learning goals.
- Consolidation. Students are provided opportunities to demonstrate what they have learned through independent practice, reflection assignment and discussion posts (Exit Slip).
- Extension Activities. Students study extra lesson resources, complete homework assignment, and response to teacher's follow-up questions to expand their learning and prepare for unit test.

A variety of teaching and learning strategies will be used in this course.

Direct Instruction Strategies	Independent Learning Strategies
• Online lecture	• Homework Q&A

- Video/Animation - Examples of full solutions - Scaffolding - Administering probes and/or prompts - Providing descriptive feedback - Providing pictorial or diagram presentation - Allowing independent practice and individually paced instruction - Teacher modelling - Providing individual instruction - Class activity, practice - Class and 1:1 Discussion/Chat - Student-Teacher Conferences - Q&A - Review, Seminar - Virtual Office Hours	- Handout, Work and Task Sheet - Class Investigations - Independent Study (teacher direction) - Self-Assessment - Self-regulation - Self-reflection - Exit Card - Survey - Learning Log - ePortfolio - Computer-Assisted Instruction - Interactive Online Activity - Student Exploration Tasks - Simulation - Graphing Software
Cooperative Strategies - Discussion Boards - Group/Peer Discussion (Think-Pair-Share) - Emails - Peer Conferencing - Peer Assessment - Peer Feedback	**Thinking-Skills Strategies** - Opinion Sharing/Commentary Offering - Oral Explanation - Presentation - Problem-Based Learning - Problem Solving - Reasoning and Proving - Reflective Thinking - Research Process - Case Study

Strategies for Assessment & Evaluation of Student Performance

Insight Academy of Canada's (IAC) Assessment and Evaluation policy is aligned with the Ministry of Education's Growing Success policy document which outlines the assessment, evaluation, and reporting policies and practices in Ontario schools.

Basic Considerations

The primary purpose of assessment and evaluation is to improve student learning. Assessment is the process of gathering information from a variety of sources that accurately reflects how well a student is achieving the curriculum expectations in a course. Evaluation refers to the process of judging the quality of student learning on the basis of established performance standards, and assigning a value to represent that quality.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, IAC teachers will use assessment and evaluation strategies that:
- are fair, transparent, and equitable for all students;
- support all students, including those with special education needs, those who are learning the language of instruction (English or French), 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 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;
- develop students' self-assessment skills to enable them to assess their own learning, set specific goals, and plan next steps for their learning

Evaluation and Reporting of Student Achievement

Insight Academy of Canada's (IAC) will use the Provincial Report Card, Grades 9–12, for formal written reports to students and parents two times a term. The report card provides a record of the student's achievement of the curriculum expectations in the course, at particular points in the school year or term, in the form of a percentage grade. The percentage grade represents the quality of the student's overall achievement of the expectations for the course and reflects the corresponding level of achievement as described in the achievement chart for the discipline.

A final grade is recorded for the course, and a credit is granted and recorded for the course in which the student's grade is 50% or higher. The final grade for the course will be determined as followings:
- Seventy per cent of the grade will be based on evaluations conducted throughout the course. This portion of the grade will reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.
- Thirty per cent of the grade will be based on a final evaluation in the form of a combination of both an examination and an investigation project and administered at the end of the course.

Assessment and Evaluation Categories and Weights			
Achievement Categories	Percent	Evaluation for Final Grade	Percent
Knowledge/Understanding	25%	Term Work	70%
Inquiry/Thinking	25%	Final Evaluation	30%
Communication	25%	Culminating Investigation	10%
Application	25%	Final Exam	20%

Reporting on Demonstrated Learning Skills & Work Habits

The report card provides a record of the learning skills demonstrated by the student in every course, in the following six categories: Responsibility, Organization, Independent Work, Collaboration, Initiative & Self-regulation. These learning skills and work habits are evaluated using a four-point scale (E-Excellent, G-Good, S-Satisfactory, N-Needs Improvement). The separate evaluation and

reporting of the learning skills and work habits in these six areas reflect their critical role in students' achievement of the curriculum expectations. To the extent possible, the evaluation of learning skills and work habits, apart from any that may be included as part of a curriculum expectation in a course, should not be considered in the determination of percentage grades.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, I.A.C teachers use a variety of strategies throughout the course.