Erindale College

Assessment Period:	**2021 S2**
Course:	**MATHEMATICAL METHODS**
Unit:	**Unit 4: Mathematical Methods (1.0)**
Accreditation:	**T**
Year:	**12**

Unit Goals

- understand the concepts and techniques in calculus, probability and statistics
- solve problems in calculus, probability and statistics
- apply reasoning skills in calculus, probability and statistics
- interpret and evaluate mathematical and statistical information and ascertain the reasonableness of solutions to problems.
- communicate their arguments and strategies when solving problems.

Content Description

Topic 1: The Logarithmic function

- Logarithmic functions:
  - o define logarithms as indices: $a^x = b$ is equivalent to $x = \log_a b$ i.e. $a^{\log_a b} = b$
  - o establish and use the algebraic properties of logarithms
  - o recognise the inverse relationship between logarithms and exponentials: $y = a^x$ is equivalent to $x = \log_a y$
  - o interpret and use logarithmic scales such as decibels in acoustics, the Richter Scale for earthquake magnitude, octaves in music, pH in chemistry
  - o solve equations involving indices using logarithms
  - o recognise the qualitative features of the graph of $y = \log_a x (a > 1)$ including asymptotes, and of its translations $y = \log_a x + b$ and $y = \log_a (x + c)$
  - o solve simple equations involving logarithmic functions algebraically and graphically
  - o identify contexts suitable for modelling by logarithmic functions and use them to solve practical problems.

- Calculus of logarithmic functions: ·
  - o define the natural logarithm $\ln x = \log_e x$
  - o recognise and use the inverse relationship of the functions $y = e^x$ and $y = \ln x$
  - o establish and use the formula $\frac{d}{dx}(\ln x) = \frac{1}{x}$
  - o establish and use the formula $\int \frac{1}{x} dx = \ln x + c$, for $x > 0$
  - o use logarithmic functions and their derivatives to solve practical problems.

Topic 2: Continuous random variables and the normal distribution

- General continuous random variables:

- use relative frequencies and histograms obtained from data to estimate probabilities associated with a continuous random variable
- understand the concepts of a probability density function, cumulative distribution function, and probabilities associated with a continuous random variable given by integrals; examine simple types of continuous random variables and use them in appropriate contexts
- recognise the expected value, variance and standard deviation of a continuous random variable and evaluate them in simple cases
- understand the effects of linear changes of scale and origin on the mean and the standard deviation.

- Normal distributions:
  - identify contexts such as naturally occurring variation that are suitable for modelling by normal random variables
  - recognise features of the graph of the probability density function of the normal distribution with mean μ and standard deviation σ and the use of the standard normal distribution
  - calculate probabilities and quantiles associated with a given normal distribution using technology, and use these to solve practical problems.

Topic 3: Interval estimates for proportions

- Random sampling:
  - understand the concept of a random sample
  - discuss sources of bias in samples, and procedures to ensure randomness
  - use graphical displays of simulated data to investigate the variability of random samples from various types of distributions, including uniform, normal and Bernoulli.

- Sample proportions:
  - understand the concept of the sample proportion $\hat{p}$ as a random variable whose value varies between samples, and the formulas for the mean p and standard deviation $\sqrt{p(1-p)/n}$ of the sample proportion $\hat{p}$
  - examine the approximate normality of the distribution of $\hat{p}$ for large samples
  - simulate repeated random sampling, for a variety of values of p and a range of sample sizes, to illustrate the distribution of $\hat{p}$ and the approximate standard normality of $\frac{\hat{p}-p}{\sqrt{\hat{p}(1-\hat{p})/n}}$ where the closeness of the approximation depends on both *n* and *p*.

- Confidence intervals for proportions:
  - the concept of an interval estimate for a parameter associated with a random variable
  - use the approximate confidence interval $\left(\hat{p}-z\sqrt{\hat{p}(1-\hat{p})/n}, \hat{p}+z\sqrt{\hat{p}(1-\hat{p})/n}\right)$ as an interval estimate for p ,where z is the appropriate quantile for the standard normal distribution
  - define the approximate margin of error $E=z\sqrt{\hat{p}(1-\hat{p})/n}$ and understand the trade-off between margin of error and level of confidence
  - use simulation to illustrate variations in confidence intervals between samples and to show that most but not all confidence intervals contain p

Assessment Tasks

Name	Due Date	Weighting
Assignment 1	16 August - 20 August	25%
Exam 1	3 September - 8 September	30%
Validation Tasks	Ongoing Assessment: 12 July - 16 November	15%
Exam 2	17 November - 19 November	30%

Specific Unit Information

Students require a graphics calculator for this course. These are available for hire at a cost of $100 per year, consisting of a $50 hire fee and a $50 refundable deposit. Students may choose to purchase or provide their own calculator.

School Assessment Information

For penalties for late and non-submission of work

See BSSS Policy and Procedure Manual 4.3.10 for further information.

For academic integrity

See BSSS Policy and Procedure Manual 4.3.12 for further information.

For appeals processes

See BSSS Policy and Procedure Manual 7.2 for further information.

For moderation procedures (internal and external)

See BSSS Policy and Procedure Manual 5 for further information.

For meshing procedures

See BSSS Policy and Procedure Manual 5.4.1 for further information.

For method of unit score calculation

See BSSS Policy and Procedure Manual 4.3.6.2 for further information.

For procedures for calculating course scores

See BSSS Policy and Procedure Manual 4.3.13.2 for further information.

Achievement Standards for MATHEMATICAL METHODS T - Year 12

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Reasoning and Communications	• represents some mathematical concepts in numerical, graphical and symbolic form in routine and non-routine problems in a variety of contexts • communicates mathematical judgements and arguments in oral, written and/or multimodal forms, which are succinct and reasoned, using appropriate and accurate language • evaluates the solutions to routine and non-routine problems in a variety of contexts • evaluates methods and models for their strengths and limitations when developing solutions to routine and non-routine problems • reflects with insight on their own thinking and that of others and evaluates planning, time management, use of appropriate strategies to work independently and collaboratively • evaluates the potential of Mathematics to generate knowledge in the public good	• represents mathematical concepts in numerical, graphical and symbolic form in routine and non-routine problems in a variety of contexts • communicates mathematical judgements and arguments in oral, written and/or multimodal forms, which are clear and reasoned, using appropriate and accurate language • analyses the solutions to routine and non-routine problems in some contexts • analyses strengths and limitations of models used when developing solutions to routine and non-routine problems • reflects on their own thinking and analyses planning, time management, use of appropriate strategies to work independently and collaboratively • analyses the potential of Mathematics to generate knowledge in the public good	• represents mathematical concepts in numerical, graphical and symbolic form in some routine and non-routine problems in some contexts • communicates mathematical judgements and arguments in oral, written and/or multimodal forms, using appropriate and accurate language • explains solutions to some routine and non-routine problems in some contexts • explains strengths and limitations of models used when developing solutions to some routine and non-routine problems • reflects on their own thinking and explains planning, time management, use of appropriate strategies to work independently and collaboratively • explains the potential of Mathematics to generate knowledge in the public good	• represents simple mathematical concepts in numerical, graphical or symbolic form in routine problems in structured contexts • communicates simple mathematical judgements or arguments in oral, written and/or multimodal forms, with some use of appropriate language • describes solutions to routine problems in limited contexts • describes strengths or limitations of simple models when solving routine problems • reflects on their own thinking with some reference to planning, time management, use of appropriate strategies to work independently and collaboratively • describes the potential of Mathematics to generate knowledge in the public good	• represents simple mathematical concepts in numerical, graphical or symbolic form in in simple problems in structured contexts • communicates simple mathematical information in oral, written and/or multimodal forms, with limited use of appropriate language • identifies solutions to routine problems in structured contexts • identifies strengths or limitations of simple models in relation to routine problems • reflects on their own thinking with little or no reference to planning, time management, use of appropriate strategies to work independently and collaboratively • identifies some ways in which Mathematics is used to generate knowledge in the public good
Concepts and Techniques	• critically and creatively applies mathematical concepts in a variety of complex contexts to routine and non-routine problems • synthesises information to select and apply mathematical techniques to solve complex problems in a variety of contexts • constructs, selects and applies mathematical models to a variety of contexts in routine and non-routine problems • uses digital technologies efficiently to solve routine and non-routine problems in a variety of contexts	• critically applies mathematical concepts in a variety of contexts to routine and non-routine problems • analyses information to select and apply mathematical techniques to solve routine and non-routine problems in a variety of contexts • selects and applies mathematical models to routine and non-routine problems in a variety of contexts • uses digital technologies effectively to solve routine and non-routine problems in a variety of contexts	• applies mathematical concepts in some contexts to routine and non-routine problems • selects and applies mathematical techniques to solve routine and some non-routine problems in some contexts • applies mathematical models to routine and non-routine problems in some contexts • uses digital technologies appropriately to solve routine and non-routine problems in a variety of contexts	• applies simple mathematical concepts in limited contexts to routine problems • applies simple mathematical techniques to solve routine problems in limited contexts • applies simple mathematical models to routine problems in limited contexts • uses digital technologies appropriately to solve routine problems in limited contexts	• applies simple mathematical concepts in structured contexts • uses simple mathematical techniques to solve routine problems in structured contexts • demonstrates limited familiarity with mathematical models to solve routine problems in structured contexts • uses digital technologies to solve routine problems in structured contexts