Erindale College

Assessment Period:	**2021 S2**
Course:	**SPECIALIST METHODS**
Unit:	**Unit 4: Specialist 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: Simple Linear Regression

- investigate scatter plots of two variables
- apply simple linear regression of y on $x(\hat{y} = bx + a)$ using method of least squares, including Interpolation and Extrapolation $b = \frac{S_{xy}}{Sx}$ and $a = \bar{y} - b\bar{x}$, where: $S_{xy} = \sum xy - \frac{\sum x \sum y}{n}$ and $S_x = \sum x^2 - \frac{(\sum x)^2}{n}$
- compute correlation coefficient (at least Pearson's Method) and coefficient of determination
- use technology to fit line of best fit eg Excel, Geogebra, Calculator etc
- use real-life data (possible sources are ABS or AIHW (http://www.aihw.gov.au/data/))
- differentiate between correlation and causation

Topic 2: Discrete random variables

- **General discrete random variables:**
  - o understand the concepts of a discrete random variable and its associated probability function, and their use in modelling data
  - o use relative frequencies obtained from data to obtain point estimates of probabilities associated with a discrete random variable
  - o recognise uniform discrete random variables and use them to model random phenomena with equally likely outcomes
  - o examine examples of non-uniform discrete random variables, for example Poisson and Hypergeometric distribution
  - o recognise the mean or expected value of a discrete random variable as a measurement of centre, and evaluate it in simple cases
  - o recognise the variance and standard deviation of a discrete random variable as a measures of

spread, and evaluate them in simple cases

- calculate means and variances of linear combinations of random variables (e.g. $E(aX+b)=aE(X)+b$, $\sigma^2_{aX+c} = a^2\sigma^2_X$ etc)
- use discrete random variables and associated probabilities to solve practical problems

- **Bernoulli distributions:**
  - use a Bernoulli random variable as a model for two-outcome situations
  - identify contexts suitable for modelling by Bernoulli random variables
  - recognise the mean *p* and variance $p(1-p)$ of the Bernoulli distribution with parameter *p*
  - use Bernoulli random variables and associated probabilities to model data and solve practical problems.

- **Binomial distributions:**
  - understand the concepts of Bernoulli trials and the concept of a binomial random variable as the number of 'successes' in *n* independent Bernoulli trials, with the same probability of success *p* in each trial
  - identify contexts suitable for modelling by binomial random variables
  - determine and use the probabilities $P(X=r)=\binom{n}{r}p^r(1-p)^{n-r}$ associated with the binomial distribution with parameters *n* and *p* ; note the mean *np* and variance $np(1-p)$ of a binomial distribution
  - use binomial distributions and associated probabilities to solve practical problems, such as Markov Chains
  - model real-life data, drawing inferences from specific to general

Topic 3: 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
  - calculate interval estimate of the mean (e.g. 95% confidence limits)
  - use Normal approximation to Binomial Distribution for np>5 and nq>5, taking into account correction for continuity

Topic 4: 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	30 August	15%
Test 1	3 September	35%
Assignment 2	8 November	15%
Test 2	12 November	35%

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 SPECIALIST 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