| Yukon University | School of Science<br>**MATH 200**<br>**Statistics for the Physical and Life Sciences** |
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| | **Term: Winter 2024**<br>**Number of Credits: 3** |

# Course Outline

**INSTRUCTOR:** Amy Feaver
**E-MAIL:** afeaver@yukonu.ca or mathfeaver@gmail.com
**COURSE DATES:** Jan. 5 – April 10, 2024
**TIME(S):** Wednesday & Friday 9:00 – 10:20
**CLASSROOM:** Check the course schedule for classroom information, after we are able to return to in person classes. Ample announcements and communications will be made.
**OFFICE HOURS:** As I do not have an office, I am happy to schedule individual 1-on-1 appointments with students as the need arises. The best way to schedule these appointments is to contact me by email, using either email address listed above.

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## COURSE DESCRIPTION

This course provides a comprehensive introduction to statistical principles and methods. At the end of the course, students should be able to utilize statistical techniques to characterize and assess research datasets and critically evaluate statistical work done by others. Topics include descriptive statistics, elementary concepts in probability, correlation and regression, sampling, estimation and hypothesis testing (including one-sample, two-sample, ANOVA, and chi-squared). This course is directed towards undergraduate science and engineering students for which fluency in basic statistical methods can greatly contribute to the depth of their core program.

## COURSE REQUIREMENTS

Prerequisite(s): Prerequisite(s): Successful completion of MATH 100 (Single Variable Calculus I) or MATH 120 (Mathematics for the Life Sciences) or permission of the instructor.

## EQUIVALENCY OR TRANSFERABILITY

Receiving institutions determine course transferability. Find further information at:
https://www.yukonu.ca/admissions/transfer-credit

## LEARNING OUTCOMES

Upon successful completion of the course, students will be able to:

- Apply the techniques of descriptive statistics in order to organize and analyze data (using histogram, mean, median, mode, and standard deviation).
- Demonstrate an understanding of probability (simple/addition/multiplication/conditional) and counting rules (combinations and permutations).

- Apply hypothesis tests to means, proportions, and variances.
- Demonstrate an understanding of ANOVA and nonparametric statistics.
- Apply the techniques of inferential statistics (correlation and regression).
- Present the findings of a research project that employs the statistical techniques learned throughout the course to a real-world, local dataset.

**COURSE FORMAT**

**Weekly breakdown of instructional hours**

*Lectures: 3 hours per week.*

The course content is covered through lectures, tutorials, and assignments. Students are expected to prepare for each class by doing assigned readings from the textbook and are also expected to engage in substantial self-directed review and practice of the material. Although it will vary from individual to individual, students should plan on spending between 3-4 hours in study and preparation outside class for each hour spent in class.

**Delivery format**

**EVALUATION**

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| Assignments | 35% |
| Quizzes | 20% |
| Exams (2) | 30% |
| Research Project | 15% |
| **Total** | **100%** |

**Assignments (35%)**

Assignments will consist of both take-home assignments and in-class assignments. These will be weighted unequally, according the to scope and number of points of the assignment.

**Quizzes (20%)**

Quizzes will be distributed by the instructor over the course of the semester. You can miss one without penalty.

**Research Project (15%)**

Students will complete an independent research project where they will apply the statistical techniques learned in the course to a scientific dataset from their own field of study. Students are encouraged to contact faculty members in their respective programs at the start of the semester; the course instructor will assist in obtaining datasets if needed, and vet those provided by School of Science faculty for suitability for the class project. The project will involve both oral and written components and be due

during the last week of class. Smaller components of the project will be due at various points throughout the term to ensure forward progress. More information on the project will be presented in the first few weeks of class.

**Exams (30% total)**

There will be two exams, worth 15% each. They will not be cumulative. The second (final) exam will be given during the final exam period at the end of the term (April 16th from 1:00 – 3:50pm). Students should contact their instructor immediately if conflicts arise.

**COURSE WITHDRAWAL INFORMATION**

The Last date to withdraw without academic penalty is Mar. 7th, 2024. Refer to the YukonU website for other important dates. https://www.yukonu.ca/admissions/important-dates

**TEXTBOOKS & LEARNING MATERIALS**

Ron Larson and Betsy Farber, Elementary Statistics: Picturing the World, 5th Edition
Available as a free pdf online:
https://www.gcsnc.com/cms/lib/NC01910393/Centricity/Domain/10320/Intro%20to%20Statistics%20Textbook.pdf

**Calculator**

You will require a scientific calculator for this course. Not a graphing calculator, but it should have a statistics function and be capable of square roots, powers, exponents, factorials, etc.

**ACADEMIC INTEGRITY**

Students are expected to contribute toward a positive and supportive environment and are required to conduct themselves in a responsible manner. Academic misconduct includes all forms of academic dishonesty such as cheating, plagiarism, fabrication, fraud, deceit, using the work of others without their permission, aiding other students in committing academic offences, misrepresenting academic assignments prepared by others as one's own, or any other forms of academic dishonesty including falsification of any information on any Yukon University document.

Please refer to Academic Regulations & Procedures for further details about academic standing and student rights and responsibilities.

**ACCESSIBILITY AND ACADEMIC ACCOMMODATION**

Yukon University is committed to providing a positive, supportive, and barrier-free academic environment for all its students. Students experiencing barriers to full participation due to a visible or hidden disability (including hearing, vision, mobility, learning disability, mental health, chronic or temporary medical condition), should contact Accessibility Services for resources or to arrange academic accommodations: access@yukonu.ca.

**TOPIC OUTLINE**

| Module | Topic(s) |
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| **1** | **Introduction to Statistics**: Statistical thinking and types of statistics; types of variables; populations and samples; scales of measurement; precision and accuracy; summation notation. |
| **2** | **Summarizing & Graphing Data**: Grouped versus ungrouped data; frequency distributions and tables; relative frequency and percentage distributions; outliers, bar graphs, pie charts, histograms, dotplots and stem-and-leaf displays; implied class limits; class intervals and class mark. |
| **3** | **Numerical Descriptive Statistics**: Measures of central tendency and dispersion for ungrouped data; mean, variance, and standard deviation for grouped data; relative standing/measures of position and box-and-whisker plots; sum of squares, degrees of freedom. |
| **4** | **Probability**: Simple and compound events; conceptual approaches: classical probability, relative frequency, and subjective probability; marginal and conditional probabilities; independent, dependent and complementary events; intersection of events and the multiplication rule; union of events and the addition rule; counting rule; factorials, combinations, and permutations. |
| **5** | **Discrete Variable Probability Distributions**: discrete versus continuous random variables, probability distributions of random variables and their mean/standard deviation; binomial distribution; hypergeometric distribution; Poisson distribution. |
| **6** | **Continuous Variables and the Normal Distribution**: continuous probability distribution; normal and standard normal distributions; z-scores and the z-table; standardizing a normal curve; one and two-tailed regions, calculating x-values; level of significance; normal approximation to the binomial distribution. |
| **7** | **Sampling Distributions**: population distribution; sampling distribution and sampling errors; mean, standard deviation and shape of the sampling distribution; central limit theorem; applications of the sampling distribution; population and sample proportions; mean, standard deviation, and shape of the sampling distribution of the sample proportion; applications of proportion sampling distributions. |
| **8** | **Estimation**: point and interval estimates of population parameters; confidence levels and confidence intervals; margin of error and required sample size estimates; introduction to t-distributions and degrees of freedom; estimation of population proportions for large samples |

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| **9** | **Hypothesis Testing – One Sample:** null and alternate hypotheses; rejection and non-rejection regions; Type I and Type II errors; one and two-tailed tests; confidence levels; hypothesis tests about the mean with known and unknown standard deviation; p-values; critical-value and p-value approaches; t-tests; hypothesis tests about a population proportion. |
| **10** | **Hypothesis Testing – Two Samples**: independent versus dependent samples; inferences about differences in sample and population means given multiple standard deviation relationships; confidence interval estimation; testing for population mean differences in paired samples; hypothesis testing for two population proportions. |
| **11** | **Chi-Square Distributions:** chi-square distributions; goodness-of-fit tests; observed and expected frequencies; tests of independence and homogeneity; contingency tables; population variance. |
| **12** | **Analysis of Variance:** F distributions; one-way analysis of variance (ANOVA); sums of squares. |
| **13** | **Correlation & Regression**: Simple and linear regression; scatter diagrams and least squares routines; standard deviation of errors and coefficient of determination; correlation coefficients, mean predictions and confidence intervals, prediction intervals. |
| | Final Exam Apr. 16, 2024 1:00 – 3:50 |