REN R 480/580

APPLIED STATISTICS FOR ENVIRONMENTAL SCIENCES

In Fall 2024, REN R 480/580, *Applied Statistics for Environmental Sciences*, is being offered at Yukon University as part of the Northern Environmental and Conservation Sciences, B.Sc. Program. All students registered in REN R 480/580 must adhere to the requirements outlined in this course syllabus. University of Alberta students must also be aware of, and adhere to, the University's Code of Student Behaviour, referenced in the outline.

INSTRUCTOR: Kathryn (Katie) Aitken, Ph.D.
Adjunct Professor, Dept. of Renewable Resources, U of Alberta, and
Assistant Professor and Coordinator, Northern Environmental and Conservation Sciences Program, Yukon University

OFFICE HOURS: Tuesdays, 1:30 – 2:30 pm, or by appointment

OFFICE LOCATION: A2509

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CLASS DAYS, TIMES, LOCATION:

Lectures: Mondays & Thursdays, 2:30 – 3:50 pm, A2210

Labs: Thursdays, 4:00 – 5:20 pm, A2702

COURSE DESCRIPTION

Focuses on problem formulation, method selection, and interpretation of statistical analysis. Covers data management and data visualization, statistical tests for parametric, non-parametric and binomial data, linear and non-linear regression approaches. Participants will gain general statistical literacy and learn how to visualize and analyze data with open-source software packages.

COURSE REQUIREMENTS

Prerequisite(s): Registration in Yukon University/University of Alberta B.Sc. in Environmental and Conservation Sciences degree program, graduate program, or permission of instructor. U of A STAT

151, Yukon University MATH 105 or RRMT 202, or an equivalent introductory statistics course is strongly recommended.

LEARNING OUTCOMES

On successful completion of this course, students will:

1. Understand the fundamental concepts of statistics and empirical research.

2. Understand the basics of experimental and sampling designs and recognize common design pitfalls and misinterpretation of results.

3. Be able to use basic statistical methods to analyze ecological data and understand the conditions and objectives under which each method is applicable.

4. Be able to formulate an experimental or sampling design to examine a research question and organize and analyze a set of ecological data.

COURSE FORMAT

The course consists of two 1.5-hour in-person lectures and a 1.5-hour in-person computer lab per week. Labs will consist of a short, written assignment, or hands-on data summaries and analyses using the statistical methods discussed during the lectures. Most labs will include completion of a short exercise (due before the start of the following week's lab session). Weekly exercises are designed to be completed during the lab, but some students may prefer to take extra time for completion.

Weekly breakdown of instructional hours

There will be 4.5 hours of in-person lectures/labs per week, delivered as two 1.5-hour lectures, and one 1.5-hour lab. Additional reading and other supplementary material will be posted on the class site on Moodle. Students should expect to spend a minimum of 1-1.5 hours outside of class for every 1 hour of lecture/lab time. Therefore, this course will require approximately 4.5-7 hours per week of homework, review, and additional reading, outside of class time, for a total of about 9-11.5 hours per week for the course. The time required will vary by individual.

EVALUATION

The course grade will be determined as follows:

REN R 480 students:

	Percent
Lab exercises (~11)	30%
Statistical test literature search project: Two short summaries posted on Moodle (5% each; due Oct. 28 and Nov. 18); Paper (10%; due Dec. 2); 3) Presentation (10%; in class Nov. 28 or Dec. 2)	30%
Final data analysis assignment (due Dec. 16)	40%
Total	100%

REN R 580 students:

	Percent
Statistical test literature search project: Two short summaries posted on Moodle (5% each; due Oct. 28 and Nov. 18); Paper (10%; due Dec. 2)	20%
Research project/proposal presentation (Nov. 28 or Dec. 2)	40%
Final data analysis assignment (due Dec. 16)	40%
Total	100%

Assignments

There will be ~11 exercises (approximately weekly) that involve completing a short, written exercise and/or analyzing or summarizing a set of data (provided by the instructor). These exercises will integrate methods and topics introduced in the lecture material and will enable the student to gain hands-on experience working with real ecological data, conducting statistical analyses, and writing up results. RENR 480 students will be graded on these exercises; RENR 580 students will not be graded on these exercises, but completion of the exercises is highly recommended.

There will also be a literature search and comparison project in which students will conduct searches of peer reviewed scientific literature to find papers that incorporate some of the statistical tests discussed in lecture, write a report comparing two papers using one of these tests, and present the comparison in class. Presentations will take place in class on Nov. 28 and Dec. 2. More information will be distributed in class. RENR 480 and 580 students will both complete this project, but RENR 580 students will only submit a report (they will not present the comparison).

RENR 580 students will deliver a seminar-style presentation on their thesis project. If the student has data, then the presentation can include a preliminary analysis and report of results; if the student does not yet have data, then they can choose to present a research proposal that includes

details of their study design and methodology, types of data they anticipate collecting, and descriptions of the types of analyses that they expect to use. RENR 580 thesis presentations will be during class time on either Nov. 28 or Dec. 2.

Students must adhere to the citation style used by the Council of Science Editors in all written assignments (https://guides.library.ualberta.ca/citing/cse).

Exams

There will be no midterm exams in this course. In lieu of a final examination, the final assessment for the course will be a data analysis assignment, in which students will apply the skills and concepts they have learned during the course to datasets provided to them by the instructor. The assignment instructions and datasets will be distributed on Dec. 5, and the final assignment will be due by Mon. Dec. 16, 11:59 pm Yukon time.

Due Dates and Late Assignments

Lab exercises are designed so that they can be completed during the scheduled lab session but if students would like to take longer to work on them, they are due (unless otherwise specified) by 2:30 pm Yukon time on the Thursday following distribution of the assignment. Late lab exercises will NOT be accepted unless the student has received a written extension from the instructor. Other assignments will lose 5% of their value per day that they are late, to a maximum of 1 week late after which they will not be accepted, unless the student has received a written extension from the instructor.

Assignment of grades

The total numerical score will be converted to a grade on the following letter grading system:

Letter grade	Percentage
A+	95-100
A	90-94
A-	85-89
B+	79-84
B	75-78
B-	71-74
C+	67-70
C	64-66
C-	60-63
D+	55-59
D	50-54
F	0-49

COURSE WITHDRAWAL INFORMATION

Students should refer to the UAlberta calendar for important dates (calendar.ualberta.ca).

TEXTBOOKS AND LEARNING MATERIALS

There is no required textbook. Readings will be posted on the class site on Moodle (moodle.yukonu.ca).

An optional resource: Whitlock M, Schluter D. 2020. The Analysis of Biological Data. 3rd edition. W.H. Freeman and Company. 818 p. ISBN: 9781319226237. An e-book version is available online for purchase or for rent (https://www.macmillanlearning.com/college/ca/product/Analysis-of-Biological-Data/p/131922623X). There will also be a copy on reserve in the YukonU library.

All students must have a valid Yukon University student computing account. Information is available here: https://www.yukonu.ca/student-life/technical-resources (scroll down to the section "Accessing your Office 365 & Moodle account").

Most of the assignments will require the use of the free open-source statistical software R and RStudio. This software is installed on the computers in the YukonU computer lab that we will be using for labs on Thursdays. Students may download R and RStudio to their own computer if they'd like to work on their assignments at home/work, or if they'd like to bring their own computer to the lab. Information on R can be found here: https://www.r-project.org/. Information on RStudio can be found here: https://www.rstudio.com/products/rstudio/. We will discuss how to download and install R and RStudio at the beginning of the course. System requirements are given at the links above.

Students will also be expected to use Microsoft Excel and Word during the course. These are available on the computers in the computer labs. YukonU students can download for free the full suite of Microsoft Office applications (Word, Excel, PowerPoint, OneNote, Outlook) and other Internet based services (OneDrive, etc). Information is available here: https://www.yukonu.ca/student-life/technical-resources (scroll down to the section "Office 365 & Email").

COURSE WEBSITE

Material for the course will be available on the REN R 480/580 class site on Yukon University's Moodle system (moodle.yukonu.ca). Lecture slides, assignments, announcements, reading, and other material will be available there for download or viewing.

ACADEMIC INTEGRITY

Yukon University Academic Standards and Regulations

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 YukonU Academic Regulations & Procedures for further details about academic standing and student rights and responsibilities.

University of Alberta Academic Integrity and Code of Student Behaviour

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.governance.ualberta.ca) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students at the University of Alberta are subject to the Code of Student Behaviour, as outlined at: http://www.governance.ualberta.ca/en/CodesofConductandResidenceCommunityStandards/CodeofStudentBehaviour.aspx Please familiarize yourself with it and ensure that you do not participate in any inappropriate behavior as defined by the Code. Key components of the code include the following statements.

30.3.2(1) No Student shall submit the words, ideas, images or data of another person as the Student's own in any academic writing, essay, thesis, project, assignment, presentation or poster in a course or program of study.

30.3.2(2) c. No Student shall represent another's substantial editorial or compositional assistance on an assignment as the Student's own work.

USE OF AI SOFTWARE

While ChatGPT and similar artificial intelligence applications can be useful tools that can provide a starting point in your writing and can assist with writing code for data analysis in R, they are not an appropriate substitution for learning to write and think critically on your own. Copying the output from Chat GPT or other AI applications and submitting this output as your own written work will be considered plagiarism. Furthermore, appropriate referencing is expected in submitted work. References to primary, peer reviewed scientific sources must be included in your work, in Council of Science Editors (CSE) format.

PROFESSIONALISM AND CLASSROOM RULES OF ENGAGEMENT

Students are expected to attend all lectures/labs, be engaged and courteous in all course activities, and to be on time for class. Please do not use cell phones during class. Laptops are permitted for note taking and in-class work; however, please do not use laptops in class for non-class-related activities. While in computer labs, students are expected to refrain from using the computers to engage in non-class-related activities (e.g., Facebook, etc.).

RECORDING OF LECTURES, LABS, ETC.

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Please note that some classes in the B.Sc. Northern ENCS Program may be recorded using web conferencing software, and links to recordings may be posted on the class website.

ACCESSIBIITY 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 (https://www.yukonu.ca/student-life/learning-matters/accessibility-services) for resources or to arrange academic accommodations: access@yukonu.ca.

TOPIC OVERVIEW:

- Framing and testing hypotheses
- Replication, pseudoreplication and randomization
- Types of experimental designs
- Sampling
- Statistical hypothesis testing, and power
- Data management and exploration
- Data transformation
- Basic comparisons
- Correlation
- Regression (linear regression, non-linear regression, multiple regression, logistic regression, regression diagnostics)
- ANOVA (one-way, two-way, randomized block ANOVA, other kinds of ANOVA)
- Analysis of categorical data, contingency tables