DEPARTMENT OF RENEWABLE RESOURCES

UNIVERSITY OF ALBERTA

RenR 480/580 - Applied Statistics for the Environmental Sciences

Fall 2020 Syllabus

eClass Website – http://tinyurl.com/rr480/eclass

Instructor	Andreas Hamann Telephone: (780) 492-6429 Email: andreas.hamann@ualberta.ca Office Hours: via Zoom by email appointment
Assistants	Zihaohan Sang Email: zihaohan@ualberta.ca Office Hours: via Zoom by email appointment
Term	Fall 2020 (First class: Tuesday Sep 1, Last class: Thursday Dec 3)
Schedule	Due to the Covid-19 pandemic, all class activities will take place online. As much content as possible will be scheduled asynchronously (i.e., you can study any time you like). However, there will be some synchronous classes with mandatory attendance for specific times (e.g. quizzes, exams), or non-mandatory synchronous activities (e.g., labs and project support). These will take place during officially scheduled class times.
Class times	Tues & Thurs 8:00 to 9:20am & Thurs 12:30 to 13:50.
No classes	Nov 10 & 12 (Fall Term reading week), Dec 3 pm (only pm lab canceled)
Credits	*3 credits

(1) Course Description

The course 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 of the REN R 480 section will gain general statistical literacy and learn how to visualize and analyze data with open-source software packages. Participants in the RENR 580 section will also engage in problem-based learning by analyzing data from their thesis research project. Graduate students without a suitable dataset should enroll in two or more ★1 modules from the REN R 581/582/585/586 options instead. Prerequisite: a minimum of ★60 of university-level courses; ★3 introductory statistics recommended.

(2) Online Course Format

We will use teaching and learning strategies referred to as a "flipped classroom". The traditional class room lectures will be provided as videos that you can watch any time that suits you. Conversely, synchronous classroom times will be used for Q&A sessions and for working on labs and projects. During these synchronous sessions, we will use Zoom breakout sessions to

divide the class into small groups (initially random, later fixed members). The instructor and TA will visit these breakout groups for Q&A sessions, trouble-shooting and mentoring. For more details and help on using Zoom in RENR 480/580, visit: http://tinyurl.com/rr480/howtozoom.

The online delivery of course material forced on us by the Covid-19 pandemic poses some challenges. It is more difficult to build an exciting and inspiring learning environment. While working from home, you will experience reduced interactions with your peers. Self-motivation to keep up with the course material may pose a challenge. The "flipped classroom" strategy ameliorates some of these issues by giving the instructor and TA more opportunity for personal mentoring, and for students to interact and work together in small groups.

To help you stay on track with the class material, we will hold short (10-20 min) online quizzes (multiple-choice / fill-in-the-blanks / short answer) once or twice per week (up to 15 in total). Subject of the quizzes will be video and lab material of the proceeding days. The exact time slot for these quizzes will be announced on eClass on Tuesdays for quizzes scheduled on the subsequent Thursday, and on Thursdays for quizzes scheduled on the subsequent Tuesday. The quizzes and exam are "semi - open book": you may consult lab handouts and your own course notes, but you may not copy and paste answers from the web or other resources that are not your own. You are also not allowed to consult other persons during quizzes or exams. There are, however, no restrictions on the use of calculators or the R programming environment!

In addition to video lectures and labs, you will also carry out a course project that involves statistical analysis. If you have enrolled in RENR 580, you are required to carry out an individual research project. Participants of RENR 480 may do their projects in groups of up to three persons, but you can also carry out an individual project if you wish. Your projects will be presented online as a website and as a 5-minute video (or narrated PowerPoint file). You will receive feedback from me and your peers on a draft version to improve your final presentation and website submissions. See previous year's projects here: http://tinyurl.com/rr480/projects.

(3) Student Learning Outcomes and Competencies

For broad course objectives watch this video: http://tinyurl.com/rr480/videos/intro. The specific course objectives are as follows:

Introductory section:

● Become familiar with the fundamental concepts of statistics and empirical research. Understand how statistics can effectively be used in science.

● By planning an independent student project, practice how to tell a scientific story from beginning to end, aided by statistical analysis and graphical presentation of quantitative data.

● Learn the basics of experimental and sampling designs, and be aware of common design pitfalls and misinterpretations of results.

Data management and exploratory graphical analysis:

● Learn how to collect and organize your data so that it is most useful for subsequent analysis.

● Gain some hands-on experience with data organization, data checking, data preparation through a set of exercises and a student project.

● Be able to thoroughly understand the nature of your data through graphical display of raw data and summary statistics before applying any statistical tests.

● Learn how to generate publication-quality scientific graphs and how to use the correct type of graph for various objectives.

Inferential statistics:

● Get an overview of statistical methods, and learn under what conditions and for what objectives each method is applicable.

● Explore how organizing your data determines what statistical analysis you can do.

● Learn how the type of variables (continuous, discrete-ordinal, discrete-nominal, and binary) determines what statistical method you should use.

● Be aware of conditions that need to be met for particular methods, learn how to test assumptions, carry out data transformation, and deal with missing values.

● Practice empirical research, application of statistical methods, and writing reports through the course project

Specific methods:

Learn how implement basic experimental and sampling designs (CRD, RCB) and analyze data with common statistical methods (T-test, F-test, single and multifactor ANOVA, multiple comparison methods, chi-square test, z-test for proportions, nonparametric methods, linear and non-linear regression and correlation analysis, mixed models) using a structured approach:

- Background
- When to use the method
- How the method works
- What to report
- Example program code

(4) Required Software, Hardware and Textbooks

This course introduces you to R, a free, open source programming environment for statistical analysis, data management and graphics. The labs are optimized for the Windows version of the R software. However, if you work on a Mac or Linux computer, you can use the open source edition of R Studio. We will work with small datasets that can be run on any computer or laptop. No textbooks are required or recommended. The lecture videos and lab handouts will be all you need for this course.

(5) Marking and Grading

Your grade will be determined based on a variety of course rubrics that are weighted differently for graduate and undergraduate students (see tables below). Generally, the workload expectations for this course are higher for graduate students in quantity and quality. The

University of Alberta expects the total workload for an undergraduate class to be about 8 hrs/week and for a graduate class about 12 hrs/week. Graduate students are further expected to do more independent, problem-based learning. The grading weights for projects and quizzes also reflect these different expectations.

For eClass quizzes, I have specified a weighted average score calculation, so that long quizzes with more questions count proportionally more than shorter quizzes. At the end of the term, an average percentage out of 100 will be calculated using the percentage weights for the different course components listed below.

The final grade determination will be based on a combination of your absolute achievement (total percentage weights out of 100) and your performance relative to the entire class. This will be done separately for RENR 480 and RENR 580 participants. Normally, the class median for RENR 480 sits between a B+ and a B, and the class median for RENR 580 centers around a B+ grade. I will let you know your class standing half-way after the draft projects have been graded.

Grading weights for RENR 480 (undergrad level)

	Percent	Due Date
Approx. weekly quizzes (up to 15), worst quiz dropped:	30	N/A
Draft project website and 5-minute presentation:	10	**Oct 27, 6pm**
Your feedback on draft projects by your peers:	10	**Nov 6, 6pm**
Final exam (on last day of class: **Dec 3, 8am**):	30	N/A
Final project website and 5-minute presentation:	20	**Dec 7, 6pm**

Grading weights for RENR 580 (graduate level)

	Percent	Due Date
Approx. weekly quizzes (up to 15), worst quiz dropped:	20	N/A
Draft project website and 5-minute presentation:	10	**Oct 27, 6pm**
Your feedback on draft projects by your peers:	10	**Nov 6, 6pm**
Final exam (on last day of class: **Dec 3, 8am**):	30	N/A
Final project website and 5-minute presentation:	30	**Dec 7, 6pm**

(6) Course policies

Course policy for late submissions: some deduction at my discretion depending on how good an excuse you have. However, there is a hard deadline for me to submit course grades, and therefore there is a hard deadline for late submissions of any kind from you as well:

> Hard deadline for late submissions of any kind:
> **Dec 11, 6pm**

Course policy for missed quizzes and exams: If you miss a quiz, it should not be a big disaster as each individual quiz will only account for approximately 2% of the grade. Furthermore, the quiz with your worst quiz grade (e.g., 0% for a missed quiz) will be dropped from the grading. If you cannot attend a quiz or the final exam for medical reasons, **I do not need** a Doctor's note. If you cannot attend a quiz or exam for any other reason (e.g. internet outage), I also **do not require** any supporting documentation, unless you want to share it with

me. However, to keep track of things and to avoid misunderstandings I ask you to send me a formal absence note within 2 days of the missed quiz or exam, using this template: http://tinyurl.com/rr480/absence. This will make you eligible for an alternative assignment request or for a deferred exam application.

Course policy for technical issues: I understand that moving this class to online delivery and online evaluation poses challenges that neither me nor you have faced before. We will learn this together, and I will post any useful insights that I have or that you share with me here: http://tinyurl.com/rr480/technology. I try to build in some room to work out technical issues: e.g., you can miss a quiz for whatever (e.g. technical) reason. If there are widespread technical problems for a particular assignment or quiz, I may remove or reschedule that assignment or quiz for every participant at my discretion. If you experience persistent technical problems working from home, consider dropping this course before the add/drop deadline. Unfortunately, stable internet to reliably access eClass, as well as adequate computer equipment to carry out assignments and participate in scheduled Zoom meetings, quizzes and exams are required for this year's online version of the class.

Individual accommodations: if you are registered with University of Alberta Accessibility Resources for a disability or health condition, please let me know at your earliest convenience so that I can implement the recommended individual accommodations for quizzes and exams.

(7) General policies of the University of Alberta

Disabilities and health conditions: The University of Alberta is committed to creating work and learning communities that inspire and enable all people to reach their full potential. Accessibility Resources promotes an accessible, inclusive, and universally designed environment. For general information to register for services visit the University of Alberta Accessibility Resources webpage.

Recording of lectures: 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).

***Plagiarism and Cheating*:** 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: University Governance > Code of Student Behaviour. 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."
Students should speak with the course instructor about any questions or concerns about the code. Students should be particularly aware of the code as it pertains to internet and library research, use of previous class notes, reclamation plans of former students and interviews or discussions with others.