

Math 410A, Fall 2021
Advanced Statistical Methods (Part 1)

Instructor: Dr. Kathy Temple

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Office Hours: MW 10 - 10:50 AM, TTh 1 - 1:50 PM, and by appointment. Office hours are available either in-person (wear a mask!) or over Zoom.

Meeting times: 9 - 9:50AM MTWTh. On Tuesdays, Wednesdays, and some Mondays we'll be in SAMU 115. On Thursdays and some Mondays we'll be in the SAMU 138 computer lab.

Course Prerequisites: Math 314 or Math 211 (formerly Math 311), or permission of the instructor.

Course Goals and Description: This course is the first of a two-part sequence designed to cover the most common statistical methods in use today. We will learn the theory behind the models and methods we use, and we will spend a lot of time using them to answer questions about real-world data. Topics in the first quarter will likely include linear regression, multiple regression, logistic regression, inference from regression, interaction terms, linear discriminant analysis, variable selection methods, and one- and two-way ANOVA.

The second half (410B) will include many details about ANOVA, non-parametric statistics, permutation and bootstrap methods, ridge regression, the lasso, time series analysis, cluster analysis, and Principal Component Analysis. This part of the course will also include a significant component on presenting statistics in public.

Students completing both parts A and B of Math 410 have seen almost all the material on the Society of Actuaries' *Statistics for Risk Modeling* exam.

Required Text: Gareth James, et al. *An Introduction to Statistical Learning with Applications in R*, 2nd ed., Springer. (Note that this text is freely available for download.)

Evaluation and Grading: Grades will consist of the following components: (approximately) weekly labs (40%), homework (10%), a quarter-long "R Journal" (5%), a take-home midterm exam (20%), and a take-home final (25%). The take-home final and some of the labs will involve an oral component where we discuss your solutions one-on-one.

Grades will be assigned according to the following scale:

	A	93-100%	A-	90-92.99%	
B+	87-89.99%	B	83-86.99%	B-	80-82.99%
C+	77-79.99%	C	73-76.99%	C-	70-72.99%
D+	67-69.99%	D	63-66.99%	D-	60-62.99%
	F	59.99% and below			

Details concerning course components

Lab Assignments

Labs will be assigned approximately weekly. Lab due dates will be given with the assignment, but will often be 5PM on Thursdays. Lab write-ups must be typed, written in complete sentences, and follow the general guidelines for written work given below.

We will be making use of the statistical software R in class, and you will be using R for labs and exams. R is a free, open-source software package that is incredibly powerful. I strongly recommend the interface R Studio and this is what I will be using and demonstrating in class. R has a bit of a

learning curve, but it's well worth working through! R is becoming more and more of a standard in industry and other disciplines.

About twice during the quarter, I'll ask you to have a short conversation with me about what you did in the lab and why. If you have a laptop, and university policy permits, we can do these conversations in-person; we'll grab a conference room and have you project your laptop onto the screen. If you don't have a laptop, we'll do the conversation over Zoom, so that you can share your screen with me. (We can also do Zoom if that's more convenient for you, regardless of what computer you have.) We'll generally aim to have these take place within a couple-day window. The main purpose with these is to practice describing your statistical analysis to someone before I ask you to do it with the take-home final.

Homework

A small amount of homework will be assigned from the book most weeks. These are designed to let you practice the basics of the new statistics we are covering, and the corresponding techniques in R. Due dates will be announced at the time the homework is assigned, but will typically be 5PM on Mondays.

Exams

There will be two take-home exams, given roughly during Week 6 and the last week of class/finals week. The written portion of the take-home final will be due early in exam week, to allow time for the oral component. More details on exams will be given a bit closer to the actual exams.

R Journal

At the end of this course, I want you to have an R script that will include all of the key ideas/techniques from the course along with comments that describe how to use the code. This is the kind of thing that can be super-useful to you later! Because, as we all know, procrastination is a thing, you'll be required to submit your script up to that point every other Thursday by 5pm, with the last one due during finals week.

General Course Policies: Come to class. Do your own work. Work really hard; this class is likely to be quite difficult, but you will leave it with a useful set of skills, and a better understanding of statistics!

Face Coverings and Social Distancing: Due to COVID-19, and under the directive and mandate of public health officials and the president of Central Washington University, students must adopt face covering protocol before entering any classroom or building at CWU until further notice. Students must also follow the social distancing placement marks in buildings and classrooms. If you do not have a face covering Central Washington University can provide one for you. If you have not yet received your CWU-supplied facial covering, please go the SURC Information Desk. Please do so prior to the start of your first class. Face coverings must cover both the mouth and nose, fitting snugly against the sides of the face. Your mask protects me; my mask protects you. Masks with one-way valves for exhalation don't have the protective value for others - please don't use them as your face covering for any in-person components. Your mask needs to stay on for the entire duration of class, and needs to stay put (no dropping, gapping, or sagging). Because of this, no eating is permitted in class, unless there is an official medical accommodation through Disability Services. Beverages are permitted ONLY if they are consumed using a straw tucked under your mask. Students not wearing a mask or not wearing one correctly will be asked to put one on; if they refuse, students will be asked to leave the classroom and building. Thank you for helping keep all of us safe!

COVID Vaccinations: In accordance with Proclamation 21.14.1, CWU has chosen to make vaccinations a priority this fall. We believe a fully vaccinated community is the best way to protect our individual and collective health and safety. *Proof of full vaccination against COVID-19 will be required by October 18, 2021* for all employees and students. Medical and/or religious

accommodation requests will be considered. All employees and students are required to wear masks indoors (see above).

Written Work: All work handed in for the course must be written neatly, legibly, clearly, using correct mathematical notation, and with sufficient explanation. A good rule of thumb is to write your solution so that a classmate who knows roughly what's going on in the course but doesn't know how to do this particular problem can understand your solution. As a side benefit, this makes it much more likely that you will be able to understand your solution when you go back to study for exams! The bottom line: for any written work handed in for the course, including lab write-ups, exams, and homework, *you must show your work*.

Late Work: No late homework will be accepted, but the lowest homework score will be dropped, because life happens. For labs and the take-home midterm exam, assignments can be submitted late with a 20% penalty per 24-hour period, up until the time that graded labs/exams are returned to the rest of the class. Labs or exams submitted after graded work is returned to the rest of the class will not receive credit, however, the lowest lab score will be dropped. (The take-home midterm, of course, cannot be dropped.) If you have extenuating circumstances around the take-home midterm or final, I encourage you to communicate with me as soon as possible; see the section on communication, below.

Submitting Work Electronically: All work for this course will be submitted electronically through Canvas.

- Labs write-ups and take-home exams are required to be typed and may be in .doc, .docx, or .pdf formats only. If you are using an alternate word processing program, please make sure that you know how to generate one of these formats.
- R scripts are to be submitted as either RStudio scripts (.r files) or RMarkdown files (.rmd). They may not be submitted as text files. This applies to code submitted with labs and take-home exams and to your R Journal.
- If you choose to type your homework, it should be in one of the formats for lab write-ups, above.
- If you choose to hand-write your homework, you have a couple of options for submission:
 - You can scan it to a PDF document using a cell phone camera. Some apps that do this (there are many others if you don't like these): Adobe (free) or CamScanner (free version) for Android phones; the Notes App (built-in) or CamScanner (free version) for iPhone.
 - You can take a well-lit, easy-to-read photograph, insert it into a Microsoft Word or OpenOffice Writer document, make sure that the photo is oriented correctly and easy to read, and then save the document as a .doc, .docx, or .pdf file for upload to Canvas.
 - If your work is multiple pages, please upload it as a SINGLE file.

Whichever method you choose, please double-check that your image is oriented correctly. Images not oriented correctly or images that are not easy to read will lead to the assignment being returned without being graded.

Contingency Planning: In the event that we are unable to meet in person (this could be due to the university shifting to remote coursework, inclement weather or wildfire smoke closures, or because I need to isolate), this course will convert for the necessary time period to a *synchronous* online course using Zoom. This means that you will be expected to continue attending class at the scheduled times, but we will meet using Zoom rather than in-person. In the event that a period

of remote learning includes a course assessment, I may change the format of the assessment if necessary.

Illness: If you are feeling unwell for any reason, *please, please, please stay home*. Being vigilant about this will help prevent the spread of COVID-19 (and other bugs!) and allow us to continue in-person classes.

Academic Honesty: Consult university policies (CWUP 5-90-040(22), CWUR 2-90-040(22), and WAC 106-125-020) for student conduct, cheating, plagiarism, and other academic expectations. CWU's policies and recommendations for academic misconduct will be followed, leading to disciplinary action up to and including failing the course.

Inclusivity Statement: As a member of a peer learning community, a high degree of professionalism is necessary. **CWU expects every member of the university community to contribute to an inclusive and respectful classroom culture.**

Classroom Conduct: Students in this class are expected to interact with students and the professor professionally. Instances of disruptive conduct, obstructive conduct, or harassment (see definitions below from the Washington Administrative Code: WAC 106-125-020) will be referred to the Dean of Student Success.

Disability Support Services: Central Washington University is committed to creating a learning environment that meets the needs of its diverse student body. Students with disabilities should contact Disability Services to discuss a range of options to removing barriers, including accommodations: Hogue Hall 126, 509.963.2214, DS@cwu.edu

Is my absence excused? Excused absences will not lower your overall grade in this class and are determined on a case-by-case basis. Excused absences include illness, bereavement, and school-related activities. With the exception of illness, documentation is required. Excused absences do not include travel for holiday breaks, work, or non-emergency travel delays.

In compliance with RCW 28B.137.010, Central Washington University makes every effort to deal reasonably and fairly with students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Students must present written notice to their instructor within the first two weeks of class listing the specific dates on which accommodations are required. Contact the Dean of Student Success at (509)963-1515 for further information or questions.

Communication: While we all hope for a smooth quarter, we know that best-laid plans can go awry! Some of us may need to quarantine or isolate in the middle of the quarter. We all may need to shift entirely remote on short notice (and it may be worth thinking in advance about how you would make that work, both in terms of technology and in terms of being able to attend class and complete work remotely). In all things, communication is going to be key. If you have something going on, please let me know (no details you don't feel comfortable sharing, of course, just a general heads-up). As things need to change during the quarter, I will do my best to let you know as soon as I can. In all things, please extend grace to me and your classmates, and I will do my best to do the same.

I reserve the right to change the policies contained in this syllabus as dictated by developments during the quarter.