

Math 410B, Winter 2023
Advanced Statistical Methods

Meeting times: Tuesday, Thursday, 10:00 – 10:50 in Samuelson 245
Monday, Wednesday, 10:00 – 10:50 in Samuelson 138

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Office Hours: By appointment (this is my only class, so I'm fairly flexible)

Course Goals and Description: This course is the second of a two-part sequence designed to cover beginning and intermediate regression, ANOVA, classification, and machine learning. We will learn the theory behind these models, and we will spend a lot of time using them to answer questions about real-world data. We will also begin to explore methods in predictive analytics, including classification methods, random trees, and random forests. Additional topics will likely include: linear regression, multiple regression, logistic regression, ANOVA, two-way ANOVA, bootstrapping, permutation methods, Principal Component Analysis, random trees and random forests, and time series analysis.

The first half of the course (410A) dealt with a lot of advanced details about linear regression (including inferential statistics), multiple regression, logistic regression, linear discriminant analysis, and k-nearest neighbors methods, along with an introduction to R.

The second half (410B) will cover non-parametric procedures, resampling methods (including the bootstrap and permutation tests), ridge regression and the lasso, time series analysis, tree-based classification methods (including bagging and boosting), Principal Components Analysis, Time Series Analysis, and (time-permitting) clustering methods. The second half of the course will include significant project in which you will perform an analysis of a real-world dataset, and a public speaking component, for which we will spend time discussing and practicing the art and science of presenting statistics in public.

A tentative plan for the course schedule follows the syllabus.

Required Text: Gareth James, et al. *An Introduction to Statistical Learning with Applications in R*, Springer.

Recommended Text: Jared P. Lander, *R for Everyone: Advanced Analytics and Graphics*, Addison Wesley Data & Analytics Series.

Evaluation and Grading: Grades will be calculated via the following components: Regular labs (20%), "R skills" labs (10%), homework and textbook reading responses (20%), two midterm exams (15% each), a public speaking component (10%), and a large quarter-long project (10%) in which you will complete and write about a significant statistical analysis of your own (or with your team).

Grades will be assigned according to the following scale:

	A	93-100%	A-	90-93%	
B+	87-90%	B	83-87%	B-	80-83%
C+	77-80%	C	73-77%	C-	70-73%
D+	67-70%	D	63-67%	D-	60-63%
	F	60% and below			

Tentative Schedule of topics

Week 1	Introduction to Cross-validation
Week 2	Bootstrapping and Permutation tests
Week 3	Ridge Regression and the Lasso
Weeks 4–5	Decision trees
Weeks 6–7	Time Series Analysis
Week 8	Principal Component Analysis
Week 9	Cluster analysis
Week 10	Final Project and presentations

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.

Labs

Most Mondays and Wednesdays we will meet in the computer lab for an opportunity to learn new statistical techniques and put them into practice. We will likely suspend a few of these during our oral presentations.

Midterm Exams

There will be two take-home mid-term exams, given during Week 4 and Week 8.

Public Speaking

There are few classes in the mathematics major (or actuarial science major) that teach skills in public speaking. This is a crucial life skill, and one that can't be fully taught in one term. Rather, this class will provide you with some tools which will improve your speaking during this quarter, but will also enable you to continue improving after the course is done. We will complete a series of public speaking assignments. Several of these will involve a short reading, the watching of some videos or life talks, and a thoughtful analysis of what you observed. You will also prepare slides for a presentation.

After completing these steps, each person (or team) will give a talk about their work in class. These talks will be recorded. Students will take their videos home, watch them (twice!), and reflect and comment on their performance.

Please note that all students are encouraged to consider giving a talk at SOURCE – Central Washington University's "Symposium Of University Research and Creative Expression." This is an excellent opportunity, and one not to be missed. Abstracts for SOURCE are usually due in late March or early April, so talk to your professor immediately if you would like to pursue this option!

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!

Policy on Academic Dishonesty

Students are on their honor to follow the student conduct code as outlined in the Washington Administrative Code. Violations of this section will result in a failing grade in the course in addition to further possible university sanctions. (See <http://apps.leg.wa.gov/WAC/default.aspx?cite=106-125>.)

Policy on Diversity

University-level education is about broadening horizons and looking at academic issues from a variety of perspectives. With this in mind, the participants in this class are encouraged to bring their own life experiences and viewpoints to bear on classroom discussions and assignments. Along with the freedom to express one's own views comes the responsibility to respect the views of others. No student will be discriminated against on the basis of race, ethnicity, age, creed, religion, gender, sexual orientation, marital status, or political ideology.

Disability Services

Central Washington University is committed to creating a learning environment that meets the needs of its diverse student body. If you anticipate or experience any obstacles to learning, contact Disability Services to discuss a range of available options. Student Disability Services is located in Hogue 126. Call (509) 963-2214 or email ds@cwu.edu for more information.

Responsible Employee Reporting

As a CWU employee I am a designated "responsible employee." This means that when disclosures of sexual violence (including domestic violence, stalking, harassment, and sexual assault, including rape) are made to me, I am required to complete a report to our Title IX Coordinator. Our university has multiple options for students to provide disclosures and seek resources confidentially. We Care: Reporting Sexual Violence at CWU, <https://www.cwu.edu/wecare/reporting-sexual-violence>.

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