Syllabus - Probability & Statistical Inference for Scientists and Engineers

MATH 530/630; Fall 2019

Instructor: Rebecca Lunsford

September 24, 2019

This course will introduce fundamental concepts underlying statistical data display, analysis, inference, and statistical decision making. The topics include presentation and description of data, basic concepts of probability, Bayes' theorem, discrete and continuous probability distributions, estimation, sampling distributions, classical tests of hypotheses on means, variances and proportions, and linear models. One of the key notions underlying this course is the role of mathematical modeling in science and engineering with a particular focus on the need for an understanding of variability and uncertainty. Examples are chosen from a wide range of domains.

Prerequisites

Although there are no formal prerequistes for this class, this course will include topics in which students will use various mathematical tools. As such, students must be familiar with the following topics:

Topic	Mathematical Tool
Probability	Set theory
Discrete random variables	Summation algebra
Continuous random variables	Univariate calculus
Statistical inference	All of the above

What does this mean? It means that you should feel comfortable being asked to review any of the above topics, and to apply them (after demonstration) in this course.

Textbook

Readings will primarily be from two free, open-source, completely online textbooks:

1. **MODERN DIVE into Data with R (MD)**
2. **R for Data Science (R4DS)**

Reading assignments will be documents that are freely available online or will be provided to you. Students will also be expected to find relevant materials using Google as well as online help forums such as stackoverflow.com.

Grades

Work in this class consists of the following six activities:

Activity	Submissions	Points per submission	Total points
iLabs	5	20	100

Activity	Submissions	Points per submission	Total points
Midterm	1	80	80
Project	5	5 / 10 / 15 / 20 / 25 / 25	100
DataCamp	Many	80% completed	40
In-Class Labs	5 (drop lowest)	checks(minus,check,plus)	40
Homework	4	10 (no partial grades)	40

The total points possible in this course is 400.

The following minimum grades will be guaranteed:

Points	Minimum grade
360	A-
320	B-
280	C-
240	D-

Integrative Labs (iLabs)

A total of 5 Integrative labs will be assigned. Although no prior R experience is required for this course, be prepared to do *a lot* of self-guided learning. Students are expected to run R on their own computer or a computer they have plenty of access to and control over. The first iLab will help you become familiar with R, RStudio, and R Markdown. This pre-lab is due before classes start and will ensure you are prepared to complete the required coursework.

Please attempt to do all iLabs on your own, but you may work with other students. However, you may not submit iLabs assignments as a group. You should submit your own original work. Please bear in mind that when an assignment involves R, you will lose points for any of the following:

- Printing entire dataframes in the R Markdown file
- Code with no comments
- Code which produces an error message

You will have at 1 week to complete each iLab assignment, and your initial solutions are due by 2pm on the due date (at the start of class). Late submissions will not be accepted. If you have not turned in an iLab by the start of class on the due date, you can do a self-assessment, but you will lose the ability to get points for your "good faith effort".

After you turn in your initial iLab solutions and are provided with the solution key (if applicable), you will hand in a self-assessment by the start of the next class. Your self-assessment must:

- Include an assessment of the accuracy and completeness of your "initial solutions"
- Give attributions as appropriate to other students who helped you

iLabs grades will be based on:

- Was your initial solution a good faith effort
- Did you catch all of your own errors in your self-assessment
- Is your updated solution correct

Grading rubric for the iLabs is 20 points, scored as follows:

- 8 points for each initial solution being "in good faith""

- 8: answer reflects strong independent problem solving, with clearly thought out attempts to approach the problem and a diligent and honest effort to find the solution.
  - 4: answer reflects some attempt to approach the problem, but approach appears to be superficial and lacks depth of analysis.

- 12 points for the quality of the final solution / discussion.

  - 12 (Exceptional): answer is thorough, concise, and clearly demonstrates ability to analyze and interpret statistics as well as theoretical understanding of statistical concepts.
  - 8 (Adequate): answer addresses the question with moderate inaccuracies in analysis and/or interpretation, or offers a correct but incomplete answer.
  - 4 (Inadequate): answer attempts to address question with substantial inaccuracies in analysis and/or interpretation.
  - 0 (Insufficient): answer does not attempt to address question or answer is insufficient to grade

All of this means that:

- If you (a) submit a perfectly accurate initial solution OR (b) submit a good-faith effort and a perfectly accurate self-assessment, you get 100% of the points.
- If you simply cannot submit an iLab on time, after the due date you can submit perfect self-assessment for a max score of 60% (12 out of 20 points). We feel this is fair given that you did not attempt a good faith effort.

What is a "good faith effort"?

Simply submitting nonsense or saying "I can't do this" will not meet our criteria for a good faith effort, because there is no attempt on your part to show us why you are struggling, what you tried but didn't work, what specific part of the problem you got stuck on, which other examples in the text/lecture you tried to work through to get a grasp on the problem, etc. This is especially true if you don't attend any office hours, post your problem online, or otherwise seek out help *before* the due date. The good faith effort is just that- we are interested in seeing evidence of a diligent and honest effort on your part, made with deliberate intention, to understand the problem and attempt an answer.

##In-class Labs There will be 5 in-class labs in this course. Your completed labs will be submitted as a raw R Markdown file and a knitted HTML file. You may submit (and re-submit) labs to Sakai until the following class date at 5PM. Labs will receive a grade of check-minus, check, or check-plus. The lowest will be dropped. Full points will be awarded for 4 checks. A check-plus balances out a check-minus.

Midterm

For the midterm, you will work individually on a take-home exam that will cumulatively cover topics in class. You may use the following resources: your class notes, online readings and assignments, your previous homeworks, the Internet. You may not use the following resources: anything that is alive or communicates back to you (including but not limited to other students, professors, professional statisticians, tutors, parents, email or phone contacts, online forums or chat rooms, etc.). You should submit your own original work.

Project

For the final project, you will reproduce and extend a published research article. Projects will be done in teams of two or more depending on class size; the same grade will be given to all team members unless there is a clear discrepancy in labor that is brought to the instructor's attention before the final report is due.

Read more about the final project here

DataCamp

DataCamp provides an interactive environment for learning and practicing data science and statistics skills in R. Full points will be awarded for completing at least 90% of the assigned DataCamp chapters. Lesser proportions will receive a commensurate reduction in points.

Homework

A total of 4 homeworks will be assigned. Some homeworks will require you to use R to analyze data. As such, your homeworks must be submitted as a knitted HTML file, created using RMarkdown. Full points will be assessed for a good-faith effort (see above). No points will be assessed otherwise. Individualized feedback will not be provided. However, after submitting your homework you will be provided with an answer key, which you should use to ensure you understand the solutions.

Academic Dishonesty and Student Behavior

Students are expected to follow University policy with regards to issues of academic dishonesty (e.g., cheating or plagiarism) and proper conduct in the classroom, as detailed in the Student Handbook. Violation of academic integrity is considered a serious offense by the University and is treated accordingly. Violations include, but are not limited to, cheating on exams, having unauthorized possession of exams, and submitting the work of another person as your own. Disciplinary action for violation of these policies will be decided on a case-by-case basis and will be in accord with University policy.

Students with Disabilities

Our program is committed to all students achieving their potential. If you have a disability or think you may have a disability (physical, learning, hearing, vision, psychological) which may need a reasonable accommodation please contact Student Access at (503) 494-0082 or e-mail at orchards@ohsu.edu to discuss your needs. You can also find more information at www.ohsu.edu/student-access. Because accommodations can take time to implement, it is important to have this discussion as soon as possible. All information regarding a student's disability is kept in accordance with relevant state and federal laws.

Using code from others

You are welcome to use code written by other people, including snippets of code you find online and code written by people who are helping you. I highly recommend Cookbook for R online, Stack Overflow, and GitHub for help. However, if you are using code from someone else, remember to give credit where it is due.

OHSU Grade Submission Policy

Graduate Studies in the OHSU School of Medicine is committed to providing grades to students in a timely manner. Course instructors will provide students with information in writing at the beginning of each course that describes the grading policies and procedures including but not limited to evaluation criteria, expected time needed to grade individual student examinations and type of feedback they will provide. Class grades are due to the Registrar by the Friday following the week of finals.

OHSU Commitment to Equity and Inclusion

OHSU is committed to creating and fostering a learning and working environment based on open communication and mutual respect. If you encounter sexual harassment, sexual misconduct, sexual assault, or discrimination based on race, color, religion, age, national origin or ancestry, veteran or military status, sex, marital status, pregnancy or parenting status, sexual orientation, gender identity, disability or any other protected status please contact the Affirmative Action and Equal Opportunity Department at 503-494-5148 or aaeo@ohsu.edu. Inquiries about Title IX compliance or sex/gender discrimination and harassment may be directed to the OHSU Title IX Coordinator at 503-494-0258 or titleix@ohsu.edu.