

# APPM 4570/5570

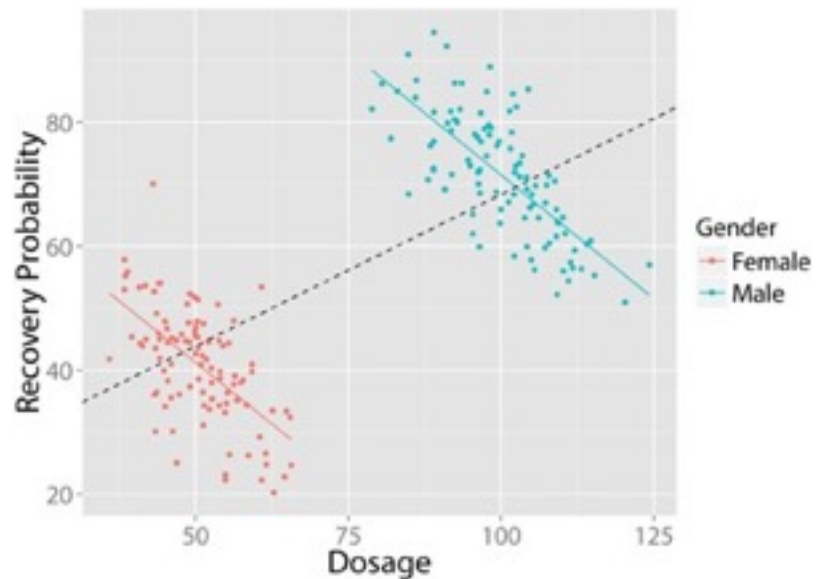
## Statistical Methods

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**Office Hrs:** Tues, 1:30pm-3pm; Wed, 3pm-4:30pm; **or** by apt  
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*“Statistics are ubiquitous in life, and so should be statistical reasoning.”*  
*Alan Blinder, former Federal Reserve vice chairman and Princeton*

## Course Description

Probability and statistics are essential tools for engineers, data scientists, and many other professionals. *Statistics* can be understood as the study and application of (1) methods for reliably gathering and presenting information (*descriptive* statistics), and (2) methods for drawing conclusions about the world from limited information (*inferential* statistics). In this course, we will be concerned with both (1) and (2). Especially for (2), we will need to learn how to analyze chance events. As such, before studying statistical inference, we will study some basic probability theory. Our ultimate goal is to use tools from mathematics to analyze sample data and try to make predictions or draw conclusions about law-like relationships that hold in more general populations. My aim in this course is to help students become proficient in the technical aspects of statistics and data analysis; but, I also aim to help students identify when certain techniques are justified, and when certain techniques might lead them astray.



## Learning Goals

By the end of this course, students should be able to:

1. load a dataset into R, clean the data, perform exploratory data analysis, and report on patterns and correlations in the data;
2. compute and interpret various measures of central tendency, such as the mean, median, and mode; and measures of dispersion, such as variance, and standard deviation;
3. write the axioms of probability theory, prove basic theorems of probability theory, and apply those theorems to solve ‘real-world’ problems involving chance events.

4. estimate population parameters of interest by calculating point and interval estimates from a sample/data;
5. perform statistical hypothesis tests;
6. construct and perform diagnostics on simple linear, multilinear, and logistic regression models to make predictions and inferences about data; and
7. construct basic data visualizations in R and organize analysis, findings, and recommendations into reports clean, easy to interpret reports.

Text  
*Probability and Statistics with R,  
 2nd Edition* by M.D. Ugarte, A.F.  
 Militino, A.T. Arnholt, CRC Press,  
 2016, ISBN-13 978-1466504394

## Course Webpage

Course materials, such as this syllabus, the course schedule, homework assignments, and general updates will be uploaded to our course webpage. Visit [math.colorado.edu](http://math.colorado.edu), click the Course Pages tab, and find APPM 4570/5570. Please check our course webpage frequently! We will also use Canvas—CU’s new online learning management system—for solutions, grades, and submitting assignments.

## Assignments

### A Note about Jupyter and R

On many assignments in this course, we will use the R programming language; we will run R within the web application Jupyter. Both Jupyter and R are great (free!) tools for data analysis/science, and I think they will be beneficial to you beyond this course. We will spend several class periods downloading these programs and becoming comfortable using them. Learning new languages and applications can be difficult and frustrating, but also rewarding. I’m here to help you on this journey! Taking the first in-class Jupyter assignment seriously will make all future assignments much easier.

### Homework (30%)

Homework will be due (roughly) once a week at the beginning of the class (dates appear on the course schedule). Late homework will **not** be accepted or graded, except in extraordinary circumstances. Homework assignments will have a *theoretical* section and a *computational* section. You will turn in a paper copy of the theoretical section of the homework at the beginning of class on the due date, and you will submit a Jupyter file electronically (on Canvas) for the computational section. The computational portion of the homework should include R code, relevant output, and a write-up and interpretation of your results. You can collaborate with your classmates on the homework assignments, but you must write up the results independently of each other.

## Exams (15% each)

There will be two midterm exams and one final exam. The first midterm will be **in class** on **Wednesday February 21**. The second midterm will be **in the evening** on **Wednesday April 4** (exact time TBA, but will be after 5pm). The final exam will be on **Wednesday May 9 from 1:30pm to 4pm**. If the evening or final exam conflicts with another university obligation, you must notify me by the end of the second week of the semester.

## Final Project (15%)

Instructions for the final project will be given out in class.

## Participation (10%)

Participation in this course is essential for doing well. We will frequently have opportunities for class participation. The majority of this portion of your grade will come from in-class assignments, attendance (you are allowed to miss three classes with no penalty to your grade), online discussion, attending office hours, and, potentially, pop quizzes. Those who participate in these activities will earn high participation grades; students who do not actively participate but seem reasonable well prepared for most seminars can expect to earn a B- for participation. Students, who regularly show up unprepared, or attempt to text, do work for other classes, etc., can expect a very low (most likely failing) participation grade. **If it becomes evident from class discussions that students are not doing the required reading before class, I reserve the right to give daily quizzes on reading assignments and to include these grades as part of the participation grade!**

## Grade Determination

The standard final grade scheme is as follows: 93–100% = A; 90–92% = A-; 87–89% = B+; 83–86% B; 80–82% = B-; etc. I reserve the right to lower the percentage points needed to obtain the corresponding letter grade.

## Policies

### Trigger Warning

It is possible that discussions in this course could be potentially disturbing or traumatizing. If you feel the need to leave class during a discussion that you find disturbing or traumatizing, for however long, you may do so without academic penalty. You will, however, be responsible for any material you miss. If you do leave class for a significant time, please make arrangements to get notes from another student (or see me). If a topic is disturbing to you to the extent that you do not feel comfortable working on it, I am happy to try to make reasonable accommodations, e.g., work with you on a different topic that demonstrates the same (or similar) learning objectives.

### Disability Accommodations

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, or <http://disabilityservices.colorado.edu/>

### Religious Observances

Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please send me e-mail or visit me in office hours to notify me of such a situation at least two weeks in advance of the event. See full details at <http://www.colorado.edu/policies/observance-religious-holidays-and-absen...>

### Classroom Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at <http://www.colorado.edu/policies/student-classroom-and-course-related-be...>

### Discrimination and Harassment

The University of Colorado at Boulder policy on Discrimination and Harassment (<http://www.colorado.edu/policies/discrimination-and-harassment-policy-an...>), the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships applies to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550.

### Honor Code

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Information on the Honor Code can be found at <http://www.colorado.edu/policies/student-honor-code-policy>. and at <http://www.colorado.edu/policies/academic-integrity-policy>.