Statistics for Planning I (4 credits) **PA 5205**

Fall 2023 (Eric Lind)

Course Description

This course will introduce you to the foundations of probabilistic analysis, which is a way to make the connection between data and useful understanding. Statistical models simplify the complexity of real-world data into relationships we hope to act on to change outcomes, or at least to understand outcomes a little better. There is an ever-growing set of statistical approaches to gathering knowledge from data, and they ultimately derive from common principles. We will focus on these principles of statistics as we apply techniques to examples in land use, transportation, and regional development.

Course Objectives

At the end of this course you should be able to:

- Ask questions to evaluate statistical evidence in scientific articles and the media
- Describe the importance of probability sampling, variability, and measurement error
- Understand and critique sampling design and survey administration
- Construct causal models underlying statistical evaluation
- Decide whether to pursue further training in advanced statistics and survey design

In this course, we will use examples in urban and regional planning, as well as public policy. We will use Stata to analyze data on land use, transportation, and health in the lab.

Instructor Contact & Availability

Eric Lind, PhD (Instructor) elind@umn.edu

Lecture (in person)
Tue & Thurs 11:15AM - 12:30PM
Blegen 415

Office hours
Tue 1:00PM – 2:00PM
HHH 133
or via Zoom by appointment

Jem Thompson (TA) thom8360@umn.edu

Lab Sessions
Lab section 002: Thurs 9:45AM - 11:00AM
Lab section 003: Tue 2:30PM - 3:45PM
HHH 85
Please direct lab-related questions to TA, who grades assignments.

Textbooks

Freedman, David, Robert Pisani, and Roger Purves (2007). *Statistics*, 4th edition. New York: Norton. ISBN 0-393-92972-8. (Most homework and exams are adapted from this book)

Utts, Jessica (2015). *Seeing through statistics*, 4th edition. Stamford, CT: Cengage Learning. (We will use several chapters of this book. It is not required to buy.)

Both books will be on reserve in the Wilson Library. Other readings will be posted on the course web.

Teaching and Learning Styles

This class will require active participation of students in lectures and labs. Exercises and discussions in class will complement lectures. There are concepts to be explained and demonstrated, but classes will be more than one-way communication from the instructor.

We will use group work in both small and large assignments. Individual learning is facilitated by feedback from peers; sometimes the best way to learn something is to explain it to someone else. Urban and Regional Planning is universally collaborative, meaning your professional life will be done in group work, so it pays to practice collaboration.

Each person learns in their own way and each person's background and perspective influence their understanding of material. One goal of the class is to promote an environment of curiosity and engagement where all students will learn. In this environment each student gives and receives respect, allows time and space for all contributions, and remains open to all perspectives. If you feel that this environment is not present for you in the class, for any reason, contact me (elind@umn.edu).

Expectations and Grading

Probability and Statistics are based in logic and math, especially integral calculus. We will not be doing any integral calculus! However, understanding the math will require you to commit to the reading and exercises, and especially to asking questions of your instructor and TA.

Grading	
15+15%	Homework [five from textbook (individual), five from lab (group)]
15+15%	Exams 1 & 2 (individual + group)
10%	Lab quiz (individual)
10%	Final exam (individual)
10%	Presentation of refereed articles
10%	Participation (individual)

The homework is a deliberately sizable portion of your grade, as (1) it is in your best interests to do it and keep up, and (2) it helps take some of the stress off the exams, and can help bring up your final grade if you have difficulty with the time pressure of exams. Answers to these questions are on the course website. Check the answers before submission. Note that copying the answers violates university policies, not to mention undermines the learning purpose of the course. Lab

homework will be group-based. You are expected to work cooperatively in groups assigned by TA. All group members are responsible for the quality of the lab homework. Only one grade will be given to each group. If your group is not working well for you, *please talk to me or TA as soon as possible*. Personalities or schedules occasionally cause conflict that is no one's fault. *For all assignments, the penalty for each day of delay (2 minutes to 24 hours) is worth 10% of the assignment grade.*

Lab quiz questions will be distributed before the quiz. You will not have access to quiz data until the quiz takes place. You cannot bring any notes/do files for lab quiz. However, you can search the internet or use the help command of Stata.

A significant proportion of questions in exams will be adapted from textbook homework, textbook examples, and other review exercises. It is of your interest to work on those questions. The key to a decent grade is to show your work, not only the answers. Exams 1 and 2 will be tested twice. Specifically, each student will take the exams individually for 75 minutes on the exam day; then the group will be tested using the same questions for 25 minutes in the following lecture. Each of the individual exam and the group exam account for 50% of the overall exam grade. After the individual exams, discuss concerns and solutions with your group members. Please take the opportunity to learn and to boost your score.

The final exam is an open-book take home test. The exam will be accessible on the course website at 11:15 am on the examination day. If you have any concern regarding exams, come to see me before exams.

While **makeup work for legitimate absences** is part of University policy, faculty and instructors choose how to accommodate absences based on their course. In this course, excused absences will be handled as follows:

Students are expected to obtain notes from a classmate of class material missed.
Students may request a make-up assignment for class material missed.

Participation will be assessed based on your participation in lectures and two confidential group evaluations. To avoid free ride, your group members will evaluate your participation in group discussion and assignments.

Statistical Software

Interaction with data is done through statistical software. Conforming with Humphrey school practice, we will use *Stata* in hands-on lab exercises. The software is available on lab computers, and can be accessed on your personal computer through the internet via AppsToGo. Various online Stata tutorials and references exist, e.g. https://libguides.princeton.edu/dss/Stata.

R is another commonly used statistical software package. Instructor will use R in class for examples and share code for those interested in building skills in that package. It is also available on lab computers and AppsToGo, but has the additional advantage of being free to download and use with many open-source components. Various online R tutorials and references exist, e.g. https://education.rstudio.com/learn/beginner/.

Course Policies

For links to University of Minnesota and Humphrey School policies, please click the "U of M Policies" link on our course Canvas site, or see https://z.umn.edu/PolicyStatements. Policies include information on student conduct, scholastic dishonesty, sexual harassment, equal opportunity, disability accommodations, and more. This course abides by these policies.

Name and Pronoun Usage
Class rosters have been provided to the instructor with the student's legal name, unless a student enters another name into their OneStop account. See the Personal Information tab at OneStop. I will happily honor your request at any point to address you by your correct name or pronouns. Please advise me on how you would like to be referred to in class.

Canvas
Some or all of our class readings, resources, and assignments are available on the course Canvas site. Find the site at canvas.umn.edu. For help with Canvas, contact OIT at canvas@umn.edu, 612-301-4357, or their live chat.

Set Your Canvas Notification Preferences
This course depends upon your ability to receive communications from your instructor and about the class. It's important that you set up your Canvas "notification preferences" to choose how and when you'd like to receive messages via text, email, or both. To set up email notifications, you can follow the guide "How do I set my Canvas notifications as a student?"

Tennessen Warning Notice Pursuant to MN Department of Administration's Data Practices
To make this class more accessible to all enrolled students, I may record all or some class lectures and discussions. Since your audio/video may be part of those recordings we are informing you. Along with the instructor and teaching assistants, these recordings will be shared with only the students enrolled in the class during this semester, in accordance with FERPA regulations.

Zoom Recordings and/or Pre-recorded Lectures
This course may include video and audio recordings of class lectures and classroom activities. These recordings will be used for educational purposes and the instructor will make these available to students currently enrolled in this course. Students must seek instructor permission in order to share either course recordings or course content/materials with others. Similarly, instructors who wish to share zoom recordings with other sections or classes must seek and document permission from students whose image or voice are in these recordings.

COVID-19

The latest information on University policies with respect to COVID-19 can be found on the Safe Campus page.

Acknowledgements

The course framework was generously provided by Dr. Jason Cao of the Humphrey School.

Lecture and Lab Schedule

WEEK 1

September 5: Introduction
Course syllabus
Read Utts Chapters 1, 2

September 7: Experiments and observational studies
Field work: Washington Ave mode split
Read Freedman et al, Chapters 1 and 2

Lab 1: Introduction to STATA and land use-transportation data
Watch the video by Dr. Fertig before lab: https://mediaspace.umn.edu/media/t/1_bkcapo9y

WEEK 2

September 12: Summarizing data: histograms and moments
Read Freedman et al, Chapters 3 & 4

September 14: The normal distribution
Read Freedman et al, Chapters 5 & 6

Lab 2: Summarizing and displaying data

WEEK 3

September 19: Probability distributions
Read Freedman et al, Chapter 13

September 21: Variability and statistical error
Read Freedman et al, Chapters 16 - 18

Lab 3: Review exercises: Chapters 3, 4, and 5

WEEK 4

September 26: The Pervasiveness of Inequality
The world is log-normally distributed

September 28: Sampling & Surveys
Read Freedman et al, Chapters 19-21

Lab 4: Review exercises: Chapters 6, 8, 9, 11, and 12

WEEK 5

October 3: Survey design and evaluation
Freedman et al, Chapters 22 and 23

October 5: DAGs, error, and correlation
Read Freedman et al. Chapters 8 and 9

Lab 5: Scatter plots, correlation coefficients, and simple regression

WEEK 6

October 10: **Exam 1 (covering Weeks 1-5, individual)**
Read Freedman et al, Chapter 15

October 12: **Exam 1 (group)** and building linear regression

Labs 6: Simple regression

WEEK 7

October 17: Building linear regression
Read Freedman et al, Chapter 10

October 19: Reading and diagnosing linear regressions
Read Freedman et al, Chapter 11

Labs 7: Review exercises: Chapters 13-15

WEEK 8
October 24: tests of "significance"
Read Freedman et al, Chapters 12 and 26
October 26: Sample tests of statistical difference
Read Freedman et al, Chapters 27 and 28
Lab 8: Review exercises: Chapters 16-18

WEEK 9
October 31: Multiple regression introduction
Read Ritter, sections 1-3
November 2: Multiple regression: interactions
Read Ritter, sections 4-7
Lab 9: Review exercises: Chapters 20-23

WEEK 10
November 7: multiple regression: coefficients
Read Ritter, sections 8-11
November 9: Multiple regression DAGs
Read McElreath
Lab 10: review exercises: Chapter 26-28 and one sample test

WEEK 11
November 14: **Exam 2 (covering Weeks 6-10, individual)**
November 16: **Exam 2 (group)** and autocorrelation & confounding
Lab 11: Independent sample test, paired sample test, Chi-square test

WEEK 12
November 21: time series analysis & BACI
November 23: Thanksgiving
No labs

WEEK 13
November 28: hierarchical & spatial regression models
November 30: machine learning & AI
Lab 13: Multiple regression

WEEK 14
December 5: Paper Presentations (Zoom)
December 7: Paper Presentations (Zoom)
Lab 14: Lab quiz

WEEK 15
December 12: Final exam (at-home open book, timed)

Important Dates:
Students are responsible for all course requirements, including deadlines and examinations. Solutions to lecture homework are available on the Moodle site.

Items	**Content**	**Due Day**
Lab Assignment 1	Check course website	Sept. 20/22 in lab
Homework 1	Chapter 2: 6.1, 6.4, 6.10 on pp. 24-27 Chapter 3: 8.2, 8.4 on pp. 50-52 Chapter 4: 8.1, 8.6, 8.7, 8.9 on pp. 74-75 Chapter 5: 7.1, 7.7, 7.9 on pp. 93-95 Chapter 6: 5.2, 5.4 on pp. 104	Sept. 21 in class
Lab Assignment 2	Check course website	Sept. 27/29 in lab
Homework 2*	Chapter 16: 5.4, 5.7 on p. 285-286 Chapter 17: 6.1, 6.2 on p. 304 Chapter 18: 7.2, 7.11 on p. 329 Chapter 20: 6.3, 6.4, 6.7 on pp. 371-372 Chapter 21: 6.5 on pp. 392	Oct. 3 in class
Exam 1		**Oct. 10 & 12 in class**
Lab Assignment 3	Check course website	Oct. 18/20 in lab
Homework 3	Chapter 8: 5.1, 5.7, 5.9 on pp. 134-137 Chapter 9: Exercise Set A 6 on p. 143 Chapter 11: 6.4, 6.5 on pp. 198-199 Chapter 12: 4.1, 4.3, 4.7, 4.8 on pp. 213-215 Chapter 26: 7.2, 7.5 on pp. 495-497	Oct 31 in class
Homework 4	Chapter 27: 6.5, 6.7 on pp. 518-520 Chapter 28; 5.2, 5.9 on pp. 541-543	Nov. 7 in class
Exam 2		**Nov. 14 & 16 in class**
Lab Assignment 4	Check course website	Nov. 21 by 3:45 pm
Homework 5 *	Multiple regression & DAG homework	Nov. 28 in class
Lab Assignment 5	Check course website	Nov. 28/30 in lab
Lab quiz		**Dec. 5/7 in lab**
Final exam		**Dec. 12**

* Homework will not be graded & returned before next exam. Please check the solutions of these questions to make sure you understand how to address them. If you have questions, please visit me or TA during office hours.