3818 - Introduction to Statistics (Online)
Syllabus/Course Information

Course Description

Econ 3818 is a first course in probability and statistical methods, with an introduction to econometrics.

This is primarily a lecture course in the theory and tools of statistics. Applications will be taken from topics in economics, and other areas. Both simulated and real data will be used in these examples.

Instructor

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Teaching Assistant

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Instructor Short Biographies

Donald Waldman is a professor in the Economics Department. Both his teaching and research concentrate on statistical methods (econometrics) and applied microeconomics (environmental economics, nonmarket valuation, labor economics, industrial organization). He has taught the classroom version of this course many times.

Patrick Gourley is an advanced Ph. D. student in the Economics Department. He has taken most of the statistics/econometrics course offerings of the Department, some with Professor Waldman. He has been a TA for this course taught in a classroom.

Prerequisites

The most important background to bring into this course is ability to think abstractly. In addition, students will find it easier if they have a good understanding of algebra at the level of high school Algebra II. Differential and integral calculus play a smaller role in this course, but they will be used. This material will be reviewed during the course of the lectures.

The course prerequisites are *one* of the following:

ECON 1078 and 1088;
MATH 1300;
MATH 1310;
MATH 1081;
MATH 1080, 1090, and 1100;
APPM 1350.

Prior to the start of class:

- Please read Caniglia (the course textbook), Chapter 2.
- Log in to Zoom.us. View the demo. Sign up for a free account. Try hosting a meeting with someone in the class, or with any friend.
- Try out Microsoft Excel, often included in any Windows PC and some Macs, available on all computers in the CU computer labs. If you are using your own computer, install the Analysis ToolPak add-in program. Here are instructions to do so:

Click the File tab, and then click Options.
Click Add-Ins, and then in the Manage box, select Excel Add-ins. Click Go.
In the Add-Ins available box, select the Analysis ToolPak check box, click OK.
If Analysis ToolPak is not listed in the Add-Ins available box, click Browse to locate it.
If the Analysis ToolPak is not currently installed, click Yes to install it.
The Data Analysis command will now be available in the Analysis group on the Data tab.

Course Objectives

• Statistics is the study of data (resulting from either the physical or social world) that is subject to randomness. The major objective of this course is to convey the basic language, mathematical symbols, tools, and techniques of statistics.

• Statistics is the building block of econometrics, which is the application of statistics to economic models and data. A second goal of this course is to provide an introduction to econometrics.

• Since the applied economist uses statistics on data, a third objective of the course is provide the student with the ability to organize and investigate data using Microsoft Excel.

Content Presentation

This course will be presented online in a series of "segments" (voice recordings accompanied by the equivalent of writing on the blackboard) for the sequence of topics that comprise an introductory statistics course.[1] Unlike a classroom lecture, where each lecture must be the same length of time, the segments will vary in length depending upon the topic. They should be watched sequentially. The recordings can be started and stopped at will, so that you will be able to view as long or as little as you like and repeat sections if necessary.

[1]I am a pretty good lecturer (you are free to disagree at the end of the course), but a pretty lousy film editor. The videos for this course were not professionally recorded. Rather they are actual, live classroom recordings (for the most part), then edited by me. Please excuse occasional pauses (for example, where I edited out student questions), some starting and ending problems, and other gaffs. The content is all good. Thanks.

Quizzes and problem sets will follow groups of segments, and will be due twice weekly. There will be two recitations per week, using online video conferencing software (Zoom), hosted by the course teaching assistant. During the recitation sessions material will be presented relevant to the problem sets, and questions can be answered about the problem sets.

Course Outline

The course begins with *probability*, continues with *statistics*, and ends with *econometrics*.

The following is a list of topics/segments, by week. This list may be useful to you to see where we are in the text, but I expect it will have little meaning to you at this point.

Week 1

- Research in "Hard" and "Soft sciences
- Introduction to probability. Axioms; Venn diagrams
- Addition and complement rules of probability
- Conditional probability
- Tree diagrams
- Independence and mutual exclusivity
- Bayes' law
- Urn problems
- Bayes' Law for partitions

Week 2

- Random variables and probability distributions
- Discrete random variables; the probability mass function
- Bernoulli, binomial, and Poisson random variables
- Mathematical expectation
- Expectation of a function of random variables; variance
- Continuous random variables; the probability density function
- The power, exponential, and standard normal distribution
- Bivariate, marginal, and conditional distributions
- Conditional expectation and variance
- Covariance and correlation

Week 3

- The general normal distribution
- From probability to statistics - population and sample
- Sampling theory - the distribution of the sample mean
- The Central Limit Theorem

- The chi-squared distribution
- Point estimation
- Unbiasedness as a property of an estimator
- Relative efficiency and best (minimum variance estimation)
- Examples from portfolio theory
- Comparing biased and unbiased estimators--mean-squared error
- Maximum likelihood estimation
- Confidence intervals

Week 4 - hypothesis testing

- Introduction - the State of Nature and the outcome of a test
- Type I and Type II errors. The power of the test
- Testing hypotheses about the population mean - classical method
- p-value and the p-value method of testing hypotheses
- Using confidence intervals
- Testing hypotheses about the population proportion
- Some caveats in testing hypotheses

Week 5 - the classical, normal, linear regression model

- Model specification and assumptions
- Estimation and hypothesis testing
- Prediction and goodness-of-fit
- Multiple regression
- Review
- Final exam

Text

Caniglia, Statistics for Economists, An Intuitive Approach, Harper Collins Publisher, 1991. This book is out of print, but available in soft cover at the CU bookstore for $60. Since there is no disk or key to unlock a publisher web site associated with this book, and since there is only one edition, any used copy is equivalent to a new copy. At this date there are 18 used, hard copies available on Amazon, also for $60. The text has been used for this course at CU for the last four semesters, so that it is available on all the second hand book sites, at the Colorado Bookstore on College Avenue in Boulder, and other places.

Student Responsibilities/Grading

This is a one-semester course in statistics. In a typical 15 week semester, there are three 50 minute lectures, which means there are $15 \times 3 \times 50 = 2{,}250$ minutes of lecture time. This summer session course is five weeks long, with nominally four days of "contact" time per week. Therefore, if you wish to view the lectures only on Monday - Thursday of

each of the five weeks, this would require you to view $2250/(5 \times 4) = 112.5$ minutes of lecture each day. In my experience, for a student with average mathematical background, an additional hour to an hour and a half *per day* will be required to read the text and work out assignments to fully understand the course material.

Assessment

Like many courses but unlike, perhaps, a "topics-in something" course, this course is sequential in nature. That is, Week 2 material will likely be unintelligible unless Week 1 material has been mastered. In fact, Wednesday's segments may not make sense unless Monday's and Tuesday's segments have been viewed and understood.

Therefore, to make understanding material easier, answers to quizzes and problem sets will be made available shortly after their due date and time. This means strict deadlines on when quizzes, and problem sets (and midterms) can be completed. All of this is another way of saying

This is not a "self-paced" course!

To get credit for assignments, they must be done in the allotted window.

There will be:

- Two 10 minute quizzes each week. The quiz for material covered Monday and Tuesday must be completed by 11 pm on Tuesday, after which solutions will be available. The quiz for material covered Wednesday and Thursday must be completed by 11 pm on Friday, and again after that time solutions will be available.

- Twice-weekly problem sets. The problem set for material covered Monday and Tuesday must be completed by 11 pm on Friday, after which solutions will be available. The problem set for material covered Wednesday and Thursday must be completed by 11 pm on Sunday, and again after that time solutions will be available.

- Three online midterm exams, one each at the conclusion of weeks two, three, and four.

- A comprehensive online final exam given after the last day of class.

Submitting Written Work:

All written work: quizzes, final and midterm exams, and problem sets, will be completed either using a word processor or hand-written, then scanning to a .pdf file and uploading to the course Dropbox before the due date and time. Since much of your written

assignments will require mathematical notation, for example

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(x-\mu)^2}$$

unless you are a proficient word processor I advise scanning (an exceptionally legible) hand-written document. Therefore it will be necessary for you to have access to a document scanner. Most copy machines can also scan and email documents. If you are on the CU-Boulder campus see http://www.colorado.edu/oit/services/teaching-learning-spaces/student-printing-and-scanning. There are more than 100 printing/scanning stations on campus. Scanning to email is free.

Of course if you happen to own a touch screen (or tablet) computer such as an iPad, Sony Vaio Touch, or Microsoft Surface Pro), you may be able to write your assignments and upload directly.

Grading: we will make every effort to grade quizzes before the next quiz is due, so twice weekly; problem sets before the next problem set is due, so once a week: and midterm exams within one week of the exam due date. Grades will be immediately posted to the course web site.

Grading Criteria

- *Quizzes* (15%)
- *Weekly Problem sets* (20%)
- *Three midterm exams* (15% each)
- *Final exam* (20%)

Course grades will be assigned based upon overall percentage course score.

"Office Hours"

I will conduct office hours twice weekly, at a time to be arranged in consultation with you. During these times, I will answer emails in real time, or if the technology works we can open up a screen-capture plus audio Zoom session.

Students with Disabilities and the Honor Code

Notice for students with disabilities:

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 be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and www.Colorado.EDU/disabilityservices

Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. The syllabus statements and answers to Frequently Asked Questions can be found at www.colorado.edu/disability services

Honor Code Policies

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 (honor@colorado.edu; 303-735-2273).

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). Other information on the Honor Code can be found at http://www.colorado.edu/policies/honor.html and at http://www.colorado.edu/academics/honorcode/