3818 - Introduction to Statistics
Summer 2016 Online
Syllabus/Course Information

Course Description

Econ 3818 is a first course in the theory and methods 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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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.

Kyoung-Gon Kim ("Gon") is an advanced Ph. D. student in the Economics Department. He has taken the statistics/econometrics course offerings of the Department, some with Professor Waldman.

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.

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/participating in a meeting with someone in the class, or with a 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.

Note: For the applied part of this course, I will use and teach Microsoft Excel. If you do not have or have access to Excel, you can use Google Sheets, SPSS, or any other good spreadsheet software. but you will have to learn the commands to do the required work.

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. For Econ majors, the second course in the quantitative sequence for the major is Econometrics, Econ 4818, or applied Econometrics, Econ 4848.

- 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 video "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 must 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.

Quizzes and problem sets will follow groups of video segments. There will be two recitations per week, using online video conferencing software (Zoom.us), hosted by Gon, the course teaching assistant. During the recitation sessions material will be presented and questions answered relevant to the problem sets. Recitations are not graded, they are for your benefit only, but **you must either attend the recitation or view it online** (this is part of what distinguishes a four credit course, such as this one, from a three credit course).

Course Outline

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

Week 1

- Research in "Hard" and "Soft sciences (8:36)
- Introduction to probability. Axioms; Venn diagrams (27:18)
- Addition and complement rules of probability (17:35)
- Conditional probability
- Tree diagrams (
- Independence and mutual exclusivity
- Bayes' law (46:10)
- 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

[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.

- 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 to purchase $60 (new), and may be available for $45 (used), and $39 and $27 to rent (new and used, respectively). Since there is no disk or key needed 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 a 30 copies available on Amazon, starting at $11.90 (on April 28). The text has been used for this course at CU for the last

seven semesters, so that it may be available on all the second hand book sites, and other places.

Student Responsibilities/Assessment

This is a one-semester course in statistics. In a typical 15 week semester, there are three 50 minute lectures, which means there are 14 (one subtracted for testing) weeks $\times$ 3 lecture/week $\times$ 50 minutes/lecture $=$ 2,100 minutes of lecture time. I have edited (and occasionally deleted) the lectures for this summer online course down to approximately 1300 minutes. As the summer session course is five weeks long, with nominally four days of "contact" time per week, this would require you to view $1{,}300/(5 \times 4) = 65$ minutes of lecture each day.

In addition to viewing the lectures, in my experience for a student with average mathematical ability and 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.

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, problem sets, and midterms can be completed**. All of this is another way of saying …

this is not a "self-paced" course!

So to get credit for assignments, they must be done by the due date. You are free to work ahead, but you cannot fall behind!

Weekly assignments:

- Two multiple choice quizzes. Quizzes are taken online (click Assessments/Quizzes), one try per quiz. Solutions can be viewed immediately upon submitting the quiz. Quizzes are timed. You have 15 minutes to complete each quiz.
- Two problem sets per week. Problem sets are to be written, scanned, and uploaded to the Course Dropbox. See below for more information on submitting problem sets.
- At the end of each of weeks 2 - 4, there will be an online, timed (75 minute) multiple choice midterm exam (to access, also click Assessments/Quizzes).

Schedule of due dates for assignments:

Participation in the online recitations and completion of quizzes and problem sets are designed to follow two days of lecture viewing. The first week of class runs from

Tuesday - Friday; the remaining four weeks of class run from Monday - Thursday. Hence the schedule of due dates differs by whether it is the first week, or weeks two through five.

In the first week of class:

- Recitation 1 (covering Tuesday's and Wednesday's lectures) will be held on Wednesday at 6 pm.
- The quiz for material covered Tuesday and Wednesday must be completed by 11 pm Thursday. **The quizzes are timed, so do not start the quiz until your are ready to take it.** I suggest you first view the lectures, attend the recitation, and read the suggested pages in the text.
  Recitation 2 (covering Thursday's and Friday's lectures) will be held on Friday at 6 pm. The quiz for material covered on Thursday and Friday must be completed by 11 pm on Saturday.
- The problem set for material covered Tuesday and Wednesday must be completed by 11 pm on Friday, after which solutions will be available. The problem set for material covered Thursday and Friday must be completed by 11 pm on Sunday, and again after that time solutions will be available.

In weeks two - five,

- Recitations will be held on Tuesdays and Thursdays at 6 pm.
- The quiz for material covered Monday and Tuesday must be completed by 11pm Wednesday. The quiz for material covered on Wednesday and Thursday must be completed by 11pm on Friday.
- The problem set for material covered Monday and Tuesday must be completed by 11pm on Friday, after which solutions will be available. The problem set for material covered Wednesday and Thursday must be completed by 11pm on Sunday, and again after that time solutions will be available.
- The three, timed (75 minutes) online midterm exams, one each at the conclusion of weeks two, three, and four, must be completed by Sunday at 11 pm. **As with the quizzes, do not start a midterm until you are ready to take it!**
- At the end of week 5, the two and a half hour comprehensive online final exam must be completed by Sunday, 11 pm.

This table summarizes the due dates:

Schedule of assignments				
	Recitation at 6pm	Quiz due by 11 pm	Problem Set due by 11pm	Exam due by 11pm
Week 1				
Lectures for Tues/Wed	**Wednesday**	**Thursday**	**Friday**	
Lectures for Thur/Friday	**Friday**	**Friday**	**Sunday**	---
Weeks 2 - 5				
Lectures for Mon/Tues	**Tuesday**	**Wednesday**	**Friday**	
Lectures for Wed/Thur	**Thurday**	**Friday**	**Sunday**	**Sunday**

Submitting Written Work

All problem sets will be completed either using a word processor or hand-written, then scaned to a pdf file and uploaded to the course Dropbox before the due date and time. Since much of these 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.

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.

If needed, problem sets may be photographed (on a smartphone, for example) and then uploaded to Dropbox. In my experience this does not always work out so well (in that photographs are not completely legible). You must submit a legible document before it can be graded.

If you are on the CU Boulder campus, you can bring your written problem sets to the Economics building and put them in the envelope taped to my office door, room 108.

Grading

The quizzes, midterms, and final exam are graded immediately, and problem sets will be graded before the next problem set is due and grades 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.

Do to the online nature of the course and the number of students, I cannot accept any late assignments, regardless of the reason. Therefore, I will drop the lowest quiz score and the lowest problem set score before calculating the final percentage course score.

Contact

I will generally quickly answer email queries, and at the least, at the end of the day.

In addition to hosting the online recitations, the TA will also have office hours and answer emails.

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/disability services

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/