Econ 102A: Introduction to Statistical Methods for Social Scientists

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Lectures: Building 370, Room 370, M/W 1:30pm – 3:20pm
Office Hours: Monday 6:30pm – 7:30pm, Wednesday 6:30pm – 7:30pm, or by appointment

Course Overview:

Economics 102A provides an introduction to probabilistic modeling, discrete and continuous random variables, covariance and correlation, central limit theorems, hypothesis testing and confidence intervals. The concepts and techniques we discuss are relevant not only to economics but also to any discipline which involves decision making and/or the need to collect, organize and interpret data.

The first part of the course is devoted to probability. Unlike many standard courses in this field, our emphasis will not be on memorizing equations or simply plugging into formulas. Our emphasis will instead be on creating models, oftentimes from current media articles. Experience suggests this applied approach is a better way to not only acquaint students with probability rules and reasoning but also deepen their understanding.

As the course progresses we introduce common probability distributions in statistical analysis. Once the theoretical underpinnings are understood, we concentrate on how sample data are used to make inferences about the underlying population. Creating confidence intervals and conducting hypothesis tests are two common procedures within this realm.

Econ 102A provides the basis for Econ 102B, which is mainly devoted to regression modeling. However, for those not planning to take Econ 102B, this course still has stand-alone value (as opposed to simply being a setup course) since the probabilistic and statistical techniques discussed are standard in social sciences, natural sciences, law and medicine.

Prerequisite: Math 20 (or equivalent)

In the probability section of Econ 102A, we will occasionally require knowledge of integration, as discussed in your past calculus course. Students should be aware of this and brush up on that material as necessary.

Textbook:

The primary reading materials for Econ 102A are the lecture notes posted weekly on our Canvas page (see below). For those wanting additional discussion and practice, the following textbook had been required by previous instructors of Econ 102A. Note that this textbook is now only recommended (not required) as many students feel the weekly lecture notes on Canvas suffice:

Moore David S., McCabe George P., Alwan Layth C. and Craig Bruce A., *The Practice of Statistics for Business and Economics*, 4th Edition, W. H. Freeman and Company, 2016.

This textbook pertains more to the material in the latter part of the course. Students looking for additional material or practice for the early part of the course may wish to consult:

Ross, Sheldon, *A First Course in Probability*, 8th Edition, Pearson Prentice Hall, 2009.

However, effort has been made to supply many practice exercises (weekly worksheets in the lecture notes, solved practice exercises, assignments and a standard packet of 80 extra solved exercises distributed within the TA sections) to forgo the need and expense of an additional probability textbook for the course.

Lecture Notes on Canvas site:

We will make extensive use of our online course page throughout the quarter. I will post lecture handouts each week which provide supporting materials for all topics covered during lecture. **These lecture handouts are the primary reading and study materials for the course.** Therefore, the recommended textbooks should be thought of as providing two services: (1) to obtain further explanations of the topics within the lecture handouts, and (2) to provide extra practice exercises to supplement the exercises within the lecture materials. Students should print out the lecture materials from our Canvas page for any specific week prior to that week's lectures. For example, students should print out the Week 1 Lecture Materials prior to the first class lecture as the first week's lectures will be referencing these materials.

Aside from posting course lecture notes, the Canvas page will also contain homework assignments, solutions, practice examinations and other supplemental information.

Economics Department Common Course Policies:

All courses taught in the Stanford Department of Economics are governed by a common set of course management rules. A document explaining these rules may be found on the Economics Department site at https://economics.stanford.edu/undergraduate/major/economics-common-syllabus. Please be sure to read this document in its entirety.

Privacy of Course Materials:

The materials posted on Canvas are meant solely for students attending Econ 102A this quarter. Unfortunately, in the past, some students have supplied online educational sites (such as Course Hero) with the Econ 102A materials after completion of the course. You do not have the instructor's permission to supply the Econ 102A course materials to any online site (such as Course Hero) which posts course-specific material for general viewing. Doing so could place you in violation of the Stanford Honor Code.

You should also not be viewing any Econ 102A examination or assignment solutions from previous years. Further, you should not be supplying any of this quarter's course materials to students who will take Econ 102A in a subsequent quarter. Using previous materials not supplied to the whole class and/or providing course materials to students who will take the course at a later time could place you in violation of the Stanford Honor Code.

Students with Documented Disabilities:

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an accommodation letter for faculty dated in the current quarter in which the request is made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. In particular, students are asked to secure this letter at least two weeks prior to any examination dates so as to provide ample time for the Economics Academic Office to accommodate the OAE recommendations. In other words, students should not be providing their OAE letters to either the instructor or the Economics Academic Office literally a day or two before an examination.

A Few Course Rules:

Any student who commits to take this course thereby agrees to the following rules:

(1) Regular class attendance is expected. If a student chooses not to attend lecture (or only attend lecture infrequently) the instructor reserves the right to lower the student's course grade accordingly. For those taking the course Credit / No Credit, failure to attend class regularly could be considered sufficient grounds for a student to receive no credit. Taking another Stanford course which meets at the same time as Econ 102A lectures **does not** constitute an acceptable reason for students to miss lecture.

(2) Any re-grading of assignments, midterms or final examinations must be done through the teaching assistants. Your course instructor can provide you with the name of the teaching assistant who graded the exercise in question, but it is this teaching assistant who has the final say in the amount of credit you ultimately receive.

(3) All examination days and times are set in stone and shown on this syllabus (please see the Examinations section below). Students may not take midterms or final examinations at alternate times due to personal conflicts or multiple examinations on the same day. This policy is described in the Economics Department Common Course Policies document referenced above.

(4) If a student adds the course after the second week of the quarter and misses one or more assignments, a zero will be assigned as that student's grade for all missed assignments (since the answers will already have been posted). These students are not allowed to waive such assignments in the determination of their final grade. Unfortunately, no student will be allowed into the course after the Final Study List Deadline has passed.

(5) Students must be physically present in class when taking any course examination. That is, students may not take an exam at a remote location and submit their exam via fax, e-mail or any other similar means. The only exception to this rule is for current varsity athletes who are traveling with their team during a scheduled exam. In such cases, students will have their exam proctored by a member of the coaching staff of their respective sport.

(6) Unfortunately, there is no opportunity for extra credit in the course either during the course or after the course has ended. Often, when students do not meet their own expectations on exam performance, many ask for an extra credit opportunity. Since virtually all students in the course would welcome a chance to improve their standing, it is not possible to offer extra credit to only certain individuals in the class.

Assignments:

There will be six individual assignments throughout the quarter. The timing of these six assignments is given in the table below.

Assignment	Due Date
Assignment 1	Wednesday, January 25th
Assignment 2	Friday, February 3rd
Assignment 3	Friday, February 10th
Assignment 4	Monday, February 27th
Assignment 5	Friday, March 10th
Assignment 6	Friday, March 17th

The grading of the assignments works as follows: for each particular assignment five questions will be chosen for grading. Although individual assignments will have more than five questions, students will not know beforehand which specific five questions will be graded and which will not. Each specific exercise chosen for grading receives a maximum of five points. So, each assignment carries a maximum of 25 points.

Please note that *all* assignments contribute to one's final grade; no assignment scores are dropped. Solutions to all assignments will be posted on Canvas.

Assignments due on Fridays are due at the time your discussion section meets. That is, the assignments are turned in during your section meeting. The assignments due on non-Fridays are due during our class lecture time. The penalty for late assignments (except Assignment 3 and Assignment 6) is as follows:

- Assignments submitted after the due date time but before midnight of the same day are discounted by 25%.
- Assignments submitted the day after the due date are discounted by 50%.
- Assignments submitted two or more days after the due date receive no credit.

The above rules do not apply to Assignment 3 or Assignment 6 as these assignments are turned in just before the midterm examination and final examination respectively. Because the solutions to these assignments must be posted promptly (as a study guide for the examinations) both Assignment 3 and Assignment 6 must be turned in on time in order to receive credit.

Examinations:

We will have one midterm during the quarter and a final examination at the conclusion of the course. The exam timing is as follows:

Examination	Date
Midterm Examination (Week 6)	Monday, February 13th
Final Examination (Week 11)	Wednesday, March 22nd 3:30pm – 6:30pm

Please make sure you are able to attend these examination times. Unfortunately, Economics Department policy does not allow for examination times to be rescheduled.

Grading:

Grades will be based on the aforementioned assignments and examinations. The specific contribution of each of these deliverables toward the final grade is as follows:

Assessment Method	Contribution Toward Final Grade
Assignments	25%
Midterm Examination	30%
Final Examination	45%

Your final grade in this course is based on your performance as compared to the class median performance. Once your scores on the assignments, midterm examination and final

examination are known, each is weighted in accordance with the above table to determine your 'raw score' for the course. Your raw score is then compared to the median raw score among all class members. The median raw score determines the B+ / B borderline. Then, grades are assigned in accordance with the following guidelines:

… raw scores more than 1.5 standard deviation *above* the median receive an A+

… raw scores between 1 and 1.5 standard deviations *above* the median receive an A

… raw scores between 0.5 and 1 standard deviation *above* the median receive an A–

… raw scores between 0 and 0.5 standard deviations *above* the median receive a B+

… raw scores between 0 and 0.5 standard deviations *below* the median receive a B

… raw scores between 0.5 and 1 standard deviation *below* the median receive a B–

… raw scores between 1 and 1.4 standard deviations *below* the median receive a C+

… raw scores between 1.4 and 1.8 standard deviations *below* the median receive a C

… raw scores between 1.8 and 2.2 standard deviations *below* the median receive a C–

… raw scores between 2.2 and 2.6 standard deviations *below* the median receive a D+

… raw scores between 2.6 and 3 standard deviations *below* the median receive a D

… raw scores between 3 and 3.4 standard deviations *below* the median receive a D–

… raw scores lower than 3.4 standard deviations *below* the median receive a 'No Pass'

For those students taking the course Credit / No Credit, a grade of C – or higher must be attained in order to receive 'Credit.'

Overview of Lecture Topics and Timing

**(Please consult McKeon Lecture Notes first;
then use textbook for additional discussion)**

Date	Topics	Primary Reading	Textbook Sections
1/9	Course introduction; probability tree modeling; general rules for probability trees; probabilistic events.	Lecture Notes Week 1	4.1, 4.2, 5.1, 5.2
1/11	Probability as belief; Venn diagrams; probability tree collapsing; probability tree flipping.	Lecture Notes Week 1	
1/16	Holiday – No Class		
1/18	Classroom demonstration; modeling real-world examples.	Lecture Notes Week 2	
1/23	Modeling a three-stage probability tree; Bayes' Rule and its relation to tree flipping; probabilistic independence.	Lecture Notes Week 2	5.2
1/25	Introduction to random variables; Bernoulli and binomial random variables; the binomial distribution formula; examples involving binomial random variables.	Lecture Notes Week 3	4.3, 5.3
1/30	Finish examples with binomial random variables; Poisson random variables; continuous random variables.	Lecture Notes Week 3	5.4
2/1	Expected value; variance and standard deviation for both discrete and continuous random variables.	Lecture Notes Week 4	4.3
2/6	Properties of expected value and variance; joint, marginal and conditional distributions; random variable independence.	Lecture Notes Week 4	2.5
2/8	Standardizing random variables; covariance; correlation coefficients.	Lecture Notes Week 5	

2/13	Midterm Examination		
2/15	Portfolio optimization with dependent investments; normal distributions; examples involving normal distributions.	Lecture Notes Week 6	1.3
2/20	Holiday – No Class		
2/22	More on normal distributions; the Central Limit Theorem of Sums; iid random variables.	Lecture Notes Week 7	
2/27	More on the Central Limit Theorem of Sums; simulation demonstration; the Central Limit Theorem of Means.	Lecture Notes Week 7	
3/1	Sampling from a population; point estimators; the distribution of sample means; begin confidence intervals.	Lecture Notes Week 8	3.1, 3.2, 3.3, 3.4, 4.4, 6.1
3/6	More on confidence intervals; t-tables; margin of error; proportion problems.	Lecture Notes Week 8	7.1, 8.1
3/8	Hypothesis testing; p-values.	Lecture Notes Week 9	6.2, 6.3, 7.1
3/13	More on hypothesis testing; proportion problems; Type I and Type II errors	Lecture Notes Week 9	6.4, 8.1
3/15	Two-population confidence intervals and hypothesis tests.	Lecture Notes Week 10	8.1, 8.2
3/22	Final Examination, 3:30pm – 6:30pm		