

ECON 120B

XINWEI MA

DEPARTMENT OF ECONOMICS

UNIVERSITY OF CALIFORNIA SAN DIEGO

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COURSE DESCRIPTION

ECON 120B is the second course in the core econometrics sequence. We will focus on the linear regression model. To be specific, assume we have the variables, Y , X_1 , X_2 , ..., X_k , in our dataset, and that we are interested in explaining Y using the X s. The model we will consider takes the form

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \text{unobserved factors,}$$

where the β s are unknown parameters. The linear regression model is widely applied in business, finance, public policy, and other areas. It is also the foundation and building block of more advanced statistical methods. Three major ideas will be introduced: using regression to infer causal relationships, quantifying uncertainty using confidence intervals, and testing hypotheses regarding one or more parameters.

PREREQUISITES: ECON 120A or ECE 109 or MAE 108 or MATH 180A or MATH 183 or MATH 186.

TEAM

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EMAIL COMMUNICATIONS

- You are welcome to email us. Please include “ECON120B” in the subject line of your email. Please also include your full name and your PID.
- We will only reply to emails from “@ucsd.edu” accounts. Please do not contact us with your personal email address.
- It is extremely difficult to explain mathematical derivations or solve problem set questions via email. Please only email us on course policies. We are available for questions during my office hour, TAs’ office hours, and discussion sessions. You are also welcome to talk to me after the lecture.
- We do not have any control over administrative issues such as enrollment, waiting list, exam time and location. These matters are handled by the registrar’s office and the undergraduate advising office.

ORGANIZATION

The information below reflects the current schedule. Please check the syllabus and Canvas announcements regularly for updates.

Both lectures and discussion sections will be held in person. Please note that neither the lectures nor the discussions will be recorded.

Please ensure you attend only the lecture/discussion section for which you are officially enrolled. Our classrooms are nearly at capacity, so it's important to avoid overcrowding.

SECTION A

Lecture: Monday/Wednesday/Friday, 9:00–9:50am @ CENTR 101.

Discussion A01: Wednesday, 5:00–5:50pm @ CENTR 214.

Discussion A02: Wednesday, 6:00–6:50pm @ CENTR 214.

SECTION B

Lecture: Monday/Wednesday/Friday, 11:00–11:50am @ MANDE B-150.

Discussion B01: Wednesday, 7:00–7:50pm @ PETER 103.

INSTRUCTOR'S OFFICE HOURS

Monday, 2:00–4:00pm @ San Diego Supercomputer Center (SDSC) E176.

TAs' OFFICE HOURS

To be announced on Canvas.

GOOGLE MAP LINKS

Center Hall: [link](#).

Mandeville Center: [link](#).

Peterson Hall: [link](#).

San Diego Supercomputer Center: [link](#).

TEXTBOOK

The required textbook for this class is *Introduction to Econometrics*, by James Stock and Mark Watson. Note that the lectures will also cover additional material not found in the textbook.

By enrolling in this course, you have been automatically enrolled in the UC San Diego Inclusive Access program. This means that your required course materials are being provided to you automatically, and at a discounted price.

A charge (\$39.00) for this material will be added to your student account and will appear as "Course Materials Central Charge." Your Opt-out deadline: April 13, 2024. Opt-out Portal Link: [UC San Diego Inclusive Access Opt-Out Portal](#).

If you decide not to participate, you can opt-out after the first day of classes through the above deadline. Once opted out you will be responsible for purchasing the materials listed below. A link to the opt-out portal has been sent to your UCSD email from noreply@follett.com.

Please contact the bookstore if you have any difficulty using your materials or opting out: textbooks@ucsd.edu.

SLIDES

My slides are available on Canvas. You should at least skim through the slides before coming to lecture.

CHEATSHEET

A comprehensive cheatsheet will be provided with the exams. (You do not need to print the cheatsheet.) It contains the standard normal distribution table, the critical values of different statistical tests (t, F, and Bonferroni), and useful formulas. Please get familiar with the cheatsheet before the exam.

SOFTWARE

We will use the statistical software package Stata for empirical illustration. You will also have to use Stata to solve assignments. Download and license information is available on Canvas. Both the installation file and the license are meant for students enrolled in this class only. Please do not distribute.

ADDITIONAL RESOURCES

PROBLEM SETS. We will give weekly problem sets for you to practice. While they will not be graded, you should still work on them carefully.

PREVIOUS EXAMS AND SOLUTIONS. All my previous exams and their solutions are available on Canvas. Please take a look so that you are familiar with the format of the exam.

ECONOMETRICS VIDEO HANDBOOK. In addition to my slides and the textbook, you will also have access to the Econometrics Video Handbook (EVH) through Canvas. The EVH allows you to review the material discussed in 120A.

ASSESSMENT

The following is my prediction of how we will assess you in this course. While we will do what we can to keep to the predicted assessments for this course, the evolving situation may make it necessary for me to make a change.

LETTER GRADE

- The following shows how we expect to assign letter grades based on the overall numerical grade. We reserve the right to make adjustments to the plan. Out of 100 points:

30 from midterm + 50 from final + 20 from two Stata Assignments.

Letter grade	Numerical grade cutoff
A	90
A-	85
B+	80
B	75
B-	70
C+	65
C	60

- Decisions on A+, C-, D, and F will be made on individual basis.
- We do not curve individual exam/assignment.
- There is no extra credit.

TWO STATA ASSIGNMENTS (10 POINTS EACH)

- The first Stata Assignment will be available from April 22, 12:00am, and will be due on April 28, 11:59pm.
- The second Stata Assignment will be available from June 3, 12:00am, and will be due on June 9, 11:59pm.
- No late submission will be accepted.
- You should submit your answers and do-file (separately) via Canvas.
- The Stata assignments will be graded on three scales: 0, 5, and 10. (For example, if you are able to answer more than half of the questions correctly, you will get full credit for an assignment.)
- However, if your do-file does not run for any reason, we will subtract 2.5 points regardless of how “small” or “minor” the mistake is. (Before submitting your do-file, you should click the “Do” button and see if Stata returns any error message.)
- Utilizing generative AI, such as ChatGPT, can be a valuable resource for learning and improving programming skills. Although they are not required for this class, you should feel free to leverage these technologies in solving the Stata Assignments. Should you choose to use ChatGPT for assistance, it is essential to verify the responses provided. It is also very important that you understand the answer, as there will be Stata related questions in the exams.

MIDTERM EXAM (30 POINTS)

- May 3, Friday, 7:00–8:20pm.
- Location: To be announced on Canvas.
- There will be no make-up midterm. If you miss the midterm for a verifiable medical reason, we will increase the contribution of the final exam to 80 points. You will need to provide a doctor’s note (with the name, affiliation, address, email, and phone number of the doctor). Failure to notify me promptly that you must miss the midterm exam will result in a zero grade for the midterm. Unexcused absences will also result in a zero.
- This is a closed book exam. The official cheatsheet will be provided (you do not need to print it).
- There is no remote option to take the exam.
- Please bring a calculator. You can use scientific, graphic or business calculators, but they are not necessary. A simple one will suffice. Other electronic devices (phone, tablet, laptop, etc.) are not permitted.
- Please bring a photo ID.

FINAL EXAM (50 POINTS)

- June 8, Saturday, 3:00–5:30pm.
- Location: To be announced on Canvas.
- A make-up final exam might be given only for medical emergencies. You will need to provide a doctor’s note (with the name, affiliation, address, email, and phone number of the doctor). Failure to notify me promptly that you must miss the final exam will result in a zero grade for the final. Unexcused absences will also result in a zero.

- This is a closed book exam. The official cheatsheet will be provided (you do not need to print it).
- There is no remote option to take the exam.
- Please bring a calculator. You can use scientific, graphic or business calculators, but they are not necessary. A simple one will suffice. Other electronic devices (phone, tablet, laptop, etc.) are not permitted.
- Please bring a photo ID.

OTHER

DISABILITY. If you believe that you have a disability and desire accommodation, please

- (1) Register with the Office for Students with Disabilities ([link](#)).
- (2) Contact econosd@ucsd.edu (cc x1ma@ucsd.edu in the email) with the Authorization for Accommodations (AFA) letter from OSD for accommodations such as extra exam time.

ACADEMIC INTEGRITY. Students who violate UCSD's academic integrity ([link](#)) policy will earn a failing grade for the course. In addition, the Council of Deans of Student Affairs will impose a disciplinary penalty.

COURSE SCHEDULE

The course is divided into 12 topics/lectures. You can find the required reading for each topic/lecture below, together with the problem set and Stata code.

We also list the sections in the Econometrics Video Handbook (EVH) for each topic/lecture. The EVH is not meant to replace my lectures, as they can differ significantly. My lectures may also cover topics not in the EVH.

LECTURE 0: INTRODUCTION

TOPICS: Economic models and econometric models · Prediction and causal inference · Cross-sectional, time-series, and panel data.

TEXTBOOK: Chapter 1.

EVH: D.1.

DISCUSSION: INTRODUCTION TO STATA

TOPICS: Stata interface · Basic data manipulations · Do-file · Summary statistics · Plotting · Hypothesis testing.

STATA CODE: 0.

LECTURE 1: REVIEW OF PROBABILITY

TOPICS: Random variables and distributions · Bernoulli distribution · Normal distribution · Expectation · Variance and standard deviation · Covariance and correlation.

TEXTBOOK: Chapter 2 (2.1–2.5).

STATA CODE: 1, 2, 3.

PROBLEM SET: 1.

EVH: B.1–B.3, E.1 (a–c).

LECTURE 2: REVIEW OF LARGE-SAMPLE TECHNIQUES

TOPICS: Law of large numbers · Central limit theorem · Properties of the sample mean.

TEXTBOOK: Chapter 2 (2.6).

STATA CODE: 4 (optional), 5 (optional).

PROBLEM SET: 2.

EVH: C.1, C.2.

LECTURE 3: REVIEW OF HYPOTHESIS TESTING

TOPICS: Size of a test · Three approaches: t statistic, p-value, and confidence interval · Two-sample t-test.

TEXTBOOK: Chapter 3.

STATA CODE: 6.

PROBLEM SET: 3.

EVH: C.3, C.4.

LECTURE 4: INTRODUCTION TO CAUSAL INFERENCE

TOPICS: Linear regression as fitting data · Potential outcomes · Average treatment effect · Linear regression for causal inference · Zero conditional mean assumption.

TEXTBOOK: Chapter 13 (13.1 and Appendix 13.3).

PROBLEM SET: 4.

EVH: E.1 (d), F.1, F.3 (a).

LECTURE 5: SIMPLE LINEAR REGRESSION

TOPICS: Linear regression terminology · Deriving the estimators · Special case: binary regressor.

TEXTBOOK: Chapter 4 (4.1, 4.2, Appendix 4.2), Chapter 5 (5.3)

STATA CODE: 7

PROBLEM SET: 5.

EVH: F.3 (b, c, j, k).

LECTURE 6: PROPERTIES OF THE REGRESSION ESTIMATES

TOPICS: Predicted values · Residuals · TSS, ESS, and SSR · R^2 · Proof of the unbiasedness of the linear regression estimates · Five assumptions for simple linear regression.

TEXTBOOK: Chapter 4 (4.3–4.5, Appendix 4.3).

STATA CODE: 8.

PROBLEM SET: 6.

EVH: F.3 (d, e).

LECTURE 7: HYPOTHESIS TESTING IN SIMPLE REGRESSIONS

TOPICS: Consistency · Asymptotic distribution · Robust standard error · Three approaches: t statistic, p-value, and confidence interval · Two-sample t-test via linear regression.

TEXTBOOK: Chapter 4 (4.5, Appendix 4.3), Chapter 5 (5.1–5.3, Appendix 5.1).

STATA CODE: 9 (optional), 10.

PROBLEM SET: 7.

EVH: F.3 (f, g, i), F.4 (a–c).

LECTURE 8: ADDITIONAL TOPICS IN SIMPLE LINEAR REGRESSION

TOPICS: Heteroskedasticity and robust standard error · Changing unit · Using log transformation.

TEXTBOOK: Chapter 5 (5.4), Chapter 8 (8.2, Appendix 8.2).

STATA CODE: 11.

PROBLEM SET: 8.

EVH: F.3 (h), F.4 (d).

LECTURE 9: INTRODUCTION TO MULTIPLE REGRESSIONS

TOPICS: Omitted variable bias · Using polynomials to model nonlinear effect · Using interaction terms · Categorical variable · Estimation with multiple linear regression · Predicted values · Residuals · TSS, ESS, and SSR · R^2 .

TEXTBOOK: Chapter 6 (6.1–6.4, Appendix 6.1), Chapter 8 (8.1–8.3), Chapter 9 (9.2).

STATA CODE: 12.

PROBLEM SET: 9.

EVH: F.3 (m), F.5 (a-c).

LECTURE 10: ASSUMPTIONS AND STATISTICAL PROPERTIES

TOPICS: Five assumptions for multiple linear regression · Unbiasedness, consistency, and asymptotic distribution · Robust standard error · Testing hypothesis about a single parameter: t statistic, p-value, and confidence interval.

TEXTBOOK: Chapter 6 (6.5–6.7), Chapter 7 (7.1).

PROBLEM SET: 10.

EVH: F.5 (d).

LECTURE 11: INTERPRETING MULTIPLE REGRESSION ESTIMATES

TOPICS: Using polynomials to model nonlinear effect · Using interaction terms · Categorical variable · Interaction among binary variables.

TEXTBOOK: Chapter 8 (8.1–8.3), Chapter 9 (9.2).

STATA CODE: 13, 14.

PROBLEM SET. 11.

LECTURE 12: HYPOTHESIS TESTING WITH MULTIPLE COEFFICIENTS

TOPICS. Testing Linear Restrictions of Coefficients · Testing Multiple Coefficients: Bonferroni and F.

TEXTBOOK: Chapter 7 (7.2–7.4, Appendix 7.1).

STATA CODE: 15.

PROBLEM SET: 12.

EVH: F.5 (e–g).