ECON 4720: Econometric Methods

Spring 2025, University of Virginia

Instructor: Lidia Kosenkova, **email:** lidia.kosenkova@virginia.edu
Lecture: MoWe 2:00pm — 3:15pm, Clinical Department Wing 2677
Office Hours: Mo 12:00pm — 2:00pm, Elson 185A
Teaching Assistant: Makoto Tanaka, **email:** mt4xq@virginia.edu
Discussion Sections: We 6:00pm - 6:50pm New Cabell Hall 132
We 7:00pm - 7:50pm New Cabell Hall 132
Office Hours (TA): Thursday 5:00pm -7:00pm, TBA
Midterm Exam 1: We, Mar 5th
Midterm Exam 2: We, Apr 9th
Final Exam: Sa, May 3, 2:00pm - 5:00pm
Textbook: James Stock and Mark Watson, "Introduction to Econometrics", 4th Edition
Companion Website: https://media.pearsoncmg.com/ph/bp/bp_stock_econometrics_4_cw/
Grading: Problem sets **(10%)**
Midterm 1 **(25%)**
Midterm 2 **(25%)**
Final Exam **(40%)**
Homework submission: Fr (6:00pm, online in Collab)
Drop deadline: Jan 28th
Withdraw deadline: Mar 10th

Homework

You are encouraged to discuss the problem sets with your classmates but you must submit your original individual answers. For the coding part you can use either MatLab or STATA. **You have to submit your code (one do/m-file per one assignment) to get full credit.** The teaching assistant will grade your submitted problem sets. Solutions together with the code files should be uploaded to the class website in Collab through Gradescope on the day that they are due (Fridays, 6:00pm). Late homework will not be accepted and there will be no extensions. Please write clearly. Any questions that you may have about the grading should be addressed to the teaching assistant **no later than one week after the graded homework is handed out**. There are eleven (11) homework assignments. The lowest grade you receive on one of the problem sets (which could be zero if a student does not submit a solution on time) will be dropped when evaluating your overall grade on problem sets. Answer keys will be uploaded to the class website shortly after the submission deadline.

Exams

There will be **NO MAKEUP MIDTERMS**. If you miss a midterm and have a Dean's excuse, the weight of the missed exam will be reallocated to the final exam, regardless of the respective means of the individual exams. The final exam is comprehensive, so you will be responsible for all the material covered in this course. The day and time of the final is set up by the University and can not be moved under any circumstances. You can bring **ONE** double-sided letter-size sheet with formulas and a calculator to all exams.

Course Outline

- Review of probability and statistical concepts being used in econometrics (Ch's 2, 3, 18)
- Linear regression models with single and multiple regressors, hypothesis testing, confidence intervals, nonlinear regressions (Ch's 4—9, 19)
- Instrumental variables (Ch 12)
- Panel Data (Ch 10)
- Time series analysis (Ch 15)

Week 1

1. (Mo, Jan 13) Random variable: support, probability distribution function, expectation, standard deviation of a discrete random variable; probability of an event; expectation, variance and standard deviation of a linear function (Ch1, Ch2.1, 2.2 (pp.1—20))
2. (We, Jan 15) The moments and the centered moments, skewness, kurtosis. Graphs of the probability density function and the cumulative distribution function. Two random variables: joint, marginal and conditional probability distributions, conditional expectation, the law of iterated expectation. Conditional variance (Ch2.3 (pp.21—28))

Week 2

3. (We, Jan 22) Independence, covariance, correlation. Properties of $E[X]$, $Var[X]$, $Corr$, Cov, $E[Y|X]$. Continuous random variables: pdf, cdf, expectation, variance. Normal distribution, standard normal distribution (Ch2.4 pp.28—34)

(Fr, Jan 24, 6:00pm online) Homework assignment 1 Due

Week 3

4. (Mo, Jan 27) Standardization. Multivariate normal distribution and its properties. Uniform, exponential, Chi-squared, Student, F distributions (Ch2.4 pp.35—38)
5. (We, Jan 29) Random sampling. Mean and variance of the sample mean. Sampling distribution. Convergence in probability and distribution. The Law of Large Numbers (LLN). The Central Limit Theorem (CLT) (Ch2.5, 2.6 pp. 39—45, Ch18.2 pp. 648—651)

Week 4

6. (Mo, Feb 3) Slutksy's theorem, continuous mapping theory. Review of statistics: three methods, properties of the sample mean (unbiasedness, efficiency, consistency, asymptotic distribution) (Ch2.6, 3.1 pp. 46—64 , Ch18.2 pp.652)
7. (We, Feb 5) BLUE, the least squares estimator. Testing hypothesis: null hypothesis, alternative hypothesis (two-sided and one-sided). p-value, calculating p-value the population variance is known. Sample variance: unbiasedness, consistency (Ch.3.2 pp.65—70)

(Fr, Feb 7, 6:00pm online) Homework assignment 2 Due

Week 5

8. (Mo, Feb 10) Calculating p-value when the population variance is unknown. t-statistics, type I, II errors, significance level, size and power of the test, critical value, one-sided alternative (Ch.3.3 pp.71—75)

9. (We, Feb 12) Confidence interval, comparing two means,treatment effect, sample covariance and sample correlation. Linear Regression with one regressor: interpretation of the parameters, OLS estimators, measures of fit (Ch.3.4—3.7, 4.1—4.3 pp.76—111)

Week 6

10. (Mo, Feb 17) Linear Regression with one regressor: measures of fit, OLS assumptions, OLS properties: unbiasedness, consistency, asy. normalily (Ch.4.3—4.6 pp.112—135)

11. (We, Feb 19) Testing hypothesis. Confidence interval, CI for the predicted effect of changing X. Homoskedasticity and heteroskedasticity. Gauss-Markov theorem. Regression with a binary variable (Ch.5 pp.136—168)

    (Fr, Feb 21, 6:00pm online) Homework assignment 3 Due

Week 7

12. (Mo, Feb 24) Linear regression in matrix form (Ch.19.1 pp.671—674)

13. (We, Feb 26) OLS estimators in matrix form. OLS assumptions. Interpretation of the parameters. Unbiasedness (Ch.6.2, 6.3, 6.5, 6.7, 19.1, pp.175—179, 183—189, 674)

    (Fr, Feb 28, 6:00pm online) Homework assignment 4 Due

Week 8

14. (Mo, Mar 3) Asymptotic normality and consistency of OLS estimator. The Multivariate Central Limit Theorem (Ch.6.6, 19.2, Appendix 19.2, pp.185—186, 675—677, 710—711)

15. (We, Mar 5) Midterm 1

Week 9 (Spring Break)

(Fr, Mar 14, 6:00pm online) Homework assignment 5 Due

Week 10

16. (Mo, Mar 17) Heteroskedasticity-Robust SE. Measures of fit. Omitted variables. Homoskedasticity (Ch. 6.1, 6.4, 6.6, Appendix 6.2—6.3, 19.2, pp. 169—174, 180—183, 185—186, 201—202, 677)

17. (We, Mar 19) Hypothesis testing: single coefficient, joint hypothesis (Ch.7.1, 7.2, Appendix 7.1, 19.3, pp.205—216, 232—234, 679—680)

    (Fr, Mar 21, 6:00pm online) Homework assignment 6 Due

Week 11

18. (Mo, Mar 24) CS for multiple coefficients. CI for the predicted effect. Control Variables (Ch.6.8, 7.3, 7.4, 19.2, 19.3, pp.189—192, 216—218, 678, 680)
19. (We, Mar 26) Nonlinear regression: polynomials, logs (Ch8.1, 8.2, Appendix 8.2, pp.235—255, 286—287)

    (Fr, Mar 28, 6:00pm online) Homework assignment 7 Due

    Week 12

20. (Mo, Mar 31) Nonlinear regression: logs, interaction between variables (Ch8.3—8.4, Appendix 8.1 pp.255—274, 283—286)
21. (We, Apr 2) Instrumental variables: demand estimation, general IV (Ch12.1, 12.2, Appendix 12.1—12.3, pp.385—402, 424—426)

    (Fr, Apr 4, 6:00pm online) Homework assignment 8 Due

    Week 13

22. (Mo, Apr 7) IV assumptions. Instrumental variables in matrix form. Testing instrumental validity (Ch12.3—12.5, Appendix 12.4—12.6, 19.7, pp.402—418, 426—431, 691—693)
23. (We, Apr 9) Midterm 2

    (Fr, Apr 11, 6:00pm online) Homework assignment 9 Due

    Week 14

24. (Mo, Apr 14) Panel data: fixed effects (entity and time), FE (Ch10.1—10.4, pp.319—332)
25. (We, Apr 16) Panel data: assumptions, SE. Time Series Data: autocorrelation (Ch10.5—10.7, 15.1, Appendix 10.2, pp.332—339, 346—348, 512—519)

    (Fr, Apr 18, 6:00pm online) Homework assignment 10 Due

    Week 15

26. (Mo, Apr 21) Time Series Data: AR(1), AR(p), ADL(p,q), log-operator, RMSFE (Ch15.2—15.5, Appendix 15.2, 15.3, pp.519—536, 563—564)
27. (We, Apr 23) Time Series Data: stationarity in AR(1), AR(p), DF-test, assumptions, Granger causality, forecast interval (Ch15.6—15.9, pp.536—554)

    Week 16

28. (Mo, Apr 28) Time Series Data: BIC, AIC, trends, spurious regression, Chow test (Ch15.6—15.9, pp.536—554)

    (We, Apr 30, 10:00pm online) Homework assignment 11 Due

29. (Sa, May 3, 2:00pm - 5:00pm) Final