Indian Institute of Technology Delhi
DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

Econometrics Methods (HUL 315)

Semester II, 2023-24

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Lecture Schedule:	MTh 5:00 PM - 6:20 PM (M)	**Location:**	LH 410
Tutorial Schedule:	TBA	**Location:**	TBA
Office:	MS 649A	**Office Hrs:**	Tue 12:00-13:00
Course website:	Moodle	**Weekly chai:**	Fr 6:00 PM @ ICH

Office hours: Please contact via e-mail (including a short description of your problem or question) to schedule a meeting during the office hour.

Prerequisite: Elementary knowledge of statistics, matrix algebra, and calculus

Course description: In this course, our primary objective is to introduce undergraduate students to the main workhorse of modern econometrics, providing them with a solid grasp of linear regression, its estimation and inference. Other topics include heteroskedasticity, time series regression, panel data methods and limited dependent variable models. The students will get hands-on experience with analysing data in economics and related disciplines. At the end of this course, students should be able to read and critique empirical papers. Accordingly, the emphasis of the course is on empirical applications.

Throughout the semester, we will cover four modules to achieve our objectives. The first module outlines the econometric perspective of data analytics. This exploration will provide students with a comprehensive overview of the relationship between econometrics and the larger landscape of data science, giving them a broader context for understanding the current state of the discipline.

The second module will focus on mastering the tools for linear regression models, with a particular emphasis on estimation techniques and inference. Linear regression models

are a fundamental aspect of econometric modelling, and by becoming proficient in these techniques, students will be well-equipped to engage with current trends in data analytics and apply these methods to real-world economic problems.

In the third module, we will expose students to time series econometrics and forecasting. These models represent key frameworks used by economists to understand and analyse various macroeconomic and finance-related phenomena. By studying these models in detail, students will gain insights into the mechanisms that drive fluctuations in the economy and how different factors interact to shape macroeconomic outcomes.

In the fourth module, we shall briefly look into panel data models, simultaneous equation models and limited dependent variable models. By the end of this course, students should have a solid foundation in modern econometric methods, enabling them to comprehend and critically evaluate contemporary empirical research in economics and related fields. The course will lay the groundwork for further exploration into advanced econometrics topics and provide a basis for more specialized courses in the field. We hope that the knowledge gained in this course will empower students to apply econometric tools to real-world scenarios and contribute to the advancement of policymaking.

Required readings:

- ■ Wooldridge, Jeffrey M. (2019). *Introductory Econometrics: A Modern Approach*. Seventh edition. Cengage Learning
- □ Varian, Hal R (2014). "Big data: New tricks for econometrics". *Journal of Economic Perspectives* 28(2): 3–28
- □ Mullainathan, Sendhil and Spiess, Jann (May 2017). "Machine Learning: An Applied Econometric Approach". *Journal of Economic Perspectives* 31(2): 87–106

Optional readings:

- Greene, William H. (2018). *Econometric Analysis*. Eighth edition. Pearson Education
- Wooldridge, Jeffrey M. (2010). *Econometric Analysis of Cross Section and Panel Data*. Second edition. MIT Press

Requirements: R, a powerful programming language commonly used in statistics and econometrics, is an integral part of this course. You may install RStudio from here.

You are expected to learn LaTeX as soon as possible. This is going to be an essential typesetting for all your assignments. Install LaTeX from here. IIT Delhi has subscription of Cloud based LaTeX platform Overleaf. Register on Overleaf using your IITD email id. You have to submit your assignments in PDF generated using LaTeX on the course website.

Tutorial: The tutorial sessions conducted by the teaching assistant (TA) will focus on problem-solving, and mastering quantitative skills in economics. The TAs will also discuss the solutions of the take-home problem sets after grading. Tutorial attendance is non-mandatory.

Assignments: The take-home assignments will assess students' understanding of the course material, critical thinking abilities, and problem-solving skills. These assignments will cover the topics taught in class and are designed to reinforce learning. Plagiarism will be dealt strictly. The assignments must be submitted electronically (PDF) on Moodle by the due date given below.

Important Dates:

1) Assignment 1 submission 14/01/2024
2) Assignment 2 submission 28/01/2024
3) Assignment 3 submission 14/02/2024
4) Mid-semester examinations ..... 19/02/2024 to 24/02/2024
5) Assignment 4 submission 10/03/2024
6) Assignment 5 submission 7/04/2024
7) Assignment 6 submission 21/04/2024
8) End-semester examinations ..... 27/04/2024 to 4/05/2024

Assignments must be submitted electronically on Moodle by 23:59 on the respective deadline.

Grading policy: The course assessment will be based on the following components:

Component	**Weightage**
Take-home assignments:	20%
In-class surprise quizzes:	20%
Minor (Mid-Semester) Examination:	30%
Major (End-Semester) Examination:	30%
Total:	100%

Best three of the class quizzes will be considered. Therefore, you may miss some of these surprise tests for whatever reasons but you must attend three quizzes. Please carry loose notebook pages in class to submit your quizzes. Weightage will be given to each evaluation component to determine the final grade. The final letter grade depends on the department's moderation. There is no guarantee that you will receive "A" if your score is 80 or above. Passing mark is 30%. The pass mark is 60% for auditing students. Any academic dishonesty will cost you "F". Please check academic dishonesty policy of IIT Delhi.

Class attendance and participation: The learning process of this class is based on in-class discussion and participation in **surprise quizzes** (graded component). The instructor or TA will not upload any slides. Attendance and careful preparation of the course material is therefore highly recommended. This includes coming to class on time and taking notes. **If a student is found to be absent in the class but his/her Timble attendance is marked, disciplinary actions will be taken**. The attendance grading policy is as follows.

- 👉 Students with attendance below 75% will be awarded one grade less than the earned grade (e.g., an "A" grade will become "A-").
- 👉 Students with attendance below 50% will not be allowed to appear in the Major examination, regardless of the reasons for the low attendance.

Re-minor/Re-major policy: There will be a re-minor if you miss the minor for any legitimate reason. If you miss the major, you have to apply to the UG section with proper justification for re-major. The syllabus will be the same as the minor/major. However, the re-minor and re-major are comparatively difficult to deter students from selectively miss the exams and take advantage of the policy.

Phone policy: In order to ensure an active participation and to keep your attention on the important things (our class), please avoid distracting yourself through (unnecessary) electronic devices. For further insights on the consequences of multitasking, I recommend the study by Bellur, Nowak, and Hull (2015). They found that in-class multitasking leads to significantly lower performance.

Table 1: Course Schedule

Date	Lecture	Topic	Reference
Monday, 1 January 2024	Lecture 1	Introductory class: The Nature of Econometrics and Economic Data	Chapt. 1
Thursday, 4 January 2024	Lecture 2	AI, ML, Big Data: Where does Econometrics fit in the larger landscape of data science?	Hal Varian's lecture slides Joshua Angrist's interview
Monday, 8 January 2024	Lecture 3	ML and Econometrics: A complementary approach	Varian (2014) Mullainathan and Spiess (2017)
Thursday, 11 January 2024	Lecture 4	The Mother of All: Fundamentals of Probability	App B.1, B.2, B.3, B.4, B.5
Monday, 15 January 2024	Lecture 5	The Mother of All: Fundamentals of Mathematical Statistics	App C.1, C.2, C.3, C.4, C.5, C.6
Thursday, 18 January 2024	Lecture 6	The Simple Regression Model	Chapt. 2

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Table 1: Course Schedule (Continued)

Date	Lecture	Topic	Reference
Monday, 22 January 2024	Lecture 7	The Simple Regression Model	Chapt. 2
Thursday, 25 January 2024	Lecture 8	Multiple Regression Analysis: Estimation	Chapt. 3, App E
Monday, 29 January 2024	Lecture 9	Multiple Regression Analysis: Estimation	Chapt. 3, App E
Thursday, 1 February 2024	Lecture 10	Multiple Regression Analysis: Inference	Chapt. 4
Monday, 5 February 2024	Lecture 11	Multiple Regression Analysis: OLS Asymptotics	Chapt. 5
Thursday, 8 February 2024	Lecture 12	Multiple Regression Analysis: Data Scaling, Functional Form, Selection of Regressors, Prediction and Residual Analysis	Chapt. 6
Monday, 12 February 2024	Lecture 13	Multiple Regression Analysis with Qualitative Information	Chapt. 7
Thursday, 15 February 2024	Lecture 14	Review	
Monday, 19 February 2024	Mid-term week		
Thursday, 22 February 2024	Mid-term week		
Monday, 26 February 2024	Lecture 15	Heteroskedasticity	Chapt. 8
Thursday, 29 February 2024	Lecture 16	More on Specification and Data Issues: Misspecification, Proxy Variables, Random Slopes, Measurement Error, etc.	Chapt. 9
Monday, 4 March 2024	Friday timetable		
Thursday, 7 March 2024	Lecture 17	Basic Regression Analysis with Time Series Data	Chapt. 10
Monday, 11 March 2024	Lecture 18	Further Issues in Using OLS with Time Series Data	Chapt. 11

Continued on next page

Table 1: Course Schedule (Continued)

Date	Lecture	Topic	Reference
Thursday, 14 March 2024	Lecture 19	Serial Correlation and Heteroskedasticity in Time Series Regressions	Chapt. 12
Monday, 18 March 2024	Lecture 20	Serial Correlation and Heteroskedasticity in Time Series Regressions	Chapt. 12
Thursday, 21 March 2024	Lecture 21	Pooling Cross Sections across Time: Simple Panel Data Methods	Chapt. 13
Monday, 25 March 2024	Semester break		
Thursday, 28 March 2024	Semester break		
Monday, 1 April 2024	Lecture 22	Advanced Panel Data Methods	Chapt. 14
Thursday, 4 April 2024	Lecture 23	Advanced Panel Data Methods	Chapt. 14
Monday, 8 April 2024	Lecture 24	Instrumental Variables Estimation and Two-Stage Least Squares	Chapt. 15
Thursday, 11 April 2024	Eid-ul-Fitr		
Monday, 15 April 2024	Lecture 25	Simultaneous Equations Models	Chapt. 16
Thursday, 18 April 2024	Lecture 26	Limited Dependent Variable Models	Chapt. 17
Monday, 22 April 2024	Lecture 27	Causality and Econometrics Revisited	Chen and Pearl (2013) Huntington-Klein (2022) Imbens (2020) Hünermund and Bareinboim (2023) Heckman and Pinto (2022)
Thursday, 25 April 2024	Lecture 28	Review	