Department of Economics
University of Texas at Austin

ECO 395M: Time Series Econometrics (35040)
Spring 2025

Lectures:	BRB 2.136; Tuesdays & Thursdays 2:00 p.m. - 3:30 p.m.
TA Help Sessions:	BRB 2.136; Fridays 2:00 p.m. - 3:30 p.m.
Course Website:	Canvas
Instructor:	Dr. Sahil Ravgotra
	Email: s.ravgotra@utexas.edu
	Office: BRB 3.128
	Office Hours: Tuesdays & Thursdays 3:30 - 4:30 p.m. or by appointment
Teaching Assistant:	Zhenghao Li
	Email: lizhenghao@utexas.edu
	Office Hours: BRB 2.128; MW 3:00 - 4:00 p.m.

Course Description

This course explores advanced econometric models and techniques specifically tailored to time series data. The course emphasizes applying time series methods to macroeconomics and finance, addressing unique challenges posed by time series data compared to cross-sectional analysis. Students will learn to construct time series models suited to various macroeconomic questions and applications and study their estimation methods.

Key topics include Distributed lag models, ARMA models, ARCH and GARCH models for volatility, Unit roots and non-stationarity, Forecasting techniques, Vector Autoregressions, Impulse response functions, Local projections, State-space models, Recursive estimation and Kalman filtering, Bayesian methods and estimation of Dynamic Stochastic General Equilibrium (DSGE) models, and Applications related to monetary and fiscal policy shocks.

By the end of the course, students will be able to decompose time series data into fundamental components, address non-stationarity issues effectively, estimate and interpret both univariate and multivariate time series models, and apply estimated models for policy analysis and forecasting. This comprehensive approach ensures students develop practical skills for analyzing and utilizing time series data in economic research and policymaking.

Prerequisites: ECO 394M Econometrics course; if you have not taken that course, you will need permission to register for this course.

Readings: There is no required textbook for this course. You are expected to study and understand the material provided during lectures, including lecture slides, notes, assigned papers, and any additional resources distributed. The **first part of the course** will primarily be based on the following books:

- Diebold, F. X. (2004). Elements of Forecasting. South-Western Cengage. (CH 7-9)

- Dougherty, C. (any edition). Introduction to Econometrics. Oxford University Press. (CH 7, 11 & 12)

- Verbeek, M. (2013). A Guide to Modern Econometrics. John Wiley & Sons (CH 8 & 9)

- Wooldridge, J. (sixth edition). Introductory Econometrics: A Modern Approach. Cengage. (CH 10-18)

There are several other textbooks and resources that you may use (**optional**) for further readings beyond the course slides.

- Asteriou, D. & Hall, S. (2011). Applied Econometrics. Macmillan

- Enders, W. (2015). Applied Econometric Time Series. 4th Ed., John Wiley & Sons.

- Gujarati, D. (any edition). Basic Econometrics. McGraw-Hill.

- Hamilton, James D. (1994). Time Series Analysis. Princeton University Press, New Jersey.

- Harris, R. & Sollis, R. (2003). Applied Time Series Modelling and Forecasting. Wiley.

- Hayashi, F (2000). Econometrics. Princeton University Press, New Jersey.

- Herbst, E. P., & Schorfheide, F. (2016). Bayesian estimation of DSGE models. Princeton University Press.

The **rest of the course will use several research papers**, some of which are listed below:

- Blanchard, O. J., & Quah, D. (1988). The dynamic effects of aggregate demand and supply disturbances.

- Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary policy shocks: What have we learned and to what end?. Handbook of macroeconomics, 1, 65-148.

- Coibion, O. (2012). Are the effects of monetary policy shocks big or small?. American Economic Journal: Macroeconomics, 4(2), 1-32.

- Gertler, M., & Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. American Economic Journal: Macroeconomics, 7(1), 44-76.

- Rossi, B., & Sekhposyan, T. (2010). Have economic models' forecasting performance for US output growth and inflation changed over time, and when?. International Journal of Forecasting, 26(4), 808-835.

- Smets, F., & Wouters, R. (2003). An estimated dynamic stochastic general equilibrium model of the euro area. Journal of the European economic association, 1(5), 1123-1175.

- Smets, F., & Wouters, R. (2005). Comparing shocks and frictions in US and euro area business cycles: a Bayesian DSGE approach. Journal of Applied Econometrics, 20(2), 161-183.

- Smets, F., & Wouters, R. (2007). Shocks and frictions in US business cycles: A Bayesian DSGE approach. American economic review, 97(3), 586-606.

- Stock, J. H., & Watson, M. W. (1988). Variable trends in economic time series. Journal of economic perspectives, 2(3), 147-174.

- Stock, J. H., & Watson, M. W. (2003). Forecasting output and inflation: The role of asset prices. Journal of economic literature, 41(3), 788-829.

- Stock, J. H., & Watson, M. W. (2018). Identification and estimation of dynamic causal effects in macroeconomics using external instruments. The Economic Journal, 128(610), 917-948.

Software: Students are required to use the statistical package STATA in this course. Class examples will be illustrated using STATA, and students will use **STATA for empirical exercises in homework assignments**. There are several options for accessing STATA:

- STATA can be purchased and installed on your computer. A six-month student STATA/BE license is available for $48 at: Buy STATA

- You can access STATA licenses owned by UT remotely on the Stat Apps Server (Wincompute). Instructions for doing this are at: Remote Access. Note that the number of available STATA licenses is limited, which might make access difficult during peak use times (i.e., the evening before a homework assignment is due).

- Various computer labs on campus have access to Stata, including the data lab in PCL. It may be possible to access these labs remotely, see: Remote Labs

- We will use STATA in the class, but students are expected to improve their software skills on their own. There are many tutorials available online that you can also consult: Learning Stata

Lecture Format: Lectures will be in person on Tuesdays & Thursdays from 2:00 p.m. - 3:30 p.m. in BRB 2.136. Regular attendance is expected. There will be no class recordings.

TA Help Sessions: Help sessions are an integral part of the course. Weekly sessions with the TA will take place every Friday from 2:00 to 3:30 p.m. in BRB 2.136. These sessions will primarily focus on empirical applications, homework assignments, and STATA. Regular attendance is strongly encouraged and expected.

Assessment and Grading:

1. **Homework Assignments (40% of total grade):** Throughout the course, you will be assigned **six** homework assignments that are directly related to the course material. These assignments will be posted on Canvas one week before the due date. They must be submitted at the beginning of class as a single PDF file along with the codes as indicated in the course schedule below. The *tentative due dates are Jan 28, Feb 11, Feb 25, Mar 25, Apr 8 & Apr 15.* You are **allowed to skip one assignment**. If you complete all six assignments, only the five with the highest grades will be considered (i.e., the lowest-graded assignment will be dropped). *Each assignment carries a weightage of 8% towards your total grade..*

2. **Exams (26% of total grade):** There are two **take-home exams**:

   - **Midterm Exam (13%):** The midterm exam is a take-home assignment with a 24-hour completion window. You will receive the exam at 3:30 p.m. on March 3 and must submit it by 3:30 p.m. on March 4. The exam will cover all course material taught up to and including Lecture 14.
   - **Final Exam (13%):** The final exam is a take-home assignment with a 24-hour completion window. You will receive the exam at 3:30 p.m. on April 23 and must submit it by 3:30 p.m. on April 24. The exam will cover the course material taught after the midterm.

3. **Article Summary (10% of total grade):** You are required to submit a summary of a recently published paper of your choice, related to the topics covered in the course. This assignment is due on March 11. The specific guidelines will be provided.

4. **Research Paper (24% of total grade):** For this component, you will develop a research idea of your choice. To meet the requirements for grading, the following steps must be completed:

   (A) **Research Proposal**: Submit a proposal for your research paper by April 1.
   (B) **Poster Presentation**: Present your preliminary results on a poster during L27 (April 22). The presentation schedule will depend on the number of students registered for the course.
   (C) **Final Submission**: Submit the final poster and an extended abstract of your research by April 30.

   This can be completed in **pairs of two students**, who will be assigned randomly. Posters serve as a means to present completed research and should meet the same research expectations as a full paper. However, given the course's time constraints, you are not required to submit a full paper. Instead, the poster and extended abstract will be graded in place of a complete paper. Specific guidelines on the format and expectations will be provided. This project constitutes 24% of your total grade, so ensure your submissions are thorough and meet all requirements.

Please note:

- **Late assignments/exams will not be accepted** neither other type of accommodation will be given. There is **no make-up exams** for reasons outside the university excused absences: Dean of Students info. Those requests should be sent to me in writing before the exam. The TA does not handle those issues.

- You are allowed/encouraged to discuss the homework assignments with your working group (will be assigned at the beginning of the semester) but you **must submit your own write-up of solutions**. Please note that you are **not allowed to discuss the take-home exams** with your classmates or working group members.

- Re-grading requests refer to the whole assignment/exam and not to specific questions/parts. All requests should be made in writing within five working days of receiving tests and assignments back. Later requests will not be accepted.

- I will use plus/minus grade categories when assigning final grades (i.e. A, A-, B+, B, ..., D-, F). Grades will be curved, meaning that your letter grade will be assigned based on your weighted average course score and your performance relative to the rest of the class.

- **Regular attendance** in lectures and help sessions is crucial for achieving good grades.

Lecture Schedule (Tentative)

1. Lecture 1 (Jan 14):

   - Introduction to the course and syllabus
   - Time series irregularities
   - Distributed lag models
   - Impact, temporary and long-run effects
   - Temporary and permanent changes

2. Lecture 2 (Jan 16):

   - Basic OLS assumptions and implications for time series models
   - Trends and seasonality

3. Lecture 3 (Jan 21):

   - Asymptotic assumptions
   - AR, MA, ARMA models
   - ACV, ACF, PACF and model selection
   - **HW1 Posted**

4. Lecture 4 (Jan 23):

   - Autocorrelation
   - Heteroskedasticity

5. Lecture 5 (Jan 28):

   - Unit roots and testing for unit roots
   - Model selection: AIC, BIC
   - **HW1 Due**

6. Lecture 6 (Jan 30):

   - Model selection in covariance stationary series
   - Model selection examples
   - ARCH and GARCH models

7. Lecture 7 (Feb 4):

   - Forecasting with ARMA (and examples)
   - Forecasting evaluation
   - **HW2 Posted**

8. Lecture 8 (Feb 6):
   - Forecasting:
     - Iterated vs Direct
     - Bivariate
     - In-sample

- Pseudo out-of-sample

9. Lecture 9 (Feb 11):

   - Forecasting: cont.
   - Autocorrelation of direct forecast errors
   - **HW2 Due**

10. Lecture 10 (Feb 13):

    - Regression with I(1)
    - Spurious regression
    - Cointegration
      - Engel-Granger
      - Dynamic OLS
      - Error Correction Model

11. Lecture 11 (Feb 18):

    - Cointegration: cont.
    - The tale of two econometricians
    - **HW3 Posted**

12. Lecture 12 (Feb 20):

    - Vector Autoregressions (VARs):
      - Introduction
      - Forecasting with VARs
      - Impulse response functions (IRFs)

13. Lecture 13 (Feb 25):

    - VARs: cont.
      - IRFs
      - Identification:
        * Short-run restrictions
        * Cholesky decomposition
      - Examples: Sims, Killian (2009)
    - **HW3 Due**

14. Lecture 14 (Feb 27):

    - Review and exam instructions

15. Lecture 15 (Mar 4):

    - **Midterm Exam**

16. Lecture 16 (Mar 6):

    - VARs:
      - Cumulative IRFs
      - Interpret economic theory long run effects as cumulative IRFs
      - Use long-run restrictions for VAR identification

17. Lecture 17 (Mar 11):

    - Macroeconomic shocks: Identification

- **Article Summary Due**
- **HW4 Posted**

18. Lecture 18 (Mar 13):

    - Local Projections
      - Examples of flexibility

19. Lecture 19 (Mar 25):

    - Monetary policy shocks: what we know so far
    - **HW4 Due**

20. Lecture 20 (Mar 27):

    - Monetary policy shocks: what we know so far: cont.

21. Lecture 21 (Apr 1):

    - Maximum Likelihood
    - **Research Proposal due**
    - **HW5 Posted**

22. Lecture 22 (Apr 3):

    - State-Space models

23. Lecture 23 (Apr 8):

    - State-Space models: cont.
    - Kalman Filter
    - **HW5 Due**
    - **HW6 Posted**

24. Lecture 24 (Apr 10):

    - Bayesian methods for DSGE

25. Lecture 25 (Apr 15):

    - Bayesian methods for DSGE: cont.
    - **HW6 Due**

26. Lecture 26 (Apr 17):

    - Bayesian methods for DSGE: cont

27. Lecture 27 (Apr 22):

    - Poster Presentation

28. Lecture 28 (Apr 24):

    - **Final Exam**

The final poster and extended abstract are due to be submitted on April 30.

University Policies & Resources

Use of Class Materials: No materials used in this class, including, but not limited to, lecture handouts, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have my explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University's Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course. Additionally, all these materials are copyright-protected works. Any unauthorized copying of the class materials is a violation of federal law and may result in disciplinary actions being taken against the student.

Diversity, Equity, and Inclusion: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that student's learning needs be addressed, and that the diversity that students bring to this class can be comfortably expressed and be viewed as a resource, strength, and benefit to all students. Please come to me at any time with any concerns.

Statement on Academic Integrity: The University of Texas Honor Code states: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and the community. Each student in this course is expected to abide by the UT Honor Code and uphold academic integrity. Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information, please visit the Student Conduct and Academic Integrity website at: conduct.

What this means for this course: You are allowed/encouraged to study together with your groups and to discuss information and concepts covered in the lecture and the recitation sections. However, this cooperation should never involve one student having possession of or copying directly from another student's work that is to be graded. Should such copying occur, both students involved will receive zeros for the assignment. In addition, directly copying from websites/books, etc., for the homework will also return zero for the assignment. In addition, any collaborative behavior or use of unauthorized material for graded work will lead to University disciplinary action. Finally, using books, notebooks, notes, electronic (e.g. phones), or other means during the exams, or copying from other students, violates the University and course policies.

In this course, every element of class assignments must be fully prepared by the student. The **use of generative AI tools for any part of your work will be treated as plagiarism**. If you have questions, please contact me.

ADA Notice: The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning, so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations, please contact Services for Students with Disabilities (SSD). Please refer to SSD's website for more information: SSD website. If you are already registered with SSD, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this course.

Counseling and Mental Health Center: The Counseling and Mental Health Center serves UT's diverse campus community by providing high quality, innovative, and culturally informed mental health programs and services that enhance and support students' well-being, and academic and life goals. To learn more about your counseling and mental health options, call CMHC at (512) 471-3515. If you are experiencing a mental health crisis, call the CMHC Crisis Line 24/7 at (512) 471-2255.

Behavior Concerns Advice Line (BCAL): If you are worried about someone who is acting differently, you may use the Behavior Concerns Advice Line to discuss by phone your concerns about another individual's behavior. This service is provided through a partnership among the Office of the Dean of Students, the Counseling

and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit behavior concerns website.

BeVocal: BeVocal is a university-wide initiative to promote the idea that individual Longhorns have the power to prevent high-risk behavior and harm. At UT Austin, all Longhorns have the power to intervene and reduce harm. To learn more about BeVocal and how you can help to build a culture of care on campus, go to BeVocal website.

Emergency Evacuation Policy: Occupants of buildings on the UT Austin campus are required to evacuate and assemble outside when a fire alarm is activated, or an announcement is made. Please be aware of the following policies regarding evacuation:

- Familiarize yourself with all exit doors of the classroom and the building. Remember that the nearest exit door may not be the one you used when you entered the building.

- If you require assistance to evacuate, inform me in writing during the first week of class.

- In the event of an evacuation, follow my instructions or those of class instructors.

- Do not re-enter a building unless you are given instructions by the Austin Fire Department, the UT Austin Police Department, or the Fire Prevention Services office.

For more information regarding emergency evacuation, please contact the Office of Campus Safety and Security, 512-471-5767, safety website.

Title IX Reporting: Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.

2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.

3. Investigate and discipline violations of the university's relevant policies (title IX relevant policies website).

Beginning January 1, 2020, Texas Senate Bill 212 requires all employees of Texas universities, including faculty, to report any information to the Title IX Office regarding sexual harassment, sexual assault, dating violence, and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be reported. I am a Responsible Employee and must report any Title IX-related incidents that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX-related incident, be sure to ask whether they are a responsible employee. If you would like to speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit title IX website, contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419.

Personal Pronouns: Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name unless they have added a preferred name with the Gender and Sexuality Center. I will gladly honor your request to address you by a name that is different from what appears on the official roster, and by the gender pronouns you use (she/he/they/ze, etc). Please advise me of any changes early in the semester so that I may make appropriate updates to my records. For instructions on how to add your pronouns to Canvas, visit pronouns website.

Land Acknowledgment: (I) We would like to acknowledge that we are meeting on Indigenous land. Moreover, (II) We would like to acknowledge and pay our respects to the Carrizo & Comecrudo, Coahuiltecan, Caddo, Tonkawa, Comanche, Lipan Apache, Alabama-Coushatta, Kickapoo, Tigua Pueblo, and all the American Indian and Indigenous Peoples and communities who have been or have become a part of these lands and territories in Texas, here on Turtle Island.

Other: Please do not use phones/laptops/tablets in the class, as it is distracting to me and your classmates. If you need to use technology inside the classroom for a specific reason, please talk to me before the class.