Course Title: Time Series Analysis (Cross Elective)
Semester: Spring 2025

Course Information

Course Duration: About 14 teaching weeks
Credit Hours: 4.5 credits
Meetings: Will be arranged as and when needed
Location**:** Sonipat Campus
Prerequisites: Successfully completed at least introductory econometrics
Class timings:

Instructor Information

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Phone:
Office:
Office Hours:

1. Course Description

Time series analysis is a crucial branch of econometrics that deals with analyzing data points collected or recorded at specific time intervals. This course is meticulously designed to provide students with both the theoretical foundations and practical skills necessary to analyze and forecast macroeconomic variables using time series data from the global economy.

Emphasizing real-world applications, the course covers key economic indicators such as Gross Domestic Product (GDP), inflation, unemployment, interest rates, exchange rates, etc. Students will engage with national and international datasets, applying various time series techniques to model, estimate, and interpret these indicators. The course integrates lectures on theoretical concepts with hands-on lab sessions using econometric software (STATA or R), ensuring that students can translate theoretical knowledge into practical analysis.

2. Learning outcome

By the end of this course, students will be able to:

- Analyze the dynamic behavior of key macroeconomic time series (e.g., GDP, inflation, unemployment, etc.).
- Use econometric models to assess macroeconomic variables.
- Apply time series econometric tools to study macroeconomic phenomena such as business cycles, inflation dynamics, and monetary policy effects.
- Work with software (STATA or R) to estimate, analyze, and interpret macroeconomic time series.

3. Academic Integrity

Academic Honesty, Cheating, and Plagiarism: University norms and policies would be applicable
Participation/Attendance Policy: As per University norms
Use of phone/texting is prohibited

4. Course Material

Enders, W. (2014). Applied Econometric Time Series. Wiley.
Stock, J. H., & Watson, M. W. (2019). Introduction to Econometrics. Pearson.

Hyndman, R. J., & Athanasopoulos, G. (2018). Forecasting: Principles and Practice. (Available for free online). A comprehensive guide on forecasting methods applicable to international time series data.
Hamilton, J. D. (1994). Time Series Analysis. Princeton University Press.
Panchanan Das (2019). Econometrics in Theory and Practice—Analysis of Cross Section, Time Series and Panel Data with Stata 15.1. Springer.
Levendis (2018). Time series econometrics. Springer.
Shumway and Stoffer (2000). Time series analysis and its applications. Springer.

5. Scheme of Evaluation and Grading

Evaluation breakup

Internal (70% of the total) and End-term (30% of the total)

Internal breakup: At least two assignments and two group presentations (Continuous Assessment)

External breakup: Written exam (30% of the total) (If possible, I will give a research paper).

6. Course Structure:

This course will integrate lectures on theoretical concepts with lab sessions focused on practical macroeconomic applications using real-world data. Each week will combine these components, allowing students to directly apply what they've learned.

Session Plan: Session plans are suggestive, and might be modified in due course keeping in mind improvements in teaching pedagogy and learning

Week 1: Introduction to Time Series Data

- Lecture:
  - Overview of time series econometrics and its relevance in macroeconomic analysis.
  - Introduction to global macroeconomic time series data (GDP, inflation, unemployment, interest rates).
- Lab:
  - Importing and visualizing global macroeconomic time series data from sources like World Bank, IMF, OECD, and United Nations.
  - Case Study: Plotting global GDP growth trends over the past two decades.

Week 2: Stationarity and Unit Roots

- Lecture:
  - Understanding stationarity and its importance in time series analysis.
  - Unit root processes and their implications for international economic modeling.
- Lab:
  - Conducting Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests on global GDP, inflation, and interest rates.
  - Case Study: Unit root analysis for GDP series of selected developed and developing countries.

Week 3: Autoregressive (AR) Models

- Lecture:
  - AR models and their application in forecasting global macroeconomic variables.
  - Modeling persistence in international inflation and GDP.
- Lab:
  - Estimating AR models for global GDP growth.
  - Application: Forecasting inflation rates for selected countries using AR models.

Week 4: Moving Average (MA) and ARMA Models

- Lecture:
  - Moving Average models and their use in capturing shocks in international macroeconomic time series.
  - Introduction to ARMA models tailored to global data.
- Lab:
  - Estimating ARMA models to analyze global unemployment rates.
  - Case Study: ARMA modeling of inflation dynamics in major economies (e.g., USA, EU, China).

Week 5: ARIMA Models

- Lecture:
  - Handling non-stationary data with ARIMA models.
  - Box-Jenkins methodology for identifying and estimating ARIMA models specific to international economic data.
- Lab:
  - Forecasting global GDP using ARIMA models.
  - Application: ARIMA-based forecasting of unemployment rates in selected countries.

Week 6: Trends and Seasonality

- Lecture:
  - Identifying and modeling trends and seasonality in international time series.
  - Seasonal decomposition of global economic time series.
- Lab:
  - Seasonal adjustment of monthly global macroeconomic data (e.g., retail sales, industrial production).
  - Case Study: Estimating Seasonal ARIMA (SARIMA) models for unemployment data in various regions.

Week 7: Model Diagnostics and Forecast Accuracy

- Lecture:
  - Evaluating the performance of time series models: residual diagnostics, ACF/PACF plots.
  - Forecast accuracy measures (RMSE, MAE, MAPE) applied to international forecasts.
- Lab:
  - Diagnostic checks and residual analysis for ARIMA models using global data.

- Case Study: Evaluating the forecast accuracy of inflation models for multiple countries using RMSE and MAE.

Week 8: Vector Autoregressive (VAR) Models

- Lecture:
  - Introduction to VAR models for analyzing dynamic interactions among global macroeconomic variables (e.g., GDP, inflation, interest rates).
  - Impulse response functions (IRFs) and variance decomposition in an international context.
- Lab:
  - Estimating a VAR model for GDP, inflation, and interest rates across different countries.
  - Application: Analyzing the effect of global monetary policy on inflation and output using IRFs.

Week 9: Cointegration

- Lecture:
  - Long-term equilibrium relationships between non-stationary international variables.
  - Introduction to cointegration and its macroeconomic applications globally.
- Lab:
  - Testing for cointegration using Engle-Granger and Johansen tests on international data.
  - Case Study: Estimating cointegrating relationships between consumption and income in different economies.

Week 10: Error Correction Models (ECM)

- Lecture:
  - Error correction models (ECM) for capturing short- and long-term dynamics in global macroeconomic variables.
- Lab:
  - Estimating an ECM for GDP and consumption data across selected countries.
  - Application: Modeling the short- and long-term relationship between GDP and consumption internationally.

Week 11: Structural Breaks and Regime Shifts

- Lecture:
  - Detecting structural breaks in international macroeconomic time series and their implications for modeling.
  - Chow test and Bai-Perron test for structural breaks in a global context.
- Lab:
  - Applying structural break tests to analyze changes in global inflation and interest rates.
  - Case Study: Detecting policy regime shifts in major economies' monetary policies and their effects on macroeconomic variables.

Week 12: Macroeconomic Forecasting Techniques

- Lecture:
  - Advanced techniques for forecasting international macroeconomic variables, including model selection and combining forecasts.
- Lab:
  - Using multiple models (ARIMA, VAR) to forecast global GDP and inflation.
  - Case Study: Comparing forecasting performance across different models using international economic data.

Week 13: Final Project and Course Review

- Lecture:
  - Review of key concepts and models covered in the course.
  - Tips for real-world macroeconomic forecasting and analysis specific to the global economy.
- Lab:
  - Final project presentations.
  - Final Project: Students present their applied time series analysis on a global macroeconomic variable, including methodology, model selection, forecasting, and interpretation of results.