

ECO376/511: Business and Economic Forecasting using Time Series Analysis
Spring, 2025 (Tuesday 5:45-9:00 PM)
updated: March 5, 2025

INSTRUCTOR: Prof. Jin Man Lee

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The best way to reach me is to send email. Please use ECO376/511 as a prefix on the subject line, and that will get my attention immediately. If you don't receive my reply within 24 hours, please remind me again. Due to many email filters and mass email, your email might be lost.

OFFICE HOURS: Monday (Zoom only) & Wednesday (Zoom and in-person) 3:00-4:00 PM or by appointment (at DPC 6230), or

ZOOM Address for office hours:

<https://depaul.zoom.us/j/95326652941>

COURSE OBJECTIVES

We will cover time series regression models throughout the quarter. Instead of technical and theoretical sides, we will mostly focus on the practical applications of the time series regression models using macroeconomic and financial data.

The example data will be from the typical website, such as yahoo.com or wsj.com, and public websites, such as FRED (Federal Reserve Economic Data) maintained by St. Louis Federal Reserve Bank. We will use the latest available data from the website and read them into the R program. This course will help you develop a higher level of R program skills and methodologies to understand the time series process in economics and finance.

RECOMMENDED TEXTBOOK

Classnotes in D2L

Time Series for Data Scientists, Juana Sanchez, 2023, Cambridge University Press

ISBN: 978 1108837774

SUPPLEMENTARY MATERIAL

Applied Econometric Time Series Analysis, Walter Enders 3rd-4th Edition

Analysis of Financial Time Series, Ruey S. Tsay, 2-3rd Edition.

Along with the textbook and my lecture notes, I will assign mandatory readings of academic articles. The readings are available for download in PDF format from D2L.

SOFTWARE USED in CLASS (required for homework and lab classes)

This course will use the statistical package, R. R and Rstudio are free. Students need to bring their laptops with the latest R and Rstudio installed. For big financial data analysis, students will have the option to use the R server version from the big blue server: <https://bigblue.depaul.edu:8787>.

GRADE

Midterm Exam (25%), Final Project (30%), Attendance (5%), Weekly Homework (40%)

Scale of grade: A: 93 or above, A-: 88-92.9, B+: 85-87.9, B: 80-84.9, B-: 77-79.9, C+: 75-76.9, C: 70-74.9, C-: 68-69.9, D+: 65-67.9, D: 60-64.9, F: Below 60

EXAMS AND FINAL PROJECT SCHEDULE

- Midterm Exam and Project (April 29- May 5)
- Final Group Project (Written report submission to D2L on June 14 at 10:00 PM.)

ASSIGNMENTS

- Homework: Problem set will be posted in D2L and it is required to submit to Dropbox in D2L
 - All assignments are to be prepared individually. You risk an academic integrity violation if you submit the same work and answers with others. Group study is encouraged but not the submission of Assignments.
 - All statistical code needs to be submitted as a txt file, For example, assignment.R.txt.
 - All submitted codes should be tested without any error. If there are any errors, the assignment will get zero credit.
 - All weekly assignments should be uploaded to D2L by Monday at 10:00 PM
 - Late submission will get a steep penalty without prior approval by the instructor.

ACADEMIC HONESTY

Work done for this course must adhere to the University Academic Integrity Policy. Violations include but are not limited to the following categories: cheating; plagiarism; fabrication and academic misconduct.

- Cheating: any action that violates University norms or an instructor's guidelines for the preparation and submission of assignments. Such actions may include using or providing unauthorized assistance or materials on course assignments, or possessing unauthorized materials during an examination.
- Plagiarism: the representation of another's work as your own. You are to prepare your own homework assignments. Violations may result in the failure of the assignment, failure of the course, and/or additional disciplinary actions.
- Misconduct: This includes but is not limited to attempts to bribe an instructor for academic advantage; persistent hostile treatment of, or any act or threat of violence against, an instructor, advisor or other students. Violations may result in additional disciplinary actions by other university officials and possible civil or criminal prosecution.

You may review the Academic Integrity Policy in the Student Handbook or by visiting Academic Integrity at DePaul University (<http://academicintegrity.depaul.edu>)

ATTENDANCE POLICY

I do not take attendance. The attendance will be automatically checked by in-class lab reports.

CLASSROOM RULES & PROFESSIONAL POINTS

- Prohibitions: Cell phones must be turned OFF. Use of the internet is not permitted unless specifically directed by me. This includes checking of email and use of instant messengers. You must sit at the front of the classroom if you are using a computer. Tape recorders, unrelated reading materials, and food are also prohibited in the classroom.
- Behavior: You may not leave the classroom for any reason during an exam (go to the bathroom beforehand!). Further, unprofessional behavior such as inappropriate chatting, leaving in the middle of class, or showing up excessively late, etc. are disruptive and unacceptable. If you need to leave class early, let me know in advance.
- For first time violations you will receive a warning. In the event that violations continue, I will ask you to leave the classroom. (I reserve the right to add to this list as situations arise.)

Student with Disability: Students with Disability may register the The Productive Learning Strategies (PLuS) Program. You may request your exam schedule arrangement by requesting through the PLuS program. For more information on the PLuS program, you may visit <http://studentaffairs.depaul.edu/plus/> or call: 312-362-8000.

SUMMARY OF WEEKLY SCHEDULE

1. Monday 10:00 AM : Weekly Class Material will be posted in D2L
2. Tuesday 5:45-9:00 PM: In-person Class (Require to attend), Weekly Lab Report due in class
3. Monday 3:00-4:00 PM: Zoom Office Hour, Wenesday 3:00-4:00 In-Person/ZOOM Open Office Hours
4. Monday 10:00 PM : Weekly Assignment Due

TENTATIVE SCHEDULE OF TOPICS

(The instructor may change the order or contents by needs, any special material needs for class will be available on D2L)

- WEEK 1 - TOPIC 1: Introduction to R for Time Series Data (CH 1, 2)
 - Using R and Rstudio on Desktop and Server
 - Introdouction to R for Time Series Data
 - Application Examples:
 - Amazon sales trend and Seasonality of electric products
 - Home sales patterns in the Chicago Area
 - Trends and seasonal patterns of Airbnb and Uber
 - Historical stock market Trends and Pattern by Different Frequency
 - Trends of Electric Car sales
- WEEK 2 - TOPIC 2: Properties of Time Series Data and Stationarity(CH 3, 4)
 - Simple Forecasting and Smoothing a Time Series: Naïve, Simple Average, Moving Average, Exponential Smoothing Methods
 - Time Trends and Seasonality
 - Stationary and Nonstationary Time Series
 - Unit root tests (DF and ADF tests)
 - White noise and Random Walk
 - Application Examples:
 - Stationarity on stock market, macroeconomic, housing, Airbnb, and Uber data
 - Forecasting on the financial Market (Individual and Portfolio of Stocks)
 - Forecasting on home prices
- WEEK 3 - TOPIC 3: Time Series Models with Moving Average (MA) and ARMA, ARIMA Process (CH 5,6)
 - Autoregressive (AR) Models
 - Moving Average (MA) Models

- Autoregressive Moving Average (ARMA), Autoregression Integrated Moving Average (ARIMA)
- Application Examples:
 - Stock market and Macroeconomic Forecasting
 - Forecasting on home prices using AR, MA, ARMA models
 - Sales forecasting using AR, MA, ARMA models on Amazon, Airbnb, Google Trends, and Uber
- WEEK 4 - TOPIC 4: Index in Time Series - Price and Portfolio Index
 - Index in Time Series - Price and Portfolio Index
 - Time series generation from transaction data
 - Methodology on Stock Index; Modern Portfolio Theory, Capital Asset Pricing Model, Arbitrage Pricing Theory
 - Application Examples: Marketing and Client Reporting
 - Benchmarking and Performance Measurement
 - Investment Strategy Development and Strategic Asset Allocation
 - Risk Management on Diversification and Volatility Analysis
 - Product Development for Financial Markets
- WEEK 5 - TOPIC 5: Univariate Forecasting Project Week (April 29- May 5, No Class)
 - Midterm Online Exam on D2L and Midterm Project Due on May 5 at 10:00 PM
- WEEK 6 - TOPIC 6: Transfer Function Models and Volatility (Part of CH 9)
 - Volatility of Time Series
 - GARCH (Generalized Autoregressive Conditional Heteroskedasticity) family models
 - Application Examples:
 - Volatility in the stock market indices
 - Energy Markets: Commodity Pricing in oil and natural gas
 - Economics: Uncertainty in macroeconomic variables such as GDP growth rates, exchange rate, and inflation rates
 - Financial Market: Option Pricing, Risk Management to estimate Value at Risk (VaR), Portfolio Allocation, Asset Management
- WEEK 7 - TOPIC 7: Dynamic Forecasting using Multivariate Time Series Model
 - Vector Autoregressive (VAR) Models for Multivariate Time Series (CH 8)
 - Granger Causality
 - Measurement of Accuracy in Forecasting
 - Application Examples:
 - Macroeconomic Policy Analysis, Economic Forecasting, and Granger Causality Testing
 - Finance: Asset return interaction, Portfolio Management, Credit Risk Analysis

Energy: Demand Supply Shocks, Dynamic relationship in energy prices, oil, electric, and natural gas

Environment: Climate Change Analysis

Marketing: Sales and Marketing Campaign Analysis

Health Economics: Disease Spread and Economic Factors

- WEEK 8 - TOPIC 8: Machine Learning Time Series Forecasting - Random Forest Model (CH 10)

- Machine Learning Applications to the Random Forest Model

- Application Examples:

- Stock Market Predictions using Machine Learning Techniques

- House Price Prediction and Sales Prediction

- Retail and Sales: Demand Forecasting, Inventory Management

- Energy: Electricity Price Forecasting, Renewable Energy Production

- Technology: Website Traffic Forecasting, User Engagement Prediction

- Manufacturing: Quality control, Maintenance Scheduling

- WEEK 9 - TOPIC 9: Time to Event Model

- Survival and Hazard Function

- Proportional Hazards Model

- Application Examples:

- Customer Churn Analysis, Fraud Detection in Insurance and E-Commerce

- Subscription-Based Business Models

- Marketing Campaign Effectiveness

- Product Life Cycle and Warranty Analysis

- Employee Retention and Turnover

- Drug Effectiveness and Patient Compliance in Healthcare

- WEEK 10 - TOPIC 10: Project on the Time Series Forecasting Models

- Final Project Proposal Presentation (Group Project) (June 3)

- <https://depaul.zoom.us/j/95326652941>

- Final Project Due

- Written report and R code submission to D2L until June 14 (Saturday) at 10:00 PM