

MTH 9893: Time Series Analysis

Course Outline

Professor Andrew Lesniewski
Baruch College, CUNY
Fall 2023

Time and location: Thu 6:05 – 9:00 pm, VC 4-185

Office: VC 6-258

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Office hours: Thu 4:00 – 6:00 pm, or by appointment (via Zoom)

Teaching Assistants:

Nikos Rachmanis: nikos.fxcube@gmail.com

Stephanie Wang: Yicen.Wang@baruch.cuny.edu

Office hours: By appointment

Class attendance: mandatory

Prerequisites: Solid grounding in probability and statistics, linear algebra, advanced calculus, and programming in Python.

Tentative list of topics covered by the course:

1. Stationary ARMA time series models, their estimation, and forecasting
2. VAR models
3. Non-stationarity, unit roots, and cointegration
4. Stochastic volatility: GARCH and extensions
5. State space models (Kalman filters, extended Kalman filters, particle filters)
6. MCMC methods (Metropolis, Gibbs, Hamiltonian)
7. Deep learning for time series

Homepage: Baruch MFE private forum site is available to registered students. If you're not registered but would like forum access, please contact the course TAs.

Textbook: There is no required textbook. Detailed lecture notes in the pdf format will be posted on the MFE Forum. A list of recommended readings will be provided with each set of notes. Good general references are:

1. R. S. Tsay: *Analysis of Financial Time Series*, Wiley (2010)
2. P. J. Brockwell and R. A. Davis: *Introduction to Time Series and Forecasting*, Springer (2016)
3. M. Joseph: *Modern Time Series Forecasting with Python*, Packt (2022)

More advanced but highly readable books are:

1. R. S. Tsay: *Multivariate Time Series Analysis*, Wiley (2014)
2. P. J. Brockwell and R. A. Davis: *Time Series: Theory and Methods*, Springer (2006)
3. J. Durbin, and S. J. Koopman, *Time Series Analysis by State Space Methods*, Oxford (2012)

Homework: Will be assigned weekly. Some of it will be in the form of programming projects in Python. You will be expected to use the following tools:

- (i) various scientific Python packages (such as numpy, scipy, statsmodels, pandas, scikit-learn, tensorflow, ...) (for computing), and
- (ii) Bloomberg or Yahoo Finance (for financial data)

Assignments should be e-mailed to the TAs in the format specified by them. Some homework assignments may have the form of open-ended projects and in-class presentations.

Final exam: The format of the final exam will be determined later.

Grading: Final Exam: 40%, Homework: 50%, Class participation: 10%