

## **Independent Study: Time Series Analysis with Financial Applications**

**Instructor:** Triet Pham, **Office:** Hill 508, **Email:** [ttmp140@math.rutgers.edu](mailto:ttmp140@math.rutgers.edu)

**Meeting Time:** TBD

**Textbook:** Time Series Analysis and Its Applications: With R Examples (Springer Texts in Statistics) by Robert H. Shumway, David S. Stoffer

### **References:**

1. The Elements of Financial Econometrics by Jianqing Fan and Qiwei Yao
2. Multivariate Time Series Analysis: With R and Financial Applications (Wiley Series in Probability and Statistics) by Ruey S. Tsay
3. Time Series: Theory and Methods by Peter J. Brockwell and Richard A. Davis

**Course Objectives:** The goal of this independent study course is to explore typical models used in time series analysis from a mathematical perspective and to apply it in the context of finance with the assistance of a programming language such as R or Python.

### **Course Outline:**

#### Weeks 1-2: Characteristics of Time Series (TSAA Chapter 1)

- The Nature of Time Series Data, Time Series Statistical Models, Autocorrelation and Cross-Correlation, Stationary Time Series, Estimation of Correlation, Vector-Valued and Multidimensional Series.

#### Weeks 3-4: Time Series Regression and Exploratory Data Analysis (TSAA Chapter 2)

- Classical Regression in the Time Series Context, Exploratory Data Analysis, Smoothing in the Time Series Context.

#### Weeks 5-6: ARIMA Models (TSAA Chapter 3)

- Autoregressive Moving Average Models, Difference Equations, Autocorrelation and Partial Autocorrelation, Forecasting, Estimation, Integrated Models for Nonstationary Data, Building ARIMA Models, Multiplicative Seasonal ARIMA Models.

#### Weeks 7-8: Spectral Analysis and Filtering (TSAA Chapter 4)

- Cyclical Behavior and Periodicity, The Spectral Density, Periodogram and Discrete Fourier Transform, Nonparametric Spectral Estimation, Parametric Spectral Estimation, Multiple Series and Cross-Spectra, Linear Filters, Lagged Regression Models, Signal Extraction and Optimum Filtering.

Weeks 9-10: Asset Returns (TEFE Chapter 1)

- Returns, Behavior of Financial Return Data, Efficient Markets Hypothesis and Statistical Models for Returns, Tests Related to Efficient Markets Hypothesis, Q-Q plot and Jarque-Bera Test.

Weeks 11-12: Factor Pricing Models and Portfolio Allocation (TEFE Chapters 5-6)

- Multifactor Pricing Models, Applications of Multifactor Models, Model Validation with tradable Factors, Fama-French Portfolios, Absence of a Risk-free asset, Macroeconomics Variables as Factors.

Weeks 13-14: Consumption based CAPM (TEFE Chapter 8)

- Utility Optimization, CCAPM, Power Utility, Mean-variance frontier. Present-value Models: Fundamental Price, Rational Bubbles, Time-varying Expected Returns, Empirical Evidence, Linear Regression under dependence.

**Grade Assignment:** Grade assignment will be based on the students' weekly project report and presentation.

## **Student-Wellness Services:**

Just In Case Web App

<http://codu.co/cee05e>

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

## **Counseling, ADAP & Psychiatric Services (CAPS)**

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ [www.rhscaps.rutgers.edu/](http://www.rhscaps.rutgers.edu/)

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

## **Violence Prevention & Victim Assistance (VPVA)**

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / [www.vpva.rutgers.edu/](http://www.vpva.rutgers.edu/)

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

## **Disability Services**

(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / <https://ods.rutgers.edu/>

Rutgers University welcomes students with disabilities into all of the University's educational programs.

In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation:

<https://ods.rutgers.edu/students/documentation-guidelines>.

If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at:

<https://ods.rutgers.edu/students/registration-form>.

### **Scarlet Listeners**

(732) 247-5555 / <http://www.scarletlisteners.com/>

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.