

UNIVERSITY OF TORONTO

TIME SERIES ANALYSIS, STA457H1 S/STA2202H S

COURSE OUTLINE

INSTRUCTOR: JEN-WEN LIN, PH.D., FRM

Office: SS6008

Office Hours: By appointment

Phone: TBA

Class Time/Place: Tuesday 6-9 pm, SS2135

Email: jenwen@utstat.toronto.ca

TA: Mark Koudstaal, markk@utstat.utoronto.ca, Lan Gong, gong@utstat.toronto.ca

Course Description

This course provides an introduction to time series analysis with finance applications. However, the techniques can be applied to other disciplines as well. Students will gain hands-on knowledge on how to analyze and model time series data after finishing this course. Topics in this course include

I. Fundamental Concepts

- a. Stochastic processes
- b. Stationarity (Weakly and Strongly)
- c. Autocovariance functions, autocorrelation functions and partial Autocorrelation Functions

II. Stationary Linear Time Series

- a. AR, MA, and ARMA (Autoregressive-Moving Average) Models
 - Causal and invertible ARMA processes
 - Moving average processes of infinite order
 - Computing the autocovariance functions of ARMA(p,q) processes
- b. Model Construction
 - Identification Techniques
 - Model Selection
 - Yule-Walker equations and Durbin-Levinson algorithm
 - Conditional maximum likelihood estimations
 - Diagnostic checking

III. Models of Non-stationary Time Series

- a. Stochastic versus deterministic time trends
- b. ARIMA (Autoregressive integrated moving average) models

IV. Prediction of Time Series

- Minimum mean squared error forecasts

- Computation of forecasts
- Updating forecasts

V. Vector Autoregressive (VAR) Models

- Introduction to VAR models
 - Granger Causality
 - Stationarity and model construction

VI. Spurious regression and Cointegration

- Spurious regression
- Introduction to cointegration
- Applications: Pair trading and index arbitrage

The following topics will be covered if time allows:

Continuous-time models, FARMA (Fractional Autoregressive-Moving Average) models, GARCH (Generalized Autoregressive Conditional Heteroscedastic) models, intervention analysis, Kalman filter and state space models, spectral Analysis, threshold Models, transfer function models

Grading SS457/2202

Midterm exam	20 % / 0%
Group project	40 % / 50%
Final exam	40 % / 50%

Textbook

Walter Enders (2004), *Applied Econometric Time Series*, Wiley, Second Ed. (available in the bookstore)

Reference Books

1. Carol Alexander (2003), *Market Models: A Guide to Financial Data Analysis*, Wiley.
2. P. J. Brockwell & R. A. Davis (1991), *Time Series: Theory and Method*, Springer; 2nd Ed.
3. Ernest P. Chan (2009), *Quantitative trading: how to build your own algorithmic trading business*, Wiley.
4. James D. Hamilton (1994), *Time Series Analysis*, Princeton University Press.
5. K. W. Hipel & A. I. McLeod (2005), *Time Series Modelling of Water Resources and Environmental Systems*, <http://www.stats.uwo.ca/faculty/aim/1994Book/default.htm>
6. Ruey S. Tsay (2000), *Analysis of Financial Time Series*, Wiley, 1st Ed.
7. Ganapathy Vidyamurthy (2004), *Pairs trading: Quantitative Method and Analysis*, Wiley.
8. William W. S. Wei (2006), *Time Series Analysis: Univariate and Multivariate Methods*, Addison Wesley, Second Ed.