Economics 871
Time Series Analysis

Eric Ghysels
TEGRhysels@unc.edu

Time and Place
TBA

Office Hours
M 2:30-5:30pm

Prerequisites
1. Economics 770 (Introduction to Econometric Theory)
2. Economics 771 (Econometrics)
3. Graduate level probability theory and mathematical statistics (usually obtained through 1 and 2).

Objectives
This course is concerned with modeling information over time from statistical, mathematical and
economic perspectives. Economic information over time exhibits stylized characteristics: 1. persistence:
values today are weakly-to-highly dependent on values in the near-to-distant past (e.g. output,
investment, equity returns); 2. nonlinearity: the relationship between economic variables over time is
often nonlinear based on forecasting principles and/or economic rational (e.g. exchange rates); 3.
heterogeneity and non-stationarity: attributes of economic events evolve or suddenly change over time
(e.g. output; shock to investment trend); 4. conditional heteroscedasticity: volatility in macroeconomic
and financial variates cluster (e.g. equity returns); 5. leptokurtosis: many economic time series have too
many large values to be modeled by a Gaussian distribution, and many suggest extremely heavy
distribution tails (infinite fourth or even second moment: asset returns).

All of these properties alone, or in combination, imply standard modeling and estimation techniques, and
accompanying large sample theory, are either more difficult to verify, or simply do not apply. We begin
by studying formal concepts of memory, from the very abstract (mixing, regularity, ergodicity, near-
epoch-dependence) to more concrete notions (autocovariance). We will use the concrete concepts
(autocovariance) to construct linear and nonlinear parametric time series models (Autoregressive Moving
Averages:ARMA, Vector Autoregression: VAR, Generalized Autoregressive Conditional
Heteroscedasticity: GARCH), and use the abstract concepts to analyze the small and large sample
properties of parameter estimators (Ordinary Least Squares, Nonlinear Least Squares, Quasi-Maximum
Likelihood).

Evaluation
There will be one midterm exam (30%), a final exam (40%), and an assortment of assignments based on
econometric theory and computer applications (30%). While students may consult with each other, each
must turn in his or her own work.
Reading and Textbooks

Required Reading


Suggested Reading

Introduction to Multiple Time Series Analysis by Helmut Lutkepohl (1991), Springer Verlag.
Forecasting by M.P. Clements and D.F. Hendry (2000), Cambridge Univ. Press.

Topics (these many change during the course of the semester)                   Readings

1. Stationarity, ergodicity, dependence concepts, limit theory for linear processes L*; D* 1, 13; B 1 W 2
2. Autocorrelation function: theory, estimation, asymptotics, inference.               H 3, 7; P #1,2; B 3, 7
3. Stationary ARMA: representation, spectrum, QML estimation, forecasting, asymptotic theory
                                           H 1-5, 7, 14; P #3
                                           B 8; D 13-20, 23-24, CH all.
4. Spectral analysis (time and frequency domain decompositions)     H 6; B 4
5. Kalman Filter - State Space representations, ARMA                   H 13
6. Regression Models with Dependent Regressors (ARX, NLARX)    H 8; P #4-6; W 3, 5
7. Model specification testing: martingale difference hypothesis, linearity.    P #7-9, 21; B 9
8. Non-Stationarity: Trend, Unit Roots, Cointegration                H 15-17, 19; P #10-12
9. Random volatility models: mixtures, GARCH, FIGARCH             H 21, G; P #13-19
10. Vector Autoregressions: estimation, asymptotic theory, cointegration. H 11; Papers #20,21

Journal Papers

1 Readings from Hamilton (H) and journal papers (P) are mandatory. * = highly recommended. All other suggested readings are based on the bibliography above. Use Davidson and White to guide your reading of the theoretical concepts developed in the lecture notes, but keep in mind that the lecture notes are merely a sketch of some ideas.
2 H = Hamilton (required reading); P = papers (required reading); L = lecture notes (suggested); D = Davidson; W = White; B = Brockwell and Davis; CH = Clements and Hendry (forecasting); G = Gourieroux.


