

SAS SHORT COURSE ON
MULTIVARIATE TIMES SERIES MODELING

Major References: Proc VARMAX documentation in SAS
New Introduction to Multiple Time Series Analysis by
Helmut Lutkepohl (Springer, 2006). Hereafter
referenced as HL2.

I. Introduction

- A. This Course is Follow-up to the Univariate Time Series Course
- B. The Major Purpose we focus on in this course is using Multiple Time Series Modeling to screen for and find useful leading indicators for Key Target Series in a Company
- C. The Role of Out-of-Sample Forecasting Experiments in Finding the Useful Indicators
- D. The Nature of Out-of-Sample Forecasting Experiments and Several Measures of Forecasting Accuracy
- E. Judging the Significance of Forecasting Accuracy Differences – Diebold-Mariano Test
- F. Box-Jenkins M-Series Data Set

References: Personal Notes

II. An Examination of Some Stylized Facts in Multiple Time Series Analysis

- A. A Discussion of the VARMA Simulator, VARMASIM, in Proc VARMAX
- B. The Results of Five Simulations
- C. The Stylized “Facts” Drawn from the Simulations
- D. Importance of Pre-testing for Unit Roots, Co-integration, and Causality

References: Proc VARMAX Documentation on VARMASIM

III. Equal Lag Length VAR

- A. Notation and Assumptions
- B. The Series M Data Set
- C. Either Trends and Seasonal Dummies or Ordinary and/or Seasonal Differencing
- D. Lag Length Selection – System-Wide Goodness-of-Fit Measures
- E. Forecasting
- F. Out-of-Sample Validation versus B-J benchmark

References: A. Chapter 2, section 1 in HL2, B. Class Discussion, C. Chapter 17, section 1 in HL2, D. Chapter 4, section 3 in HL2, E. Chapter 2, section 2 in HL2, E. Class Discussion, F. Class Discussion

IV. Tests of Causality and Stability

- A. Chow Test of Stability
- B. Granger Test of Causality

References: A. Chapter 4, section 6, B. Chapter 3, section 6, and Chapter 4, section 2.2 in HL2

V. Bayesian VARs

- A. Minnesota (Litterman) Priors
- B. Forecasting with BVARs
- C. Choosing Tightness of Priors by Out-of-Sample Validation

References: A. Chapter 7, section 4 in HL2, B. Class Discussion, C. Class Discussion

VI. Cointegration and Error Correction Models (ECMs)

- A. Definition of Cointegration
- B. Granger Representation Theorem
- C. Testing for Cointegration
 - i. Engle/Granger Single Equation Tests
 - ii. Johansen Tests (Trace and Max-Eigenvalue tests)
- D. Forecasting with ECM
- E. Term Structure of Interest Rate Example
- F. Out-of-Sample Validation

References: Chapter 6, sections 1 – 6 and Chapter 8 in HL2.

VII. VARX Models and Company Scenarios

- A. Notation
- B. National Wood Flooring Manufacturers' Data
- C. Deterministic Trend and Deterministic Seasonals
- D. Multipliers and Mean Response Analysis
- E. Forecasting and Scenario Playing with VARX Models
- F. Out-of-Sample Validation and the Ashley Criterion

Reference: Chapter 10 in HL2.

VIII. VARs and Innovation Accounting

- A. Wold Infinite VMA Representation of Stationary VARs.
- B. Structural VARs and Their Impulse Response Functions
 - i. Choleski Decomposition
 - ii. Sims (1986) and Bernanke (1986)
 - iii. Blanchard and Quah (1989)
- C. Impulse Response Functions for ECM Models
- D. Error Variance Decompositions
- E. Impulse Response Functions for VARX Models

F. An Example: The Texas Economy and Oil Prices

Reference: Chapter 9 in HL2