Econometrics III: Financial Econometrics

Spring 2013
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Course: 1 semesters, 3 hours per lecture.
Hours: Tue. 6:10pm-9:00pm
Office Hours: Tue. 14:00-17:00, Room A406

This course focuses exclusively on financial time series analysis or financial econometrics. I am aiming at equipping the students with proper tools for advanced empirical work and lay the foundation for future theoretical research in this area.

I shall cover closely the contents of the recently published new book, An introduction to financial time series with R written by Ruey Tsay. After a quick review of linear time series modeling, I shall cover volatility modeling. Univariate GARCH and stochastic volatility model and multivariate volatility models. Extreme values analysis and VaR are the second main topic. High frequency financial econometrics comprises the third topic.

In additional to econometric analysis, I also emphasize computational aspects of these complicated econometric techniques. R, is the statistical packages used in this course.

Main textbook


Reference books:

- Andersen, T.G.; Davis, R.A.; Kreib, J.-P.; Mikosch, Th. (Eds.) Handbook of Financial Time Series, 2009, Springer-Verlag

Course evaluation: homework and class attendance (30%), midterm (30%), term paper (40%).

**Topics**

1. Financial data, their properties and R programming (1 lecture)
2. Linear models for financial time series (2 lectures)
3. Case studies of linear time series (2 lectures)
4. Asset volatility and volatility models (3 lectures)
5. Applications of volatility models (1 lecture)
6. High frequency financial data (3 lectures)
7. Value at Risk (4 lectures)

**Softwares**

*R*: freely available at
http://www.r-project.org

1 **Financial data, their properties and R programming**

Tsay, chap 1

1. Asset Returns
2. Bond Yields and Prices
3. Implied Volatility
4. R Packages and Demonstrations
5. Installation of R Packages
6. The Quantmod Package
7. Some Basic R Commands
8. Examples of Financial Data
9. Distributional Properties of Returns
10. Review of Statistical Distributions and Their Moments
11. Visualization of Financial Data
12. Some Statistical Distributions
  13. Normal Distribution
  14. Lognormal Distribution
  15. Stable Distribution
  16. Scale Mixture of Normal Distributions
  17. Multivariate Returns

2 Univariate ARIMA modelling

Tsay, chap2; Granger & Newbold chap 3

- Autocorrelation, partial autocorrelation function, inverse autocorrelation function
- Wold representation theorem
- Random walk model
- General ARIMA model
- Variance stabilization transformation
- Model identification
  - using ACF & PACF
  - using AIC, BIC, & SC criterion
- Estimation
– method of moment
– maximum likelihood method
– nonlinear estimation

• diagnostic checking

3 Univariate volatility modeling


• ARCH
• GARCH
• GARCH-M
• metro-shower

4 Stochastic volatility models

Tsay, chaps 4, 5.

• SV vs. GARCH
• Estimating SV model
• SV and option pricing
• SVpack in OX
1. Ghysels, E., Harvey, A.C., Renault, E., 1996. Stochastic volatility, in: Mad- 
sterdam.

2. Liesenfeld, and J-F Richard, 2004, "Classical and Bayesian Analysis of Uni-
ivariate and Multivariate Stochastic Volatility Models," Department of Eco-
nomics, Christian-Albrecht-Universitat, Ohlshausenstr. 40-60, 24118 Kiel, 

5 Multivariate GARCH Models

TSay chaps 4,5

- Reparameterizations
- VEC, GBEKK, CCC, DCC
- Leverage effects in MGARCH models
- Estimation
- Diagnostic checking
- Applications


2. R. Engle (2002) ”Dynamic conditional correlationXa simple class of multi-
ivariate GARCH models,” Journal of Business and Economic Statistics 20: 
339V350.

3. Tse YK, Tsui AKC (2002) ”A multivariate GARCH model with time-varying 

6 High frequency financial data

Tsay, chap 6.

1. Nonsynchronous trading
2. Bid-ask spread of trading prices
3. Empirical characteristics of trading data
4. Model for price changes
5. Duration models
6. Realized volatility

7 Value at risk

Tsay, chap 7.
1. Risk measure and coherence
2. Calculating risk measures
3. RiskMetrics
4. An Econometric approach
5. Quantile estimation
6. Extreme value theory
7. An extreme value approach to VaR
8. Peaks over thresholds
9. The stationary loss process

Softwares

*R*: freely available at
http://www.r-project.org

*Task view: Empirical finance*
http://cran.r-project.org/src/contrib/Views/Finance.html

- *R packages*
  - *quantmod*: designed to assist the quantitative trader in the development, testing, and deployment of statistically based trading models.
  - *urca*: Unit root and cointegration analysis
  - *arima, forecasting*: classical time series analysis and forecasting
  - *fSeries, fMultivar*: GARCH, and more
• *dse, vars*’ multivariate time series analysis

• *fExtremes*: extreme value analysis

The *Rmetrics* bundle comprised of the *fArma, fAsianOptions, fAssets, fBasics, fBonds, fCalendar, fCopulae, fEcofin, fExoticOptions, fExtremes, fGarch, fImport, fMultivar, fNonlinear, fOptions, fPortfolio, fRegression, fSeries, fTrading, fUnitRoots* and *fUtilities* packages contains a very large number of relevant functions for different aspect of empirical and computational finance.