Econometrics III: Financial Time Series

Spring 2009
Jin-Lung Lin

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.

After a quick review of stochastic process and time series modeling, I start the econometric analysis with volatility modeling. Univariate GARCH and stochastic volatility comes first, followed by multivariate volatility models. Extreme values analysis and VaR are the second main topic. High frequency financial econometrics comprises the third and credit risk modeling the fourth. If time permits, I shall cover the event study methodology as it is very useful.

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

Textbook

Reference Books:

• Andersen, T.G.; Davis, R.A.; Kreib, J.-P.; Mikosch, Th. (Eds.) Handbook of Financial Time Series, 2009, Springer-Verlag
• Aris Spanos, Statistical Foundations of Econometric Modelling, 1986, Cambridge University Press
• Stephen Taylor, Modelling Financial Time Series, 2nd Ed. World Scientific

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

1. Review of stochastic process, random walks Brownian Motion, functional central limit theorem, and stochastic integration (1 lecture)
2. ARIMA modeling and R (1 lecture)
3. Univariate volatility modeling (3 lectures)
4. Multivariate volatility modeling (3 lectures)
5. Extreme value analysis and VaR (2 lectures)
6. Credit risk models (2 lectures)
7. High frequency financial econometrics: realized volatility (2 lectures)
8. Event study analysis (2 lectures)

Softwares

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

1 Review of stochastic processes

Spanos chap 8

- definition
- memory and heterogeneity
  - stationary
  - Martingale
  - Markov
- Brownian motion
  - derivation
  - nowhere differentiability
  - role in stochastic integral
- ARIMA processes
2 Univariate ARIMA modelling

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
  Box-Pierce Q-statistics

3 Univariate volatility modeling

4 Stochastic volatility models

- SV vs. GARCH
- Estimating SV model
- SV and option pricing
- SVpack in OX


5 Multivariate GARCH Models

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


### 6 Econometrics for high-frequency financial data

- realized volatility
- Jump-diffusion process

1. Tsay (2002), chap 5


### 7 Credit risk modeling

- Introduction of credit risk: credit-risky instruments, defaults, ratings
- Merton’s model of the default of a firm
- Credit risk models
  - Poisson random variables: Poisson mixture portfolio model: CreditRisk+
  - Binomial random variables: Binomial mixture portfolio model: CreditMetricsTM (Equity is the driver) KMVXR - Model (Asset Value is the driver)
  - Ratings-based model: CPV - credit portfolio view
  - Dynamic intensity process (times)
- Common industry models (KMV, CreditMetrics, CreditRisk+)
- Modelling dependence between defaults with factor models
• Calculating the portfolio credit loss distribution
• Large portfolio behaviour of the credit loss distribution
• Calibration and statistical inference for credit risk models


8 Event Study

• Definition
• methods
• Implementation
• Examples


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**
  • *urca*: Unit root and cointegration analysis
  • *arima, forcasting*: 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 aspects of empirical and computational finance.