

TIME SERIES ANALYSIS FOR FINANCIAL RISK MANAGEMENT (TIME SERIES ANALYSIS II)

Instructor: *Dean FANTAZZINI*

- **Course Objectives:** The goal of this course is to introduce some advanced time series models for empirical work with financial time series data, focusing particularly on Financial Risk Management. The initial part of the course introduces some advanced econometric methods such as nonlinear models for volatility, till copula modelling. The core part of the course is devoted to Financial Risk Management, focusing on Market Risk Management, Credit Risk Management and Operational Risk Management. Applied aspect of time series analysis is emphasized in the course.
- **Prerequisites:** Students should be familiar with basic concepts of time series analysis including ARIMA models, VAR models, and maximum likelihood. Students need to have a knowledge of a statistical software before start the course. We will use **Eviews**, **Gauss**, **R** and **STATA** throughout the lectures.
- **Textbooks:**
 - Umberto Cherubini, Elisa Luciano and Walter Vecchiato (2004), *Copula Methods in Finance*, Wiley
 - James D. Hamilton (1994), *Time Series Analysis*, Princeton University Press
 - Philippe Jorion (2007), *Financial Risk Manager Handbook*, Fourth Edition, Wiley
 - Ruey Tsay (2002), *Analysis of Financial Time Series*, Wiley
 - Alexander McNeil, Rudiger Frey and Paul Embrechts (2005), *Quantitative Risk Management*, Princeton University Press
- **Method of Grading:** Each student should take a final exam which considers both theoretical and applied aspects.

Course Outline

1. Models for Volatility

- 1.1 ARCH models
- 1.2 GARCH models
- 1.3 Nonlinear GARCH models
- 1.4 Introduction to Multivariate GARCH models: BEKK, VEC, CCC and DCC models
- 1.5 Empirical applications: An ARCH model for West Texas Oil Price
- 1.6 Empirical applications: An AR-TGARCH model for the RTS index
- 1.7 Empirical applications: BEKK, VEC, CCC and DCC models.

2. Market Risk Management

- 2.1 Risk Measures: Definitions and Properties
- 2.2 Standard Methods for Market Risks
- 2.3 Univariate Value at Risk with GARCH models
- 2.4 Multivariate Value at Risk with M-GARCH models
- 2.5 Empirical applications: Univariate T-GARCH models for Value at Risk forecasting with European stocks.
- 2.6 Empirical applications: Multivariate Diagonal-VECH, Diagonal-BEKK, CCC-GARCH and DCC models for Value at Risk forecasting.

3. Copula Theory

- 4.1 Introduction
- 4.2 Survey of Copula Families (Elliptical and Archimedean)
- 4.3 Limitations of Correlation, Tail dependence and other alternative Dependence Measures
- 4.4 Estimation from market data and Simulation
- 4.5 Empirical applications: Bivariate copula modelling with R.
- 4.6 Empirical applications: Multivariate copula modelling with Gauss.

4. Advanced Market Risk Management

- 4.1 Multivariate Copula - GARCH models for financial returns
- 4.2 Market Risk Management with Multivariate Copula-GARCH models
- 4.3 Empirical applications with Gauss: Multivariate Value at Risk with Copula-GARCH models

5. Credit Risk Management

- 4.1 Univariate Credit Risk Models
- 4.2 Model Evaluation: ROC, AUC and Loss Functions
- 4.3 The Father of (many) Credit Models for Quoted Stocks: Merton's Model
- 4.4 Empirical Applications: Logit, Panel Logit and Merton's model
- 4.5 Introduction to Multivariate Credit Risk Models: CreditMetrics, KMV, CreditRisk+, CreditPortfolioView
- 4.6 Backtesting and Validation of Multivariate Credit Models
- 4.7 Empirical applications: Multivariate Credit Risk Models and Validation

6. Operational Risk Management

- 6.1 Basel II approaches: the Basic Indicator and the Standardized approach
- 6.2 Advanced Measurement Approaches (AMA)
- 6.3 The Canonical Aggregation Model via Copulas
- 6.4 Empirical Applications with **Gauss**: the Case of Comonotonic Losses and the Canonical Aggregation via Copulas

References

1. Models for Volatility

- Hamilton, chapters 21
- Tsay, Chapter 3,9

2. Market Risk Management

- Jorion, chapter 10-12, 14-15
- McNeil, Frey and Embrechts, chapter 1-2,4,6
- Tsay, Chapter 9

3. Copula Theory

- Cherubini, Luciano and Vecchiato, chapter 2-6
- Mcneil, Frey and Embrechts, chapter 5
- Selected readings announced during lectures

4. Advanced Market Risk Management

- Selected readings announced during lectures

5. Credit Risk Management

- Jorion 18-20, 23
- Mcneil, Frey and Embrechts, chapter 8
- Selected readings announced during lectures

6. Operational Risk Management

- Jorion 24,31
- Mcneil, Frey and Embrechts, chapter 10
- Selected readings announced during lectures