

# MULTIVARIATE GARCH (VOLATILITY) MODELS FOR RISK MANAGEMENT

## GENERAL DESCRIPTION

The growth in financial instruments during the last decade has resulted in a significant development of econometric methods (financial econometrics) applied to financial data. The objective of our Multivariate Garch Models for Risk Management course is to provide participants with a comprehensive overview of the principal methodologies, both theoretical and applied, adopted for the analysis of risk in financial markets. To this end, the course focuses on the modelling and forecasting of financial time series and in particular modelling returns and volatility in asset returns; the modelling of cross market correlations, volatility spill-overs and contagion in financial asset markets; and the implementation of both factor models and principal components analysis for the identification of specific asset, country and global factors. The course concludes with an analysis of the available risk management tools/measures widely adopted in academia and the financial sector. During the course, a number of alternative GARCH models, models of conditional correlations, and Value at Risk models will be reviewed.

In common with TStat's training philosophy, throughout the course the theoretical sessions are reinforced by case study examples, in which the course tutor discusses current research issues, highlighting potential pitfalls and the advantages of individual techniques. The intuition behind the choice and implementation of a specific technique is of the utmost importance. In this manner, course leaders are able to bridge the "often difficult" gap between abstract theoretical methodologies, and the practical issues one encounters when dealing with real data. At the end of the course, participants are expected to be able to autonomously implement the theories and methodologies discussed in the course.

## TARGET AUDIENCE

The course is of particular interest to: i) Master and Ph.D. Students and researchers in public and private research centres, and ii) professionals employed in risk management in the following sectors: asset management, exchange rate and market risk analysis, front office and research in investment banking and insurance, needing to acquire the necessary econometric/statistical toolset to independently conduct an empirical analysis of financial risk.

## COURSE REQUISITES

Participants are required to have a basic knowledge of either econometrics or statistics. Previous experience with statistical software will facilitate the practical sessions.

## PROGRAM

### SESSION I: UNIVARIATE AND MULTIVARIATE CONDITIONAL MEAN FORECASTING

1. Estimation and forecasting: ARMA (p,q) Processes, Exponential Smoothing (ES), Holt-Winter's ES (HWES)
2. Forecast Evaluation: ME, MAE, MSE, RMSE, Theil's U, Diebold-Mariano test. Combination of Forecasts
3. Vector Autoregressive (VAR) models to model interdependencies
4. Empirical Applications: modelling and forecasting returns and equity premium, term structure and the bond markets, foreign exchange rates. Yield curve forecasting

### SESSION II: VOLATILITY MODELS: GARCH

1. Analysis of financial time series features: stationarity, autocorrelation, conditional heteroscedasticity, fat tails
2. Modelling and forecasting asset returns volatility with univariate ARCH and GARCH models:
  - ARCH, GARCH, GARCH-in-mean
  - Integrated GARCH
  - RiskMetrics
  - Modelling asymmetric shock impacts on volatility with asymmetric GARCH models:
    - SAARCH
    - EGARCH
    - GJR
    - TGARCH
    - APARCH
    - News Impact Curve

### SESSIONS III / IV: MULTIVARIATE VOLATILITY (MGARCH) MODELS. CONDITIONAL CORRELATION MODELS AND CONTAGION

- Modelling cross-markets correlations and testing for volatility spillovers with:
  - Diagonal VECH (DVECH)
  - Constant Conditional Correlation (CCC)
  - Dynamic Conditional Correlation (DCC) models
- Assessing contagion in financial markets. Testing for high moments contagion cross-market correlation coefficients, Markov switching regressions, higher moments contagion
- Empirical applications: forecasting volatility and correlations in financial markets. Contagion between markets

### SESSION V: FACTOR MODELS

- Static and dynamic factors, factor estimation, determining the number of factors, nonstationary factor models
- Identifying global, asset related and country specific factors in data with a large number of assets with principal component analysis and static and dynamic factor models
- Applications of factor analysis to (bond and asset) portfolio management, stock liquidity and its determinants

### SESSION VI: RISK MANAGEMENT TOOLS

- Portfolio Value-at-Risk (VaR)
- Parametric VaR
- Historical simulation VaR
- Monte Carlo VaR
- Expected Shortfall (ES) and Tail Risk (TR)
- Backtesting procedures
- Unconditional coverage
- Independence

- Conditional coverage
- Duration based tests of independence

## USEFUL TEXTS

S. Boffelli and G. Urga (2016), [Financial Econometrics Using Stata](#). Stata Press Publication.

## DATES AND LOCATION

The 2023 edition of this training course will be offered **ONLINE** on a part-time basis on the **26th-27th of January and the 2nd-3rd of February**. To this end, programme includes a series of sessions based on 4 modules from 10.00 am to 1.30 pm Central European Time (CET).

## REGISTRATION FEES

Full-time students\*: € 710.00  
 Ph.D. Students: € 910.00  
 Academic: € 1010.00  
 Commercial: € 1350.00

\*To be eligible for student prices, participants must provide proof of their **full-time** student status for the current academic year. Our standard policy is to provide all **full-time students**, be they Undergraduates or Masters students, access to student participation rates. Part-time master and doctoral students who are also currently employed will however, be allocated academic status.

Fees are subject to VAT (applied at the current Italian rate of 22%). Under current EU fiscal regulations, VAT will not however applied to companies, Institutions or Universities providing a valid tax registration number.

The number of participants is limited to 8. Places will be allocated on a first come, first serve basis. The course will be officially confirmed, when at least 5 individuals are enrolled.

Course fees cover: teaching materials (handouts, Stata *do files* and datasets to used during the course) and a temporary licence of Stata valid for 30 days from the beginning of the course.

Individuals interested in attending this course must return their completed registration forms by email ([training@tstat.eu](mailto:training@tstat.eu)) to TStat by the **6th January 2023**.

## CONTACT INFORMATION:

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The logo for TStat, featuring a stylized red 'T' and the word 'Stat' in a black, cursive font, all enclosed within a grey circular background.