MODELLING AND FORECASTING ENERGY MARKETS

Frankfurt am Main, 2-5 September 2025

Over the last two decades, international energy markets have witnessed major structural changes that have profoundly impacted energy prices. Factors such as market liberalisation, increased renewable energy production, rising demand from data centres, and extreme climate events have made demand and supply less predictable, leading to greater price volatility. Accurate modelling and forecasting of energy demand and prices is crucial, not only for energy producers but also for commodity traders and financial analysts. The statistical features of energy data, which tends to follow periodic patterns and exhibit spikes, non-constant means and non-constant variances, renders the task of forecasting and modelling of energy data somewhat challenging.

The objective of TStat's "Modelling and Forecasting Energy Markets" course is to provide participants with the analytical tools to undertake a rigorous and in-depth analysis of both demand and prices for international energy markets. The programme covers a wide range of econometric methods, including univariate and multivariate time series models for forecasting prices and volatility and cointegration and panel data models for modelling and forecasting energy demand.

Aligned with TStat's training philosophy, the teaching approach combines theoretical sessions, which provide the intuition behind the specific techniques, with numerous practical sessions utilising econometric software and real-world data. This structure allows course leaders to effectively bridge the gap between abstract theoretical methodologies and the practical issues encountered when working with real-world data.

By the end of the programme, participants will have acquired the skills to independently conduct comprehensive energy market analyses. They will be able to identify the most suitable econometric methods for their specific needs, assess the validity of their estimated models, and evaluate the robustness of their findings with confidence.

TARGET AUDIENCE

Researchers and professionals working either in the energy and related sectors, needing to model energy price and demand or on trading desks in financial institutions. Economists based in research policy institutions. Students and researchers in engineering, econometrics and finance needing to learn the econometrics methods and tools applied in this field.

PREREQUISITES

Participants are required to have a good working knowledge of:

- Linear regression model definition and assumptions;
- Ordinary Least Squares (OLS) estimation. Properties of OLS;

COURSE CODE

D-EF49

MODELLING AND FORECASTING ENERGY MARKETS

- Inference in the linear regression model: confidence intervals, t-test, F-test;
- Violation of the linear regression model assumptions: heteroscedasticity, serial correlation, functional form misspecification, non-Normality. Consequences of violations and remedies;
- Diagnostic analysis of regression: tests for heteroscedasticity, test for serial correlation, Normality test, Ramsey's RESET;
- Regression with time series data. Concepts of lagged variable and differenced variable;
- Dynamic models.

Attendees do NOT however, require any previous knowledge of the software *Stata*.

These topics are covered in all the introductory econometrics textbooks, for example:

- Brooks, C. (2019). *Introductory Econometrics for Finance*. Cambridge University Press. Chapters: 3-5.
- Wooldridge, J. M. (2020). *Introductory Econometrics: A Modern Approach*. Seventh Edition. Cengage Learning. Chapters: 2-12.

PROGRAMME

DAY 1 ENERGY DATA ANALYSIS (HALF DAY)

SESSION I: ENERGY DATA ANALYSIS

1. An introduction to Stata for energy data analysis.
2. Creating tables of descriptive statistics to understand the features of energy data.
3. Tests for autocorrelation and autoregressive conditional heteroscedasticity.
4. Unit root tests for checking nonstationary of energy time series.

DAY 2 MODELS AND FORECASTING ENERGY PRICES

SESSION I: UNIVARIATE TIME SERIES MODELS FOR MODELLING AND FORECASTING ENERGY PRICES (ELECTRICITY, NATURAL GAS, CRUDE OIL AND OIL DERIVATIVES)

1. Univariate time series models for modelling and forecasting energy prices (ARMA, ARIMA, ARFIMA, SARIMA). Diagnostic tests for univariate time series models.
2. Switching regressions for capturing stable and spiky regimes in energy prices.
3. Practical applications: modelling and forecasting energy prices with univariate models using market data for OECD countries.

SESSION II: MULTIVARIATE TIME SERIES MODELS FOR MODELLING AND FORECASTING ENERGY PRICES (ELECTRICITY, NATURAL GAS, CRUDE OIL AND OIL DERIVATIVES)

1. Vector autoregressive (VAR) models for understanding interdependences between energy markets. Forecasting energy markets with VAR models.
2. Granger predictability of energy prices.
3. Practical applications: modelling and forecasting energy prices with VAR models using market data for OECD countries.

DAY 3 MODELLING AND FORECASTING ENERGY MARKETS VOLATILITY

SESSION I: UNIVARIATE GARCH MODELS FOR MODELLING AND FORECASTING ENERGY PRICES VOLATILITY (ELECTRICITY, NATURAL GAS, CRUDE OIL AND OIL DERIVATIVES)

1. *ARCH, GARCH, GARCH-in-mean and IGARCH models for energy markets volatility.*
2. *Asymmetric GARCH models (EGARCH, TGARCH, APARCH).*
3. *Practical applications: fitting symmetric and asymmetric GARCH models for forecasting energy markets volatility.*

https://www.tstattraining.eu/training/modelling-energy-markets/

MODELLING AND FORECASTING ENERGY MARKETS

SESSION II: MULTIVARIATE GARCH MODELS FOR MODELLING AND FORECASTING ENERGY PRICES VOLATILITY AND CORRELATION (ELECTRICITY, NATURAL GAS, CRUDE OIL AND OIL DERIVATIVES)

1. From univariate to multivariate GARCH models. Diagonal VECH model.
2. Constant Conditional Correlation (CCC) model, Dynamic Conditional Correlation Model (DCC) by Engle (2002) and Dynamic Conditional Correlation Model (DCC) by Tse and Tsui (2002).
3. Practical applications: testing for interdependencies between energy markets volatility using CCC and DCC models. Empirical properties of oil, natural gas, and electricity price volatilities using a range of univariate and multivariate GARCH models and daily data from wholesale markets in the United States and Europe.

DAY 4 MODELLING THE DEMAND OF ENERGY

SESSION I: COINTEGRATION MODELS FOR ENERGY DEMAND (ELECTRICITY, NATURAL GAS, CRUDE OIL AND OIL DERIVATIVES)

1. An introduction to the theory of cointegration.
2. Cointegration models for energy data: autoregressive distributed lag models and error correction models. The Engle & Granger procedure and the Johansen's approach to cointegration.
3. Practical applications: Estimating energy demand models using market data for OECD countries. Cointegration between oil and gas markets, and gas and power spot prices (de Jong and Schneider, 2009).

SESSION II: PANEL DATA MODELS FOR ENERGY DEMAND (ELECTRICITY, NATURAL GAS, CRUDE OIL and OIL DERIVATIVES)

1. An introduction to panel data analysis: types of panel data, advantages of panel data. Fixed versus random effects estimators. Hausman Test.
2. Estimators for dynamic models. Arellano and Bond estimator, Blundell and Bond estimator.
3. Practical applications: modelling and forecasting energy demand with a panel data approach using data for OECD countries.

SUGGESTED READINGS

- Becketti, S. (2020). *Introduction to Time Series Using Stata*. Stata Press Publication.
- Boffelli, S. & Urga G. (2016). *Financial Econometrics Using Stata*. Stata Press Publication.
- Brooks, C. (2019). Introductory Econometrics for Finance. Cambridge University Press.
- Linton, O. (2019). Financial Econometrics. Cambridge University Press.
- Stock, J.H., and Watson, M.W. (2019). Introduction to Econometrics, Fourth edition, Pearson.
- Wooldridge, J.M. (2020). Introductory Econometrics: A Modern Approach. Seventh Edition, Cengage LearWooldridge, J.M. (2020). Introductory Econometrics: A Modern Approach. 7th Edition, Cengage Learning.

DATE AND LOCATION

The course will be held at the Flemings Selection Hotel Frankfurt-City on:

Sept. 2, 1:30 pm - 5.30 pm
Sept. 3, 9:00 am -1:00 pm / 2:00 pm - 5:30 pm
Sept. 4, 9:00 am -1:00 pm / 2:00 pm - 5:30 pm
Sept. 5, 9:00 am -1:00 pm / 2:00 pm - 4:30 pm

https://www.tstattraining.eu/training/modelling-energy-markets/

MODELLING AND FORECASTING ENERGY MARKETS

REGISTRATION FEES

Full-time Students*: € 945
Full-time Ph.D. Students: € 1140
Academic: € 1645
Commercial: € 2415

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

Individuals interested in attending the training course should contact TStat Training to ask for a registration form. The completed application must then be returned to TStat by the 3rd of August 2025.

Further details regarding our registration procedures, including our commercial terms and conditions, can be found at https://www.tstattraining.eu/training/modelling-energy-markets/.

COURSE LEADERS

Dr Elisabetta PELLINI, Bayes Business School, City St George's, University London (UK).

Professor Giovanni URGA, Bayes Business School, City St George's, University London (UK).

CONTACTS

Monica Gianni

TStat S.r.l. | Via Rettangolo, 12-14
I-67039 Sulmona (AQ)
T. +39 0864 210101

training@tstat.eu
www.tstattraining.eu
www.tstat.it

TStat