V Residential SUMMER SCHOOL

MODELLING AND FORECASTING ENERGY MARKETS

Florence, 30 August - 3 September 2021

In the last two decades, energy markets operators have witnessed major structural changes that have had a profund impact on how prices are determined on the market. Events like market liberalization, adoption of energy efficiency regulation, increased production from renewable energy sources, and climate change have contributed in making the demand and supply less predictable and the prices more volatile. The accurate modelling and forecasting of energy demand and prices has become of utmost importance, not only to energy producers themselves, but also to commodity traders and financial analysts focusing on the energy sector. 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" Summer School is therefore to provide participants with the specific analytical tools to undertake a rigorous and in-depth analysis of both demand and prices in international energy markets.

The programme covers a wide range of econometric methods currently available to researchers and practitioners, such as: i) univariate and multivariate time series models for forecasting prices and demand; ii) univariate and multivariate GARCH models for forecasting price volatility and iii) cointegration models and panel data models for assessing the sensitivity of energy demand to price, income and climate variables and for constructing long-run policy scenarios.

Following TStat's training philosophy, the teaching style features both theoretical sessions, where participants are given the intuition behind the choice of a specific technique, and several practical sessions using econometric software. In this manner, the 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.

The 2021 edition also includes an extended Case Study Group session during which participants will either work in small groups on a short applied case study or on a presentation of their own research work. Course leaders will discuss with participants the appropriateness of the methods adopted in their case study and the interpretation of the results obtained and will also provide feedback and guidance on possible future developments of individual research agendas.

At the end of the School participants are expected to be in a position to autonomously conduct energy markets analysis. In particular, participants will be able to evaluate which econometric method is more appropriate to the analysis in hand and will be able to test the appropriateness of their estimated model and the robustness of the results obtained.

SUMMER SCHOOL CODE

I-SS12

PREREQUISITES

A knowledge of intermediate statistics and econometrics, such as that of Wooldridge, J.M. (2019) and/or Brooks, C. (2019), is required.

In particular, participants must be familiar with linear regression analysis, inference, regression misspecification issues and time series concepts of autocorrelation, stationarity and volatility.

During the Summer School, participants will be introduced to the econometric/statistical software **Stata**. Attendees do not however, require any previous knowledge of the software.

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

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TARGET AUDIENCE

Researchers and professionals working either: i) in the energy and related sectors, needing to model energy price and demand, and ii) 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.

PROGRAMME

DAY 1 ENERGY DATA ANALYSIS

SESSION I: AN INTRODUCTION TO ENERGY DATA

1. Data cleaning and data preparation (creating logs, log-differences).
2. Graphical analysis of energy time series: line plots, distribution plots, sample correlograms.
3. Understanding non-stationarity and volatility from visual inspection of the time series.

SESSION II: ENERGY DATA ANALYSIS

1. Creating tables of descriptive statistics to understand the features of energy data.
2. Test for autocorrelation and heteroscedasticity. Normality test.
3. Unit root tests for checking nonstationary of energy time series.

DAY 2 TIME SERIES MODELS

SESSION I: UNIVARIATE TIME SERIES MODELS FOR ENERGY DEMAND AND PRICES (ELECTRICITY, CRUDE OIL, NATURAL GAS...)

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 ENERGY DEMAND AND PRICES (ELECTRICITY, CRUDE OIL, NATURAL GAS...)

1. Vector autoregressive (VAR) models for forecasting energy prices and for understanding interdependences between energy markets.
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 VOLATILITY MODELS

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

1. ARCH, GARCH, GARCH-in-mean and IGARCH models for energy prices.
2. Inverse leverage effect in energy markets. Estimating asymmetric GARCH models (EGARCH, TGARCH, APARCH).
3. Practical applications: fitting symmetric and asymmetric GARCH models for energy prices volatility.

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

1. VECH and Diagonal VECH models.
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.

DAY 4 COINTEGRATION MODELS

SESSION I: COINTEGRATION MODELS OF ENERGY DEMAND (ELECTRICITY, CRUDE OIL, NATURAL GAS…

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.

SESSION II: APPLIED CASE STUDY ANALYSIS

1. In this session, participants will be encouraged to discuss their own research projects and data issues. Course leaders are available for feedback and guidance on how to deal with research projects.

DAY 5 PANEL DATA MODELS

SESSION I: STATIC PANEL DATA MODELS FOR ENERGY DEMAND (ELECTRICITY, CRUDE OIL, NATURAL GAS…)

1. An introduction to panel data analysis: types of panel data, advantages of panel data.
2. Fixed vs random effects models in typical (large N and small T) panels.
3. Least squares dummy variables, within, between and GLS estimators. Hausman Test.

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

1. An introduction to the Generalised Methods of Moments estimation approach.
2. Estimators for dynamic models. Anderson and Hsiao estimator, Arellano and Bond estimator, Blundell and Bond estimator.
3. Practical applications: modelling energy demand with a panel data approach using data for OECD countries.

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COURSE REFERENCES

Introductory Econometrics: A Modern Approach. 7th Edition, Wooldridge, J.M. (2019).

Introductory Econometrics for Finance, Cengage Learning and/or Brooks, C. (2019), Cambridge University Press.

COURSE LEADERS

Dr Elisabetta PELLINI, Centre for Econometric Analysis, Cass Business School, London (UK).

Professor Giovanni URGA, Centre for Econometric Analysis, Cass Business School, London (UK).

REGISTRATION DEADLINE

Individuals interested in attending this summer school must return their completed registration forms by e-mail training@tstat.eu to TStat by 10th August, 2021.

CONTACTS

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DATE AND LOCATION

The Summer School will take place from the **30th of August to the 3rd of September 2021** at the CISL Studium Center, Via Della Piazzola, 71 | I-50123 Florence | www.centrostudi.cisl.it.

Due to the ongoing COVID-19 situation, participants who register, and are then unable to travel due to COVID restrictions, will be offered the opportunity to participate ONLINE or to withdraw (in accordance with our COVID cancellation conditions reported on the registration forms) from the school. Participation fees for those candidates unable to attend in presence will be adjusted accordingly to reflect their ONLINE non-residential status.

REGISTRATION FEES

The Summer School fee amounts to:

Full-time Students*: € 1250.00
Academic: € 2200.00
Commercial: € 3250.00

*To be eligible for student prices, participants must provide proof of their full-time student status for the current academic year. Residential costs for full time students are completely covered TStat Training through our Investing in Young Researchers Programme. Participation is however restricted to a maximum of 3 students.

Fees are subject to VAT (applied at the current Italian rate of 22%). However, under current EU fiscal regulations, VAT will not be applied to companies, institutions or universities, providing a valid tax registration number.

Please note that a *non-refundable deposit* of €100.00 for students and €250.00 for Academic and Commercial participants, is required to secure a place and is payable upon registration. The number of participants is limited to 15. Places will be allocated on a first come, first serve basis.

Course fee covers: teaching materials (copies of lecture slides, databases and routines used during the school); a temporary software licence for use throughout the sessions, valid for 30 days from the first day of the course; half board accommodation (breakfast, lunch and coffee breaks), a single room at CISL Studium Center or equivalent (5 nights). Participants requiring accommodation the night of the final day of the school, are requested to contact us as soon as possible.

To maximize the usefulness of this summer school, we strongly recommend that participants bring their own laptops with them, to enable them to actively participate in the empirical sessions.