Lancaster University Management School

timberlake

statistics | econometrics | forecasting

Econ 604: Advanced Forecasting for Time Series

COURSE AIMS & OBJECTIVES, KEY SKILLS AND LEARNING OUTCOMES

Course Aims & Objectives: The course aims to develop students' econometric skills and provide practical guidance on how to forecast. Economics needs to forecast a non-stationary and evolving world, using a forecasting model that differs from the economic mechanism. The resulting framework, its basic concepts and main implications are sketched. Many famous theorems of economic forecasting no longer hold—rather their converses often do. We will examine how standard macroeconometric models fail in many forecasting scenarios, which provides guidance in how to correct for such forecast failure. We shall also look at how the forecast theory developed can be applied to other disciplines. The course will be practical. All empirical examples will be worked through using the econometric software package OxMetrics.

Completion of Time Series Econometrics and Forecasting (Core 2) is a prerequisite for taking this module.

Key Skills: By the end of this course, students should have some knowledge and understanding of:

- Use the model selection software, Autometrics, to select macroeconometric models used for forecasting.
- Compute point and interval forecasts using standard and robust forecasting devices.
- Evaluate forecasts of macroeconomic variables.
- Develop an understanding of when forecasts may or may not perform well.

Desired Outcomes: By the end of this course, students should be able to:

- Engage in abstract thinking by extracting the essential features of complex systems to facilitate problem solving and decision-making
- Communicate and present complex arguments in oral and written form with clarity and succinctness
- Present, interpret and analyse information in numerical form
- Utilise effectively statistical and other packages
- Apply basic statistical techniques to analyse economic and financial datasets
- Work effectively both individually and within a team environment.

COURSE STRUCTURE

Econ 604 is a 10 credits course and therefore students are expected to input approximately 100 hours of study into the course. The total number of contact hours on Econ 604 is 15 hours. This leaves 85 hours for private study. Course Delivery comes in the form of Lectures with 15 hours delivered over the first 3 weeks of the term (10 hours of lectures and 5 hours of tutorials). There will be optional clinics on the last day of the course.

During your private study you should strike a balance between reading the course material (which is the primary source of information) and the recommended textbooks, thinking critically about how these fit in to the body of knowledge on the subject and about how our level of knowledge can be improved, performing exercises, completing coursework and revising for examinations. You can expect to perform well on this course only if you work consistently through the year.

COURSE CONVENOR

Professor Jennifer Castle, Professor Jurgen Doornik, Professor David Hendry (special guest lecturer)

LECTURERS CONTACT INFORMATION (Including Office Hours)

Email: jurgen@doornik.com; jennifer.castle@magd.ox.ac.uk

Available by appointment (please email to arrange a convenient time)

COURSEWORK ASSESSMENT

The CWA mark will be calculated as 100% coursework. The coursework will be assigned at the end of the course

The coursework will be delivered to students at the end of week 6 of each term and is due for submission at the end of week 10, allowing students 4 weeks for completion.

Coursework must be submitted electronically through the Moodle site for this course

FEEDBACK ON COURSEWORK:

The coursework will be marked and returned to students within 4 weeks of the submission deadline. Feedback will consist of marker's notes appended to the pdf of your coursework.

MARKING CRITERIA AND PENALTIES

Marking criteria can be found in the Economics Undergraduate Handbook and the general course information paper. An electronic copy of this can be found via the Current Student page of the university website then follow the Academic Regulations link https://gap.lancs.ac.uk/ASQ/QAE/MARP/Documents/UG-Assess-Regs.pdf

FINAL MARK INFORMATION

This course is assessed 100% by means of coursework. The final mark is the average of the marks obtained in the two pieces of coursework.

COURSE TEXT AND RECOMMENDED READING

Main texts

- **The main recommended textbook is:** Castle, Jennifer L., Clements, M.P. and Hendry, D.F. (2019) Forecasting: An Essential Introduction, Yale University Press.

Note Copies of the lecture slides will be made available on the course web pages. You **MUST** print off the notes for each lecture **prior to** attending. Solutions to exercises, and some additional material associated with these lectures and course announcements will also be placed on this website.

COURSE OUTLINE/LECTURE SCHEDULE

Day 1:

Session 1: Introduction to Economic Modelling and Forecasting

The framework for economic modelling and forecasting, its basic concepts and main implications will be sketched. The theory of reduction underpins economic modelling: Models with no losses on reduction are congruent; those that explain rival models are encompassing. The main reductions correspond to key econometrics concepts (causality, exogeneity, invariance, etc.), and are the null hypotheses of model- evaluation tests, sustained by a taxonomy of evaluation information. Congruent and encompassing sub- models can, therefore, be justified, motivating the question 'how should they be selected'? The key problems in forecasting are also highlighted, emphasising the distinction between determining economic relationships or testing theories and forecasting. Good models may forecast badly and bad models can forecast well – a concept that will be explored throughout the course.

Session 2: Introduction to OxMetrics.

In this applied session we will introduce OxMetrics (data input, transformation, graphics, modules and recording results) and PcGive, the basic modelling tool, including model formulation, selection, and evaluation. This session will also explore the forecasting tools available in the software, including graphical and statistical output. Various applications will illustrate the software.

Day 2:

Session 3: Selecting Forecasting Models.

Model selection theory poses great difficulties: all statistics for selecting models and evaluating their specifications have distributions, usually interdependent, and possibly altered by every modelling decision. General-to-specific (Gets) modelling will be described, emphasising automatic procedures. Gets mimics reduction by simplifying a congruent general unrestricted model (GUM) to a dominant minimal representation. Autometrics will be explained and its properties discussed. The properties of model selection will be discussed by way of a class Monte Carlo experiment, in which each participant generates a draw of data from a DGP using PcNaive, a software package within OxMetrics, and we compare the retention of relevant and irrelevant variables to the theory predictions, contrasting the results with the notion of 'size'. Methods for handling more candidate variables than observations are shown, leading to empirical model discovery.

Session 4: Forecasting Problems.

We examine the main sources of forecast failure using artificial data in a series of examples to highlight the results. PcNaive will be used to generate the forecasting examples explored. A range of parameter changes in integrated-cointegrated, I(1), time series are hardly reflected in econometric models thereof: zero-mean shifts are not easily detected by conventional constancy tests. The breaks in question are changes that leave the unconditional expectations of the I(0) components unaltered. Thus, dynamics, adjustment speeds etc. may alter with a low chance of detection. However, shifts in long-run means are generally noticeable. We'll draw important implications for the choice of forecasting device.

Day 3:

Session 5: Foundations of Unpredictability.

Six aspects of the role of unpredictability in forecasting are distinguished, compounding four additional mistakes likely when estimating forecasting models. Many of the famous theorems of economic fore- casting do not hold in a non-stationary and evolving world, when the model and mechanism differ; rather their converses often do. Equilibrium-correction models are shown to be a risky device from which to forecast. Potential explanations for the intermittent occurrence of forecast failure include poor models, inaccurate data, inadequate methodology, mis-calculation of uncertainty, structural change, over-parameterization, incorrect estimators, and inappropriate variables. In fact, using a simplified taxonomy of forecast errors, most of these can be shown not to explain forecast failure, and the forecast-error taxonomy shows that forecast failure depends primarily on forecast-period events, particularly location shifts.

Session 6: Robustifying Forecasts.

In this practical session we shall explore one method of robustifying forecasts to location shifts. Differencing lowers the polynomial degree of deterministic terms: double differencing usually leads to a mean-zero, trend-free series, as continuous acceleration is rare in economics (except perhaps during hyperinflations or major technological shifts). The impact on forecast performance is traced. A new explanation for the empirical success of second differencing is proposed. Forecasting will be conducted for several model variants, with and without forecast failure. The role of parameter estimation uncertainty is considered. The practical role of forecast-error corrections will be investigated, and many theoretical issues illustrated through both successful and unsuccessful forecasting, including how to cope with location shifts. Examples will include Japanese Export forecasts and UK GDP forecasts.

Day 4:

Session 7. Robust Systems

In this practical session we shall work with the Cointegrated Vector Autoregressive model (CVAR) to show how to implement robustification in the system. We shall use the well known example of forecasting UK M1 money demand when there was a legislative change leading to large forecast failure. This practical session will demonstrate the use of multivariate modelling within PcGive and results in the very general class of robust forecasting devices that uses local averages to estimate the changing location and growth rate parameters.

Session 8. Forecasting Breaks

We note research on forecasting breaks, and the demanding conditions under which that might be possible, as well as learning about breaks during transitions. The possible roles of parsimony and collinearity in forecasting highlight the potential importance of excluding irrelevant, but changing, effects. While intercept corrections help robustify forecasts against biases due to location shifts, they are ineffective for measurement errors: conversely EWMA corrections are excellent for measurement errors, but not breaks. Rapid updating is related both to moving windows and to forecasting breaks, with some properties that can help alleviate failure. Forecast pooling can also sometimes help, but needs to be combined with model selection to exclude really bad forecasting devices. Then, pooling can lead to improved forecasts over the best of a set of devices in a world of mis-specified models and location shifts. However, care is needed in selecting what enters the pool, and indiscriminate pooling (as in Bayesian model averaging) can be counter-productive.

Day 5

Session 9. Forecasting with Factors

Dynamic Factor Models are a common approach to forecasting. In this practical session we discuss the computation of Principal Components and use these to build forecasting models. We will compare direct and iterated forecasts, as well as a comparison with unobserved component models. We'll explore the generic approach of including both factors and variables, made feasible with Autometrics by applying selection to ensure sparsity. We will conclude with a forecasting game: Who can obtain the lowest RMSFE for three target variables?

Session 10. Conclusions and Discussion

In this session we shall draw together various aspects that we have discussed on the course. Some extensions will be discussed, including extending the robust forecasting device to longer horizons and applications to other fields including climate. We will end with a guide to modelling and forecasting, illustrated by an example using UK CO2 emissions. First, impulse and step indicators are selected at very tight significance levels holding all other variables fixed. Next, the regressors are selected over at looser significance levels. The selected model is solved for the cointegrating, or long-run, relation and the non-deterministic terms are reparameterized to differences, with step indicators included in the cointegrating relation. The non-integrated formulation is re-estimated and used to produce conditional forecasts. The VAR is then constructed to obtain unconditional system forecasts and the importance of step indicator saturation is observed.