Lancaster University Management School

timberlake
statistics | econometrics | forecasting

Econ 610 Econometrics of Productivity Measurement and Efficiency 2022-2023

COURSE AIMS & OBJECTIVES, KEY SKILLS AND LEARNING OUTCOMES

Course Aims & Objectives: This course will provide the students with an in-depth understanding of the fundamental concepts of econometric production analysis and with the practical skills to use econometric software to empirically analyse production technologies and producer behaviour. The module will build on the foundation of core econometrics courses and prepare students for MSc and PhD research or work as an econometrician, consultant, or quantitative analyst for public and private institutions within the broad area of econometric production analysis.

Key Skills: By the end of this course, students should have obtained the following knowledge and skills:

- know the basics of microeconomic production theory that build the theoretical foundation of econometric production analysis;
- describe the taught approaches to econometric production analysis and assess their suitability in various empirical settings;
- use econometric software to empirically analyse production technologies and producer behaviour; and
- calculate various indicators of production technologies and producer behaviour and interpret their meaning regarding the “real-world” situation.

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

- apply various approaches to econometric production analysis to investigate various real-world questions;
- critically evaluate the appropriateness of a specific econometric production analysis for analysing a specific real-world question; and
- communicate and present the results of econometric production analysis in oral and written form with clarity and succinctness.

COURSE STRUCTURE

Econ 610 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 610 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

Arne Henningsen, PhD, Associate Professor, University of Copenhagen

LECTURERS CONTACT INFORMATION (Including Office Hours)

Email: arne@ifro.ku.dk

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

COURSEWORK ASSESSMENT

The final mark for the course will depend on a written exam. Timetable for details of time and venues will be communicated via Moodle and by Timberlake well in advance.

The CWA mark will be calculated as 100% coursework. The coursework will be assigned at the beginning of the module.

Coursework must be submitted electronically through the Moodle site for this course: https://mle.lancs.ac.uk/course. Login using your regular Lancaster University access details. This opens a page headed MLE: My home.

The format of the submission is as follows.

- The submitted file must be in pdf format with the following name

  stud#_studname_cw_**cw#.pdf**

  where: **stud#** is your student number, **studname** is your name in the format *surname_name*, **cw#** is either 1 or 2 according to the piece of coursework submitted. Eg a student with student number 111 would submit a file named *111_surname_firstname_cw_1.pdf*.

- Maximum file size is 2MB: figures resolution must be adjusted accordingly.

Note that your work will be screened using software designed to detect plagiarism.

Do not rely upon someone else to submit your coursework.
*Word counts are inclusive of all material submitted apart from the Bibliography.

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:

- Henningsen, A. (2020): Introduction to Econometric Production Analysis with R. Collection of Lecture Notes. 5th Draft Version. Department of Food and Resource Economics, University of Copenhagen. Available at http://leanpub.com/ProdEconR/

Readings regarding specific topics of the course:

- Chambers, R.G. (1988): Applied Production Analysis. A Dual Approach. Cambridge University Press, Cambridge.
- Coelli, T.J., D.S.P. Rao, C.J. O'Donnell, and G.E. Battese (2005): An Introduction to Efficiency and Productivity Analysis, 2nd ed. New York: Springer.
- Henningsen, A., Bělín, M., and Henningsen, G. (2017): New Insights into the Stochastic Ray Production Frontier. Economics Letters 156, p. 18-21.
- Henningsen, A. and C.H.C.A. Henning. 2009. "Imposing Regional Monotonicity on Translog Stochastic Production Frontiers with a Simple Three-Step Procedure." Journal of Productivity Analysis 32:217–229.
- Henningsen, A, Henningsen, G., and Literáti, G. (forthcoming): Econometric Estimation of the Constant Elasticity of Substitution Function in R: the micEconCES Package. In: Hashimzade, N. and Thornton, M. (editors): Handbook of Research Methods and Applications in Empirical Microeconomics. Edward Elgar.

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: Introduction & Econometric Analysis with Production Functions (part 1)

Microeconomic production theory (primal approach)

- definition of technology sets, production functions, input requirement sets, and isoquants
- average products / partial productivities
- total factor productivity
- properties of production functions
- marginal products
- output elasticities
- elasticities of scale
- most productive scale size
- marginal rates of technical substitution
- elasticity of substitution

Statistical methods

- delta method

Empirical analyses

- preparing data sets
- calculating average products / partial productivities
- calculating total factor productivity

Cobb-Douglas production function

- specification
- estimation
- checking if the theoretical properties of production functions are fulfilled
- interpretation of estimation results, output elasticities
- elasticity of scale: calculation, interpretation, standard deviation, confidence intervals, and t-test
- calculation and interpretation of (relative) marginal rates of technical substitution
- elasticity of substitution

Day 2: Econometric Econometric Analysis with Production Functions (part 2)

Translog production function

- specification
- estimation
- testing against the Cobb-Douglas production function
- test of statistical significance of individual inputs
- calculation and interpretation of output elasticities
- checking if the theoretical properties of production functions are fulfilled
- calculation and interpretation of elasticities of scale
- optimal scale size
- calculation and interpretation of elasticities of substitution

- imposing monotonicity
- mean-scaled quantities

Constant Elasticity of Substitution (CES) production function

- specification
- nested CES functions
- estimation, grid search

General topics regarding production functions

- suitability of production functions for econometric applications
- comparing functional forms
- Data Envelopment Analysis (DEA)
- nonparametric estimation of a production function using kernel regression

Day 3: Econometric Analysis with Cost Functions

Microeconomic theory: cost functions

- definition
- properties, linear homogeneity and concavity in input prices
- cost flexibility, elasticity of size, and elasticity of scale
- Shephard's Lemma
- marginal costs

Cobb-Douglas and Translog cost functions

- specification
- estimation
- checking if the theoretical properties of production functions are fulfilled
- checking and imposing linear homogeneity in input prices
- cost flexibility, elasticity of size, and optimal firm size
- optimal cost shares vs. observed cost shares
- marginal costs
- total cost curve, average cost curve, marginal cost curve

General topics regarding cost functions

- Suitability of cost functions for econometric applications

Day 4: Stochastic Frontier Analysis

Microeconomic theory

- different measures of technical efficiency (Shephard, Farrell, output-oriented, input-oriented)
- allocative efficiency, cost efficiency, scale efficiency

Stochastic frontier analysis

- specification, parametrisation, assumptions
- estimation procedure
- output elasticities and marginal products,
- technical efficiency estimates
- importance of the monotonicity conditions
- distributional assumptions about the inefficiency term
- "Efficiency Effects Frontier"
- stochastic cost frontier

Cobb-Douglas and Translog stochastic production frontier

- residuals from OLS estimations
- estimation
- interpretation of estimation results
- testing Cobb-Douglas vs. Translog functional form
- testing statistical significance of the inefficiency term (LR test SFA against OLS)
- obtaining efficiency estimates
- truncated normal inefficiency term
- additional explanatory variables that affect the frontier
- additional explanatory variables that affect the efficiency level

Cobb-Douglas stochastic cost frontier

- specification
- residuals from OLS estimations
- estimation

Day 5: Econometric Analysis of Multiple-Output Technologies

Microeconomic theory

- cost functions for multiple outputs
- output distance functions
- input distance functions
- stochastic ray production frontier
- distance elasticities and elasticity of scale

Cobb-Douglas and Translog cost functions for multiple outputs

- specification
- estimation

Other topics regarding cost functions for multiple outputs

- other functional forms
- using multiple-output cost functions for regulating natural monopolies

Cobb-Douglas and Translog output distance function

- specification
- estimation
- distance elasticities and elasticity of scale
- efficiency estimates

Cobb-Douglas and Translog input distance function

- specification
- estimation
- distance elasticities and elasticity of scale
- efficiency estimates

Cobb-Douglas and Translog stochastic ray production frontier

- specification
- estimation
- distance elasticities and elasticity of scale
- efficiency estimates