



Wageningen School
of Social Sciences

THEORY AND PRACTICE OF EFFICIENCY & PRODUCTIVITY MEASUREMENT: STATIC & DYNAMIC ANALYSIS

**Subal Kumbhakar, Chris Parmeter,
Alfons Oude Lansink, Frederic Ang**

4-8 and 11-15 July 2022

**Course organised by the Wageningen School of Social Sciences (WASS),
Wageningen University**

Introduction

Productivity growth entails changes in scale, efficiency gains and technological change. Innovations are needed to keep pushing the competitive envelope, and efficiency gains are needed to ensure that implemented technologies achieve their potential. Conventional economic approaches assume that all firms operate rationally and efficiently. This summer school, however, challenges this assumption and presents concepts, models and tools needed to analyze and quantify the levels of inefficiency and productivity at a point in time and their movement over time.

The summer school is designed to bridge the gap between theory and practice. It is organized into distinct parts: “Parametric, Static Approaches” (Week 1) and “Dynamic Approaches” (Week 2). Participants may enrol for either week 1 or 2, or both weeks. Although each week is independent, participants are encouraged to take both weeks.

Week 1 (4- 8 July 2022): Parametric Efficiency and Productivity Analysis

Lecturers:	Subal Kumbhakar Professor of Economics Binghamton University, USA	Chris Parmeter Associate Professor of Economics University of Miami, USA
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The parametric course uses Stochastic Frontier Analysis and semi-parametric techniques to measure efficiency and productivity by letting the data span the frontier to establish best practice. This approach coupled with the microeconomic theory of the firm provides firm-specific measurements of efficiency and best practice role models for improving performance.

Week 2 (11– 15 July 2022) : Data Envelopment Analysis : Static and Dynamic Efficiency and Productivity Analysis

Lecturers:	Alfons Oude Lansink Professor of Business Economics Wageningen University, NL
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The second week introduces the students into Data Envelopment Analysis (DEA) and the dynamic perspective to measuring efficiency and productivity. DEA is a nonparametric technique for measuring efficiency and productivity. The technique does not require distributional assumptions on the efficiency term and is a flexible approach that can be applied to many situations. Dynamic efficiency and productivity analysis is a relatively new approach that has found a more wide application the economics literature. The approach explicitly accounts for the role of adjustment costs in investments.

Course activities

The course consists of theory and method sessions in the morning followed by an afternoon practicum session. The computer lab will include applications of the theory, computer analyses with actual data sets, and interpretations in practice. Applications to various economic sectors will be considered such as agriculture, banking and finance, chain management, health, electrical power generation, and sports. Extensions of these models will be addressed that measure input-specific technical efficiency and characterize the dynamic linkages in decision making, and introduce hybrid nonparametric-parametric approaches.

Objectives

Participants will learn the theories concerning efficiency and productivity measurement and will develop proficiency with software to facilitate the initiation of their own research in efficiency and productivity measurement. The course deals with both conceptual and methodological issues.

In particular, after successful completion (of either module) participants are expected to be able to:

- Understand sources of efficiency from the perspective of technical feasibility, allocating scarce resource among competing ends, and the firm scale of operations;
- Understand the input and output perspectives of technical and allocative efficiency;
- Characterize efficiency and productivity growth from a primal, dual and distance function perspective;
- Decompose productivity growth that explicitly accounts for the presence of inefficiency;
- Use DEA models to measure technical, allocative, and scale efficiency levels and productivity growth;
- Characterize definitions of variables of interest to be employed (goods and services; inputs, outputs, environmental, nonmarket goods/services);
- Assess the appropriate use of parametric and nonparametric approaches given the data and problem setting (understanding the advantages and disadvantages of both perspectives);
- Use these approaches to articulate the forces driving efficiency gains and productivity growth;
- Use these approaches for benchmarking, identifying best practice and role models to plan for performance enhancement/gains;

The Dynamic Analysis"" course will further cover:

- Delineation of variable and quasi-fixed factors and their treatment in efficiency and productivity;
- Use of econometric approaches to address efficiency and productivity change measurement over time.

Target group

The course is oriented toward PhD candidates, postdoctoral researchers and others with background in economics.

Assumed prior knowledge

Microeconomic theory at the graduate level such as the treatment in H. Varian, Microeconomic Analysis, W.W. Norton. Completion of a course in dynamic optimization is strongly recommended. Econometric theory and applications at the graduate level to include topics in Maximum Likelihood Estimation and System Estimation are required and some exposure to panel data econometrics is desirable.

Course Materials:Week 1:

- Kumbhakar, S. and C.A.K. Lovell, *Stochastic Frontier Analysis*, Cambridge University Press, 2000.
- Subal C. Kumbhakar, Christopher F. Parmeter and Valentin Zelenyuk, 'Stochastic Frontier Analysis: Foundations and Advances I, *Handbook of Production Economics*, edited by R. Chambers, S. C. Kumbhakar and S. Ray, Springer, 2022.
- Subal C. Kumbhakar, Christopher F. Parmeter and Valentin Zelenyuk, 'Stochastic Frontier Analysis: Foundations and Advances II,' *Handbook of Production Economics*, edited by R. Chambers, S. C. Kumbhakar and S. Ray, Springer, 2022.

Week 2:

- Silva, E., S. Stefanou and A. Oude Lansink (2021). *Dynamic Efficiency and Productivity Measurement*. Oxford University Press, 28 Jan 2021, Oxford University Press. 248 p.

Participants should make sure they have the books of *Kumbhakar et al. (2000)* and *Silva et al. (2021)* before the course starts; the costs of these books are not included in participation fee. The two chapters from the handbooks of production economics (Kumbhakar et al. (2022)) and other accompanying materials will be distributed during the course

Course fees

The course fee for each week is €600. For PhD candidates of Wageningen School of Social Sciences with an approved TSP the course fee is reduced to €300. For those registering for both weeks the course fees are €950 (€475 for WASS PhDs with an approved TSP). The course fee does not include books. It includes additional training material, coffee / tea, lunches and an informal dinner.

Outline of the Course in Hours

Students can choose to participate in the course and receive 1.5 ECTS per week, or write a paper (one for each week) and receive 3 ECTS per week. 1 ECTS is equivalent to 28 hours of work load. For participation in the full 2-week programme, which entails 168 hours of preparation, attendance and two papers, 6 ECTS can be obtained.

Course Schedule

Parametric Efficiency & Productivity Analysis Course Schedule and Plan, July 4-8, 2022

Day	Lecture	Computer lab
1	<ul style="list-style-type: none"> • Introduction • Cross-Sectional Methods • Estimating Firm Specific Inefficiency 	<ul style="list-style-type: none"> • Determinants of Inefficiency • Alternative SF models (mixture models/ZISF) • Estimation/Inference of Cross-Sectional SF models in R
2	<ul style="list-style-type: none"> • History of Panel Data Stochastic Frontier Model • First Generation Panel Data Models 	<ul style="list-style-type: none"> • Second Generation Panel Data Models • The Closed Skew Normal Distribution • Estimation/Inference of Panel Data SF models in Stata
3	<ul style="list-style-type: none"> • Semi/Nonparametric Production Frontiers • Nonparametric Estimation of the Determinants of Inefficiency 	<ul style="list-style-type: none"> • Estimation of Non/Semiparametric SF models in R
4	<ul style="list-style-type: none"> • Modeling Multiple Outputs • The Input/Output Distance Function 	<ul style="list-style-type: none"> • Endogeneity in the Cross Sectional Stochastic Frontier Model • Endogeneity in the Panel Data Stochastic Frontier Model
5	<ul style="list-style-type: none"> • Spatial stochastic frontier models 	<ul style="list-style-type: none"> • Alternative uses of Stochastic Frontier Analysis

DEA: Static and Dynamic Efficiency & Productivity Analysis Schedule and Plan, July 11-15, 2022

Day	Lecture	Practicum
1	<p>Establishing Production Technologies</p> <ul style="list-style-type: none"> • Nonparametric representation of technology (FA) <ul style="list-style-type: none"> ○ Axioms ○ Constructing cost and profit maximization as LP problem • Radial Distance Functions (FA) <ul style="list-style-type: none"> ○ Input distance functions ○ Output distance functions ○ Duality between input distance functions and Cost function ○ Duality output distance and Revenue function • Directional Distance Functions (AOL) <ul style="list-style-type: none"> ○ Definition and properties ○ Translation ○ Duality Directional Distance function and Cost and Profit functions 	<p>Introduction to R for nonparametric analysis</p> <p>Computational approaches to Data Envelopment Analysis</p> <ul style="list-style-type: none"> ○ Constructing nonparametric benchmark technologies ○ Generating cost and profit maximization problems for actual data using nonparametric technology framework ○ Generating the nonparametric distance functions for actual cases
2	<p>Characterizing Dynamic Production and Efficiency</p> <ul style="list-style-type: none"> • Overview (FA) • Defining Dynamic Production Possibility Sets (FA) • Technical Efficiency measures (AOL) <ul style="list-style-type: none"> ○ Graphically piece-wise linear technology ○ Radial & Directional Distance measures <p>Dynamic Optimization (AOL)</p> <ul style="list-style-type: none"> • Cost Efficiency (AOL) • Dynamic Duality with the directional input distance function (AOL) • Decomposition of cost efficiency (allocative & technical) (AOL) 	<p>Dynamic cost inefficiency, dynamic technical inefficiency, dynamic allocative inefficiency</p> <p>Application: NY Dairy Farm panel; US electric utility firms panel</p> <p>Students may use their own data as well</p>
3	<p>Characterizing pollution in a production framework and environmental efficiency (FA)</p> <ul style="list-style-type: none"> • Pollution as input • Pollution as weakly disposable output • Pollution as a by-product <p>Determinants of technical efficiency (AOL)</p> <ul style="list-style-type: none"> • Discretionary factors • Two-stage truncated bootstrap regression 	<p>Data for environmental efficiency: nuclear power plants/international ag.</p> <p>Data for determinants of technical efficiency</p>
4	<p>Productivity Growth</p> <ul style="list-style-type: none"> • Intro: theoretical vs. economic approach (FA) • Static (FA) • Dynamic (AOL) • By-Production (FA/AOL) 	<ul style="list-style-type: none"> • As in day 2 and 3
5	<p>Some New Directions & Discussion</p> <p>New Directions: (FA and AOL)</p> <ul style="list-style-type: none"> • Multiple sub-technologies • Input-specific inefficiency <p>Open Questions (FA and AOL)</p> <ul style="list-style-type: none"> • Parametric v. Nonparametric • Structural Modeling v. Technical Modeling • Where is the literature going? 	

Location

The sessions will be held in building “De Leeuwenborch”, Hollandseweg 1 in Wageningen, The Netherlands. The exact rooms will be announced before the start of the course.

Registration

Registration is possible electronically via the WASS courses page:

[Registration form - WUR](#)

The maximum number of participants is set at 20, the minimum at 10.

Please make sure that you provide the most recent contact details so that in case of any changes you will be notified promptly. After your internet registration you will receive a short notification that your name has been registered. At least two weeks before the course you will receive a confirmation about the location and the schedule. WASS will also send an invoice to the address indicated in the registration form.

Please e-mail to Marcella.Haan@wur.nl in case you have not received the second confirmation two weeks before the course.

Cancellations

Cancellations may be made free of charge until 1 month before the start of the course. Cancellation fee of 100 % applies if participants cancel the course less than 1 month prior to the course. The organisers have a right to cancel the course not later than 1 month before the course starts. The participants will be notified of any changes at their e-mail addresses.

Further information

On course content please contact the course organiser, Alfons Oude Lansink . He can be reached through Alfons.OudeLansink@wur.nl

For details about the logistics, accommodation, registration, fees, study materials, etc. please contact

Marcella Haan

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Marcella.haan@wur.nl

Contact addresses:

Wageningen School of Social Sciences

Wageningen University

Hollandseweg 1

6706 KN WAGENINGEN

The Netherlands

Useful information on accommodation for participants from outside Wageningen

Hotels:

Wageningen International Congress Centre (WICC): 75 euro for 1 persons room, 90 euros for 2 persons room, both prices are including breakfast; <https://www.wicc.nl/en/>

Hotel de Wageningseberg: 85 euro for 2 persons room, also including breakfast; <http://hoteldewageningscheberg.nl/en/>

Hotel Nol in 't Bosch: 79 euro for 1 person room, 85 euro for 2 persons room, also including breakfast; <http://www.nolintbosch.nl/>

Air B&B Wageningen:

https://www.airbnb.com/s/Wageningen--Netherlands/homes?allow_override%5B%5D=&ne_lat=51.98588152023385&ne_lng=5.688003552017875&search_by_map=true&sw_lat=51.965332680231015&sw_lng=5.656776971552205&zoom=15&s_tag=vDEq_E8E

Bed&Breakfast:

See also : <https://www.bedandbreakfast.nl/bed-and-breakfast/wageningen/netherlands/c2745088> or <http://www.shortstaywageningen.nl/> or <https://www.duwowageningen.com/>

B&B De Heksenspeeltuin: 30 euro for a 1 person room
Address: Einthovenstraat 15, 6706JA Wageningen
Phone: +31 317-418161
E-mail: callyd@zonnet.nl
Website: www.heksenspeeltuin.nl

Ons Bakhuus Bed & Breakfast: 50 euro for a 1 person room
Address: Dolderstraat 64, 6706 JG Wageningen
Phone.:+31 317-411994
E-mail: info@onsbakhuis.nl
Website: www.onsbakhuis.nl

Toproom B&B: 60 euro for a 1 person room
Vossenlaan 17
6705 CD Wageningen-Hoog
Phone: +31 317-450214
E-mail: info@toproom.nl
Website: www.toproom.nl
Possibilities to rent a bike

From Schiphol Airport to Wageningen

At the Airport you can buy a train ticket in the 'arrivals' area by the baggage claims. You will see the sign "Train tickets" near the exit. Then follow the signs 'Nederlandse Spoorwegen' (NS) or 'Trains and busses' to the railway station.

Buying a single-use chipcard

You can travel with the train on NS with a **single-use chipcard** The single-use chipcard is a paper ticket with a chip inside.

- The most important thing to be aware of when buying a single-use chipcard is that you can only buy these tickets from an NS ticket machine (with the blue sign and white NS logo across the top).
- Tickets can also be purchased from the Tickets & Service desks at major stations.



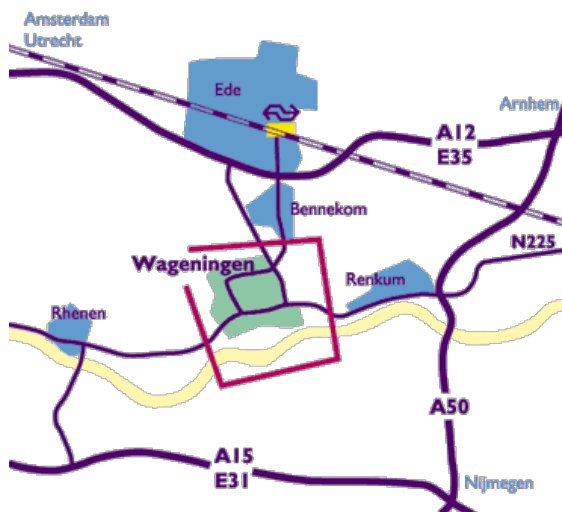
Travelling with a single-use chipcard or OV-chipkaart

To travel with a single-use chipcard or OV-chipkaart you have to **check in** and **out** at an access gate or check-in/check-out point. When travelling with NS you have to check in and out with an NS reader at a gate or post. If you change to a different carrier during your journey, you have to check in and out then as well. For questions about using the card, please contact our staff at the Tickets & Service counter, at the station or on the train.



There are direct connections from Schiphol Amsterdam Airport to Ede-Wageningen every 30 minutes. Additionally, twice an hour there is a connecting service from Schiphol to Ede-Wageningen where you have to change trains in Utrecht. The destination boards on the platform will indicate the different stations where the train will stop. Check for the names Ede-Wageningen or Utrecht and board the train and when necessary change in Utrecht. The trip from Schiphol to Ede-Wageningen takes you a bit more than one hour.

For Dutch train connections use www.ns.nl, www.thalys.com, www.db.de



The train station is not located directly in Wageningen. This lack is fully compensated by fair means of transportation by buses and taxis. From railway station Ede-Wageningen you can take a taxi (approx. 15 min.). Taxis leave at the north side of the station. You can also come by bus: line 84, line 86 or line 88 (direction Wageningen/ Arnhem) leaves from the north side of the station. You have to purchase a ticket from the driver in the bus, which will cost about 3 euros.

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