

Modern Data Envelopment Analysis (DEA) & Stochastic Frontier Analysis (SFA) using Python

PEMA Professional Development Workshop



2- 4 December 2025

The University of Sydney, CBD Campus

Level 17, 133 Castlereagh Street,
Sydney, NSW 2006

Acknowledgement of Country

We acknowledge the traditional owners of the lands on which the University of Sydney is located, the Gadigal people of the Eora Nation, and we pay our respect to the knowledge embedded forever within the Aboriginal Custodianship of Country.



Location Guide for In-person Participants



The University of Sydney, CBD Campus

Address: Level 17, 133 Castlereagh Street, Sydney, Australia

Getting There

By train

The nearest train stations are St James Station and Town Hall Station.

By bus

The nearest bus stops are located on Castlereagh Street or on Elizabeth Street.

By car

There is no car parking available onsite. However, [Piccadilly Secure Parking](#) (137 Castlereagh St) provides parking spaces. We suggest pre-booking online to avoid a high cost.

For directions, go to [Campus Maps](#) and search for 133 Castlereagh Street.

Computing facilities - Bring your own device/s

Please bring your own laptop. Extension cords, power boards and WiFi password will be provided.

Accommodation

PEMA does not engage in the administration of temporary accommodation. It is up to you to find suitable living arrangements.

Workshop Summary

This workshop showcases three days on contemporary and hands-on methodology for productivity and efficiency analysis using one of the most popular data science languages, with applications to various economic agents (e.g., departments, firms, industries, regions, countries, public utilities, etc.).

The first day is devoted to a gentle introduction to Python and is taught by [Dr. Jessica Leung](#), Faculty of Business and Economics, Monash University. Dr Leung is a Lecturer in Business Analytics, specialising in management science, optimisation, machine learning, and data science. She is also an associate investigator at the ARC Industrial Transformation Training Centre in Optimization Technologies, Integrated Methodologies, and Applications (OPTIMA). She is a co-author of the popular [Python Language Companion to Efficiency and Productivity Analysis](#).

The second day is devoted to production theory and data envelopment analysis and is taught by [Professor Valentin Zelenyuk](#), School of Economics, University of Queensland. Professor Zelenyuk is a former ARC Future Fellow and an elected member of the Conference on Research in Income and Wealth (CRIW) group of the National Bureau of Economic Research (NBER). He is a founding member of the International Society for Efficiency and Productivity Analysis (ISEaPA). His research focuses on economic theory of production, econometric estimation and applications. He has co-authored over 70 publications in such leading journals as Operations Research and Journal of Econometrics, and a book with Robin Sickles, Rice University, titled ["Measurement of productivity and efficiency: theory and practice"](#).

The third day is devoted to stochastic frontier analysis is taught by [Professor Artem Prokhorov](#), Discipline of Business Analytics, University of Sydney. Professor Prokhorov is a fellow of the Centre interuniversitaire de recherche en économie quantitative (CIREQ) at University of Montreal, Canada. He is a founding member of the International Society for Efficiency and Productivity Analysis (ISEaPA). His research interests are in the field of theoretical and applied econometrics, with applications in business, finance, risk management, labour and health economics, and have intersections with statistical machine learning and high-dimensional statistics. He has published in such leading journals as Journal of Econometrics and European Journal of Operational Research and has consulted widely for business and government. He is the author of a new book titled ["Efficiency and Productivity Analysis: Using Copulas in Stochastic Frontier Models"](#).

You can choose to attend either one or two or three days.

Day 1 (2 Dec 2025): *Introduction to Python for productivity and efficiency analysis*, by Jessica Leung, Monash University

This day assumes no knowledge of Python and only basic knowledge of mathematics. Starting from scratch, we will install Python and all the necessary packages that will be used in the next two days. We will cover basic operations with functions contained in those packages, including how to use matplotlib, scipy.optimize, statsmodels, sklearn.linear_model. We will then delve into additional fundamental topics such as writing functions in Python and understanding and manipulating Python data structures effectively. By the end of the day, you will be able to write and run Python codes and have packages required for Days 2 and 3. The material in Day 1 is of interest independently of Days 2 and 3, as a hands-on workshop for those looking for a gentle introduction to one of the most popular programming languages.

Day 2 (3 Dec 2025): *Production theory and Data Envelopment Analysis*, by Valentin Zelenyuk, University of Queensland

This day assumes basic knowledge of economics, statistics, and mathematics and a working knowledge of Python at a level equivalent to Day 1. The day is composed of four sessions. The first session is focused on axiomatic approach to production theory, covering the essence of its economic foundation and mathematical structure. The second session is focused on various methodological approaches to implementing DEA. The third session is focused on statistical foundations of DEA. The fourth session is about implementing DEA in Python. By the end of Day 2, you will understand the axiomatic approach to production theory and be able to obtain and interpret DEA output in Python and perform related statistical analysis.

Day 3 (4 Dec 2025): *Stochastic Frontier Analysis*, by Artem Prokhorov, University of Sydney

This day assumes basic knowledge of economics, statistics, and mathematics and a working knowledge of Python at a level equivalent to Day 1. We start with the estimation of cross-sectional stochastic frontier models (SFM) with multiple inputs. Then, we include environmental variables that affect inefficiency scores, allow for time varying technical inefficiency and for unobserved effects and we consider estimation of stochastic frontier models using panel data. Finally, we cover applications in agriculture, power generation, efficiency of airlines, coal mines, and banks. The last session will be a Python tutorial showcasing how the methods are used in practice. By the end of Day 3, you will be able to estimate SFMs, test hypotheses about them, interpret the estimates and obtain efficiency rankings.

Program

Day 1: Tuesday 2 December 2025

8.40 – 9.30

Welcome tea & Coffee

Session 1 Dr Jessica Leung Lecturer, Department of Econometrics and Business Statistics, Monash University	
9:30 – 11:00	Python installation <i>Installation of Anaconda Python and necessary packages used in DEA and SFA</i>

11:00 – 11:30

Morning Tea

Session 2 Dr Jessica Leung Lecturer, Department of Econometrics and Business Statistics, Monash University	
11:30 – 13:00	Python Basics <i>Introduction to Python and basic operations such as writing a function and understanding data structures</i>

13:00 – 14:00

Lunch

Session 3 Dr Jessica Leung Lecturer, Department of Econometrics and Business Statistics, Monash University	
14:00 – 15:30	Practical guide for Python packages - I <i>Introduction to `scipy.optimize` and `matplotlib`</i>

15:30 – 16:00

Afternoon Tea

Session 4 Dr Jessica Leung Lecturer, Department of Econometrics and Business Statistics, Monash University	
16:00 – 17:30	Practical guide for Python packages - II <i>Introduction to `sklearn.linear_model` and `statsmodel`</i>

Kindly note: The precise content per session is subject to reshuffling and fine-tuning.

Day 2: Wednesday 3 December 2025

8.40 – 9.30

Welcome tea & Coffee

Session 1 Prof Valentin Zelenyuk ARC Future Fellow, School of Economics, University of Queensland	
9:30 – 11:00	Foundations of productivity and efficiency analysis <i>Characterizations of technology via functions and sets, axiom of production theory, modelling returns to scale, profit functions, revenue functions, cost functions, Shephard's distance functions, Farrell (radial) technical efficiency measures, allocative efficiency measures, other performance measures</i>

11:00 – 11:30

Morning Tea

Session 2 Prof Valentin Zelenyuk ARC Future Fellow, School of Economics, University of Queensland	
11:30 – 13:00	Foundations of DEA <i>Activity analysis modelling, Data Envelopment Analysis: Farrell's approach, Data Envelopment Analysis: CCR approach, returns to scale in DEA, handling Big-Wide Data in DEA; LASSO+DEA</i>

13:00 – 14:00

Lunch

Session 3 Prof Valentin Zelenyuk ARC Future Fellow, School of Economics, University of Queensland	
14:00 – 15:30	Selected Topics in DEA <i>Statistical foundations for DEA: analysis of densities, analysis of aggregate efficiency (bootstrap, bias correction, and new CLTs), regression of DEA-estimated efficiency on covariates (truncated regression with bootstrap).</i>

15:30 – 16:00

Afternoon Tea

Session 4 Dr Jessica Leung Lecturer, Department of Econometrics and Business Statistics, Monash University	
16:00 – 17:30	DEA in Python <i>Hands-on tutorial on implementing DEA in Python</i>

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Day 3: Thursday 4 December 2025

8.40 – 9.30

Welcome tea & Coffee

Session 1 Prof Artem Prokhorov, Discipline of Business Analytics, University of Sydney	
9:30 – 11:00	SFA for cross-sections: COLS, MLE <i>Parameter interpretation; Corrected Ordinary Least Squares (COLS); Maximum Likelihood Estimation (MLE); alternative distributional assumptions; specification testing; LASSO+SFA; prediction of technical inefficiency</i>

11:00 – 11:30

Morning Tea

Session 2 Prof Artem Prokhorov, Discipline of Business Analytics, University of Sydney	
11:30 – 13:00	SFA for cross-sections: determinants of inefficiency <i>Inclusion of determinants of inefficiency; environmental variables; non-zero mean; heteroskedasticity; testing nested model; scaling property; marginal effects; alternative distributions</i>

13:00 – 14:00

Lunch

Session 3 Prof Artem Prokhorov, Discipline of Business Analytics, University of Sydney	
14:00 – 15:30	SFA for panels: LSDV, RE, FE, MSLE <i>Data structure; Least Squares Dummy Variable (LSDV) estimation; Fixed and Random Effects (FE and RE); prediction of technical inefficiency; time-varying inefficiency; Maximum (Simulated) Likelihood Estimation (MSLE)</i>

15:30 – 16:00

Afternoon Tea

Session 4 Dr Jessica Leung Lecturer, Department of Econometrics and Business Statistics, Monash University	
16:00 – 17:30	SFA in Python <i>Hands-on tutorial on implementing SFA in Python</i>

Kindly note: The precise content per session is subject to reshuffling and fine-tuning.