



**SURREY  
BUSINESS  
SCHOOL**

UNIVERSITY OF SURREY

# **INTERNATIONAL CONFERENCE ON DATA ENVELOPMENT ANALYSIS**

**September 4-6, 2023  
Surrey Business School  
University of Surrey  
Guildford  
United Kingdom**



**CENTRE FOR  
BUSINESS  
ANALYTICS  
IN PRACTICE**

UNIVERSITY OF SURREY

## Dear DEA45 Conference Participants,

We are delighted to extend our warmest welcome to all participants of the DEA Conference. This International Conference on Data Envelopment Analysis marks a significant milestone as we celebrate the 45th anniversary of the groundbreaking paper on DEA authored by Charnes, Cooper, and Rhodes in 1978. Over the years, DEA has evolved into a cutting-edge methodology, offering insights into efficiency and productivity across various sectors of the economy.

The vitality of DEA is evident in the countless academic papers, applications, chapters, books, and consultancy documents it has inspired. With attendees hailing from more than 20 countries, this conference showcases a diverse array of themes. Our programme features enlightening plenary sessions that explore both recent theoretical advancements and innovative applications of DEA.

We have diligently strived to unite academics and practitioners, and we are particularly proud to showcase contributions highlighting the use of DEA in fields spanning a wide spectrum, including network industry regulation, banking, healthcare delivery, justice administration and education.

The host University of Surrey, situated on a picturesque green campus just beyond the outskirts of London, promises a serene and refreshing environment. The conference is meticulously organized by the Centre for Business Analytics in Practice (CBAP), a multi-disciplinary research hub with a vision focused on leveraging analytics for informed decision-making. CBAP is dedicated to exploring how data, regardless of its volume, can drive organizational success through proactive, data-driven decisions. Our primary areas of focus encompass AI and big data, performance measurement and management, operations and supply chain analytics, as well as sustainability and net-zero analytics.

Delegates will be presented with the choice of five parallel streams and a selection of plenary/semi-plenary sessions. As organizers, we are particularly excited to offer support to those new to research in the realm of efficiency and productivity. The conference has been thoughtfully tailored to cater to such individuals, featuring a Special Issue of the Annals of Operations Research, as well as dedicated sessions offering guidance on conducting and publishing research in this field. The conference proceedings, to be published by Springer, further enhance the dissemination of our collective knowledge.

We are confident that the conference will prove to be a source of inspiration and productivity for all participants. We welcome each and every one of you to this event and look forward to the exciting exchanges that lie ahead.

**Ali Emrouznejad**, Director, Centre for Business Analytics in Practice, Surrey Business School, University of Surrey, Guildford, UK

**Emmanuel Thanassoulis**, Professor Emeritus, Aston Business School, Aston, University, Birmingham, UK

**SEPTEMBER 2023**

## University of Surrey

The University of Surrey is located on a landscaped campus in Guildford. London is only 35 minutes away by train and its major airports of Heathrow and Gatwick are both within easy reach, giving ready access from all over the world.

## Surrey Business School (SBS)

Surrey Business School is in the top 20 business schools in the UK for world-leading research that is having a real-world impact. In the Research Excellence Framework 2021, the School achieved an overall ranking of 19th for research quality, 10th for research outputs and 16th for research impact. It is ranked Top 10 in the UK for business and economics in the Times Higher Education World Rankings 2023 and is accredited by both the Association to Advance Collegiate Schools of Business (AACSB) and the Association of MBAs (AMBA). The School is within University of Surrey, located in Guildford, Surrey.

## Centre for Business Analytics in Practice (CBAP)

The Centre for Business Analytics in Practice (CBAP) is a multi-disciplinary research centre with the vision of using analytics for better decision-making. The focus of CBAP is to investigate how data of any size can help organizations succeed through fact-based, data-driven, proactive decision-making. We are focused on theoretically driven, empirically rigorous research in these fields, particularly around their applications outside academia. Our Centre brings together research into the methods and applications in key areas, including:

- Business analytics
- AI and big data
- Health analytics
- Operations and supply chain analytics
- Sustainability and net-zero analytics.

The need for data-driven, better and faster solutions is more critical now than ever before. Using analytics for better decision-making has grown exponentially over the past decade. Driven by business and societal needs, decision analytics has become one of the most active research areas in academics and in industry. The tools, techniques, and algorithms used for big data projects leverage the most current, state-of-the-art methods applied in a wide variety of fields that include business and management science, computer science, statistics, data science, engineering, and mathematics.

**LinkedIn:**



# CONFERENCE COMMITTEE

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## CONFERENCE ORGANIZERS:

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**Ali Emrouznejad**, Director, Centre for Business Analytics in Practice, Surrey Business School, University of Surrey, Guildford, UK

**Emmanuel Thanassoulis**, Emeritus Professor, Aston Business School, Aston University, Birmingham, UK

## CONFIRMED INVITED SPEAKERS / PANELISTS:

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**De Witte, Kristof** (Economics and Business at KU Leuven, Belgium)

**Førsund, Finn** (University of Oslo, Norway)

**Kuosmanen, Timo** (Alto University School of Business, Finland)

**Olesen, Ole** (University of Southern Denmark, Denmark)

**Podinovski, Victor** (Loughborough University, UK)

**Portela, Maria Silva** (Portuguese Catholic University, Portugal)

**Ray, Subhash** (University of Connecticut, USA)

**Simar, Léopold** (Université Catholique de Louvain – UCLouvain, Belgium)

**Thanassoulis, Emmanuel** (Aston University, UK)

**Wilson, Paul W** (Clemson University, USA)

## LOCAL ORGANIZING COMMITTEE

Surrey Business School, University of Surrey, UK

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**Aitken, James**

**Blamey, Vicki**

**Clear, Emma**

**Dacey, Alastair**

**Emrouznejad, Ali**

**Giraleas, Dimitris**

**Maher, Donna**

**Morgan, Cat**

**Sengupta, Abhijit**

**Toloo, Mehdi**

# REGISTRATION

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## Registration desk

When		Where
Monday (4 September):	08:00 – 11:00	Rik Medlik Building (MS) Foyer (Surrey Business School)
Monday (4 September):	11:00 – 17:00	
Tuesday (5 September):	08:00 – 17:00	Lecture Theatre Block (LT), Level 1 Foyer
Wednesday (6 September):	08:00 – 11:00	

All participants are required to register at the conference desk before attending the sessions.

## Name badges

A name badge is provided at the conference desk and must be visible and worn at all sessions and social events throughout the conference.

## Welcome reception

### When:

Monday (4 September)  
18:00 – 19:30

### Where:

Surrey Business School,  
Lakeside Restaurant

## Gala dinner

### When:

Tuesday (5 September):  
19:30 – 23:00

### Where:

Harbour Hotel Guildford  
Address: 3 Alexandra Terrace, Guildford GU1 3DA  
Phone: 01483 792300

## Internet access

The login and password are available at the registration desk.

## Emergency

Security: 01483 683333

Firefighters and ambulance: 999

In case of significant problems concerning the conference (e.g. delay for presentations) please contact the registration desk or call to (Ali Emrouznejad 074991 867862).

Non-emergency (01483 682002)

## Website

<https://dataenvelopment.com/dea45/>

## Email

[DEA45@dataenvelopment.com](mailto:DEA45@dataenvelopment.com)

## Social media:

To share your moments on LinkedIn, Facebook or Twitter please join to the following groups:

 <https://www.linkedin.com/in/dataenvelopment>

 <https://www.facebook.com/DataEnvelopment>

 <https://twitter.com/DataEnvelopment>

 <https://chat.whatsapp.com/JQUIC0KcbIkHeKZjBg2W0y>

# REMARKS FOR SPEAKERS & CHAIRS

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- There are typically four talks in each 90-minute session, allowing 20 minutes for each speaker, including questions, with 2–3 minutes allocated for speaker transitions.
- Speakers: please bring your paper presentations on a pre-loaded memory stick to your sessions.
- The last presenter in each session will also serve as the session chair.
- Session chairs are responsible for introducing the speakers at the beginning of the session.
- As a speaker, please arrive at least 15 minutes before your session starts. This will give you time to check-in with the session chair and set up your computer and projector.
- Attendees are kindly requested to switch off cell phones and mobile devices prior to the start of the presentations.
- If you are chairing a session, ensure that the presentations follow the order indicated in the program.
- In case a scheduled speaker is absent, please maintain the original time schedule instead of shifting every talk forward. This approach facilitates seamless session transitions.
- Should the designated session chair be absent, the final speaker should assume the role of chair for the session.

# PUBLICATIONS

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## Special issue of journals:

### Annals of Operations Research

**Special issue:** In Memoriam of Professor Rajiv Banker on the New Developments in Data Envelopment Analysis and Its Applications

**Editors**

*Ali Emrouznejad & Victor Podinovski*

**Submission deadline:** December 31, 2023

### OR Spectrum

**Special issue** on “Advancements in Stochastic DEA and Environmental Efficiency Applications”

**Editors:**

*Ali Emrouznejad & Vincent Charles*

**Submission deadline:** October 31, 2023

### Journal of Environmental Science & Policy

**Special issue** on “DEA-Based Index Systems for Addressing the United Nations’ SDGs”

**Editors:**

*Vincent Charles & Ali Emrouznejad*

**Submission deadline:** October 31, 2023

## Conference Proceedings

**The book of proceedings for the DEA45 conference will be published by Springer** as part of the Lecture Notes in Operations Research series. Should you wish to have your article included, please visit the details page and submit your full paper by 30 August, 2023.

**Editors:**

*Ali Emrouznejad, Emmanuel Thanassoulis & Mehdi Toloo*

**Submission deadline:** 30 August, 2023

**To submit your paper to any of the aforementioned journals or conference proceedings, please visit the conference’s website.**



# DEA45 - PROGRAMME



Time	Monday 4 September	Tuesday 5 September	Wednesday 6 September	Time
<b>08:00 - 09:00</b>	Registration			<b>08:00 - 09:00</b>
<b>09:00 - 09:30</b>		Parallel Sessions T1	Parallel Sessions W1	<b>09:00 - 09:30</b>
<b>09:30 - 10:30</b>	Opening Session			
<b>10:30 - 11:00</b>	Coffee Break			<b>10:30 - 11:00</b>
<b>11:00 - 12:30</b>	Parallel Sessions M1	Semi-Plenaries & Memorial of Prof Banker T2	Parallel Sessions W2	<b>11:00 - 12:30</b>
<b>12:30-14:00</b>	Lunch Break		Closing Session	<b>12:30 - 13:00</b>
			Lunch Break	<b>13:00 - 14:00</b>
<b>14:00-15.30</b>	Semi-Plenaries M2	Regulation Session/ Parallel Sessions T3		<b>14:00 - 15.30</b>
<b>15:30-16:00</b>	Coffee Break			<b>15:30 - 16:00</b>
<b>16:00-17:30</b>	Parallel Sessions M3	Regulation Session / Parallel Sessions T4		<b>16:00 - 17:30</b>
<b>17:30-18:00</b>				<b>17:30-18:00</b>
<b>18:00-19:30</b>	Drink Reception			<b>18:00-19:30</b>
<b>19:30-23:00</b>		Gala Dinner		<b>19:30-23:00</b>

**Monday 4 September 2023: 08:00 - 09:30****Registration  
Surrey Business School, Rik Medlik Building****Monday 4 September 2023: 09:30 - 10:30****Opening session  
Surrey Business School, Rik Medlik, Room (03MS01)**

The conference now moves to the Lecture Theatre Block. You will find the helpdesk on Level 1 of the Lecture Theatre. You will return to the Surrey Business School this evening for the drinks reception.

**M1-1 (Monday 4 September 2023: 11:00 - 12:30)****DEA and econometric methods in education  
Room (Lecture Theatre D)**

<b>DEA45-021</b>	<b>Using DEA to identify Hispanic serving institutions for best practices in Increasing STEM degrees awarded to Hispanics</b> Omar S Lopez (Texas State University)*
<b>DEA45-069</b>	<b>How unequal is school development in India? An application of meta-frontier benefit-of-doubt approach for unveiling spatial gaps</b> Sunil Kumar (South Asian University); Rachita Gulati (Indian Institute of Technology Roorkee)*; Anup Kumar Bhandari (Indian Institute of Technology Madras)
<b>DEA45-074</b>	<b>Incorporating production trade-offs in DEA models with ratio inputs and outputs: An application to schools in England</b> Junlin Wu (Loughborough University)*; Nikos Argyris (Loughborough University); Victor Podinovski (Loughborough University)
<b>DEA45-061</b>	<b>Performance evaluation of university faculty members using DEA models with categorical variables</b> Tamas Koltai (Budapest University of Technology and Economics)*; Kata Gerákné Krasz (Budapest University of Technology and Economics)

## M1-2 (Monday 4 September 2023: 11:00 - 12:30)

### DEA and econometric methods in financial services Room (Lecture Theatre G)

<b>DEA45-122</b>	<b>Investment performance of Taiwan venture capital management consulting corporations and managing fees</b> Shu-Chin Huang (Ming Chuan University)*; Chung Wei Chiu (National Innovation and Entrepreneurship Association, R.O.C.); Shao-Fang Chen (National Innovation and Entrepreneurship Association, R.O.C.); Yu-Han Wang (National Innovation and Entrepreneurship Association, R.O.C.)
<b>DEA45-171</b>	<b>Performance assessment of Turkish banks using a common-weight network DEA approach with weight restrictions</b> Ece Ucar Keles (Galatasaray University)*; E. Ertugrul Karasak (Galatasaray University)
<b>DEA45-179</b>	<b>Is the digitalization changing banks' efficiency? The case of German banks</b> Roland von Horn (University of Applied Science Bremen)*; Armin Varmaz (Hochschule Bremen)
<b>DEA45-170</b>	<b>Estimating shadow prices from a Data Envelopment Analysis Model: an illustrative example of banks</b> Hirofumi Fukuyama (Fukuoka University)*

## M1-3 (Monday 4 September 2023: 11:00 - 12:30)

### Non-convex DEA Room (Lecture Theatre L)

<b>DEA45-112</b>	<b>Revenue functions are non-concave in the inputs when the technology is non-convex: the unbearable lightness of convexification</b> Oleg Badunenko (Brunel University London); Kristiaan HJ Kerstens (IESEG School of Management)*; Jafar Sadeghi (Kharazmi University)
<b>DEA45-113</b>	<b>Incentive regulation of electricity distribution and non-convexities: why economists are wrong, and engineers are only half right</b> Miguel A Pereira (INESC TEC)*; Kristiaan HJ Kerstens (IESEG School of Management); Ana Camanho (University of Porto)
<b>DEA45-127</b>	<b>Cost efficiency under convex and non-convex technologies: does output aggregation matter?</b> KH Dakpo (INRA)*; Frederic Ang (WUR); Kristiaan HJ Kerstens (IESEG School of Management)
<b>DEA45-152</b>	<b>Evaluating the efficiency of IoT providers using non-convex technology</b> Majid Azadi (Aston University)*; Kristiaan HJ Kerstens (IESEG School of Management); Reza Kazemi Matin (Islamic Azad University); Reza Farzipoor Saen (Sultan Qaboos University)

## **M1-4 (Monday 4 September 2023: 11:00 - 12:30)**

### **Fuzzy DEA (FDEA) Room (Lecture Theatre M)**

<b>DEA45-187</b>	<b>Development of intuitionistic fuzzy revenue efficiency models in DEA: an application to the Indian public sector banks</b> Anjali Sonkariya (Indian Institute of Technology Roorkee)*; Shiv Prasad Yadav (Indian Institute of Technology Roorkee)
<b>DEA45-031</b>	<b>A generalized DEA approach to performance assessment: case study of Adriatic Sea ports</b> Evelin Krmac (Faculty of Maritime Studies and Transport, University of Ljubljana)*; Mozghan Mansouri Kaleibar (Faculty of Maritime Studies and Transport, University of Ljubljana)
<b>DEA45-134</b>	<b>Fuzzy DEA in group decision-making</b> Pegah Khoshnevis (University of Sheffield)*; Adel Hatami-Marbini (University of Huddersfield); Aliasghar Arabmaldar (Technical University of Darmstadt)

## **M1-5 (Monday 4 September 2023: 11:00 - 12:30)**

### **FDEA in transportation Room (Lecture Theatre F)**

<b>DEA45-015</b>	<b>Incorporating union metafrontier into the network dea framework: airline environmental efficiency analysis</b> Ming-Miin Yu (National Taiwan Ocean University)*, Kok Fong See (Universiti Sains Malaysia)
<b>DEA45-156</b>	<b>The returns to scale of US airlines according to the selected inputs and outputs</b> Sepideh Kaffash (Suffolk University)*; Dariush Khezrimotlagh (Penn State University)
<b>DEA45-092</b>	<b>A Selecting Data Envelopment Analysis approach under an Onion framework to select quality service criteria and evaluate the perception of airport concessionaires' users about Brazilian airports</b> Paulo Nocera Alves Junior (Universidad Católica del Norte (UCN), Escuela de Ingeniería de Coquimbo)*; Isotilia Costa Melo (Universidad Católica del Norte, Escuela de Ingeniería de Coquimbo); Tatiana Kimura Kodama (São Carlos School of Engineering, University of São Paulo); Jessica Suárez Campoli (Luiz de Queiroz College of Agriculture, University of São Paulo); Marcelo Seido Nagano (University of São Paulo)
<b>DEA45-057</b>	<b>Efficiency-driven socio technical system design: a research agenda</b> Konstantinos Triantis (Virginia Tech)*

## **M2-1 (Monday 4 September 2023: 14:00 - 15:30)**

### **Semi-plenary (Chair: Emmanuel Thanassoulis) Room (Lecture Theatre D)**

<b>DEA45-168</b>	<b>Cost sub-additivity and sources of potential gains from mergers between firms</b> Subhash C Ray (University of Connecticut)*
<b>DEA45-145</b>	<b>Identifying merger opportunities: the case of air traffic control</b> Nicole Adler (The Hebrew University, Business School); Ole B Olesen (University of Southern Denmark)*; Nicola Volta (Cranfield University)

## **M2-2 (Monday 4 September 2023: 14:00 - 15:30)**

### **Semi-plenary (Chair: Hirofumi Fukuyama) Room (Lecture Theatre G)**

<b>DEA45-197</b>	<b>Inference in dynamic nonparametric models of production for general technologies</b> Leopold Simar (Université Catholique de Louvain)*; Paul W Wilson (Clemson University)
<b>DEA45-045</b>	<b>Accounting for ratio inputs and outputs in DEA models</b> Victor Podinovski (Loughborough University)*

## **M3-1 (Monday 4 September 2023: 16:00 - 17:30)**

### **DEA and econometric methods in education Room (Lecture Theatre D)**

<b>DEA45-087</b>	<b>Learning mobility in European higher education: how has the Union's flagship initiative progressed?</b> Miguel A Pereira (INESC TEC)*; Ana Camanho (University of Porto)
<b>DEA45-094</b>	<b>Assessing the progressive and ethical research performance of academic institutions: a case of the Northeast region of the United States</b> Youngbok Ryu (Northeastern University)*; Hoang Nguyen (Northeastern University); Ji-Young Yun (Johns Hopkins University)
<b>DEA45-099</b>	<b>Untangling Higher Education Sector: a systematic literature review of DEA and artificial intelligence methods</b> Anna Rita Dipierro (LUM Giuseppe Degennaro)*; Kristof De Witte (KU Leuven); Pierluigi Toma (University of Salento)
<b>DEA45-104</b>	<b>Are you really better than me? A new method to deal with input and output composition in performance evaluation</b> Giovanna D'Inverno (University of Pisa)*; Antonio Peyrache (University of Queensland); Gabriela Sicilia (University of La Laguna)

### M3-2 (Monday 4 September 2023: 16:00 - 17:30)

#### DEA modelling and algorithms Room (Lecture Theatre G)

<b>DEA45-093</b>	<b>Reviewing fast DEA procedures</b> Gregory Koronakos (University of Piraeus)*; Jose Dulá (Culverhouse College of Business, University of Alabama); Dimitris Despotis (University of Piraeus)
<b>DEA45-095</b>	<b>Finding different stepwise alternatives based on limited efforts: setting targets and identifying leading benchmarks in intermediate steps</b> Xianhua Wu (Shanghai Maritime University)*; Zhiyong Ji (Shanghai Maritime University); Ji Guo (Shanghai Maritime University)
<b>DEA45-096</b>	<b>Pareto-Koopmans Efficient Industry Structure in the Long Run and the Short Run: An Application to Retail Pharmacies</b> Gokulananda Patel (Birla Institute of Management Technology)*; Subhash C Ray (University of Connecticut)
<b>DEA45-118</b>	<b>Handling negative inputs and outputs in data envelopment analysis</b> Maria Trnovska (Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava)*

### M3-3 (Monday 4 September 2023: 16:00 - 17:30)

#### Health and hospital efficiency track in memory of Prof Jon Chilingirian Room (Lecture Theatre L)

<b>DEA45-221</b>	<b>Going beyond hospital-level analysis: leveraging diagnosis-related group (DRG) level data for more accurate hospital efficiency comparisons</b> Jiaye Shen (Brandeis University)*
<b>DEA45-222</b>	<b>Evaluating surgeon performance and learning from outliers</b> Richard G Bachu (Harvard Medical School); Kyle A Perry (The Ohio State University); Jon A Chilingirian (Brandeis University); Mitchell Glavin (Stonehill College)*
<b>DEA45-223</b>	<b>Unlocking physician efficiency at the DRG Level: a Malmquist Productivity Index Approach with insights into the impact of hospital volume on physician efficiency</b> Jiaye Shen (Brandeis University)*
<b>DEA45-224</b>	<b>Use of Data Envelopment Analysis for the measurement of absorptive capacity and technological change in health care</b> Jon Chilingirian (Brandeis University); Mitchell Glavin (Stonehill College)*

### M3-4 (Monday 4 September 2023: 16:00 - 17:30)

#### DEA in net-zero, circular economy Room (Lecture Theatre M)

<b>DEA45-020</b>	<b>Eco-efficiency approach in sustainable waste management: An uncertainty analysis for Chile</b> Maria Molinos-Senante (Pontificia Universidad Catolica de Chile)*; Ramon Sala-Garrido (University of Valencia); Alexandros Maziotis (Pontificia Universidad Catolica de Chile); Manuel Mocholi-Arce (University of Valencia)
<b>DEA45-097</b>	<b>Cost-efficiency of renewable district heating systems: the case of Austria</b> Andrea Frank-Stocker (Institute for Industrial Research); Wolfgang Koller (Institute for Industrial Research); Bernhard Mahlberg (Institute for Industrial Research)*
<b>DEA45-165</b>	<b>Performance-based carbon emission allocation for sustainable development</b> Li-Hsueh Chen (Department of Applied Economics, Fo Guang University)*; Bo Hsiao (National Yunlin University of Science and Technology); Je-Liang Liou (Center for Green Economy, Chung-Hua Institution for Economic Research)
<b>DEA45-131</b>	<b>Sustainable refrigeration system technology selection: A novel DEA-TOPSIS hybrid model</b> Behrouz Arabi (Heriot-Watt University); Mehdi Toloo (Surrey Business School)*; Zaoli Yang (Heriot-Watt University); Peihao Zhang (Heriot-Watt University); Bing Xu (Heriot-Watt University)

### M3-5 (Monday 4 September 2023: 16:00 - 17:30)

#### DEA and machine-learning/AI/big data Room (Lecture Theatre F)

<b>DEA45-044</b>	<b>Exploratory benchmarking with DEA and multidimensional scaling – process and reference model</b> Steffen Hoffmann (FernUniversität in Hagen)*
<b>DEA45-079</b>	<b>An effective sequence computation scheme for large-scale Data Envelopment Analysis</b> Qianwei Zhuang (Osaka University)*; Hiroshi Morita (Osaka University)
<b>DEA45-183</b>	<b>Measurement and prediction about efficiency of institutions of higher education in India using DEA and ML algorithms</b> Preeti Tyagi (SRM University, Delhi NCR Sonapat, Haryana)*
<b>DEA45-081</b>	<b>A Machine Learning-based approach to estimate efficient frontiers: Efficiency Analysis Trees</b> Juan Aparicio (Universidad Miguel Hernández de Elche)*

## Tuesday 5 September 2023: 08:00 - 09:00

**Registration, cloakroom and helpdesk  
Lecture Theatre Block (LT), Level 1 Foyer**

## T1-1 (Tuesday 5 September 2023: 09:00 - 10:30)

### **DEA and econometric methods in education Room (Lecture Theatre D)**

<b>DEA45-133</b>	<b>Evaluating the sustainability performance of higher education institutions in East and West coastal regions of the United States</b> Mikhail Oet (Northeastern University); Youngbok Ryu (Northeastern University)*; Monica Borgida (Northeastern University); Lilo Altali (Northeastern University)
<b>DEA45-161</b>	<b>Mapping the research landscape of DEA in higher education: a bibliometric analysis</b> Violeta Cvetkoska (Ss. Cyril and Methodius University in Skopje); Milena Popovic (Faculty of Organizational Sciences, University of Belgrade); Milan Martić (Faculty of Organizational Sciences, University of Belgrade); Gordana I Savić (Faculty of Organizational Sciences, University of Belgrade)*
<b>DEA45-173</b>	<b>DEA as a tool for policy formulation in the public basic education: an application in Brazilian schools</b> Marco Antonio Alves de Souza Junior (University of São Paulo)*; Alexandre Pereira Salgado Júnior (University of São Paulo); Perla Calil Pongeluppe Wadhy Rebehly (University of São Paulo); Yago Silveira Marinzeck Santos (University of São Paulo); Luiz Alberto Frezzatti Negreiros (University of São Paulo); Leonardo Guimarães Medeiros (University of São Paulo)
<b>DEA45-204</b>	<b>Research, co-operation, and innovation: unveiling the triple faces of efficiency within Italian universities through two-stage Data Envelopment Analysis</b> Angela Rella (Università LUM Giuseppe Degennaro)*; Filippo Vitolla (Università LUM Giuseppe Degennaro)

## T1-2 (Tuesday 5 September 2023: 09:00 - 10:30)

### **DEA modelling and algorithms Room (Lecture Theatre G)**

<b>DEA45-159</b>	<b>The impact of price on Data Envelopment Analysis with accounting measures</b> Claire Cui (The University of Auckland)*; Julie Harrison (The University of Auckland); Fredrick Ng (The University of Auckland); Paul Rouse (The University of Auckland)
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<b>DEA45-019</b>	<b>Markov settings in Data Envelopment Analysis multiple stages – multiple targets</b> Andreas C Georgiou (University of Macedonia)*; Emmanuel Thanassoulis (Aston Business School); Georgios Tsaples (University of Macedonia)
<b>DEA45-157</b>	<b>A modified slacks-based measure of efficiency with an adjustable range in the presence of negative data</b> Shuguang Lin (Fujian Jiangxia University)*; Paul Rouse (The University of Auckland)
<b>DEA45-144</b>	<b>On the best practice production function used in economics</b> Finn R Førsund (University of Oslo)*

### **T1-3 (Tuesday 5 September 2023: 09:00 - 10:30)**

#### **DEA and econometric methods in regulation Room (Lecture Theatre L)**

<b>DEA45-135</b>	<b>An analysis of the Malmquist-DEA productivity index applied to the segment of Electric Power Transmission in Brazil</b> Joice Figueiredo (Siglasul)*; Solange Kileber (Siglasul); Leonardo Campos Filho (Siglasul); Amaro Pereira (UFRJ); Erika Nogueira (UFRJ); Mayara Silva (UFRJ); Rafael Morais (UFRJ); Ligianne Dâmaso (ISA CTEEP); Ubaldo Rios (ISA CTEEP); Andrea Gonzaga (ISA CTEEP); Bianca S Morais (ISA CTEEP)
<b>DEA45-125</b>	<b>Second stage analysis of regulatory cost-efficiency of Brazilian transmission system operators</b> Bruno Vilela (Federal University of Espírito Santo, UFES)*; Marcelo Costa (Federal University of Minas Gerais, UFMG); Ana Lúcia Lopes-Ahn (Lopes-Ahn Consultoria e Pesquisa); Heinz Ahn (Technische Universität Braunschweig)
<b>DEA45-124</b>	<b>DEA with bootstrap, weight restrictions and negative outputs: shortcomings of the proposal for the Brazilian Distribution Service Operators regulation</b> Ana Lúcia Lopes-Ahn (Lopes-Ahn Consultoria e Pesquisa); Ana Beatriz Rodrigues Alves Branquinho Barbosa (CPFL Energia)*; Bruno Vilela (Federal University of Espírito Santo, UFES); Marcelo Costa (Federal University of Minas Gerais, UFMG); Rafael de Oliveira Gomes (CPFL Energia); Heinz Ahn (Technische Universität Braunschweig)
<b>DEA45-037</b>	<b>Individualized second stage corrections in data envelopment analysis</b> Mohsen Afsharian (Leibniz FH, University of Applied Sciences)*; Sara Kamali (Technische Universität Braunschweig); Heinz Ahn (Technische Universität Braunschweig); Peter Bogetoft (Copenhagen Business School)

## T1-4 (Tuesday 5 September 2023: 09:00 - 10:30)

### DEA for justice and court efficiency Room (Lecture Theatre M)

<b>DEA45-126</b>	<b>Assessing the efficiency and scope economies in the Spanish Courts of Justice</b> Pablo Arocena (Universidad Pública de Navarra)*
<b>DEA45-196</b>	<b>Evaluating the efficiency of civil county courts in Greece</b> Giannis Karagiannis (University of Macedonia); Panagiotis Ravanos (University of Macedonia)*
<b>DEA45-199</b>	<b>Comparing the efficiencies of courts in Sweden and Denmark</b> Mette Asmild (University of Copenhagen)*; Jonas Månsson (Blekinge Institute of Technology)
<b>DEA45-141</b>	<b>Prisons service quality: a study of Data Envelopment Analysis Visualisation</b> Ane Elixabete Ripoll-Zarraga (Universitat Autònoma de Barcelona)*

## T1-5 (Tuesday 5 September 2023: 09:00 - 10:30)

### DEA in net-zero, circular economy Room (Lecture Theatre F)

<b>DEA45-182</b>	<b>Benchmarks with uncertain electricity generation efficiency of variable renewable energy power plants: Photovoltaic power plants in Japan</b> Yuya Nakamoto (Oita University)*; Shogo Eguchi (Fukuoka University); Hiroataka Takayabu (Kindai University)
<b>DEA45-184</b>	<b>Investigating power generation efficiency of PV power plants focusing on new market entrants: A combined approach of metafrontier DEA and global Malmquist index</b> Shogo Eguchi (Fukuoka University)*; Yuya Nakamoto (Oita University); Hiroataka Takayabu (Kindai University)
<b>DEA45-167</b>	<b>Environmental performance of coal based thermal generation plants: A two-stage DEA model with undesirable factors</b> Shambhavi Mishra (Indian Institute of Technology Kanpur)*; Anoop Singh (Indian Institute of Technology Kanpur); Sufia (Indian Institute of Technology, Kanpur)
<b>DEA45-203</b>	<b>Assessing Europe's circular economy: a stochastic Data Envelopment Analysis approach</b> Behrouz Arabi (Heriot-Watt University)*; Mehdi Toloo (Surrey Business School); Ruini Qu (Heriot-Watt University); Bing Xu (Heriot-Watt University)

## **T2-1 (Tuesday 5 September 2023: 11:00 - 11:45)**

**Semi-plenary (Chair: Konstantinos Triantis)  
Room (Lecture Theatre D)**

<b>DEA45-178</b>	<b>Efficiency decomposition for network production technologies – application to courts of law</b> Maria CA Silva (Católica Porto Business School, Porto)
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## **T2-2 (Tuesday 5 September 2023: 11:00 - 11:45)**

**Semi-plenary (Chair: H David Sherman)  
Room (Lecture Theatre G)**

<b>DEA45-033</b>	<b>Estimating the causal impact of an intervention on efficiency</b> Kristof De Witte (KU Leuven)*
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## **T2-3 (Tuesday 5 September 2023: 11:45 - 12:30)**

**A tribute to Prof Rajiv Banker  
Room (Lecture Theatre D)**

	A tribute to Prof Rajiv Banker
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## **T3-1 (Tuesday 5 September 2023: 14:00 - 15:30)**

**Regulation session (Part 1)  
Chair: Srin Parthasarathy  
Room (Lecture Theatre D)**

<b>DEA45-155</b>	<b>Improving out-of-sample predictive power of benchmark technologies: Recent developments in the electricity distribution regulation in Finland</b> Timo Kuosmanen (University of Turku)
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<b>DEA45-213</b>	<b>Cost frontier benchmarking in energy network regulation: A Norwegian perspective</b> Tore Langset (Director, The Norwegian Energy Regulatory Authority)*
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<b>DEA45-210</b>	<b>Future systems and network regulation</b> Teresa Romano (Head of Strategic Costs Networks, OFGEM)*
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### T3-2 (Tuesday 5 September 2023: 14:00 - 15:30)

#### DEA modelling and algorithms Room (Lecture Theatre G)

<b>DEA45-077</b>	<b>The manufacturing industry in the North American economies, 1984-2018: an estimate of technological gaps through DEA-Metafrontier model</b> Odette Delfin-Ortega (Universidad Michoacana de San Nicolás de Hidalgo)*; César Lenin Navarro-Chávez (Universidad Michoacana de San Nicolás de Hidalgo)
<b>DEA45-049</b>	<b>A global multi-directional Malmquist Index for addressing infeasibility in variable-specific productivity</b> Kwaku Ohene-Asare (University of Ghana)*, Emily Asaa Addison (University of Ghana)
<b>DEA45-066</b>	<b>A gender inequality index under the capability approach: a proposal with Malmquist Index</b> Enzo B Mariano (State University of São Paulo (UNESP))*; Vanessa Ferrari (UNESP)
<b>DEA45-036</b>	<b>Economic development, industrialization, and poverty eradication: A benchmarking analysis of developing, emerging, and developed countries</b> Diogo Ferreira (Instituto Superior Técnico, University of Lisbon)*

### T3-3 (Tuesday 5 September 2023: 14:00 - 15:30)

#### Malmquist productivity index Room (Lecture Theatre L)

<b>DEA45-202</b>	<b>Made in China 2025: identifying spires of excellent manufacturers for Venture Capital Investments in Zhejiang Province</b> Arie Y Lewin (Duke University)*; Ziyang Tan (Zhejiang University)
<b>DEA45-175</b>	<b>Productivity change and the dynamics of cost competitiveness: an interstate analysis of Indian manufacturing</b> Kankana Mukherjee (Babson College)*; Subhash C Ray (University of Connecticut)
<b>DEA45-163</b>	<b>Technical efficiency of Italian theatrical firms – a bootstrap and conditional DEA approach</b> Concetta Castiglione (University of Calabria); Davide Infante (University of Calabria); Marta Zieba (Kemmy Business School, University of Limerick)*
<b>DEA45-176</b>	<b>Axiomatic modelling of fixed proportion technologies</b> Xun Zhou (University of York)*; Timo Kuosmanen (Turku School of Economics, University of Turku)

### T3-4 (Tuesday 5 September 2023: 14:00 - 15:30)

#### DEA in agriculture and food security Room (Lecture Theatre M)

<b>DEA45-034</b>	<b>Effect of global economic shocks on sustainable agrifood security in Ghana; the path analysis method on COVID-19</b> Ebenezer Frimpong (Corvinus University of Budapest)*
<b>DEA45-054</b>	<b>Role of China's agricultural water policy reforms and production technology heterogeneity on agriculture water usage efficiency and total factor productivity change</b> Wasi Ul Hassan Shah (Zhejiang Shuren University)*; Nan ZHU (Southwestern University of Finance and Economics)
<b>DEA45-009</b>	<b>R&amp;D Performance Evaluation in the Chinese Food Manufacturing Industry Based on Dynamic DEA in the COVID-19 Era</b> Shiping Mao (University of Bristol); Marios Dominikos Kremantzis (University of Bristol); Leonidas S Kyrgiakos (University of Thessaly)*; George Vlontzos (University of Thessaly)
<b>DEA45-014</b>	<b>Agro-climatic environment heterogeneity and productivity convergence</b> Barnabe Walheer (Université de Liège)*

### T4-1 (Tuesday 5 September 2023: 16:00 - 17:30)

#### Regulation session (Part 2) Chair: Srinivas Parthasarathy Room (Lecture Theatre D)

<b>DEA45-211</b>	<b>On-going cost assessment developments in the UK water and sewerage sectors</b> Daniel Mitchell/Asen Velyov (Head of Base Expenditure at PR24)*
<b>DEA45-214</b>	<b>Common or individual capital costs in regulatory benchmarking: theory and empirics</b> Per Agrell (Faculty Dean, Louvain School of Management; Senior Associate Sumicid Group)*
<b>DEA45-212</b>	<b>Cost frontier benchmarking in energy network regulation: a Dutch perspective</b> Marcel Vermeulen (Autoriteit Consument & Markt ACM)*
	<b>Discussion with Q&amp;A</b> Emmanuel Thanassoulis (Aston Business School)

## T4-2 (Tuesday 5 September 2023: 16:00 - 17:30)

### DEA and econometric methods in financial services Room (Lecture Theatre G)

<b>DEA45-028</b>	<b>Measuring the efficiency of hedge fund's performance: a Data Envelopment Analysis approach</b> Huda Ibrahim Aldhahi (University of East Anglia)*
<b>DEA45-067</b>	<b>A second chance for failed projects using Data Envelopment Analysis based on project attractiveness factors</b> Mahmoud Ahmad Isied (Eastern Mediterranean University); Sahand Daneshvar (Eastern Mediterranean University)*
<b>DEA45-038</b>	<b>Does income diversification affect bank efficiency, effectiveness and performance? Evidence from Indian banking industry</b> Mehak Gupta (South Asian University)*; Sunil Kumar (South Asian University)
<b>DEA45-083</b>	<b>DEA as an audit tool to identify unusual operating results for auditor review and validation</b> H David Sherman (Northeastern University)*; Joe Paradi (University of Toronto)

## T4-3 (Tuesday 5 September 2023: 16:00 - 17:30)

### Malmquist productivity index Room (Lecture Theatre L)

<b>DEA45-005</b>	<b>Productivity evaluation of African banking firms: an application of MPI</b> Muhammad Auwalu Haruna (Ahmadu Bello University)*
<b>DEA45-116</b>	<b>Malmquist Productivity Index from a regulator's perspective</b> Laura Carosi (Department of Economics and Management, University of Pisa)*; Giovanna D'Inverno (University of Pisa); Maria Molinos-Senante (Pontificia Universidad Catolica de Chile)
<b>DEA45-106</b>	<b>Impact of the digitalization on productivity</b> Mikulas Luptacik (Vienna University of Economics and Business); Eduard Nežinský (University of Economics in Bratislava)*
<b>DEA45-084</b>	<b>Industrial robots and employment change in manufacturing: a combination of index and production-theoretical decomposition analysis</b> Bernhard Mahlberg (Institute for Industrial Research)*; Andreas Eder (Institute for Industrial Research); Wolfgang Koller (Institute for Industrial Research)

## **T4-4 (Tuesday 5 September 2023: 16:00 - 17:30)**

### **Pure Inputs of Outputs DEA Models and others Room (Lecture Theatre M)**

<b>DEA45-186</b>	<b>Measuring performance of supply chains based on network Data Envelopment Analysis and multi-regional input-output analysis in manufacturing sectors</b> Hirotaka Takayabu (Kindai University)*; Shogo Eguchi (Fukuoka University); Yuya Nakamoto (Oita University)
<b>DEA45-109</b>	<b>A new class of BoD models accommodating forward and reverse component indicators</b> Giannis Karagiannis (University of Macedonia); Stavros Kourtzidis (University of Dundee)*
<b>DEA45-195</b>	<b>Tracking the performance of European skills systems: A re-estimation of the European Skills Index</b> Ilias Livanos (European Centre for the Development of Vocational Training); Panagiotis Ravanos (University of Macedonia)*
<b>DEA45-194</b>	<b>Estimating nonparametric conditional frontiers and efficiencies: a new approach</b> Camilla Mastromarco (University of Calabria)*; Leopold Simar (Université Catholique de Louvain La Neuve); Ingrid Van Keilegom (KULeuven, Leuven)

## **Wednesday 6 September 2023: 08:00 - 09:00**

**Registration, cloakroom and helpdesk  
Lecture Theatre Block (LT), Level 1 Foyer**

## W1-1 (Wednesday 6 September 2023: 09:00 - 10:30)

### DEA in health and hospital efficiency Room (Lecture Theatre D)

<b>DEA45-177</b>	<b>Maximizing efficiency and mobility in education funding: a three-stage centralized data envelopment analysis</b> Bo Hsiao (National Yunlin University of Science and Technology)*; Kok Fong See (Universiti Sains Malaysia)
<b>DEA45-050</b>	<b>Dealing with uncertainty in healthcare performance assessment: a fuzzy network-DEA approach with undesirable outputs</b> Guilherme P Afonso (Civil Engineering Research and Innovation for Sustainability)*; Diogo Ferreira (Instituto Superior Técnico, University of Lisbon); José Rui Figueira (Technical University of Lisbon)
<b>DEA45-082</b>	<b>Primary healthcare efficiency assessment using panel data</b> Silvia González-de-Julián (Universitat Politècnica de València)*; Isabel Barrachina-Martínez (Universitat Politècnica de València); David Vivas-Consuelo (Universitat Politècnica de València)
<b>DEA45-048</b>	<b>A box-uncertainty in DEA: A robust performance measurement framework</b> Akram Dehnokhalaji (Aston University)*; Somayeh Khezri (Unicamp); Ali Emrouznejad (Surrey Business School)

## W1-2 (Wednesday 6 September 2023: 09:00 - 10:30)

### DEA modelling and algorithms Room (Lecture Theatre G)

<b>DEA45-063</b>	<b>A four stages AHP-DEA based FMCEA method: ranking failure modes of radio frequency identification systems</b> Khaoula Chnina (Eastern Mediterranean University)*; Sahand Daneshvar (Eastern Mediterranean University)
<b>DEA45-086</b>	<b>Not all most preferred solutions are valid in VEA</b> Panagiotis Ravanos (University of Macedonia)*; Giannis Karagiannis (University of Macedonia)
<b>DEA45-073</b>	<b>Constant returns-to scale DEA models with ratio inputs and outputs: An application in the context of school education</b> Grammatoula Papaioannou (Loughborough University)*; Victor Podinovski (Loughborough University)
<b>DEA45-035</b>	<b>Can super-efficiencies improve bias correction? A Bayesian data envelopment analysis approach</b> Panagiotis D. Zervopoulos (University of Sharjah)*; Angelos Kanas (University of Piraeus); Ali Emrouznejad (Surrey Business School); Phil Molyneux (University of Leeds)



### W1-3 (Wednesday 6 September 2023: 09:00 - 10:30)

#### Network DEA and dynamic efficiency Room (Lecture Theatre L)

<b>DEA45-053</b>	<b>Modelling sub-process non-homogeneity in parallel network Data Envelopment Analysis</b> Charles Turkson (University of Dundee)*
<b>DEA45-003</b>	<b>Measurement and evaluation of multi-function parallel network hierarchical DEA systems</b> Marios Dominikos Kremantzis (University of Bristol)*; Patrick Beullens (University of Southampton); Leonidas S Kyrgiakos (University of Thessaly); Jonathan Klein (University of Southampton)
<b>DEA45-107</b>	<b>Channel efficiency in omni-channel environment: a network DEA Model</b> Pankaj Priya (Birla Institute of Management Technology)*; Gokulananda Patel (Birla Institute of Management Technology)
<b>DEA45-108</b>	<b>A generalised additive two-stage network DEA model: the case of an external single constant input</b> Giannis Karagiannis (University of Macedonia); Stavros Kourtzidis (University of Dundee)*; Nickolaos Tzeremes (University of Thessaly)

### W1-4 (Wednesday 6 September 2023: 09:00 - 10:30)

#### Stochastic DEA (SDEA ) and others Room (Lecture Theatre M)

<b>DEA45-085</b>	<b>An empirical data-fitting approach to estimate the production frontier</b> Yu Zhao (Tokyo University of Science)*
<b>DEA45-091</b>	<b>Stochastic Data Envelopment Analysis (DEA), principles of Optimal Control Theory (OCT), and inventory management: stochastic and dynamic cost efficiency analysis</b> Paulo Nocera Alves Junior (Universidad Católica del Norte, Escuela de Ingeniería de Coquimbo)*; Ali Emrouznejad (Surrey Business School); Wilfredo Yushimito (Universidad Adolfo Ibáñez, Facultad de Ingeniería y Ciencias); Carlos Monardes (Universidad Católica del Norte, Escuela de Ingeniería de Coquimbo); Isotilia Costa Melo (Universidad Católica del Norte, Escuela de Ingeniería de Coquimbo)
<b>DEA45-192</b>	<b>A stochastic ranking procedure in data envelopment analysis under uncertainty</b> Mohammadreza Ghasemi (Hakim Sabzevari University); Joshua Ignatius (Aston Business School)*
<b>DEA45-120</b>	<b>Are European football clubs overpaying their players? A metafrontier analysis of Europe's top leagues</b> Gabriel Villa (University of Seville); Sebastián Lozano (University of Seville)*

## W1-5 (Wednesday 6 September 2023: 09:00 - 10:30)

### Inverse DEA and others Room (Lecture Theatre F)

<b>DEA45-174</b>	<b>Network DEA model for measuring the efficiency of national innovation systems</b> Milica Jovanović (Faculty of Organizational Sciences, University of Belgrade)*; Gordana I Savić (Faculty of Organizational Sciences, University of Belgrade); Maja Levi-Jakšić (Faculty of Organizational Sciences, University of Belgrade); Milan Martić (Faculty of Organizational Sciences, University of Belgrade)
<b>DEA45-076</b>	<b>Towards gaining robustness in inverse DEA models</b> Adel Hatami-Marbini (Huddersfield Business School); Aliasghar Arabmalidar (Technical University of Darmstadt)*; Matthias Klump (School of Management, Politecnico di Milano)
<b>DEA45-102</b>	<b>Efficiency evaluation in the presence of undesirable factors: an inverse DEA approach</b> Ali Emrouznejad (Surrey Business School); Maria Michali (University of Bristol)*; Gholam R Amin (University of New Brunswick)
<b>DEA45-052</b>	<b>Business partnerships in non-homogenous decision making units</b> Gholam R Amin (University of New Brunswick)*; Mustapha Ibn-Boamah (University of New Brunswick)

## W2-1 (Wednesday 6 September 2023: 11:00 - 12:30)

### DEA in health and hospital efficiency Room (Lecture Theatre D)

<b>DEA45-200</b>	<b>Performance measurement to evaluate policy reforms and systems management with Malmquist indices</b> Argyro Fourlopoulou (Department of Health Policy, School of Public Health, University of West Attica; Psychiatric Hospital of Attica)*; Nikos Maniadas (UWA)
<b>DEA45-110</b>	<b>Comparative efficiency analysis of public and private hospitals in Colombia</b> Ricardo Losada (Universidad del Politècnica de Valencia)*; David Vivas Consuelo (Universidad Politècnica de Valencia); Javier Gonzalez Rodriguez (Universidad del Rosario)
<b>DEA45-166</b>	<b>Assessment of countries' containment performance against COVID-19 using a benefit-of-the-doubt approach</b> Roxani Karagiannis (Center of Planning and Economic Research)*; Giannis Karagiannis (University of Macedonia)

<b>DEA45-181</b>	<b>Regional surgical systems response to COVID-19 pandemic - Preliminary insights through longitudinal DEA analysis</b> Sean Shao Wei Lam (SingHealth, Duke NUS Medical School, Singapore Management University)*, Yao Ge (SingHealth), Ashish Kumar (Duke NUS Medical School), Ginny Zhenzhi Chen (SingHealth), Ahmadreza Pourghaderi (Monash University), Ma Wai Wai Zaw (SingHealth), Pierce KH Chow (SingHealth, Duke NUS Medical School), Hiang Khoon Tan (SingHealth, Duke NUS Medical School)
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## **W2-2 (Wednesday 6 September 2023: 11:00 - 12:30)**

### **DEA and econometric methods in financial services Room (Lecture Theatre G)**

<b>DEA45-041</b>	<b>Evaluation of private interest and public interest in the regional banking business</b> Takayoshi Nakaoka (Kindai University)*
<b>DEA45-100</b>	<b>Revisiting the impact of banking competition with nonconvex technology</b> Oleg Badunenko (Brunel University London)*; Jérémie Bertrand (IESEG School of Management); Kristiaan HJ Kerstens (IESEG School of Management); Paul-Olivier Klein (IAE)
<b>DEA45-043</b>	<b>Merger dilemma in yardstick competition</b> Richard Kalis (University of Economics Bratislava)*; Peter Bogetoft (Copenhagen Business School)

## W2-3 (Wednesday 6 September 2023: 11:00 - 12:30)

### DEA in agriculture and food security Room (Lecture Theatre L)

<b>DEA45-164</b>	<b>Impact of water-scarcity on groundwater use efficiency in India: a Data Envelopment Analysis</b> Aryama Sarkar (Indian Institute of Technology Madras)*; Sabuj Mandal (Indian Institute of Technology Madras)
<b>DEA45-162</b>	<b>Proposal of mixed method in efficiency for best practices on sucroenergetic sector</b> Alexandre Pereira Salgado Junior (University of São Paulo)*; Stella Vannucci Lemos (University of São Paulo); Perla Calil Pongeluppe Wadhy Rebehy (University of São Paulo); Renato Radaelli Gatti (University of São Paulo); Leonardo Guimarães Medeiros (University of São Paulo); Fábio Vogelaar Carlucci (University of São Paulo)
<b>DEA45-121</b>	<b>Regulating multiple interacting externalities using DEA-based approaches</b> Mette Asmild (University of Copenhagen)*; Frank Jensen (University of Copenhagen); Rasmus Nielsen (University of Copenhagen)

## W2-4 (Wednesday 6 September 2023: 11:00 - 12:30)

### DEA in supply chain management Room (Lecture Theatre M)

<b>DEA45-070</b>	<b>Modelling resource optimisation for supply chains to reduce the impact of a pandemic</b> Gokulananda Patel (Birla Institute of Management Technology)*; Chandra Lalwani (University of Hull)
<b>DEA45-098</b>	<b>Assessing sustainable procurement in the chemical industry: a fuzzy two-stage data envelopment analysis model</b> Alka Arya (Indian Institute of Management Kashipur)*; Adel Hatami Marbini (University of Huddersfield)
<b>DEA45-039</b>	<b>Estimating product costs applying DEA and regression trees – insights from an automotive supplier</b> Andreas S. Dellnitz (Leibniz FH University of Applied Sciences)*; Andreas Kleine (FernUniversität in Hagen)

**W2-5 (Wednesday 6 September 2023: 11:00 - 12:30)**

**DEA software  
Room (Lecture Theatre F)**

<b>DEA45-046</b>	<b>DEA and hyperbolic efficiencies: An extension of application possibilities and the advantage for between-group comparison</b> Alexander Öttl (University of Copenhagen)*; Mette Asmild (University of Copenhagen)
<b>DEA45-060</b>	<b>Francisco – a web tool for the prediction of network services based on the fractal structure of the network traffic by using DEA models</b> Francisco Daladier Marques Júnior (IFPB)*; Francisco Iarlyson Santana de Andrade (IFPB)
<b>DEA45-058</b>	<b>DEA-VIZ: A software for visualization of Data Envelopment Analysis problems</b> Shahin Ashkiani (Bank of England)*

**W2 (Wednesday 6 September 2023: 12:30 - 13:00)**

**Closing session  
Room (Lecture Theatre D)**

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