Master Class in Productivity and Efficiency Analysis in Agriculture

Performance Measurement with Data Envelopment Analysis

Performance measurement is important for evaluating how well firms are using available resources given the available production technology. This course introduces the fundamental concepts of performance measurement from an economic perspective, which is the basis for efficiency and productivity analysis. Students learn how to program and compute different measures of efficiency using the mathematical programming technique called data envelopment analysis (DEA). Efficiency measures are relevant for making managerial decisions and public policy. The aim of the course is to train and equip students with relevant knowledge and practical programming skills needed to perform performance benchmarking for decision-making units with efficiency analysis.

Certified learning

1. Understand the basic concepts and different measures of firm efficiency.
2. Understand the implications of key assumptions of production technologies when modelling firm efficiency.
3. Appreciate the importance of efficiency analysis for management practice and public policy making.
4. Program and compute different measures of firm efficiency using data envelopment analysis in Microsoft Excel.

Duration and mode of delivery

This is a four-week course, from 2nd to 28th August 2021. The course will mostly be delivered online with pre-recorded lectures and programming demonstrations labs. Virtual interactive sessions with the instructor will be arranged.

Sponsorship

This course is sponsored by the Australia Africa University Network in conjunction with the UWA Africa Research & Engagement Centre (AFREC). The course is offered by the UWA Institute of Agriculture at the University of Western Australia in collaboration with the Department of Agricultural Economics at the University of Nairobi.

Who should attend?

The course intended for individuals who want to gain knowledge and practical skills in performance benchmarking using efficiency analysis with DEA. It is suitable for graduate students in business and applied economics, applied economics

researchers and statisticians, and business consultants from both the private and public sector organisations.

Participants are expected to understand microeconomics and matric algebra at an intermediate undergraduate level.

Course registration

Individuals who are interested in this course must submit their application to **agecon@uonbi.ac.ke** with a copy to **mern.mn@gmail.com**, Department of Agricultural Economics at the University of Nairobi. Successful applications will enrol in an online platform to access the course materials. Applications will close on 23rd July 2021, 11.59 PM East Africa Time.

Course structure

The course is structured in three modules.

Course value and fee

The full value of this course is A$3000. However, the course is delivered free of charge for successful applicants.

Certificate of completion

Individuals will receive a certificate of completion upon successful completion of the coursework and three assessments.

Module 1: Fundamental of Performance Measurement with DEA

Lecture	Topic	August Week	Date
1	Introduction to course	1	2
2	Importance of PM	1	2
3	Applications of PM	1	2
4	Origins of efficiency analysis	1	2
5	Production function and technology	1	3
6	Stages of production	1	3
7	Technology representation	1	3
8	Assumptions in production analysis	1	3

9	Cost minimization	1	4
10	Profit maximization	1	4
11	Farrell measures of efficiency	1	4
12	Shephard measures of efficiency	1	5
13	Measures of efficiency	1	5
14	Summary	1	5
15	**Assessment**	1	6

Module 2: Data Envelopment Analysis Models

Lecture	Topic	August Week	Date
1	Introduction to LP	2	9
2	Duality in LP	2	9
3	Solving LP problems	2	9
4	DEA	2	10
5	Returns of scale	2	10
6	ITE CCR model	2	10
7	OTE CCR model	2	10
8	ITE and OTE BBC model	2	11
9	Duality	2	11
10	Dual ITE model	2	11
11	Dual OTE model	2	11
12	Scale efficiency	2	12
13	Additive model	2	12
14	Slack-based model	2	12
15	Sub-vector model	2	13
16	Cost efficiency	2	13

17	Profit efficiency	2	13
18	Data considerations in DEA modelling	3	16
19	Steps in DEA modelling	3	16
	Assessment	3	17

Module 3: Data Envelopment Analysis Modelling with Microsoft Excel

Lecture	Topic	August Week	Date
1	ITE CRS multiplier	3	18
2	ITE VRS multiplier	3	18
3	OTE CRS multiplier	3	19
4	OTE VRS multiplier	3	19
5	ITE Envelopment	3	20
6	OTE Envelopment	3	20
7	Scale efficiency	4	20
8	Sub-vector model	4	23
9	Additive model	4	23
10	Weighted additive model	4	23
11	ITE Slack-based model	4	24
12	OTE Slack-based model	4	24
13	Cost efficiency	4	25
14	Profit efficiency	4	25
15	Summary	4	25
	Assessment – Project (two days)	4	26-27

About the course instructor

Dr Amin Mugera is an Applied Economist at the University of Western Australia and Theme Leader of the Agribusiness Ecosystems program at the UWA Institute of Agriculture. He holds a PhD in Economics from Kansas State University and double

MS in Agricultural Economics and Agribusiness from Michigan State University. His research is at the intersection of agricultural economics, development economics, and agribusiness. It is mostly empirical in nature and aimed at producing evidence-based policies to address pertinent challenges in agricultural development using a combination of mathematical programming and econometric methods. He has supervised 12 PhDs and over 30 Masters and Honours thesis to completion. Besides teaching applied economics at both undergraduate and graduate levels, Mugera has provided executive training in applied productivity and efficiency analysis, agribusiness development, and economics of climate change in numerous countries including South Africa, India, Bangladesh, and Brunei Darussalam. His selected publications related to the subject of this course include the following:

- Oumer, AM, Burton, M, Hailu, **A, Mugera**, A. Sustainable agricultural intensification practices and cost efficiency in smallholder maize farms: Evidence from Ethiopia. *Agricultural Economics*. 2020; 51: 841– 856.
- **Mugera, A**., M. Langemeier., and A. Ojede. "Do Productivity and Relative Price Changes Contribute to Profitability Change? Evidence from a Sample of Kansas Farms." *American Journal of Agricultural Economics* 94(2016):1210-1229.
- **Mugera, A** and G.G. Nyambane. "Impact of Debt Structure on Production Efficiency of Broadacre Farms in Western Australia." *Australian Journal of Agricultural and Resource Economics* 59(2014):208-224.
- **Mugera, A**. "Measuring Technical Efficiency of Dairy Farms with Imprecise Data: A Fuzzy Data Envelopment Analysis Approach." *Australian Journal of Agricultural and Resource Economics*, 57(2013):501-519.
- **Mugera, A.,** and A. Ojede. "Technical Efficiency in African Agriculture: Is it Catching-up or Lagging behind." *Journal of International Development*, 26 (2013):979-795.
- Ojede, A., **A. Mugera**., and D. Seo. "Macroeconomic Policy Reforms and Productivity Growth in African Agriculture." *Contemporary Economic Policy*, 31(2013): 814-830.
- **Mugera, A.**, M.R. Langemeier., and A.M. Featherstone. Labour Productivity Convergence in the Kansas Farm Sector: A Three-stage Procedure using Data Envelopment Analysis and Semiparametric Regression Analysis. *Journal of Productivity Analysis*, 38(2012):67-79.
- **Mugera, A**., and M.R. Langemeier. "Does Farm Size and Specialization Matter for Productive Efficiency? Results from Kansas." *Journal of Agricultural and Applied Economics*, 43(2011):1-14.
- **Mugera, A.,** M, Langemeier, and A. M. Featherstone. "Labor Productivity Growth in the Kansas Farm Sector: A Tripartite Decomposition using Non-Parametric Approach." *Agriculture & Resource Economics Review*, 41(2012):298-312.
- Fogarty, J., and **A. Mugera**. "Local Government Efficiency: Evidence from Western Australia." *The Australian Economic Review*, 46(2013):300-311.