

**2014 INTERNATIONAL DATA ENVELOPMENT ANALYSIS WORKSHOP:**  
*“Applications of DEA models to sustainable development, economic integration, industry and services”.*

**PROGRAM SUMMARY**

|                        |  |
|------------------------|--|
| SEPT. 17 <sup>th</sup> |  |
| 16:00 -18:00           | <b>Dr. Ali Emrouznejad, DEA Software Tutorial.</b>   |
| 19:00 -21:00           | Welcome reception  |
| SEPT. 18 <sup>th</sup> |  |
| 08:30 -10:30           | Opening ceremony (Centro de las Artes, Aula Magna)   |
| 09:30 -10:30           | <b>Keynote speaker: Dr. Rajiv D. Banker, “Strategic Scorecard Analysis for Governments”</b>  |
| 10:30 -11:00           | <b>Coffee Break</b>  |
| 11:00 -12:40           | Plenary Session 1 (Department of Mathematics, Enrique Valle Flores Auditorium)<br><b>Data Envelopment Analysis: Theory</b>                 |
| 11:00 -11:20           | Virtual-Gap measurement model for assessing a set of units by DEA  |
| 11:20 -11:40           | Procedures of modeling network DEA based on virtual-gap measures<br><b>Sustainable development</b>   |
| 11:40 -12:00           | Sustainable development: basic concepts  |
| 12:00 -12:20           | Effects of Air Pollutants on Health<br><b>International Commerce</b>   |
| 12:20 -12:40           | The Fair Trade in Mexico: A Sustainable Alternative of Social Development  |
| 13:30 -15:00           | <b>Lunch</b>   |
| 16:00 -19:00           | Plenary Session 2 (Department of Mathematics, Enrique Valle Flores Auditorium)<br><b>Public Services</b>                                   |
| 16:00 -16:20           | Efficiency in Mexico Universities: A Comparative of Data Envelopment Analysis (DEA) and Stochastic Frontier (SFA) with Maximum Likelihood. |
| 16:20 -16:40           | Short-Run Cost Minimization and Capacity Utilization over Regional Public Hospitals in South Korea<br><b>Energy</b>                        |
| 16:40 -17:00           | An empirical comparative Malmquist analysis of two Refineries: Searching new technological inputs<br><b>Corporate and Public Finance</b>   |
| 17:00 -17:20           | Measurement of capacity and fiscal effort in the states of Mexico  |
| 17:20 -17:40           | Mexican bank’s productivity and global financial crisis  |

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| 17:40 -18:00                           | <b>Coffee Break</b>   |
| 18:00 -18:20                           | <b>Environment protection</b><br>A simple model for monitoring ecological protection  |
| 18:20 -18:40                           | A neural network approach to look for stable states in an ecological protection model.<br>Mexican case.   |
| 18:40 -19:00                           | Efficiency assessment of water industry in Mexico   |
| 20:30 -23:00<br>SEPT. 19 <sup>th</sup> | <b>Gala Dinner</b>  |
| 9:00 -10:00                            | <b>Keynote Speaker: Prof. Dr. hab Joost (Johannes) Platje: “Capacity and capability for sustainable development - a transaction costs and property rights perspective”</b> (Centro de las Artes, Aula Magna). |
| 10:00 -10:30                           | <b>Coffee Break</b>   |
| 10:30 -12:50                           | Plenary Session 3 (Department of Mathematics, Enrique Valle Flores Auditorium)<br><b>Regional development</b>   |
| 10:30 -10:50                           | An analysis of technical efficiency and productivity change in the Mexican manufacturing sub-sectors between 1988 and 2008.   |
| 10:50 -11:10                           | <b>Econometrics and big data</b><br>Self Adaptive Genetic Algorithms for the modeling of Time series with missing and incorrect values.   |
| 11:10 -11:30                           | 2G algorithm applied in error correction in forecasting a real problem  |
| 11:30 -11:50                           | The big data explosion: a big problem or a big opportunity?   |
| 11:50 -12:50                           | <b>Panel: “Sustainable development: past, present and future”.</b>  |
| 13:00 -14:15                           | Campus Tour   |
| 14:30 -16:30                           | <b>Lunch</b>  |
| 16:30 -19:30                           | City Tour   |
| 20:30 -21:30<br>SEPT. 20 <sup>th</sup> | <b>Dinner</b>   |
| 8:00 -20:00                            | Optional Trip: San Carlos, Nuevo Guaymas.   |

**2014 INTERNATIONAL DATA ENVELOPMENT ANALYSIS WORKSHOP:**  
*“Applications of DEA models to sustainable development, economic integration, industry and services”.*

**SCIENTIFIC PROGRAM**

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|--|---|
| SEPT. 17 <sup>th</sup><br>16:00 -18:00<br>19:00 -21:00 | <b>Dr. Ali Emrouznejad, DEA Software Tutorial.</b><br>Welcome reception   |
| SEPT. 18 <sup>th</sup><br>08:30 -10:30<br>09:30 -10:30 | Opening ceremony (Centro de las Artes, Aula Magna)<br><b>Keynote speaker: Dr. Rajiv D. Banker, “Strategic Scorecard Analysis for Governments”</b>   |
| <b>10:30 -11:00</b>                                    | <b>Coffee Break</b>   |
| 11:00 -12:40<br>11:00 -11:40<br>11:00 -11:20           | Plenary Session 1 (Department of Mathematics, Enrique Valle Flores Auditorium)<br><b>Data Envelopment Analysis: Theory</b><br><b>Presiding: Joel Enrique Espejel Blanco</b><br>Virtual-Gap measurement model for assessing a set of units by DEA<br>Fuh-Hwa Liu and Yang-Cheng Huang  |
|  | Non-radial data envelopment analysis (DEA) models such as ADD, MIP, RAM and SBM have advantages to substitute radial models in certain circumstances. We develop virtual-gap measurement (VGM) model to improve those non-radial models. The dual VGM model assigns an optimal set of weights of input and output measures to the decision-making unit (DMU) under evaluation to have the minimum virtual-gap between its sum of weighted inputs (virtual-input) and its sum of the weighted outputs (virtual-output), so that its efficiency is maximized as well. The model set a lower bound for each and every weighted measure. The lower bound is adjusted according to the optimal solutions. The prime VGM model maximizes the sum of the ratios of slack to each input and output measure so that each and every measure’s improvement target locates on the efficiency frontier. We introduce a new method to compute the efficiency score of non-radial models with the condition of variable return-to-scale. The ratio of the constant to variable efficiency scores is the scale efficiency. For the case of increase (decrease) return-to scale, the efficiency score is |

monotone increasing as the improvement ratios on inputs (outputs). VGM is unit-invariant, transform-invariant.

11:20 -11:40

Procedures of modeling network DEA based on virtual-gap measures

Fuh-Hwa Liu and Yu-Cheng Liu

Network DEA models assess production systems that contain a set of network structured sub-systems. Each sub-system has input and output measures from and to outside the network and has intermediate measures links to other sub-systems. Most of the literatures show how to employ radial DEA models to establish network DEA models. Static and dynamic network DEA models respectively do not adjust and adjust the intermediate measures. Tone and Tsutsui employed a non-radial, slack-base measurement (SBM) to develop a dynamic network DEA model that appeared in OMEGA 2010. Each intermediate measure could play either 'as-input' or 'as-output' according to the binary decision variable. The mixed binary integer program mistakenly set the total numbers of 'as-input' and 'as-output' equal to the total number of intermediate measures in the objective function. We substitute SBM by virtual-gap measurement (VGM) model to construct a mixed integer program to solve dynamic network DEA problems. To have the best-practice efficiency, each DMU determines a set of weights for input, output and intermediate measures, and the intermediate measures are played either 'as-input' or 'as-output'. Input and as-input measures reduce slacks while output and as-output measures increase slacks to reach their target on the production frontier.

11:40 -12:00

**Sustainable development**

**Presiding: Luis Eduardo Velazquez**

11:40 -12:00

Sustainable development: basic concepts

Jaime Varela Salazar

There are many definitions of sustainable development. For instance the Brundtland Commission (1987) states that sustainable development is the one that satisfies the present generation needs without committing capacity of future generations to satisfy their own necessities. It is a great scope change of a new paradigm that requires a change in values, which means a new moral code.

As long as sustainable development is concerned, three priorities stand out: maintenance of ecological processes, sustainable use of resources and preservation of the genetic diversity. To sum up, sustainable development is an assessable environmental process that improves quality of life and productivity of human beings. In addition, it is based on proper measures of ecologic equilibrium and utilization of natural resources, in such a way that no commitment on future generations is imposed.

12:00 -12:20

Effects of Air Pollutants on Health

Jaime Varela Salazar

According to law everyone has the right to a healthy environment for his/her development and welfare. The State ensures respect for this right. Damage and deterioration of environment is responsibility of whoever that causes it as stated by provisions of law.

In this paper the evolution of Mexican ecological legislation is reviewed. In addition, the origin and effects of pollutants on health is reported. Carbon monoxide, sulfur oxides, ozone,

nitrogen oxides and particles are the main air pollutants. The concepts of risk, resilience, susceptibility, and the norm are associated in order to evaluate the effects of pollution on health.

12:20 -12:40

### **International Commerce**

**Presiding: Luis Eduardo Velazquez**

12:20 -12:40

The Fair Trade in Mexico: A Sustainable Alternative of Social Development

Carlos Germán Palafox Moyers, Joel Enrique Espejel Blanco and Benjamín Burgos Flores

The new economic configuration of conventional international trade worldwide, which is composed more and more aggressively compete for international markets dominate trading blocs have caused high rates of poverty and social inequality in developing countries. In turn, this economic scenario has caused environmental devastation in the poorest countries due to indiscriminate exploitation of natural resources and minerals through unfair labor and trade systems and cleaner production systems.

With this international approach, an alternative social and sustainable development would be the implementation of Social Solidarity Economy Models, such as Fair Trade, which aims at marketing products free of contaminants and chemical (organic) and sustainably elaborate crafts for families, associations, cooperatives from poor and marginalized regions. Mexico is no stranger to this global context of global free trade, speculation and price fluctuations of international market. Therefore, Mexico as well as other emerging countries seeking alternatives to social and environmental development. In this regard, a research question arises: Is the Fair Trade social and environmental capital form in underserved areas in our region and thereby be brewing nascent unconventional model integration in Latin America and in Mexico?

The objective of this article is to design the theoretical and methodological basis for determining whether models of Fair Trade in Mexico and Latin America impact on the formation of social capital (eg. building trust, collective action and social cohesion and inclusion of poor communities) and environmental capital (eg. care of natural resources and minerals in underserved areas).

13:30 -15:00

**Lunch**

16:00 -19:00

Plenary Session 2 (Department of Mathematics, Enrique Valle Flores Auditorium)

16:00 -16:40

**Public Services**

**Presiding: Moonhwee Kim**

16:00 -16:20

Efficiency in Mexico Universities: A Comparative of Data Envelopment Analysis (DEA) and Stochastic Frontier (SFA) with Maximum Likelihood.

César L. Navarro-Chávez and Odette V. Delfin-Ortega

In this research, is calculated the efficiency of 32 public universities in Mexico in 2012 from a comparative analysis of methodologies for Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) with Maximun Likelihood (ML). Regarding by DEA, it calculated pure technical efficiency, scale efficiency and overall technical efficiency, applying bootstrap to give robustness to the calculations.

DEA is a nonparametric method that envelops observations in order to identify a frontier that is used to evaluate decision making unit and examine its position relative to the optimal

situation. Meanwhile SFA involves a production function for cross-sectional data with an error term with two components: one for measuring the random effect ( $v$ ); and another to measure technical inefficiency ( $u$ ).

The results show higher levels of efficiency with DEA than SFA. When it has used VRS DEA, the efficiency score with bootstrap was 85%, while SFA the inefficiency score was 54%. The efficiency score of CRS DEA with bootstrap was 77% -inefficiency of 33% -, this score approximates the DEA and SFA measurements, and however differences in the results of the implementation of these two techniques is still significant.

16:20 -16:40

Short-Run Cost Minimization and Capacity Utilization over Regional Public Hospitals in South Korea

Moonhwee Kim and Sangmok Kang

This paper intends to seek for the maximum capacity utilization and capacity utilization rate over 34 regional public hospitals in South Korea from 2007 to 2010 using Data Envelopment Analysis (DEA). Also, it estimates the scale efficiency to check the losses from not operating at the optimal size of these hospitals. The annual capacity utilization ratio and scale efficiency are 0.49 and 0.63, respectively, on average. Only Jeju shows the highest level of the capacity utilization rate and scale efficiency. It indicates that almost all regional public hospitals except for Jeju operate neither under the optimal scale nor with a full capacity during the same period .

16:40 -17:00

**Energy**

**Presiding: Rolando Valdivia Paravicini**

16:40 -17:00

An empirical comparative Malmquist analysis of two Refineries: Searching new technological inputs

Rolando Valdivia Paravicini

A productivity change is analyzed over three period (I; 1999-2003), (II, 2004-2008), (III; 2008-2010). An empirical Malmquist Indexes analysis month a month is applied in order to find the technological productivity variations because of the enterprise management change. A comparative analysis involves two Refineries, not only across each one, but also within them across time. The two Refineries began to work simultaneously with the same new agent in the second period. One of the requirements to the second period is to improve the productivity with new technology that had to be introduced in both Refineries. Nevertheless, we don't know precisely the moment of the introduction nor then the supposed growth. In the third period the enterprise management, the Refineries returned to original owner. The purpose of this research is to find when the technological input began to improve the productivity, has decreased or extended to the next period.

17:00 -17:40

**Corporate and Public Finance**

**Presiding: Rolando Valdivia Paravicini**

17:00 -17:20

Measurement of capacity and fiscal effort in the states of Mexico

Roberto Ramírez and Alfredo Erquizio Espinal

It aims to measure the ability and effort of collecting taxes and own income for the states in Mexico. For this purpose, we use the method of stochastic frontier regression for panel data in order to estimate the levels of both capacity and fiscal effort by state. It is found that the socioeconomic determinants of tax effort not operate in the same direction and with the same

intensity for both to own income taxes. Changes are also observed in the distribution pattern of the levels of tax effort by state taxes to both own income. It is concluded that a reform of fiscal federalism should consider factors related to fiscal capacity, the needs and the fiscal effort of the states.

17:20 -17:40

Mexican bank's productivity and global financial crisis

Francisco Vargas, Luis Renteria, Gang Cheng and Panagiotis Zervopoulos

This paper presents an attempt of comparison of productivity for the Mexican banking sector in two different periods: the 2007-2011 period of global financial crisis and the 2003-2006 stage, which can be regarded as a relatively stable period. The purpose of this study is to disclose whether the global financial crisis affected the Mexican banking productivity. Three data envelopment models (DEA) are tested, in order to assess whether there is a significant difference between the productivity patterns of Mexican banks before and after the financial crisis. Such models are the radial Malmquist Index, the non-radial and slacks based model and non-radial and non-oriented. Essentially, no significant difference of productivity indicators for both foreign and domestic banks was found. Likewise, no significant difference between the pre and after crisis periods was perceived, as far as productivity indicators are concerned. Therefore, the global financial crisis was effectless in banking operation.

17:40 -18:00

Coffee Break

18:00 -19:00

**Environment protection**

**Presiding: Luis Rentería Guerrero**

18:00 -18:20

A simple model for monitoring ecological protection

Arnulfo Castellanos and Juan Miguel Castellanos.

Responsiveness to the planet pollution, based on a principle of theoretical simplicity, is studied. The state variables are global biocapacity and ecological footprint. A time series analysis to demonstrate that variables develop according to a straight line, from which random deviations occur, is performed.

This result is used to propose a mathematical model in which a function of environmental protection is defined by a bilinear form. Classical physics is used to interpret the function as a potential in which a particle, whose mass is used to scale the time variable, in order to obtain a real-time prediction. Such a function is catastrophic, and therefore, the introduction of penalty functions so that to modify the result, is suggested. Thus, a stable point is achieved that otherwise would not exist. Hence, the effect of actions to protect environment could be monitored and the functions would be fitted using one free parameter

18:20 -18:40

Looking for stable states in an ecological protection model. Mexican case.

Arnulfo Castellanos-Moreno and Juan Miguel Castellanos

The ecological protection model proposed by A. Castellanos et al is applied to the particular case of Mexico, for whose environment protection function is written and calculated. At least one penalty function is proposed and the minimum is calculated by dealing with a programming problem.

18:40 -19:00

Efficiency assessment of water industry in Mexico

M. Violeta Vargas, Parra, Francisco Vargas Serrano, Noemí Haro Velarde and Luis Rentería Guerrero.

As energy prices and environmental concerns increase, the need to improve water processes is badly needed. The aim of this study is to measure the performance of water industry for 2004 and 2008. The analysis encompasses plants in most of the 32 states of Mexico. Three models to assess water industry efficiency were applied. Such models were the radial efficiency, cost efficiency and revenue efficiency. Efficiency scores were calculated with each model. As a result, a ranking in best practices is obtained. Thereby, evidencing improvement opportunities for the most decision making units.

20:30 -23:00

Gala Dinner

SEPT. 19<sup>th</sup>

9:00 -10:00

**Keynote Speaker: Prof. Dr. hab Joost (Johannes) Platje: “Capacity and capability for sustainable development - a transaction costs and property rights perspective”** (Centro de las Artes, Aula Magna).

10:00 -10:30

Coffee Break

10:30 -12:50

Plenary Session 3 (Department of Mathematics, Enrique Valle Flores Auditorium)

10:30 -10:50

**Regional development**

10:30 -10:50

**Presiding: María de Guadalupe Cota**

An analysis of technical efficiency and productivity change in the Mexican manufacturing sub-sectors between 1988 and 2008.

Even though the service and commerce sectors account for the most part of the economy in many advanced and developing countries, in various instances the manufacturing sector plays a fundamental role in economic development mainly via exports. For that reason, the question of the evolution and sources of productivity growth in manufacturing activity keeps relevant.

In this paper we analyze the technical efficiency change and total factor productivity in the Mexican manufacturing at the subsector level (excluding oil industries) in the period 1988-2008. By using employment and fixed assets as inputs and total gross production as output, we apply Data Envelopment Analysis, the Malmquist index and the decomposition of the index into its two components "technical change" and "efficiency change". The data come from the economic censuses carried out by the national institute of statistics, geography and informatics.

Due to the productive characteristics in manufacturing industries we expect that any positive changes in productivity in the study period were driven by the "frontier shift" (technological change) effect and, to a lesser extent, by the "catching up" effect (technical efficiency change). We hypothesize that technical efficiency change can also be negative which is detrimental to productivity growth in Mexican manufacturing.

10:50 -11:50

**Econometrics and big data**

10:50 -11:10

**Presiding: Maria De Guadalupe Cota**

Self Adaptive Genetic Algorithms for the modeling of Time series with missing and incorrect

values.

Pedro Flores and Maria De Guadalupe Cota

In this work it is presented a methodological proposal to build models for Time Series with missing and erroneous values. This methodology consist of two stages: first, it is realized an estimating of the missing and erroneous values of the series; and second, it is built a model for the series. The proposal is based on Self Adaptive Genetic Algorithms that were especially utilized to calculate ARMA models for the NN5-REDUCED problems which results are presented in this work. This methodology here presented can be generalized for the treatment of this type of Time Series by other non linear models that use, for example, neuronal networks, fuzzy logic, etc.

11:10 -11:30

2G algorithm applied in error correction in forecasting a real problem

María de Guadalupe Cota Ortiz, Pedro Flores Pérez, José Arturo Montoya Laos and Juan Pablo Soto Barrera

2G algorithm is based in decision trees with original contributions. Pattern recognition techniques are applied to training sets to generate classification rules, which are used to evaluate new instances. At the end of the classification process, the procedure "no explicit virtual patterns" is applied to classify unclassified examples. Dual condition is used to evaluate new cases but can use more attributes if necessary. This paper describes how the algorithm is applied to correct errors in results of energy demand forecasts obtained with time series. Experimental results indicate efficiency but more data are needed to balance the class information in the training set. The algorithm is developed with MySql Connection to access data stored in database management systems. The algorithm has connectivity to database systems and could be adapted to the analysis of big data to recognize hidden patterns, correlations and other useful information for decision making. Some description details of the problem will be restricted for reasons of confidentiality.

11:30 -11:50

The big data explosion: a big problem or a big opportunity?

Francisco Enrique Andrade López

Big Data has rapidly become one of the most written about topics in IT, but much of the commentary is limited to discussing exponential data growth, which is only one part of today's data challenge. Pundits and vendors pay less attention to the detailed challenges enterprises face or exactly how organizations can profit from this latest IT wave.

The data landscape has changed. In previous decades companies achieved success by analyzing their transactional business data and using this historic view to make an informed choice about the future. Today, the game-changers are adding machine data and human information to their analytics.

The unstructured data (machine data and human information) is ten times larger than structured business data and has a ten times higher growth rate. The shift in the data landscape brings an enormous opportunity—but only to enterprises who can harness insight from all their data.

11:50 -12:50

**Panel: "Sustainable development: past, present and future".**

**Panelists: Ali Emrouznejad, Joost (Johannes) Platje, Jaime Varela Salazar, Luis Eduardo Velázquez.**

**Presiding: Pedro Flores Pérez**

14:30 -16:30  
16:30 -19:30  
20:30 -21:30

**Lunch**  
City Tour  
**Dinner**

SEPT. 20<sup>th</sup>  
8:00 -20:00

Optional Trip: San Carlos, Nuevo Guaymas.