Predictive Analytics of India In Olympics using Machine Learning Algorithms

**Varagiri Shailaja, Rayala Lohitaa, Sreethi Musunuru, K Deepthi Reddy, J Padma Priya**

***Abstract: Different reasons have been insinuated for India’s lack of tendency to stand atop the podium in the Olympics. Raw talent can only take the athletes so far, since support and encouragement- whether financial, emotional or physical are essential aspects that any athlete requires, and without them, their cause can be hopeless. The power of education is king, and sports are only seen as recreational activities for millions of youth in the country. The combination of this with terrible food habits, inefficient coaching, bad rehab facilities, increase in competition in schools, shortfall of exercise with physical education and long commutes from work results in many talents getting wasted. This project focuses on using Data Science and Machine Learning algorithms to build a model for predicting why India performs well or poorly in the Olympics by taking into account country-wise GDP, population data and several attributes that contribute to the performance of the athletes. The results of this project can be used to prepare a report to persuade a country to improve its positioning in prestigious sporting events.***

***Keywords: Olympics, Data pre-processing, Data Science, Machine Learning, Regression.***

**I. INTRODUCTION**

The Olympics or Olympic games are considered to be prominent international sporting events in which thousands of athletes from around the world come together to participate in a variety of competitions. More than 200 nations take part in The Olympic Games which are considered the world's foremost sports competition. Data Science and Machine Learning approaches are to be considered as a great help in the decision-making process of trainers, athletes and the government of these nations. Machine Learning is widely recognized as the methodology of choice in analyzing the Olympics Games data. In order to acquire a convincing result, data of the previous Olympics seasons are collected for model training and testing. This project aims at getting good accuracy and specific insights using the concept of Correlation. This paper embarks on predicting the outcomes of a country’s performance in sports using a supervised learning approach. The insights gathered can be used to reinforce the need to devise new policies to improve the quality of physical education in a country. The statistics show that a lot of attributes contribute to the performance of these countries in the games.

**II. LITERATURE SURVEY**

Chandrasegar Thirumalai, S Monica, A Vijayalakshmi (2017): To predict a nation in view of medals owned by 2012, they used a combination of Pearson correlation coefficient, Spearman correlation coefficient and linear regression.

Philip K Porter, Deborah Fletcher (2008): They used data from the 1996 Summer Olympic Games and 2002 Olympic Winter Games to test the predictions of regional input-output models.

Rory P. Bunker, Fadi Thabtah (2017): They used Artificial Neural Networks for sports result prediction. A novel sports prediction framework had been devised using Machine Learning.

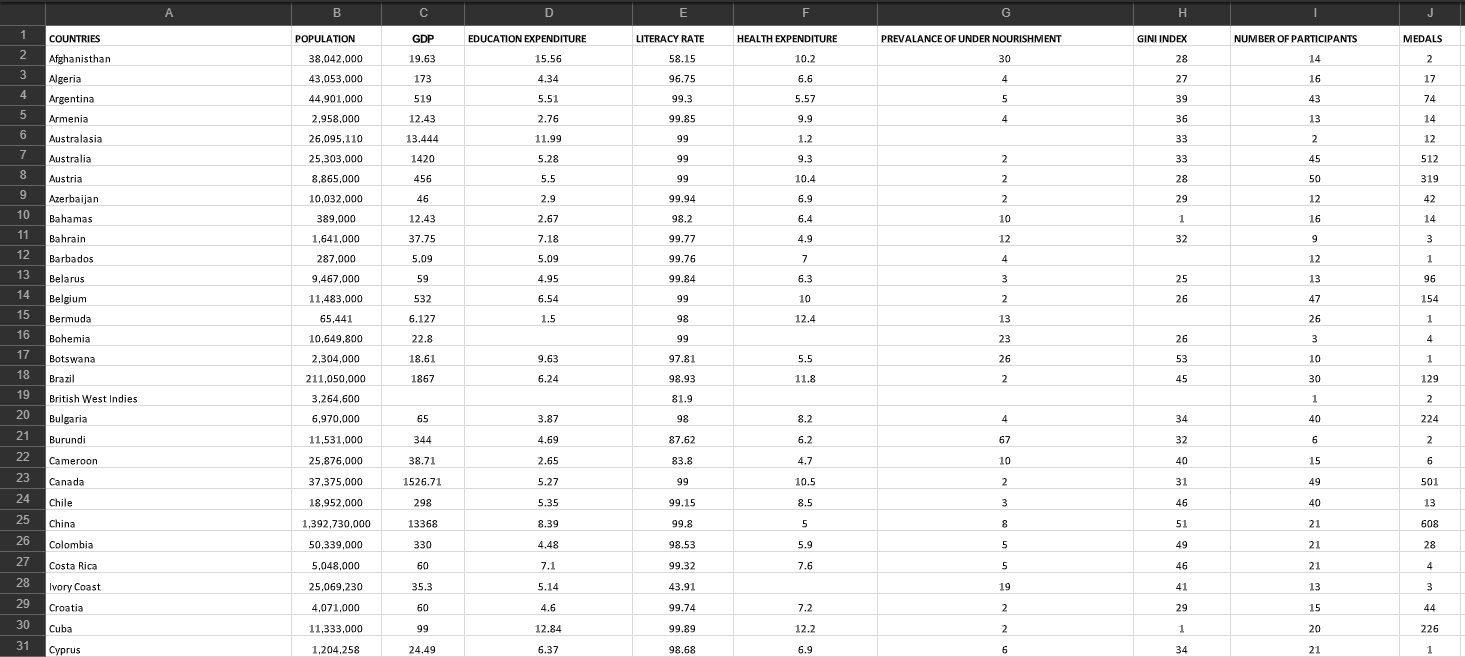
Yamunathangam.D, Kirthicka.G, Shahanas Parveen(2018): Performance Analysis was done on Olympic games datasets using Python to evaluate the contributions of each country in the Olympics.

M. Flegl, L. A. Andrade (2018): They used data envelopment analysis to understand how economic active population and corruption factors can work with the traditional system for medal prediction.

Sebastian Lozano, Gabriel Villa, Fernando Guerrero, Pablo Cortes (2015): The proposed approach considers two inputs (GNP and population) and three outputs (number of gold, silver and bronze medals won).

**III. Methodology**

*Data Collection:* The dataset for prediction and analysis of India’s performance in the Olympics is collected from various sources on the web. The dataset consists of 227 rows and 10 attributes. The attributes of the dataset include countries, population, GDP, expenditure on education, literacy rate, expenditure on health, the prevalence of undernourishment, Gini index, number of games participated and medals won. This research would analyze if the external attributes affect a country’s performance in the Olympics.

** **Fig 1: Dataset snapshot**

*Data Cleaning and Pre Processing:* The dataset is built by collecting the data from the real world. Hence it contains missing values. These missing values may reduce the model accuracy and so they need to be handled. Also, the data is having values over a wide range and it needs to be normalized.

There are many ways to fill the missing values like simply filling the values with zero or calculating the central tendencies. But since our dataset contains all continuous values over a wide range using the KNN algorithm is considered as an efficient solution.

*Missing Values:* Using KNN algorithm, a value can be approximated by the values of the points closest to it based on the other attributes. The number of neighbours to consider, the aggregation method to use and the distance function are the parameters to be focused. For this dataset, the k value is taken as 10, euclidean for numeric distance and hamming for categorical distance are used, and the median is taken as the aggregation method.

*Normalization:* Normalization is a technique applied as a part of data preparation to change the values of numeric columns to a common scale, without distorting differences in the ranges of values. The sigmoid activation function is used to normalize the dataset. With the help of this function, we are able to reduce the loss during the time of training because it eliminates the gradient problem.

This is the most interesting phase in Applying Machine Learning to any Dataset. It is also known as Algorithm selection for Predicting the best results. Usually, data scientists use different kinds of Machine Learning algorithms for large datasets. We can divide those algorithms into supervised and unsupervised algorithms. Depending on the output label supervised is again classified into classification and regression.

The output label of the dataset is identified as continuous and hence this becomes a regression problem. The following regression algorithms are applied to the dataset:

1. *Decision tree regressor:*

It builds a decision tree by breaking down the data into sets and subsets. The final output can be read from the decision nodes and leaf nodes.

This was chosen as it considers all outputs of a decision and helps trace all paths to a conclusion.

1. *K nearest neighbours regressor:*

It stores all cases and classifies them based on distance function.

This has been considered as it can be used for pattern recognition and statistical estimation.

1. *Linear Regression:*

It is a method used to model scalar response and one or more explanatory variables.

The linear regression line has the form of Y= a+bX.

This has been considered as it models the independent variables and dependent variables.

1. *Random forest regressor:*

A random forest is capable of performing both regression and classification tasks using multiple decision trees.

This has been considered as it offers efficient estimates of test error.

1. *Bayesian ridge regression:*

A probabilistic model of the regression problem can be estimated using Bayesian ridge regression.

The estimate of β is obtained using L2-constrained least-squares.

βb = arg min β ky − µ1 − Xβk 2 + λkβk 2 This has been considered as it recovers the whole range of inferential solutions.

The task of these algorithms is to predict the state of an outcome variable at a particular time point with the help of other correlated independent variables.

There are various metrics used to evaluate the results of these predictions. The following metrics are considered for this project :

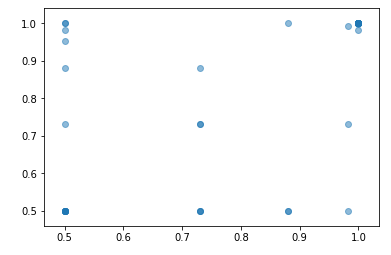
1. Mean Squared Error(MSE)
2. Root-Mean-Squared-Error(RMSE).
3. Mean-Absolute-Error(MAE).

**IV. RESULTS**

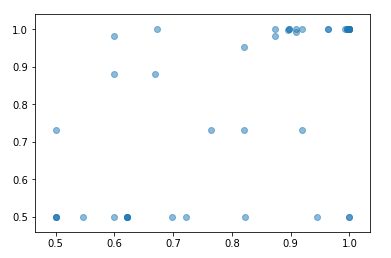
The predicted values and the actual values of all the algorithms are plotted against each other using a scatter plot.

*Studying scatter plots:* The points in neither of the graphs is either a straight line or a curve. Hence we cannot directly estimate the correlation. We need to divide the graph into four quadrants and use a trend test table. The quadrants are generated by dividing the graph such that either horizontally or vertically there are equal numbers of points on both sides. Then we take the minimum of the sum of the upper left quadrant and lower right quadrant, and upper right quadrant and lower left quadrant. This is verified against the trend test table and the correlation is obtained.

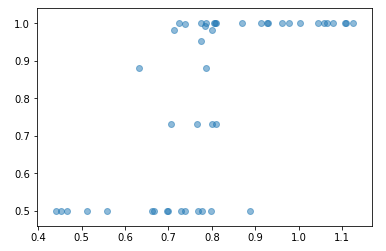
The scatter plot for Decision Tree regressor:

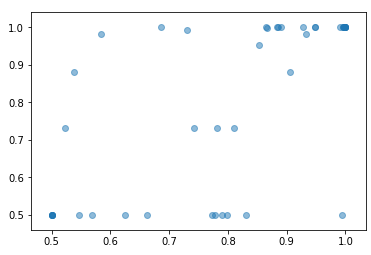


The scatter plot for KNN regressor:

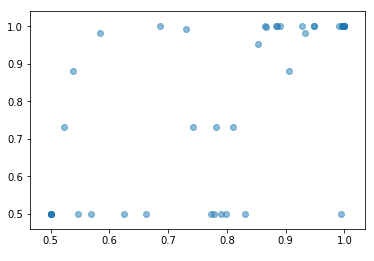


The scatter plot for Linear regression:



The scatter plot for Random forest regressor:

The scatter plot for Bayesian ridge regression:

The mean absolute error(MAE), mean square error(MSE) and root square error

(R2) calculated for the algorithms are:

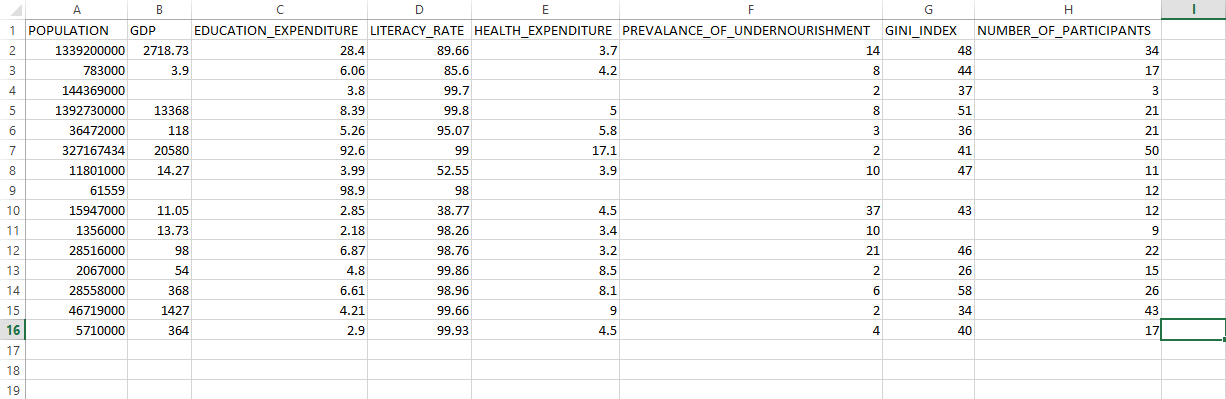
| **Algorithm** | **MAE** | **MSE** | **R2** |
| --- | --- | --- | --- |
| Decision tree regressor | 0.109 | 0.042 | 0.182 |
| KNN regressor | 0.122 | 0.033 | 0.344 |
| Linear regression | 0.143 | 0.028 | 0.426 |
| Random forest  regressor | 0.109 | 0.029 | 0.438 |
| Bayesian ridge | 0.109 | 0.029 | 0.438 |

The error given by the decision tree regressor is low when compared to the other algorithms. But when we observe the scatter plots of every algorithm, we can derive the correlation between the predicted and actual values.

Thus considering both the error values and the correlation values, KNN regressor is the final selected algorithm.

*Testing using a validation dataset:*

A new dataset is created for the purpose of testing the performance of the algorithm.





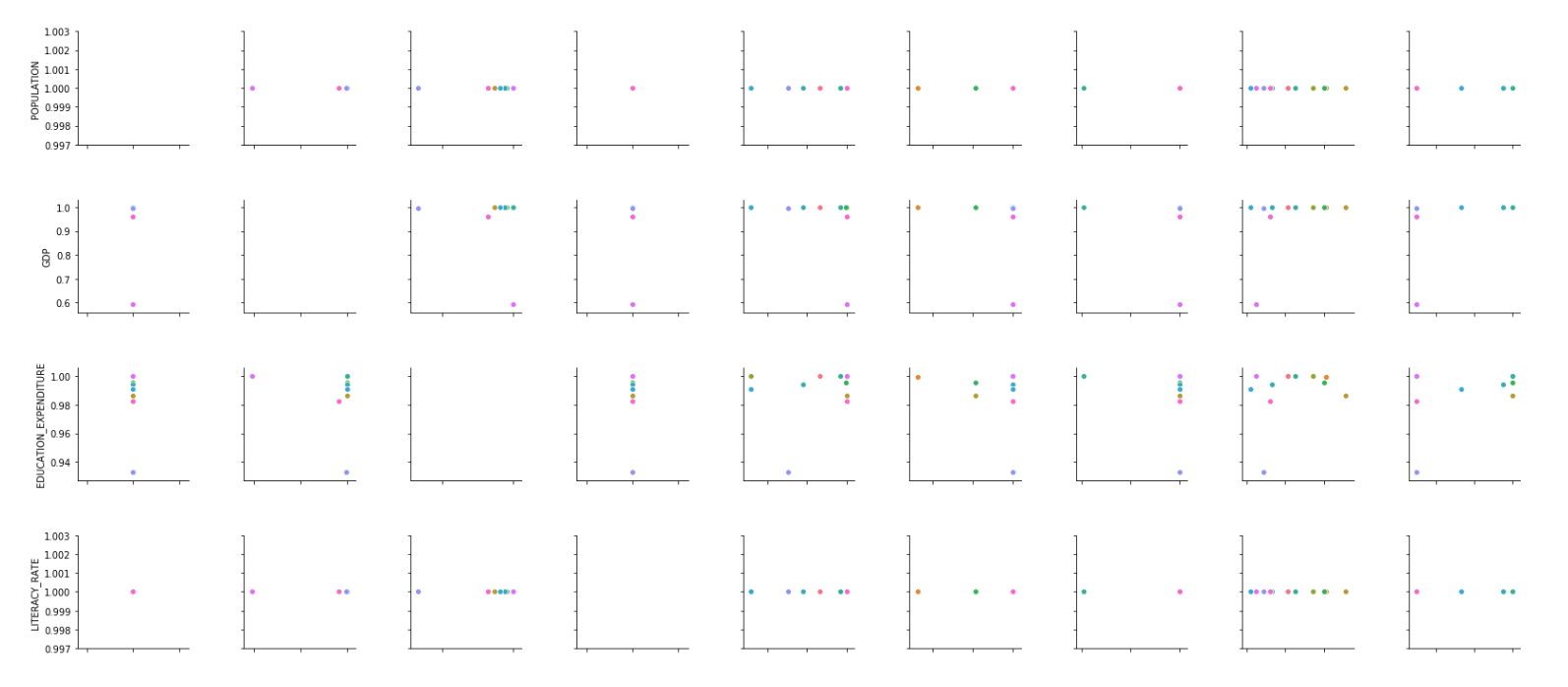
*Correlation between attributes:* A pairwise scatter plot of each attribute with every other attribute is obtained and the gr

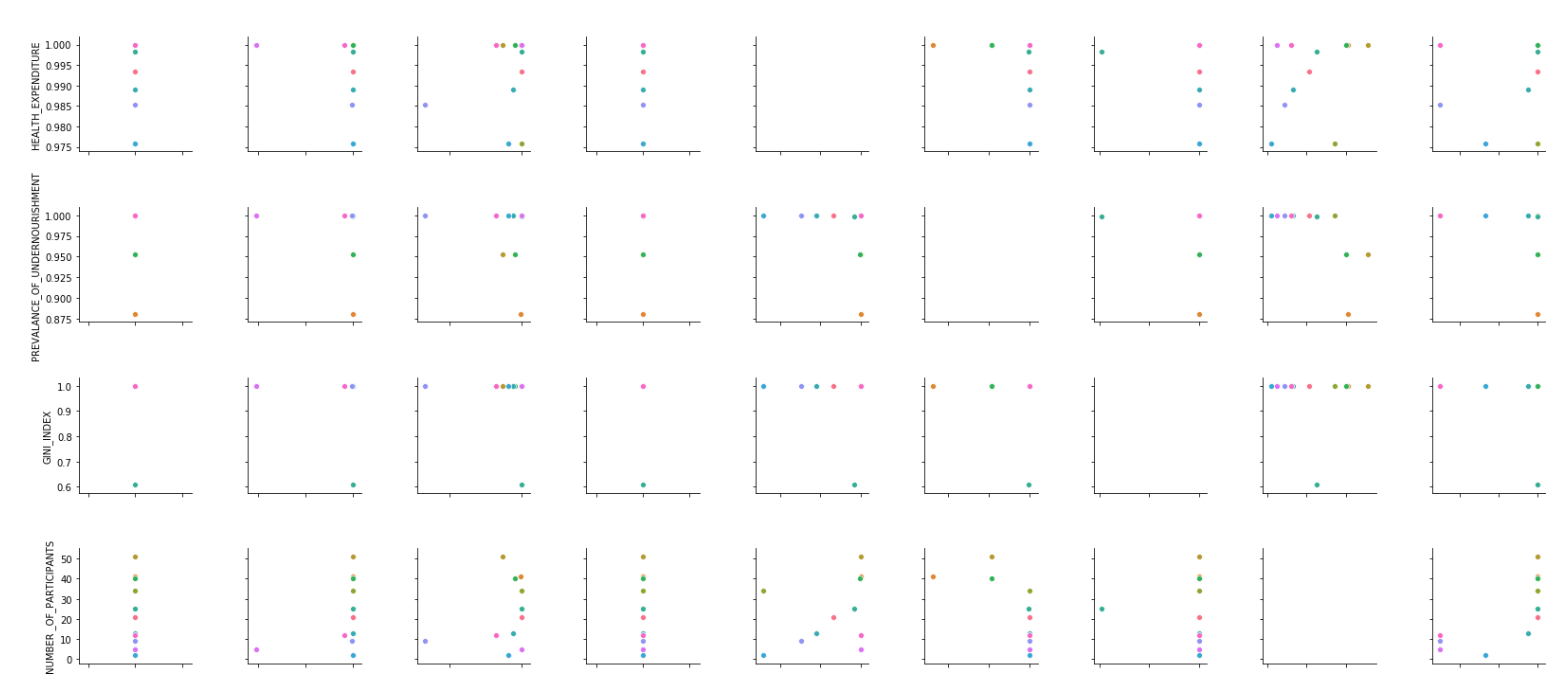
aphs are studied to understand the correlation. Taking *hue* as the countries the following visualization is obtained. The observations made are:

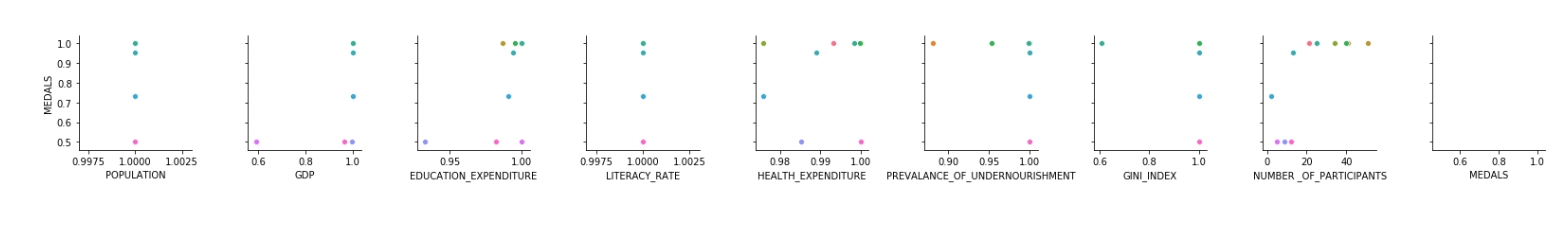
The number of medals won is strongly positively correlated with the population and literacy rate.

Prevalence of undernourishment, GDP and Gini index is positively correlated with medals with some outliers. Education expenditure is in a weak positive correlation on the other hand health expenditure is not correlated. But health expenditure is in positive correlation with the prevalence of undernourishment. Thus all the considered attributes affect the performance of a country in the Olympics either directly or indirectly.









**V. CONCLUSION**

Let us compare India with China which is among the top ten countries in the Olympics and whose population is nearly equal to India.

We see that although the population is similar there is a huge difference in the medals won which shows that the population is not affecting the performance of India. When we look at the education expenditure by the countries, India spends more than 3 times what China is spending and yet the literacy rate of India is less than that of China. If a part of that amount is spent on sport in India it not only helps India to increase their winning rate but may also provide an occupation to the people who need it.

The health expenditure of India is lesser than in China. One of the major aspects that can directly affect an athlete's performance is his health. If the nutrition intake is not sufficient, he may not perform to his full extent. Prevalence of undernourishment is thus higher in India which requires immediate attention. The GDP of China is about 6 times more than that of India. This shows that the size and growth of the economy are very low in India. The distribution of the economy among the population is also not efficient, which means there is a huge gap among the economic status of people in the country.

From these insights, we see that education is given higher importance in India and yet the literacy rate and economic status of its people are low. Hence sports should be given higher importance and not be treated as recreational activities only. Also, health should be given higher importance as it has a direct effect on an athletes fitness.

**REFERENCES**

1. Chandrasegar Thirumalai, S Monica, A Vijayalakshmi, Heuristics Prediction of Olympic Medals using Machine Learning

(2017) IEEE - International Conference on Electronics, Communication and Aerospace Technology ICECA 2017, At Coimbatore, India.

1. Philip K Porter, Deborah Fletcher, The Economic Impact of the Olympic Games: Ex Ante Predictions and Ex Poste Reality

(2008), Journal of sports management

1. Rory P. Bunker, Fadi Thabtah, A machine learning framework for sport result prediction (2017)
2. Yamunathangam.D, Kirthicka.G, Shahanas Parveen, Performance Analysis in Olympic Games using Exploratory Data Analysis Techniques, International Journal of Recent Technology and Engineering (IJRTE)

ISSN: 2277-3878, Volume-7 Issue-4S, November 2018

1. M. Flegl, L. A. Andrade (2018) Measuring countries’ performance at the Summer Olympic Games in Rio 2016, OPSEARCH, Springer;Operational Research Society of India, vol. 55(3), pages 823-846, November.
2. Sebastian Lozano, Gabriel Villa, Fernando Guerrero, Pablo Cortes Measuring the Performance of Nations at the Summer Olympics Using Data Envelopment Analysis · May 2002 *with* 158 Reads

* Sebastián Lozano at Universidad de Sevilla
* **Sebastián Lozano**
  + [38.53](https://www.researchgate.net/profile/Sebastian_Lozano)
* [**Gabriel Villa**](https://www.researchgate.net/profile/Gabriel_Villa)
  + [19.8](https://www.researchgate.net/profile/Gabriel_Villa)
  + [Universidad de Sevilla](https://www.researchgate.net/institution/Universidad_de_Sevilla)
* Fernando Guerrero at Universidad de Sevilla
* [**Fernando Guerrero**](https://www.researchgate.net/profile/Fernando_Guerrero24)
  + [15.14](https://www.researchgate.net/profile/Fernando_Guerrero24)
  + [Universidad de Sevilla](https://www.researchgate.net/institution/Universidad_de_Sevilla)
* Pablo Cortés at Universidad de Sevilla
* [**Pablo Cortés**](https://www.researchgate.net/profile/Pablo_Cortes2)
  + [31.49](https://www.researchgate.net/profile/Pablo_Cortes2)
  + [Universidad de Sevilla](https://www.researchgate.net/institution/Universidad_de_Sevilla)

Abstract

In this paper a well known tool for relative efficiency assessment, namely Data Envelopment Analysis (DEA), is used to measure the performance of the nations participating at the last five Summer Olympic games. The proposed approach considers two inputs (GNP and population) and three outputs (number of gold, silver and bronze medals won). To increase the consistency of the results, weight restrictions are included, guaranteeing a higher valuation for gold medals than for silver medals and higher for the latter than for bronze medals. Variable returns to scale are assumed. The results for the last five Summer Olympics are analysed. For each of them, a performance index as well as benchmarks are computed for each country. In addition, plotting the performance of a specific country for the different games can help identify trends as well as objective successes and disappointments.

Do you want to **read the rest** of this article?

Request full-text

Request Full-text Paper PDF

Citations (98)

References (20)

* ... al. 2006; Zhou et al. 2013), and banks (see, e.g. Cook and Zhu 2010; Grigoroudis et als are sure performance of participating nations at five Summer Olympic Games (1984). Lins et al. (2003 found that each sum of numbers of gold, silver and bronze medals was constant, and developed the so-called Zero-Sum Gains (ZSG) DEA model to rank participating nations ...
* ... Churilov and Flitman (2006) used self-organizing maps to group participating countries into homogenous clusters, and then applied DEA models to evaluate the performance of each nation in clusters. To increase the validity of evaluation results, both Lozano et al. (2002) and Lins et al. (2003) applied the same set of assurance region (AR) constraints for all participating nations. Li et al. (2008) claimed that different countries should fit in with different ARs, and applied context-dependent assurance region DEA (CAR-DEA) to measuring sports levels of nations in the Summer Olympics. ...
* ... Output-orientation is assumed in this paper, since the Olympics achievement is measured with respect to medals won (Li et al. 2008). In addition, as all the DEA literature has stated, such as Lozano et al. (2002), Lins et al. (2003, Churilov and Flitman (2006), Wu et al. (2009a, b), the population of participating nations varies greatly, then the variable return to scale (VRS) is an another assumption in the model. Denote each participating nation as DMU j ( j = 1, . . . ...
* [**Measuring Olympics achievements based on a parallel DEA approach**](https://www.researchgate.net/publication/272524595_Measuring_Olympics_achievements_based_on_a_parallel_DEA_approach)
* Article
* Full-text available
  + Mar 2015
  + [ANN OPER RES](https://www.researchgate.net/journal/0254-5330_Annals_of_Operations_Research)
  + Xiyang Lei
  + [Xiyang Lei](https://www.researchgate.net/profile/Xiyang_Lei)
  + [Qiwei Xie](https://www.researchgate.net/scientific-contributions/2071405332_Qiwei_Xie)
  + Yongjun Li
  + [Yongjun Li](https://www.researchgate.net/profile/Yongjun_Li11)
  + [Liang Liang](https://www.researchgate.net/scientific-contributions/65141109_Liang_Liang)
* [View](https://www.researchgate.net/publication/272524595_Measuring_Olympics_achievements_based_on_a_parallel_DEA_approach)
* Show abstract
* ... • Economic situation: The most popular indicators of a country's economic situation are GDP (e.g., Bernard & Busse, 2004;Emrich, Pitsch, Klein, & Pierdzioch, 2012;Johnson & Ali, 2004) and GNP (Lozano, Villa, Guerrero, & Cortés, 2002). Some authors also use income per capita (Johnson & Ali, 2004;Lui & Suen, 2008;Noland & Stahler, 2016), export or import (Condon, Golden, & Wasil, 1999;Gásquez & Royuela, 2014), capital formation (Gásquez & Royuela, 2014), or inflation (Gásquez & Royuela, 2014). ...
* ... Finally, studies that suggest an assessment or benchmarking tool commonly measure success with the help of a production function, where success determinants such as GDP or population size are inputs and number of medals or share are outputs. This area of research usually employs the data envelopment analysis technique (Churilov & Flitman, 2006;Lins, Gomes, Soares de Mello, & Soares de Mello, 2003;Li, 2016;Lozano et al., 2002;Wu, Liang, & Yang, 2009) or stochastic frontier analysis (Rathke & Woitek, 2007). Previous research on country-level determinants of sport success uses data for national teams. ...
* ... It reflects the demographic power of a nation (Wu et al., 2009) and thus the number of potential players (Rathke & Woitek, 2007). Lozano, Villa, Guerrero, and Cortés (2002) argue that, despite more precise metrics such as population height or weight, the total number of people in a country is a predictor of success for all types of traditional sports. Although eSports is not closely connected to physical excellence, 3 we argue that population can be used as a proxy for the probability of talented eSports players within a particular country. ...
* [**Determinants of performance in eSports: A country-level Analysis**](https://www.researchgate.net/publication/324152297_Determinants_of_performance_in_eSports_A_country-level_Analysis)
* Article
* Full-text available
  + Feb 2018
  + [INT J SPORT FINANC](https://www.researchgate.net/journal/1558-6235_International_journal_of_sport_finance)
  + Petr Parshakov
  + [Petr Parshakov](https://www.researchgate.net/profile/Petr_Parshakov)
  + Marina Oskolkova
  + [Marina Oskolkova](https://www.researchgate.net/profile/Marina_Oskolkova)
* [View](https://www.researchgate.net/publication/324152297_Determinants_of_performance_in_eSports_A_country-level_Analysis)
* Show abstract
* ... In this context, the definition of efficiency is the relationship between the observed output-level and the ideal (or potential) output-level (Greene, 2008), which can be obtained using frontier methods (i.e., DEA and stochastic frontier models). Lozano, Villa, Guerrero, and Cortés (2002) are pioneers in this strand of the literature. 1 Previous research has used the number of medals or diplomas to determine success and has incorporated the relative value of medals into the analyses (Churilov & Flitman, 2006;Lozano et al., 2002;Zhang, Li, Meng, & Liu, 2009). Nevertheless, the computation of medals, weighted points (e.g., 3-gold; 2-silver; 1-bronze), or diplomas might not be the most appropriate system to define success in the Olympic Games. ...
* ... In this context, the definition of efficiency is the relationship between the observed output-level and the ideal (or potential) output-level (Greene, 2008), which can be obtained using frontier methods (i.e., DEA and stochastic frontier models). Lozano, Villa, Guerrero, and Cortés (2002) are pioneers in this strand of the literature. 1 Previous research has used the number of medals or diplomas to determine success and has incorporated the relative value of medals into the analyses (Churilov & Flitman, 2006;Lozano et al., 2002;Zhang, Li, Meng, & Liu, 2009). Nevertheless, the computation of medals, weighted points (e.g., 3-gold; 2-silver; 1-bronze), or diplomas might not be the most appropriate system to define success in the Olympic Games. ...
* ... With the aim of designing an objective system of analysis for the Olympic Games, the nonparametric data envelopment analysis (DEA) model has become increasingly popular. In particular, Lozano et al. (2002) pioneered the application of this method to evaluate the relative efficiencies of participants in the Olympics. ...
* [**A Country-Level Efficiency Analysis of the 2016 Summer Olympic Games in Rio: A Complete Picture**](https://www.researchgate.net/publication/326998393_A_Country-Level_Efficiency_Analysis_of_the_2016_Summer_Olympic_Games_in_Rio_A_Complete_Picture)
* Article
* Full-text available
  + Jan 2017
  + Julio Del Corral
  + [Julio Del Corral](https://www.researchgate.net/profile/Julio_Del_Corral2)
  + Carlos Gómez-González
  + [Carlos Gómez-González](https://www.researchgate.net/profile/Carlos_Gomez-Gonzalez2)
  + José Manuel Sánchez Santos
  + [José Manuel Sánchez Santos](https://www.researchgate.net/profile/Jose_Sanchez_Santos)
* [View](https://www.researchgate.net/publication/326998393_A_Country-Level_Efficiency_Analysis_of_the_2016_Summer_Olympic_Games_in_Rio_A_Complete_Picture)
* Show abstract
* ... In the prior DEA literature on evaluating participants' Olympics achievements, DMUs correspond to participating nations, and outputs are usually defined as the numbers of gold, silver and bronze medals, and inputs as population and GDP per capita or GNP. Lozano et al. (2002) used these three outputs, and the GNP and population as two inputs to measure performance of participating nations at five Summer Olympic Games (1984)(1985)(1986)(1987)(1988)(1989)(1990)(1991)(1992)(1993)(1994)(1995)(1996)(1997)(1998)(1999)(2000). Lins et al. (2003) found that each sum of numbers of gold, silver and bronze medals was constant, and developed the so-called Zero-Sum Gains (ZSG) DEA model to rank participating nations in the Olympic Games. ...
* ... Churilov and Flitman (2006) used self-organizing maps to group participating countries into homogenous clusters, and then applied DEA models to evaluate the performance of each nation in clusters. To increase the validity of evaluation results, both Lozano et al. (2002) and Lins et al. (2003) applied the same set of assurance region (AR) constraints for all participating nations. Li et al. (2008) claimed that different countries should fit in with different ARs, and applied context-dependent assurance region DEA (CAR-DEA) to measuring sports levels of nations in the Summer Olympics. ...
* ... Output-orientation is assumed in this paper, since the Olympics achievement is measured with respect to medals won (Li et al. 2008). In addition, as all the DEA literature has stated, such as Lozano et al. (2002), Lins et al. (2003), Churilov and Flitman (2006), Wu et al. (2009a, b), the population of participating nations varies greatly, then the variable return to scale (VRS) is an another assumption in the model. ...
* [**Measuring Olympics achievements based on a parallel DEA approach**](https://www.researchgate.net/publication/272683679_Measuring_Olympics_achievements_based_on_a_parallel_DEA_approach)
* Data
* Full-text available
  + Feb 2015
  + Xiyang Lei
  + [Xiyang Lei](https://www.researchgate.net/profile/Xiyang_Lei)
  + Yongjun Li
  + [Yongjun Li](https://www.researchgate.net/profile/Yongjun_Li11)
  + [Qiwei Xie](https://www.researchgate.net/scientific-contributions/2071405332_Qiwei_Xie)
  + [Liang Liang](https://www.researchgate.net/scientific-contributions/65141109_Liang_Liang)
* [View](https://www.researchgate.net/publication/272683679_Measuring_Olympics_achievements_based_on_a_parallel_DEA_approach)
* ... The second category is based on classical DEA models in which inputs vary with nations and correspond to some social economic variables. For example, Lozano, Villa, Guerrero, and Cortés (2002) considered two inputs (GNP and population) and three outputs (total numbers of gold, silver, and bronze medals) to measure the performance of participating nations in five Summer Olympic Games (1984). Lins et al. (2003 considered the limited number of medals to be won and proposed a zero-sum game DEA model to analyze the performance of participating nations. ...
* ... Churilov and Flitman (2006) linked self-organizing maps to a DEA model to rank participating nations. To increase the validity of evaluation results, both Lozano et al. (2002) and Lins et al. (2003) applied the same set of assurance region (AR) constraints to all nations. Li, Liang, Chen, and Morita (2008) assumed that different nations impose different AR constraints and applied context-dependent AR DEA to measuring the performance of participating nations. ...
* [**Performance evaluation of participating nations at the 2012 London Summer Olympics by a two-stage data envelopment analysis**](https://www.researchgate.net/publication/273340543_Performance_evaluation_of_participating_nations_at_the_2012_London_Summer_Olympics_by_a_two-stage_data_envelopment_analysis)
* Article
  + Dec 2014
  + [EUR J OPER RES](https://www.researchgate.net/journal/0377-2217_European_Journal_of_Operational_Research)
  + Qianzhi Dai
  + [Qianzhi Dai](https://www.researchgate.net/profile/Qianzhi_Dai)
  + Yongjun Li
  + [Yongjun Li](https://www.researchgate.net/profile/Yongjun_Li11)
  + Xiyang Lei
  + [Xiyang Lei](https://www.researchgate.net/profile/Xiyang_Lei)
  + [Liang Liang](https://www.researchgate.net/scientific-contributions/65141109_Liang_Liang)
* [View](https://www.researchgate.net/publication/273340543_Performance_evaluation_of_participating_nations_at_the_2012_London_Summer_Olympics_by_a_two-stage_data_envelopment_analysis)
* Show abstract
* ... O primeiro modelo DEA aplicado a Jogos Olímpicos foi proposto por Lozano et al. (2002). Nesse artigo, as medalhas de ouro, prata e bronze conquistadas por cada país foram utilizadas como outputs, e os inputs utilizados para avaliação do desempenho foram população e o Produto Nacional Bruto (PNB). ...
* ... Produto Nacional Bruto (PNB). O artigo comparou a eficiência em 5 diferentes olimpíadas de verão (1984)(1985)(1986)(1987)(1988)(1989)(1990)(1991)(1992)(1993)(1994)(1995)(1996)(1997)(1998)(1999)(2000). É importante ressaltar que grande parte da literatura sobre aplicação de DEA em Jogos Olímpicos utiliza este mesmo par input/output apresentado por Lozano et. al. (2002), sendo que normalmente é utilizado o PIB no lugar do PNB. Lins et al. (2003) desenvolveram um modelo levando em conta uma restrição a mais: a quantidade total de medalhas a ser distribuída entre os países é constante. Isto resultou em um novo modelo, o chamado modelo DEA de ganhos de soma zero (Zero Sum Gains DEA model -ZSG-DEA). Li et ...
* [**COMPARAÇÃO DA EFICIÊNCIA DOS JOGOS OLÍMPICOS RIO 2016 PARA DOIS CONJUNTOS DIFERENTES DE OUTPUTS ATRAVÉS DA UTILIZAÇÃO DE UM MODELO NETWORK DEA BCC ADITIVO**](https://www.researchgate.net/publication/319090035_COMPARACAO_DA_EFICIENCIA_DOS_JOGOS_OLIMPICOS_RIO_2016_PARA_DOIS_CONJUNTOS_DIFERENTES_DE_OUTPUTS_ATRAVES_DA_UTILIZACAO_DE_UM_MODELO_NETWORK_DEA_BCC_ADITIVO)
* Conference Paper
* Full-text available
  + Jan 2017
  + Karina Sacramento
  + [Karina Sacramento](https://www.researchgate.net/profile/Karina_Sacramento)
  + [Gustado Freitas](https://www.researchgate.net/scientific-contributions/2131715966_Gustado_Freitas)
  + [Mendes Callado](https://www.researchgate.net/scientific-contributions/2131732557_Mendes_Callado)
  + João Carlos Correia Baptista Soares de Mello
  + [João Carlos Correia Baptista Soares de Mello](https://www.researchgate.net/profile/Joao_Mello)
* [View](https://www.researchgate.net/publication/319090035_COMPARACAO_DA_EFICIENCIA_DOS_JOGOS_OLIMPICOS_RIO_2016_PARA_DOIS_CONJUNTOS_DIFERENTES_DE_OUTPUTS_ATRAVES_DA_UTILIZACAO_DE_UM_MODELO_NETWORK_DEA_BCC_ADITIVO)
* Show abstract
* ... Team handball is a relatively young sport on the global stage. The (Bernand and Busse, 2004;Lozano et al., 2002). This paper examines Olympic success from a different perspective; namely, a case study of the success of Icelandic handball in 2008. ...
* ... Countries with larger populations should have an advantage over smaller countries because they can select players with advantageous physical attributes. Existing research supports this claim indirectly, in the sense that there is a positive relationship between population size and Olympic medals (Bernand and Busse, 2004;Lozano et al., 2002). However, there may not be a linear relationship between population size and the number of players with the right skills and characteristics. ...
* [**No Man is his Own Creation: The social context of excellence in sports.**](https://www.researchgate.net/publication/331327060_No_Man_is_his_Own_Creation_The_social_context_of_excellence_in_sports)
* Thesis
* Full-text available
  + Jun 2012
  + Vidar Halldorsson
  + [Vidar Halldorsson](https://www.researchgate.net/profile/Vidar_Halldorsson)
* [View](https://www.researchgate.net/publication/331327060_No_Man_is_his_Own_Creation_The_social_context_of_excellence_in_sports)
* Show abstract
* ... Winning athletes are not only awarded medals but also typically receive monetary rewards from their home countries. Given the importance of the Olympic Games, it is not surprising that there has been much prior research on national Olympic performance (Emrich, Klein, Pitsch, and Pierdzioch, 2012; Vagenas and Vlachokyriakou, 2012; Forrest, Sanz, and Tena, 2010; Wu, Liang, and Yang, 2009; Li, Liang, Chen, and Morita, 2008; Lui and Suen, 2008; Rathke and Woitek, 2008; Bernard and Busse, 2004; Churilov and Flitman, 2004; Hoffman, Ging, and Ramasamy, 2004; Johnson, 2004; Lins, Gomes, de Mello, and de Mello, 2003; Tcha and Pershin, 2003; Lozano, Villa, Guerrero, and Cortes, 2002; Condon, Golden, and Wasil, 1999). Some of the above studies utilized a frontier analysis (data envelopment analysis). ...
* ... Some of the above studies utilized a frontier analysis (data envelopment analysis). In this type of study, the determinants of Olympic medal success were not directly addressed; rather, a ranking of Olympic performance was calculated (Wu, Liang, and Chen, 2009; Wu, Liang, and Yang, 2009; Li, Liang, Chen, and Morita, 2008; Churilov and Flitman, 2006; Lins, Gomes, de Mello, and de Mello, 2003; Lozano, Villa, Guerrero, and Cortes, 2002). Other studies used a wide variety of analyses including neural networks (Condon, Golden, and Wasil, 1999); revealed comparative advantage (Tcha and Pershin, 2003); efficiency and production analyses (Rathke and Woitek, 2008); Tobit analysis (Forrest, Sanz, and Tena, 2010); and Poisson analysis (Lui and Suen, 2008). ...
* [**Estimating the Determinants of Summer Olympic Game Performance**](https://www.researchgate.net/publication/267391137_Estimating_the_Determinants_of_Summer_Olympic_Game_Performance)
* Article
* Full-text available
  + Mar 2014
  + Onur Burak Celik
  + [Onur Burak Celik](https://www.researchgate.net/profile/Onur_Celik3)
* [View](https://www.researchgate.net/publication/267391137_Estimating_the_Determinants_of_Summer_Olympic_Game_Performance)
* Show abstract
* ... Lozano et al. have employed this method for the first time. In fact, they regarded GNP and population of each country as inputs and medals as outputs [5]. In a similar approach, Linz et al. have considered more restriction to make a new model in which the number of all medals was fixed. ...
* [**Performance evaluation and ranking of participation Asian countries in 2012 London Olympic Games through Data Envelopment Analysis**](https://www.researchgate.net/publication/271703932_Performance_evaluation_and_ranking_of_participation_Asian_countries_in_2012_London_Olympic_Games_through_Data_Envelopment_Analysis)
* Article
* Full-text available
  + Jul 2014
  + Farhad Yazdani
  + [Farhad Yazdani](https://www.researchgate.net/profile/Farhad_Yazdani2)
  + Hadi Shirouyehzad
  + [Hadi Shirouyehzad](https://www.researchgate.net/profile/Hadi_Shirouyehzad)
* [View](https://www.researchgate.net/publication/271703932_Performance_evaluation_and_ranking_of_participation_Asian_countries_in_2012_London_Olympic_Games_through_Data_Envelopment_Analysis)
* Show abstract
* ... CHURILOV; FLITMAN, 2006;HAI, 2007;LEI et al., 2014;LI et al., 2008LI et al., , 2015LINS et al., 2003;LOZANO et al., 2002 2014;LACERDA et al., 2011;SAATY, 2008;SITARZ, 2012 Índices h sucessivos também podem ser calculados para diversos fins. Prathap (2006) propôs o cálculo do índice h do índice h de autores, para encontrar os principais autores de certo departamento, enquanto Schubert (2007) ...
* [**Identificação das Potências Olímpicas dos Jogos Olímpicos de 2016 Utilizando o Conceito de Núcleo h**](https://www.researchgate.net/publication/319236250_Identificacao_das_Potencias_Olimpicas_dos_Jogos_Olimpicos_de_2016_Utilizando_o_Conceito_de_Nucleo_h)
* Article
* Full-text available
  + Aug 2017
  + [Juliana De](https://www.researchgate.net/scientific-contributions/2132026067_Juliana_De)
  + [Castro Reis](https://www.researchgate.net/scientific-contributions/2132029215_Castro_Reis)
  + Bruno Torres
  + [Bruno Torres](https://www.researchgate.net/profile/Bruno_Torres7)
  + João Carlos Correia Baptista Soares de Mello
  + [João Carlos Correia Baptista Soares de Mello](https://www.researchgate.net/profile/Joao_Mello)
* [View](https://www.researchgate.net/publication/319236250_Identificacao_das_Potencias_Olimpicas_dos_Jogos_Olimpicos_de_2016_Utilizando_o_Conceito_de_Nucleo_h)
* Show abstract
* ... There are already some approaches using DEA to establish Olympic rankings. The very first one was proposed by Lozano et al (2002). They used population and GNP as inputs and the medals as outputs. ...
* [**Some rankings for the Athens Olympic Games using DEA models with a constant input**](https://www.researchgate.net/publication/267403155_Some_rankings_for_the_Athens_Olympic_Games_using_DEA_models_with_a_constant_input)
* Article
* Full-text available
  + Jun 2008
  + João Carlos Correia Baptista Soares de Mello
  + [João Carlos Correia Baptista Soares de Mello](https://www.researchgate.net/profile/Joao_Mello)
  + Lidia Angulo-Meza
  + [Lidia Angulo-Meza](https://www.researchgate.net/profile/Lidia_Angulo-Meza)
  + [Brenda Branco Da Silva](https://www.researchgate.net/scientific-contributions/2056923732_Brenda_Branco_Da_Silva)
* [View](https://www.researchgate.net/publication/267403155_Some_rankings_for_the_Athens_Olympic_Games_using_DEA_models_with_a_constant_input)
* Show abstract
* ... However, this practice mainly leads to two problems, namely (1) the results of evaluation are too subjective because it heavily relies on the given weights, and (2) one group of weights is not reasonable because different countries are differently sensitive to different medals that they won. To solve these two problems, this paper applies the proposed GEEFDEA models with the assurance region (AR) (Churilov and Flitman, 2006; Dyson, 1988; Li, Liang, Chen, & Morita, 2008; Lozano, Villa, Guerrero, & Cortés, 2002; Zhu & Cook, 2007) to the dataset. For example, we can add assurance region (Sitarz (2013), De Mello, Angulo-Meza, Da Silva (2009) and Hai (2007)) constraints ...
* [**A generalized equilibrium efficient frontier data envelopment analysis approach for evaluating DMUs with fixed-sum outputs**](https://www.researchgate.net/publication/276169430_A_generalized_equilibrium_efficient_frontier_data_envelopment_analysis_approach_for_evaluating_DMUs_with_fixed-sum_outputs)
* Article
  + Apr 2015
  + [EUR J OPER RES](https://www.researchgate.net/journal/0377-2217_European_Journal_of_Operational_Research)
  + Min Yang
  + [Min Yang](https://www.researchgate.net/profile/Min_Yang17)
  + Yongjun Li
  + [Yongjun Li](https://www.researchgate.net/profile/Yongjun_Li11)
  + [Liang Liang](https://www.researchgate.net/scientific-contributions/65141109_Liang_Liang)
* [View](https://www.researchgate.net/publication/276169430_A_generalized_equilibrium_efficient_frontier_data_envelopment_analysis_approach_for_evaluating_DMUs_with_fixed-sum_outputs)
* Show abstract
* ... The first branch is related to the papers investigating the Olympic performance with respect to other factors. Lozano et al. (2002) consider two inputs (GNP and population) and three outputs (number of gold, silver, and bronze medals won), and then use DEA to measure the performance of nations participating in five Summer Olympic Games. Lins et al. (2002)2012, 2013) presents mean value and volume-based sensitivity analysis, and the incenter of a convex cone for Olym ...
* [**Measuring Olympics performance based on a distance-based approach**](https://www.researchgate.net/publication/285392722_Measuring_Olympics_performance_based_on_a_distance-based_approach)
* Article
  + Nov 2015
  + [Int Trans Oper Res](https://www.researchgate.net/journal/0969-6016_International_Transactions_in_Operational_Research)
  + [Xiongfei Cao](https://www.researchgate.net/scientific-contributions/2086518593_Xiongfei_Cao)
  + Yelin Fu
  + [Yelin Fu](https://www.researchgate.net/profile/Yelin_Fu)
  + [Jiangze Du](https://www.researchgate.net/scientific-contributions/2068585840_Jiangze_Du)
  + [Ming Wang](https://www.researchgate.net/scientific-contributions/2002387447_Ming_Wang)
* [View](https://www.researchgate.net/publication/285392722_Measuring_Olympics_performance_based_on_a_distance-based_approach)
* Show abstract
* ... Table 9 displays the review of literature on performance measurement in Olympics. The very first one was carried out by Lozano et al. (2002). They assessed the performance of the countries that participated in the last five Summer Olympic Games. ...
* [**A Comprehensive Review of Data Envelopment Analysis (DEA) in Sports**](https://www.researchgate.net/publication/336769140_A_Comprehensive_Review_of_Data_Envelopment_Analysis_DEA_in_Sports)
* Article
* Full-text available
  + Oct 2019
  + Zahoor Ul Haq Bhat
  + [Zahoor Ul Haq Bhat](https://www.researchgate.net/profile/Zahoor_Ul_Bhat2)
  + [D Sultana](https://www.researchgate.net/scientific-contributions/2154294491_D_Sultana)
  + Qaiser Farooq Dar
  + [Qaiser Farooq Dar](https://www.researchgate.net/profile/Qaiser_Dar2)
* [View](https://www.researchgate.net/publication/336769140_A_Comprehensive_Review_of_Data_Envelopment_Analysis_DEA_in_Sports)
* Show abstract
* ... Some focus on medal counts [2][3][4][5], while other studies examine a country's total medals expressed as a share of all available medals [6][7][8]. Another branch of literature employs methods more commonly used to study firm efficiency, including data envelope analysis [9,10] and stochastic frontier analysis [11]. All of these cited studies point to considerable variation in country-level performance, which implies the presence of unobserved country-specific traits, such as sports culture, elite sports institutes, sports management, and sports medicine in generating success [12][13][14][15][16]. ...
* [**Success at the Summer Olympics: How Much Do Economic Factors Explain?**](https://www.researchgate.net/publication/307822604_Success_at_the_Summer_Olympics_How_Much_Do_Economic_Factors_Explain)
* Article
* Full-text available
  + Dec 2014
  + Pravin Trivedi
  + [Pravin Trivedi](https://www.researchgate.net/profile/Pravin_Trivedi)
  + [David M. Zimmer](https://www.researchgate.net/scientific-contributions/11146474_David_M_Zimmer)
* [View](https://www.researchgate.net/publication/307822604_Success_at_the_Summer_Olympics_How_Much_Do_Economic_Factors_Explain)
* Show abstract
* ... For instance, the market share of a certain industry is constant, so each firm in the industry attempts to compete for more market share from its competitors. Similar cases also occur in Olympic Games evaluations (Lozano, Villa, Guerrero, & Cortes, 2002; Churilov & Flitman, 2006; Li, Liang, Yao, & Hiroshi, 2008; Wu, Liang, Chen, 2009; Wu, Liang, Yang, 2009), in which the total number of medals is fixed. When evaluating Olympic Achievements, Lins, Gomes, Soares de Mello, and Soares de Mello (2003) observed that increasing the number of medals won by one country will reduce the total number of medals won by the other countries. ...
* [**An equilibrium efficiency frontier data envelopment analysis approach for evaluating decision-making units with fixed-sum outputs**](https://www.researchgate.net/publication/264161307_An_equilibrium_efficiency_frontier_data_envelopment_analysis_approach_for_evaluating_decision-making_units_with_fixed-sum_outputs)
* Article
  + Dec 2014
  + [EUR J OPER RES](https://www.researchgate.net/journal/0377-2217_European_Journal_of_Operational_Research)
  + Min Yang
  + [Min Yang](https://www.researchgate.net/profile/Min_Yang17)
  + Yongjun Li
  + [Yongjun Li](https://www.researchgate.net/profile/Yongjun_Li11)
  + Ya Chen
  + [Ya Chen](https://www.researchgate.net/profile/Ya_Chen7)
  + [Liang Liang](https://www.researchgate.net/scientific-contributions/65141109_Liang_Liang)
* [View](https://www.researchgate.net/publication/264161307_An_equilibrium_efficiency_frontier_data_envelopment_analysis_approach_for_evaluating_decision-making_units_with_fixed-sum_outputs)
* Show abstract
* ... DEA는 스포츠서비스산업의 과학적이고 효과적인 분 석에 다양하게 적용되고 있다. 예를 들면, 올림픽 경기 [22,23], 축구[24,25], 농구[26], 미식축구[27,28], 골프[29] 등이 있다. ...
* [**Selecting the Batters of National Baseball Squad using Data Envelopment Analysis**](https://www.researchgate.net/publication/264031411_Selecting_the_Batters_of_National_Baseball_Squad_using_Data_Envelopment_Analysis)
* Article
  + Jan 2014
  + [Yeung-Ki Suk](https://www.researchgate.net/scientific-contributions/2067900099_Yeung-Ki_Suk)
* [View](https://www.researchgate.net/publication/264031411_Selecting_the_Batters_of_National_Baseball_Squad_using_Data_Envelopment_Analysis)
* Show abstract
* ... There are many applica- tions of the DEA methodology to sports: Olympic Games (e.g. Lozano, Villa, Guerrero, & Cortés, 2002;Li, Liang, Chen, & Morita, 2008;Soares de Mello, Angulo-Meza, & Branco da Silva, 2009;Wu, Liang, & Chen et al., 2009 ;Wu, Zhou, & Liang, 2010;Zhang, Li, Meng, & Liu, 2009 ); basketball (e.g. Cooper, Ruiz, & Sirvent, 2009, Cooper, Ramón, Ruiz, & Sirvent, 2011; baseball (e.g. ...
* [**Assessing the scoring efficiency of a football match**](https://www.researchgate.net/publication/303439446_Assessing_the_scoring_efficiency_of_a_football_match)
* Article
  + May 2016
  + [EUR J OPER RES](https://www.researchgate.net/journal/0377-2217_European_Journal_of_Operational_Research)
  + Gabriel Villa
  + [Gabriel Villa](https://www.researchgate.net/profile/Gabriel_Villa)
  + Sebastián Lozano
  + [Sebastián Lozano](https://www.researchgate.net/profile/Sebastian_Lozano)
* [View](https://www.researchgate.net/publication/303439446_Assessing_the_scoring_efficiency_of_a_football_match)
* Show abstract
* ... 2014), Olympic games (e.g. Lozano et al., 2002;Wu et al., 2010), sport 3 federations (de Carlos et al., 2017), tennis (e.g. Klaasen and Magnus, 2009;Ruiz et al., 2013), etc. ...
* [**Benchmarking Formula One auto racing circuits: a two stage DEA approach**](https://www.researchgate.net/publication/326996727_Benchmarking_Formula_One_auto_racing_circuits_a_two_stage_DEA_approach)
* Article
* Full-text available
  + Aug 2018
  + Ester Gutierrez
  + [Ester Gutierrez](https://www.researchgate.net/profile/Ester_Gutierrez)
  + Sebastián Lozano
  + [Sebastián Lozano](https://www.researchgate.net/profile/Sebastian_Lozano)
* [View](https://www.researchgate.net/publication/326996727_Benchmarking_Formula_One_auto_racing_circuits_a_two_stage_DEA_approach)
* Show abstract
* ... Observa-se que essa área, apesar de ainda pequena, é bastante concentrada e consistente no que se refere à fundamentação teórica. Em média, cada estudo mencionou outros cinco trabalhos da amostra, sendoLozano et al. (2002) os autores que receberam o maior número de citação. Em seguida, surgem Lins et al. (2003) e Churilov & Flitman (2006), cada um citado 17 vezes por autores da mesma amostra. ...
* [**Revisão bibliográfica das aplicações de Análise Envoltória de Dados em Jogos Olímpicos**](https://www.researchgate.net/publication/335415928_Revisao_bibliografica_das_aplicacoes_de_Analise_Envoltoria_de_Dados_em_Jogos_Olimpicos)
* Article
* Full-text available
  + Aug 2019
  + Wallace Rodrigues
  + [Wallace Rodrigues](https://www.researchgate.net/profile/Wallace_Rodrigues2)
  + Mariana Almeida
  + [Mariana Almeida](https://www.researchgate.net/profile/Mariana_Almeida)
  + [Alessandro Teixeira de Lima](https://www.researchgate.net/scientific-contributions/2161788920_Alessandro_Teixeira_de_Lima)
* [View](https://www.researchgate.net/publication/335415928_Revisao_bibliografica_das_aplicacoes_de_Analise_Envoltoria_de_Dados_em_Jogos_Olimpicos)
* Show abstract
* ... Por esta e outras razões, esse ranking apesar de bastante difundido, não é uma unanimidade, e diversos outros métodos de classificação foram propostos, tanto para Jogos Olímpicos como para outras competições multimodalidades [Lozano et al., 2002;Tcha;Pershin, 2003;Churilov e Flitman, 2006;Hai, 2007;Li et al., 2008;Saaty, 2008;Branco Da Silva, 2008;Zhang et al., 2009;Lacerda et al., 2011;Wang;Liu, 2011;Sitarz, 2012Sitarz, , 2013Bergiante, 2012;Benicio;Soares, 2013;Gomes Júnior;Angulo Meza, 2014;Lei et al., 2014;Marinho;Almeida;Souzacardoso, 2016]. ...
* [**ANÁLISE DE PERFORMANCE DOS JOGOS OLÍMPICOS DE 2016 E 2018 COM UMA METODOLOGIA BASEADA NO NÚCLEO H**](https://www.researchgate.net/publication/329130989_ANALISE_DE_PERFORMANCE_DOS_JOGOS_OLIMPICOS_DE_2016_E_2018_COM_UMA_METODOLOGIA_BASEADA_NO_NUCLEO_H)
* Conference Paper
* Full-text available
  + Nov 2018
  + [Juliana de Castro Reis](https://www.researchgate.net/scientific-contributions/2116044375_Juliana_de_Castro_Reis)
  + Bruno Torres
  + [Bruno Torres](https://www.researchgate.net/profile/Bruno_Torres7)
  + João Carlos Correia Baptista Soares de Mello
  + [João Carlos Correia Baptista Soares de Mello](https://www.researchgate.net/profile/Joao_Mello)
* [View](https://www.researchgate.net/publication/329130989_ANALISE_DE_PERFORMANCE_DOS_JOGOS_OLIMPICOS_DE_2016_E_2018_COM_UMA_METODOLOGIA_BASEADA_NO_NUCLEO_H)
* Show abstract
* ... DEA also provides useful benchmark information that can improve the performance of inefficient DMUs. This methodological approach to sport has been used previously in the Olympics (Lozano, Villa, Guerrero, & Cortés, 2002) and to evaluate individual players of different sports (Ruiz, Pastor, & Pastor, 2013;Sueyoshi, Ohnishi, & Kinase, 1999). To the best of the author's knowledge, this is a novel contribution in the field of classification in para-sport. ...
* [**A mathematical model for decision-making in the classification of para-footballers with different severity of coordination impairments**](https://www.researchgate.net/publication/329909788_A_mathematical_model_for_decision-making_in_the_classification_of_para-footballers_with_different_severity_of_coordination_impairments)
* Article
  + Dec 2018
  + [J SPORT SCI](https://www.researchgate.net/journal/0264-0414_Journal_of_Sports_Sciences)
  + Diego Pastor
  + [Diego Pastor](https://www.researchgate.net/profile/Diego_Pastor)
  + [María Campayo-Piernas](https://www.researchgate.net/scientific-contributions/2122584255_Maria_Campayo-Piernas)
  + Jesús T. Pastor
  + [Jesús T. Pastor](https://www.researchgate.net/profile/Jesus_T_Pastor)
  + Raul Reina
  + [Raul Reina](https://www.researchgate.net/profile/Raul_Reina)
* [View](https://www.researchgate.net/publication/329909788_A_mathematical_model_for_decision-making_in_the_classification_of_para-footballers_with_different_severity_of_coordination_impairments)
* Show abstract
* ... Towards improving the inefficient entities, a side outcome of the efficiency evaluation arises from the effort that most of the studies make in order to identify a reference set for the individual DMU. This benchmark set is usually in the form of a linear combination of the DMUs offering the ultimate target that the inefficient entity is recommended to consider in order to become (more) efficient (see Abolghasem et al. [1]; Lozano et al. [38]; Wu et al. [78]). However, Flokou et al. [25] argued that the provided benchmark set may not include similar references in comparison to the inefficient DMU in terms of operating practices and hence this approach may offer goals which practically cannot be attained by the inefficient DMU. ...
* [**Cross-efficiency evaluation in the presence of flexible measures with an application to healthcare systems**](https://www.researchgate.net/publication/331458023_Cross-efficiency_evaluation_in_the_presence_of_flexible_measures_with_an_application_to_healthcare_systems)
* Article
  + Mar 2019
  + [Health Care Manag Sci](https://www.researchgate.net/journal/1386-9620_Health_Care_Management_Science)
  + Sepideh Abolghasem
  + [Sepideh Abolghasem](https://www.researchgate.net/profile/Sepideh_Abolghasem)
  + Mehdi Toloo
  + [Mehdi Toloo](https://www.researchgate.net/profile/Mehdi_Toloo)
  + Santiago Amézquita
  + [Santiago Amézquita](https://www.researchgate.net/profile/Santiago_Amezquita2)
* [View](https://www.researchgate.net/publication/331458023_Cross-efficiency_evaluation_in_the_presence_of_flexible_measures_with_an_application_to_healthcare_systems)
* Show abstract
* ... The majority of existing approaches to measuring Olympic achievement are related to Data Envelopment Analysis (DEA), evaluating input (i.e., GDP per capita and population) and output (i.e., the number of medals) efficiency using a family of DEA models and their variants. The pioneering work in this domain is presented by Lozano et al. [6]. Lins et al. [7] take into consideration the fact that the sum of medals is constant and then develop zero-sum gains DEA model to rank NOCs in Olympics. ...
* [**Modifying Olympics Medal Table via a Stochastic Multicriteria Acceptability Analysis**](https://www.researchgate.net/publication/327056785_Modifying_Olympics_Medal_Table_via_a_Stochastic_Multicriteria_Acceptability_Analysis)
* Article
* Full-text available
  + Aug 2018
  + [MATH PROBL ENG](https://www.researchgate.net/journal/1024-123X_Mathematical_Problems_in_Engineering)
  + [Jiangze Du](https://www.researchgate.net/scientific-contributions/2068585840_Jiangze_Du)
* [View](https://www.researchgate.net/publication/327056785_Modifying_Olympics_Medal_Table_via_a_Stochastic_Multicriteria_Acceptability_Analysis)
* Show abstract
* ... Recently, evaluating the performance of participating countries in the Olympic Games is a relevant application of DEA ( Lei et al., 2015). Previous studies have used DEA models to measure the efficiency of participating countries in Los Angeles 1984, Seoul 1988, Barcelona 1992, Atlanta 1996and Sydney 2000(Lozano et al., 2002), Sydney 2000 ( Lins et al., 2003;Churilov & Flitman, 2006), Athens 2004(Mello, Angulo-Meza & Silva, 2009Zhang et al., 2009;Azizi & Wang, 2013), Beijing 2008 (Wu, Zhou & Liang, 2010;Chiang, Hwang & Liu, 2011;Mello, Angulo-Meza & Lacerda, 2012), London 2012(Bi et al., 2014Li et al., 2015;Yang, Li & Liang, 2015) and Rio 2016(Del Corral, Gonzalez & Santos, 2017Jablonsky, 2018) Olympic Games. Nevertheless, the two-stage contextual DEA model has not been used previously in research on the Olympic Games. ...
* [**A two-stage DEA model to evaluate the efficiency of countries at the Rio 2016 Olympic Games**](https://www.researchgate.net/publication/334457237_A_two-stage_DEA_model_to_evaluate_the_efficiency_of_countries_at_the_Rio_2016_Olympic_Games)
* Article
  + Jul 2019
  + Carlos Alberto Gonçalves
  + [Carlos Alberto Gonçalves](https://www.researchgate.net/profile/Carlos_Goncalves15)
  + [Tiago Silveira Gontijo](https://www.researchgate.net/scientific-contributions/2132929574_Tiago_Silveira_Gontijo)
  + [Alexandre De Cássio Rodrigues](https://www.researchgate.net/scientific-contributions/2150274032_Alexandre_De_Cassio_Rodrigues)
* [View](https://www.researchgate.net/publication/334457237_A_two-stage_DEA_model_to_evaluate_the_efficiency_of_countries_at_the_Rio_2016_Olympic_Games)
* Show abstract
* ... Novelty of our approach consists in selection of variables and application of an original two-stage serial DEA model. Lozano et al. (2002) analyzed results of the last five Summer Olympic Games using DEA models with variable returns to scale and two inputs (population and GDP) and three outputs (the numbers of gold, silver and bronze medals). Weight restrictions have been used in order to assign higher importance to golds than to silvers and the same for silvers to bronzes. ...
* [**Ranking of countries in sporting events using two-stage data envelopment analysis models: a case of Summer Olympic Games 2016**](https://www.researchgate.net/publication/324483999_Ranking_of_countries_in_sporting_events_using_two-stage_data_envelopment_analysis_models_a_case_of_Summer_Olympic_Games_2016)
* Article
  + Apr 2018
  + [CENT EUR J OPER RES](https://www.researchgate.net/journal/1435-246X_Central_European_Journal_of_Operations_Research)
  + Josef Jablonsky
  + [Josef Jablonsky](https://www.researchgate.net/profile/Josef_Jablonsky)
* [View](https://www.researchgate.net/publication/324483999_Ranking_of_countries_in_sporting_events_using_two-stage_data_envelopment_analysis_models_a_case_of_Summer_Olympic_Games_2016)
* Show abstract
* ... La revisión de la literatura sobre la eficiencia en la relación de los resultados deportivos nos muestra estudios que utilizan el método DEA, aplicado a los países participantes en los Juegos Olímpicos, de los cuales podemos destacar los siguientes trabajos. Lozano et al. (2002) midieron el desempeño de las naciones participantes en cinco Juegos Olímpicos de Verano (Los Ángeles 1984, Seoul 1988, Barcelona 1992, Atlante 1996, y Sydney 2000, mediante un modelo DEA. Esta investigación toma en consideración dos inputs como son el Producto Interno Bruto (PIB) y la población, y tres outputs o resultados como son medallas de oro, medallas de plata y medallas de bronce. ...
* [**Medición de la eficiencia en las organizaciones de deporte formativo mediante un modelo DEA (Measuring efficiency in sports organizations using a DEA model)**](https://www.researchgate.net/publication/324313470_Medicion_de_la_eficiencia_en_las_organizaciones_de_deporte_formativo_mediante_un_modelo_DEA_Measuring_efficiency_in_sports_organizations_using_a_DEA_model)
* Article
* Full-text available
  + Feb 2017
  + Xavier Omar Jácome Ortega
  + [Xavier Omar Jácome Ortega](https://www.researchgate.net/profile/Xavier_Jacome_Ortega)
  + [Jorge Luis Delgado Salazar](https://www.researchgate.net/scientific-contributions/2140945679_Jorge_Luis_Delgado_Salazar)
* [View](https://www.researchgate.net/publication/324313470_Medicion_de_la_eficiencia_en_las_organizaciones_de_deporte_formativo_mediante_un_modelo_DEA_Measuring_efficiency_in_sports_organizations_using_a_DEA_model)
* Show abstract
* ... Table 9 displays the review of literature on performance measurement in Olympics. The very first one was carried out by Lozano et al. (2002). They assessed the performance of the countries that participated in the last five Summer Olympic Games. ...
* [**A COMPREHENSIVE REVIEW OF DATA ENVELOPMENT ANALYSIS (DEA) IN SPORTS**](https://www.researchgate.net/publication/336738780_A_COMPREHENSIVE_REVIEW_OF_DATA_ENVELOPMENT_ANALYSIS_DEA_IN_SPORTS)
* Article
* Full-text available
  + Jan 2019
  + Zahoor Ul Haq Bhat
  + [Zahoor Ul Haq Bhat](https://www.researchgate.net/profile/Zahoor_Ul_Bhat2)
  + [D Sultana](https://www.researchgate.net/scientific-contributions/2154294491_D_Sultana)
  + Qaiser Farooq Dar
  + [Qaiser Farooq Dar](https://www.researchgate.net/profile/Qaiser_Dar2)
* [View](https://www.researchgate.net/publication/336738780_A_COMPREHENSIVE_REVIEW_OF_DATA_ENVELOPMENT_ANALYSIS_DEA_IN_SPORTS)
* Show abstract
* ... The predominant technique that has been used for analysing the success of nations at the Olympic Games is data envelopment analysis (Churilov & Flitman, 2006;Gomes & Lins, 2008;Li, Lei, Dai, & Liang, 2015;Li, Liang, Chen, & Morita, 2008;Lozano, Villa, Guerrero, & Cortés, 2002;Yang, Li, & Liang, 2015;Zhang, Li, Meng, & Liu, 2009). This procedure is inherently nonparametric, which makes it robust against model misspecification at the cost of reduced power and clarity. ...
* [**A comparison of Olympic and Paralympic performances**](https://www.researchgate.net/publication/323936481_A_comparison_of_Olympic_and_Paralympic_performances)
* Article
  + Mar 2018
  + [J OPER RES SOC](https://www.researchgate.net/journal/0160-5682_Journal_of_the_Operational_Research_Society)
  + [David F. Percy](https://www.researchgate.net/scientific-contributions/7291202_David_F_Percy)
* [View](https://www.researchgate.net/publication/323936481_A_comparison_of_Olympic_and_Paralympic_performances)
* Show abstract
* [**Assessment of the efficiency of Croatia compared to other European countries using data envelopment analysis with application of window analysis**](https://www.researchgate.net/publication/264436708_Assessment_of_the_efficiency_of_Croatia_compared_to_other_European_countries_using_data_envelopment_analysis_with_application_of_window_analysis)
* Article
  + Jan 2013
  + [Int J Sustain Econ](https://www.researchgate.net/journal/1756-5804_International_Journal_of_Sustainable_Economy)
  + Lorena Skuflic
  + [Lorena Skuflic](https://www.researchgate.net/profile/Lorena_Skuflic)
  + Danijela Rabar
  + [Danijela Rabar](https://www.researchgate.net/profile/Danijela_Rabar)
  + Bruno Skrinjaric
  + [Bruno Skrinjaric](https://www.researchgate.net/profile/Bruno_Skrinjaric)
* [View](https://www.researchgate.net/publication/264436708_Assessment_of_the_efficiency_of_Croatia_compared_to_other_European_countries_using_data_envelopment_analysis_with_application_of_window_analysis)
* Show abstract
* [**Performance Analysis During the 2014 FIFA World Cup Qualification**](https://www.researchgate.net/publication/269872983_Performance_Analysis_During_the_2014_FIFA_World_Cup_Qualification)
* Article
* Full-text available
  + Dec 2014
  + [Open Sports Sci J](https://www.researchgate.net/journal/1875-399X_The_Open_Sports_Sciences_Journal)
  + Martin Flegl
  + [Martin Flegl](https://www.researchgate.net/profile/Martin_Flegl2)
* [View](https://www.researchgate.net/publication/269872983_Performance_Analysis_During_the_2014_FIFA_World_Cup_Qualification)
* Show abstract
* [**Game, set and match: evaluating the efficiency of male professional tennis players**](https://www.researchgate.net/publication/271919765_Game_set_and_match_evaluating_the_efficiency_of_male_professional_tennis_players)
* Article
  + Apr 2014
  + [J PROD ANAL](https://www.researchgate.net/journal/0895-562X_Journal_of_Productivity_Analysis)
  + Anthony Glass
  + [Anthony Glass](https://www.researchgate.net/profile/Anthony_Glass2)
  + Karligash Kenjegalieva
  + [Karligash Kenjegalieva](https://www.researchgate.net/profile/Karligash_Kenjegalieva)
  + [Jason Taylor](https://www.researchgate.net/scientific-contributions/2065989992_Jason_Taylor)
* [View](https://www.researchgate.net/publication/271919765_Game_set_and_match_evaluating_the_efficiency_of_male_professional_tennis_players)
* Show abstract
* [**Applying a Peer-Restricted Cross-Efficiency Approach to Measuring the Performance of International Tourist Hotels in Taipei**](https://www.researchgate.net/publication/271936733_Applying_a_Peer-Restricted_Cross-Efficiency_Approach_to_Measuring_the_Performance_of_International_Tourist_Hotels_in_Taipei)
* Article
  + Feb 2014
  + [J Hospit Market Manag](https://www.researchgate.net/journal/1936-8623_Journal_of_Hospitality_Marketing_Management)
  + Zhixiang Zhou
  + [Zhixiang Zhou](https://www.researchgate.net/profile/Zhixiang_Zhou3)
  + Jie Wu
  + [Jie Wu](https://www.researchgate.net/profile/Jie_Wu83)
* [View](https://www.researchgate.net/publication/271936733_Applying_a_Peer-Restricted_Cross-Efficiency_Approach_to_Measuring_the_Performance_of_International_Tourist_Hotels_in_Taipei)
* Show abstract
* [**Measuring countries’ performance at the Summer Olympic Games in Rio 2016**](https://www.researchgate.net/publication/329263896_Measuring_countries'_performance_at_the_Summer_Olympic_Games_in_Rio_2016)
* Article
  + Nov 2018
  + Martin Flegl
  + [Martin Flegl](https://www.researchgate.net/profile/Martin_Flegl2)
  + Luis Antonio Andrade Rosas
  + [Luis Antonio Andrade Rosas](https://www.researchgate.net/profile/Luis_Andrade_Rosas)
* [View](https://www.researchgate.net/publication/329263896_Measuring_countries'_performance_at_the_Summer_Olympic_Games_in_Rio_2016)
* Show abstract
* [**Quantitative and qualitative impact of GDP on sport performance and its relation with corruption and other social factors**](https://www.researchgate.net/publication/319319100_Quantitative_and_qualitative_impact_of_GDP_on_sport_performance_and_its_relation_with_corruption_and_other_social_factors)
* Article
* Full-text available
  + Jan 2019
  + Luis Antonio Andrade Rosas
  + [Luis Antonio Andrade Rosas](https://www.researchgate.net/profile/Luis_Andrade_Rosas)
  + Martin Flegl
  + [Martin Flegl](https://www.researchgate.net/profile/Martin_Flegl2)
* [View](https://www.researchgate.net/publication/319319100_Quantitative_and_qualitative_impact_of_GDP_on_sport_performance_and_its_relation_with_corruption_and_other_social_factors)
* Show abstract
* [**A study of efficiency monitoring systems for match-fixing players in the Chinese Professional Baseball League**](https://www.researchgate.net/publication/276520214_A_study_of_efficiency_monitoring_systems_for_match-fixing_players_in_the_Chinese_Professional_Baseball_League)
* Article
  + May 2015
  + [Eur Sport Manag Q](https://www.researchgate.net/journal/1618-4742_European_Sport_Management_Quarterly)
  + Wen-Bin Lin
  + [Wen-Bin Lin](https://www.researchgate.net/profile/Wen_Bin_Lin2)
  + [Mei-Yen Chen](https://www.researchgate.net/scientific-contributions/38799065_Mei-Yen_Chen)
* [View](https://www.researchgate.net/publication/276520214_A_study_of_efficiency_monitoring_systems_for_match-fixing_players_in_the_Chinese_Professional_Baseball_League)
* Show abstract
* [**A DEA Approach to Performance-Based Budgeting of Formula One Constructors**](https://www.researchgate.net/publication/274505868_A_DEA_Approach_to_Performance-Based_Budgeting_of_Formula_One_Constructors)
* Article
  + Feb 2012
  + [J SPORT ECON](https://www.researchgate.net/journal/1527-0025_Journal_of_Sports_Economics)
  + Ester Gutierrez
  + [Ester Gutierrez](https://www.researchgate.net/profile/Ester_Gutierrez)
  + Sebastián Lozano
  + [Sebastián Lozano](https://www.researchgate.net/profile/Sebastian_Lozano)
* [View](https://www.researchgate.net/publication/274505868_A_DEA_Approach_to_Performance-Based_Budgeting_of_Formula_One_Constructors)
* Show abstract
* [**Comparative Assessment the of Effectiveness of Sports Development in the Russian Regions on the Basis of DEA Method**](https://www.researchgate.net/publication/321799442_Comparative_Assessment_the_of_Effectiveness_of_Sports_Development_in_the_Russian_Regions_on_the_Basis_of_DEA_Method)
* Article
* Full-text available
  + Nov 2017
  + Yuri Zelenkov
  + [Yuri Zelenkov](https://www.researchgate.net/profile/Yuri_Zelenkov)
  + [V. A. Tsvetkov](https://www.researchgate.net/scientific-contributions/2136399497_V_A_Tsvetkov)
  + [I. V. Solntsev](https://www.researchgate.net/scientific-contributions/2136410278_I_V_Solntsev)
* [View](https://www.researchgate.net/publication/321799442_Comparative_Assessment_the_of_Effectiveness_of_Sports_Development_in_the_Russian_Regions_on_the_Basis_of_DEA_Method)
* Show abstract
* [**O Apoio à Decisão em Avaliação Esportiva**](https://www.researchgate.net/publication/278038036_O_Apoio_a_Decisao_em_Avaliacao_Esportiva)
* Data
* Full-text available
  + Jun 2015
  + João Carlos Correia Baptista Soares de Mello
  + [João Carlos Correia Baptista Soares de Mello](https://www.researchgate.net/profile/Joao_Mello)
  + Lidia Angulo-Meza
  + [Lidia Angulo-Meza](https://www.researchgate.net/profile/Lidia_Angulo-Meza)
  + Silvio Figueiredo Gomes Júnior
  + [Silvio Figueiredo Gomes Júnior](https://www.researchgate.net/profile/Silvio_Gomes_Junior)
* [View](https://www.researchgate.net/publication/278038036_O_Apoio_a_Decisao_em_Avaliacao_Esportiva)
* [**Measuring the NBA Teams' Cross-Efficiency by DEA Game**](https://www.researchgate.net/publication/278038562_Measuring_the_NBA_Teams'_Cross-Efficiency_by_DEA_Game)
* Article
* Full-text available
  + May 2014
  + [AJOR](https://www.researchgate.net/journal/2160-8830_American_Journal_of_Operations_Research)
  + [Luiz Aizemberg](https://www.researchgate.net/scientific-contributions/2046929655_Luiz_Aizemberg)
  + [Marcos Costa Roboredo](https://www.researchgate.net/scientific-contributions/2032924595_Marcos_Costa_Roboredo)
  + Thiago Graça Ramos
  + [Thiago Graça Ramos](https://www.researchgate.net/profile/Thiago_Ramos)
  + [Alessandro Martins Alves](https://www.researchgate.net/scientific-contributions/81134097_Alessandro_Martins_Alves)
* [View](https://www.researchgate.net/publication/278038562_Measuring_the_NBA_Teams'_Cross-Efficiency_by_DEA_Game)
* Show abstract
* [**Η επίδραση της αυτοαντίληψης και του κλίματος κινή- τρων στην ηθική ικανότητα στη φυσική αγωγή. Εμπειρι- κή μελέτη σε καλλιτεχνικά και τυπικά γυμνάσια**](https://www.researchgate.net/publication/282247203_E_epidrase_tes_autoantilepses_kai_tou_klimatos_kine-_tron_sten_ethike_ikanoteta_ste_physike_agoge_Empeiri-_ke_melete_se_kallitechnika_kai_typika_gymnasia)
* Conference Paper
  + Jan 2012
  + [Ιωάννα Παρίση](https://www.researchgate.net/scientific-contributions/2081748692_Ioanna_Parise)
  + [Κατερίνα Μουρατίδου](https://www.researchgate.net/scientific-contributions/2081724492_Katerina_Mouratidou)
* [View](https://www.researchgate.net/publication/282247203_E_epidrase_tes_autoantilepses_kai_tou_klimatos_kine-_tron_sten_ethike_ikanoteta_ste_physike_agoge_Empeiri-_ke_melete_se_kallitechnika_kai_typika_gymnasia)
* [**BİST Sürdürülebilirlik Endeksindeki Şirketlerin Etkinliklerinin Ölçülmesi: Veri Zarflama Analizi İle Bir Uygulama - Measuring the Efficiency of Companies in BIST Sustainability Index: An Application With Data Envelopment Analysis**](https://www.researchgate.net/publication/325427545_BIST_Surdurulebilirlik_Endeksindeki_Sirketlerin_Etkinliklerinin_Olculmesi_Veri_Zarflama_Analizi_Ile_Bir_Uygulama_-_Measuring_the_Efficiency_of_Companies_in_BIST_Sustainability_Index_An_Application_Wit)
* Article
* Full-text available
  + May 2018
  + [Harun Dumlu](https://www.researchgate.net/scientific-contributions/2134143774_Harun_Dumlu)
  + [ESEN GÜRBÜZ](https://www.researchgate.net/scientific-contributions/2143084292_ESEN_GUeRBUeZ)
* [View](https://www.researchgate.net/publication/325427545_BIST_Surdurulebilirlik_Endeksindeki_Sirketlerin_Etkinliklerinin_Olculmesi_Veri_Zarflama_Analizi_Ile_Bir_Uygulama_-_Measuring_the_Efficiency_of_Companies_in_BIST_Sustainability_Index_An_Application_Wit)
* Show abstract
* [**A cross-efficiency data envelopment analysis (DEA) based model for measuring environmental performance**](https://www.researchgate.net/publication/286380640_A_cross-efficiency_data_envelopment_analysis_DEA_based_model_for_measuring_environmental_performance)
* Article
  + May 2014
  + [ENVIRON ENG MANAG J](https://www.researchgate.net/journal/1582-9596_Environmental_engineering_and_management_journal)
  + [Jing Yang](https://www.researchgate.net/scientific-contributions/2072991189_Jing_Yang)
  + [Xianguo Li](https://www.researchgate.net/scientific-contributions/2088040842_Xianguo_Li)
  + Zhixiang Zhou
  + [Zhixiang Zhou](https://www.researchgate.net/profile/Zhixiang_Zhou2)
* [View](https://www.researchgate.net/publication/286380640_A_cross-efficiency_data_envelopment_analysis_DEA_based_model_for_measuring_environmental_performance)
* Show abstract
* [**Do que é feito um país campeão? Análise empírica de determinantes sociais e econômicos para o sucesso olímpico**](https://www.researchgate.net/publication/295394676_Do_que_e_feito_um_pais_campeao_Analise_empirica_de_determinantes_sociais_e_economicos_para_o_sucesso_olimpico)
* Article
* Full-text available
  + Aug 2015
  + [Edimilson Torres de Oliveira Neto](https://www.researchgate.net/scientific-contributions/2100135734_Edimilson_Torres_de_Oliveira_Neto)
  + [Geovana Lorena Bertussi](https://www.researchgate.net/scientific-contributions/44853678_Geovana_Lorena_Bertussi)
* [View](https://www.researchgate.net/publication/295394676_Do_que_e_feito_um_pais_campeao_Analise_empirica_de_determinantes_sociais_e_economicos_para_o_sucesso_olimpico)
* Show abstract
* [**Presentation a New Model for Measuring the Performance of Participating Nations at the International Game (in Persian)**](https://www.researchgate.net/publication/301339224_Presentation_a_New_Model_for_Measuring_the_Performance_of_Participating_Nations_at_the_International_Game_in_Persian)
* Article
* Full-text available
  + Apr 2013
  + Mohammad Zarei Mahmoudabadi
  + [Mohammad Zarei Mahmoudabadi](https://www.researchgate.net/profile/Mohammad_Zarei_Mahmoudabadi)
  + [Mohammad Hosein Tahari Mehrjardi](https://www.researchgate.net/scientific-contributions/2107520450_Mohammad_Hosein_Tahari_Mehrjardi)
  + [Hosein Mohebbi](https://www.researchgate.net/scientific-contributions/2107295400_Hosein_Mohebbi)
* [View](https://www.researchgate.net/publication/301339224_Presentation_a_New_Model_for_Measuring_the_Performance_of_Participating_Nations_at_the_International_Game_in_Persian)
* Show abstract
* [**Extension a nonparametric model for measuring the performance of participating nations at the Olympic Games (in Persian)**](https://www.researchgate.net/publication/301517046_Extension_a_nonparametric_model_for_measuring_the_performance_of_participating_nations_at_the_Olympic_Games_in_Persian)
* Article
* Full-text available
  + Oct 2012
  + [J SPORT MANAGE](https://www.researchgate.net/journal/0888-4773_Journal_of_Sport_Management)
  + [Seyed Mahmoud Zanjirchi](https://www.researchgate.net/scientific-contributions/2107527805_Seyed_Mahmoud_Zanjirchi)
  + Hamid Babaei Meybodi
  + [Hamid Babaei Meybodi](https://www.researchgate.net/profile/Hamid_Babaei_Meybodi)
  + [Mohammad Hosein Tahari Mehrjardi](https://www.researchgate.net/scientific-contributions/2107520450_Mohammad_Hosein_Tahari_Mehrjardi)
  + Mohammad Zarei Mahmoudabadi
  + [Mohammad Zarei Mahmoudabadi](https://www.researchgate.net/profile/Mohammad_Zarei_Mahmoudabadi)
* [View](https://www.researchgate.net/publication/301517046_Extension_a_nonparametric_model_for_measuring_the_performance_of_participating_nations_at_the_Olympic_Games_in_Persian)
* Show abstract
* [**Analyzing Olympic Games through dominance networks**](https://www.researchgate.net/publication/305364130_Analyzing_Olympic_Games_through_dominance_networks)
* Article
  + Jul 2016
  + [PHYSICA A](https://www.researchgate.net/journal/0378-4371_Physica_A_Statistical_Mechanics_and_its_Applications)
  + Laura Calzada
  + [Laura Calzada](https://www.researchgate.net/profile/Laura_Calzada)
  + Sebastián Lozano
  + [Sebastián Lozano](https://www.researchgate.net/profile/Sebastian_Lozano)
* [View](https://www.researchgate.net/publication/305364130_Analyzing_Olympic_Games_through_dominance_networks)
* Show abstract
* [**FleglAndrade\_Rio2016\_OlympicSportEconomicData.xlsx**](https://www.researchgate.net/publication/311417424_FleglAndrade_Rio2016_OlympicSportEconomicDataxlsx)
* Data
  + Jan 2016
  + Luis Antonio Andrade Rosas
  + [Luis Antonio Andrade Rosas](https://www.researchgate.net/profile/Luis_Andrade_Rosas)
  + Martin Flegl
  + [Martin Flegl](https://www.researchgate.net/profile/Martin_Flegl2)
* [View](https://www.researchgate.net/publication/311417424_FleglAndrade_Rio2016_OlympicSportEconomicDataxlsx)
* Show abstract
* [**Performance Evaluation of Iranian Sports Federations in the Rio 2016 Olympic Games with Data Envelopment Analysis (DEA) Approach (in Persian)**](https://www.researchgate.net/publication/340503034_Performance_Evaluation_of_Iranian_Sports_Federations_in_the_Rio_2016_Olympic_Games_with_Data_Envelopment_Analysis_DEA_Approach_in_Persian)
* Article
* Full-text available
  + Apr 2019
  + Seyed Mohammad Javad Razavi
  + [Seyed Mohammad Javad Razavi](https://www.researchgate.net/profile/Seyed_Mohammad_Javad_Razavi)
  + Mohammad Zarei Mahmoudabadi
  + [Mohammad Zarei Mahmoudabadi](https://www.researchgate.net/profile/Mohammad_Zarei_Mahmoudabadi)
* [View](https://www.researchgate.net/publication/340503034_Performance_Evaluation_of_Iranian_Sports_Federations_in_the_Rio_2016_Olympic_Games_with_Data_Envelopment_Analysis_DEA_Approach_in_Persian)
* Show abstract
* Show more

Primis Player Placeholder

1. (2015)
2. Josip Hucaljuk, Alen Rakipovic, Predicting football scores using machine learning techniques, Proceedings of the 34th International Convention MIPRO2011

## Dragan Miljković, Ljubisa Gajic, Aleksandar Kovacevic, Zora Konjovic, The use of data mining for basketball matches outcomes prediction IEEE 8th International Symposium on Intelligent Systems and Informatics 2010

## Alan McCabe, Jarrod Trevathan, Artificial Intelligence in Sports Prediction Fifth International Conference on Information Technology: New Generations (itng 2008) 2008