

Predicting track and field records in London 2012 Olympic games using gray model

Fatemeh. Mollaei¹ and Mehrali. Hemati Nejad²

¹*Department of Physical Education, Qazvin Branch, Islamic Azad University, Qazvin, Iran*

²*Department of Physical Education, Guilan University, Iran*

ABSTRACT

Gray prediction model is one of the quantitative prediction methods, which was used in this study to predict track and field records in London 2012 Olympic Games. After predicting the records, their accuracy and controllability were investigated sport branches and finally prediction records of 2008 Olympic Games were compared with their actual records. This study sought to predict records of track and field branches for men and women in 2012 Olympic Games by gray model. The necessary data were collected via the Internet and, finally, prediction model was tested and investigated in terms of controllability, prediction error and reliability of the results. The research methodology was descriptive and its statistical population included results of all track and field competitions in 26 Olympics Games between 1986 and 2008. Considering the nature of research, the number of samples included track and field records in at least 4 recent Olympic Games. The research tools were observing available documents, using online databases, articles, magazines, newspapers and books in this area. Findings of this study showed that record prediction of 19 branches of track and field competition in 2012 Olympic Games was possible for men and women using gray model. All these predictions were acceptable and controllable. Prediction error of records was not different between men and women. Prediction of records and accuracy and controllability of predicted records in the current and similar previous studies approve the reliability of gray prediction model. The purpose of these predictions is to provide guidelines for decision makers, athletes and even sport fans.

Key words: Prediction, Gray prediction model, Decision making, Track and field.

INTRODUCTION

Predicting trend of changes in all areas is one of the main concerns of managers and planners. But, there are always some problems in the prediction path, which make reliable and accurate predictions almost impossible. Existence of many and sometimes hidden parameters has converted prediction into a complicated problem and even giant mathematical algorithms have failed to provide appropriate solutions for building an efficient prediction model.

High and middle level managers constantly deal with some kinds of prediction. Prediction is a part of planning and managing processes and efficient and effective prediction is a requirement for attaining accurate and precise estimates for these processes. Timely and proper predictions assist in achieving operational and strategic goals and are driving force of systems in all organizations [1].

Prediction was first used in planning. Observing repetition in the occurrence of events creates this presupposition that the results and consequences can be generalized to all the events with the same type. During two recent decades, emergence of artificial intelligence and its combination with long-term science of statistics along with advanced and innovative algorithms such as genetic algorithm, meta-heuristic methods and artificial neural networks has caused extensive development in this field [2].

It is worth noting that, in recent years, several studies have been done on how to evaluate prediction accuracy. Environmental characteristics such as changing nature of the case to be predicted, prediction horizon, predictor's ideology and applied technologies are the factors which affect prediction accuracy [3].

In recent years, there has been a continuous movement from merely theoretical researches to applied studies, especially in the field of information processing for the problems with no solutions or those which cannot be easily solved. Accordingly, a growing interest has been formed in theoretical development of model free intelligent dynamic systems based on experimental data. In this regard, computational intelligence (CI) or soft computing meaning intelligence, knowledge, algorithm or mapping extracted from numerical calculations play a key role based on updated presentation of numerical data, the fundamental components of which include artificial neural network (ANN), fuzzy logic (approximate calculations) and genetic algorithm (genetic calculations), each of which model human brain. Neural networks, fuzzy logic and genetic calculations model synaptic connections and neural structure, approximate inferences and mutation analysis of brain, respectively [4].

A question that is raised here is that whether predictions by statistical models are more accurate and reliable than definitions by experts based on subjective judgments. Given less routine situations and more uncertain situations, experts with subjective judgments may make better prediction than statistical models because of using qualitative criteria [5]. Numerous investigations have been done to compare these two methods in different areas like medicine, college success, business decision-making, weather forecasting, macroeconomic prediction, inflation rate and results of political elections and it can be seen that statistical models have made better predictions in most of them [6, 7, 8, 9, 10, 11]. Also, such studies are repeatedly found in the field of sports [12, 13, and 15].

Several studies have suggested that sport predictions based on data and information are completely different from what is done randomly such as lottery [16].

Since professionalism has found its stance in all countries, it has been observed that enormous costs are spent for obtaining a certain ranking or position and athletes and sport professionals make great efforts to occupy international chairs. Thus, role of prediction system in sport fields for planning future issues has attracted more and more attention. In the development of all branches of science including sports, prediction of results and assessment of performances in future success are very important for exploiting available material and human resources and increasingly justify application of other calculation sciences in such predictions. In recent years, use of mathematics and its related branches has come to assist managers, coaches and experts in sports to present accurate planning for future by investigating performance of different countries. Through using these new scientific methods and identification of influencing factors on the results, results of events and ranking of countries can be predicted.

All decisions about future are made based on one kind of prediction; therefore, the more organized these predictions, the more reliable they would be. In other words, planned predictions are more correct than perceptual and sensory prediction [17]. As revealed from its lexical meaning, prediction refers to visualization of a condition or situation in future. In general, based on the assumed objective of prediction, it can be defined as a warning about future, explanation of desired future conditions, description of future conditions and so on. Therefore, it can be said that prediction encompasses any expression of future conditions; but, in scientific dimension, it is defined as expression of actual events before their occurrence based on analyzing available information and scientific and logical rules and terms with specified probability [18].

In the procedure of scientific management, proper decision making can lead to most of success in future; these decisions are made based on the prediction envisaged for future. Sports and physical education as a subset of humanities and social sciences is not exempt from this case and requires futures studies to plan and optimally apply equipment and facilities. The few works on sport predictions either have not been based on scientific solutions or have used traditional-scientific methods.

According to Armstrong, prediction is the process of estimating unknown situations. Prediction provides a prophecy about future events and can convert previous experiences into prediction of future events [19]. Delurgio defined prediction as probable estimation or description of future conditions and values [1]. Kasabov considered prediction as the process of collecting information for probable future evolvement or development according to the data related to present and past of this evolvement [20].

In other words, according to the above definition, for making a market prediction, the historical market data should be searched and their relationship should be found. Then, future situations are obtained based on these relationships. This definition is based on the premise that there are such relationships between the information existing in market. But, the following problem should be solved before prediction: are there any relationships based on which future values can be determined or is the market randomly fluctuating and there is no room for prediction? This question should be answered before making any prediction [21].

Measurement criteria in prediction error

Prediction error is the difference between actual and predicted values in the corresponding period. If E is prediction error at time t, Y is actual value in period t and F is predicted value in period t, prediction error is calculated by: $E = Y - F$

MATERIALS AND METHODS

Research methodology

This research was descriptively conducted. Statistical population included results of all track and field competitions since the beginning till the 26th Olympic Games and, based on the research nature, the number of samples was track and field records of at least 4 recent Olympic Games.

Research tools included observing documents and using databases on FINA website, articles and magazines, newspapers and books in this area.

Gray method was used for reporting record prediction. The research findings using descriptive statistical methods were initially shown in tables and charts. To do so, prediction equation was calculated for both men and women in each track and field branch, which was done by calculating model parameters.

Prediction equations were obtained for each competition branch for both men and women using the above parameters and were used in predicting records of 2012 Olympic Games.

To calculate the model and determine prediction accuracy, Chebyshev's theorem was applied by calculating the considered indices related to prediction errors and tracking signal (TS) method was used to determine controllability of the prediction model.

RESULTS

Table 1 show that values of error measurement for 15 men's branches and 12 women's branches were in the range of 99.7%, all of which were controllable. Since all the values of error measurement indices for both men and women were in the confidence range, the prediction model of the competitions was controllable.

In addition, it can be observed that minimum prediction errors in men's competitions were related to 100 and 200 m run and maximum errors happened in predicting records of 110 m hurdles run.

In women's competitions, minimum prediction errors were related to relief 4×400 and 4×100 tournaments and maximum errors happened in predicting records of 400 m hurdles run.

- For women, 11 and only 1 branches had first grade and second grade prediction accuracy, respectively.
- Table 2 shows that, in track and field record prediction in women's 2008 Beijing Olympic Games, 8 branches had lower than 1% prediction error, 3 branches had 1 to 2 percent prediction error and just one branch had more than 5% prediction error. As a result, prediction of 11 branches had lower than 2% error and only one branch had more than 5% prediction error.

Table 1: Comparing actual records and predicted records for men in 2008 Olympic Games

Field of track events	Men's real record	Men's prediction record	Fault percent
100 meters	9/7	9/76	0/0061
200 meters	19/3	19/67	0/0191
400 meters	43/75	43/60	0/0034
800 meters	1/44/65	1/43/48	0/0111
1500 meters	3/33/11	3/31/87	0/0057
3000 meters	8/10/3	8/10/37	0/0131
5000 meters	12/57/8	13/10/1	0/0158
10000 meters	27/01/2	26/53/12	0/004
4×100 meters relay	37/1	37/83	0/0196
4×400 meters relay	2/55/4	3/15/63	0/115
110 meters hurdles	12/93	12/73	0/0154
400 hurdles	47/25	47/23	0/0004
20 kilometers walk	1/19/01	1/18/52	0/0062
Marathon	2/06/32	2/8/31	0/0157
50 kilometers walk	3/37/09	3/34/40	0/0123

Table 2: Comparing actual and predicted records in women's 2008 Olympic Games

Field of track events	women's real record	women's prediction record	Fault percent
100 meters	9/7	9/76	0/0061
200 meters	19/3	19/67	0/0191
400 meters	43/75	43/60	0/0034
800 meters	1/44/65	1/43/48	0/0111
1500 meters	3/33/11	3/31/87	0/0057
3000 meters	8/10/3	8/10/37	0/0131
5000 meters	12/57/8	13/10/1	0/0158
10000 meters	27/01/2	26/53/12	0/004
4×100 meters relay	37/1	37/83	0/0196
4×400 meters relay	2/55/4	3/15/63	0/115
110 meters hurdles	12/93	12/73	0/0154
400 hurdles	47/25	47/23	0/0004
20 kilometers walk	1/19/01	1/18/52	0/0062
Marathon	2/06/32	2/8/31	0/0157
50 kilometers walk	3/37/09	3/34/40	0/0123

The information in Table 3 shows that, in 2012 London Olympic Games, men's track and field records will be broken in 13 branches including 100m, 200m, 400m, 1500m, 3000m, 10000m, 50000m, relief 4×100, relief 4×400, 110m, 20km walking, marathon and 50km walking. Moreover, in women's Olympics, track and field records of three branches including 800m, 10000m and 400m hurdles run will be broken.

Table 3: Latest actual and predicted records in 2012 Olympic Games

Field of track events	predictions records2012		The last Olympic prediction record	
	Women	Men	Women	Men
100 meters	10/70	*9/61	10/62	9/69
200 meters	21/58	*19/18	21/34	19/30
400 meters	49/42	*43/35	48/25	43/49
800 meters	*1/52/73	1/43/63	1/53/43	1/42/58
1500 meters	4/00/11	*3/30/18	3/53/96	3/32/07
3000 meters	-	*6/8/80	-	8/05/51
5000 meters	15/31/02	*12/53/51	14/40/79	2/57/82
10000 meters	*29/42/95	*26/8/38	29/54/66	27/01/17
4×100 meters relay	41/99	*36/86	41/60	37/10
4×400 meters relay	3/18/14	*2/54/58	3/15/17	2/55/39
100 meters hurdles women	12/53	-	12/37	-
110 meters hurdles	-	*12/75	-	12/91
400 hurdles	*52/35	46/85	52/64	46/78
20 kilometers walk	-	*1/18/13	1/26/31	1/18/59
Marathon	2/26/16	*2/4/08	2/23/14	2/06/39
50 kilometers walk	-	*3/33/03	-	3/37/09

CONCLUSION

In this study, besides stating the concept, importance and stance of prediction and description of gray prediction model as a quantitative prediction method, the required data were collected and track and field records were predicted for both men and women in 2012 Olympic Games. For men, all 15 branches were predictable. According to the study by Jiang et al. (2007) in which gray method was used to predict records of 2004 and 2008 Olympic Games, although prediction of only 9 branches in 2014 competitions was less than 1%, all predictions were controllable. In predicting records of 2008 Olympic Games, 17 predictions were of first grade type; however, all the predictions were controllable. These results demonstrated that gray prediction model was a reliable method for predicting records in sport competitions. In the final step, a series of indices and their calculations were defined in order to test the model and determine accuracy of predicted values. Considering these indices, reliability of the predicted values can be considered. In this regard, index TS indicates controllability or uncontrollability of prediction model. TS values for all swimming branches were between $-3MAD$ and $+3MAD$, which indicated controllability of the prediction model; i.e. trend of numbers related to each of running branches had a clear path over time without unexpected events. Index $\bar{E}$ suggested that predictions in general were either lower or higher than actual values for each of the track and field branches.

Considering the meaning and interpretations of each index, it can be said that the minimum error in terms of MAD index in men's competitions was related to 100m and 200m run and, in women's competitions, it happened in 4×100m and 4×400m competitions. Index $\bar{E}$ showed its maximum value in 110m hurdles run for men and 400m run for women. Index TS did not exceed any of control limits in the branches of track and field for men's competitions, which indicated its controllability. According to the study conducted by Hemmati et al. (1999), prediction of all 25 branches of track and field for both men and women in 2010 Asian Games had first grade accuracy and they were all controllable. Therefore, accuracy rate of predictions and their adjustment toward actual values and ideas and judgments of experts can be used to predict future values of records for planning purposes.

As mentioned above, the term prediction mean visualization of a condition or situation in future and is scientifically defined as expression of actual events before their occurrence based on available information and scientific and logical rules and terms with a certain probability. In general, wherever decision making is needed for planning something, the issue of prediction is followed. So, these predictions can be considered the guides for decision makers including athletes and sport managers in order to identify and consider their ideals in future and plan and take the required measures to achieve them.

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