Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

European Journal of Experimental Biology, 2013, 3(5):68-75

ISSN: 2248 –9215
CODEN (USA): EJEBAU

Predicting jumping and throwing records in London 2012 olympic games using gray model

Fatemeh. Mollaei[1] and Mehrali. Hemati Nejad[2]

[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 (jumping and throwing) in London 2012 Olympic Games. After predicting the records, their accuracy and controllability were investigated. Finally, prediction records of 2008 Olympic Games were compared with their actual records. This study sought to predict records of track and field events 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 its controllability and prediction error and reliability of the results were investigated. The research methodology was descriptive and its statistical population included results of all track and field competitions in 26 Olympic Games between 1896 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 and using online databases, articles, magazines, newspapers and books in this area. Findings of this study showed that record prediction of 8 events of track and field competitions in 2012 Olympic Games was possible for men and women using Gray model. All these predictions were acceptable and controllable. Prediction error of the records was not different between men and women. Thus, prediction of records and accuracy and controllability of predicted records in the current and similar previous studies approved reliability of Gray prediction model. The objective of these predictions is to provide guidelines for decision makers, athletes and even sport fans of this sport.

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

INTRODUCTION

Herbert Simon and a group of experts have defined management and decision making as two synonymous words and have considered management nothing but decision making. They believe that main focus of management is formed by decision making and performing all management duties is in fact nothing but decision making. Therefore, according to Chester Barnard, Newman et al., decision making is the basis of management and planning. Considering that planning refers to decision making for performing an activity in future, thus, position and importance of planning are also identified in management process [1].

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 [2]. In one sense, science refers to a set of systematic knowledge based on valid methods on the phenomena and their relationships. This concept of science covers experience, induction and generalization and predicts future based on analogy. Experts have considered three duties of interpretation and explanation of realities, technical application and prediction for science [4].

The goal of mentioning the above cases is reference to position and importance of prediction from the perspective of science. From another important perspective, i.e. organizational perspective, its prediction and importance position can be discusses; also, dealing with the issue of organization is accompanied by issue of management. Although position and importance of prediction have been merely referred to from the perspective of science, organization and management, this does not mean limitation in using prediction; generally, issue of prediction will be raised in any case or situation in which it is necessary to make decisions on planning an activity. There are different techniques and methods for performing the important issue of prediction which have been classified from different perspectives. One of these classifications is in terms of qualitative and quantitative methods. It is evident that making all predictions is not possible using quantitative methods. Sometimes, the data related to the past of a phenomenon may be limited or not available. At some other times, different social and political factors may have an essential effect on the occurrence of a phenomenon. In such situations, referring to experts' viewpoints and using qualitative methods can be effective. These methods generally have low reliability because they are not based on accurate and recorded statistics and data and their accuracy depends on skill of the predictor. Skill of people is promoted with increase of information in economic, social and political fields. One of the qualitative methods is personal judgment, collective agreement, survey, brainstorming and Delphi method.

Unlike qualitative methods, quantitative ones are applied when the data relating to the past of a phenomenon are available. In all the quantitative methods, the assumption is that what has happened in the past will happen in future and the data pattern will be repeated in future. This assumption is not a hundred percent acceptable; but, it can be accepted by some connivance. To increase reliability level of these methods, they can be mixed with qualitative ones and subjective fittings. From one perspective, quantitative methods include two kinds of causal prediction methods and time series prediction methods [4].

The question that is raised here is that whether predictions by statistical models are more accurate and reliable than predictions made by experts based on subjective judgments. In less routine and more uncertain situations, experts with subjective judgments, because of using qualitative criteria, may make better predictions than statistical models [5]. In the complex and advanced world of sports, correct, scientific and timely decision making plays a very important and determining role in failure or success. In this regard, number of criteria, complexity of data and dynamicity of environment are among the factors which have seriously challenged decision making problem in sports in the recent decade. Today, novel scientific methods have been selected for predicting results of sport events [6]. Different papers have also stated that sport predictions which are based on data and information are completely different from what is randomly performed such as lottery predictions [7].

All the 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 proper than perceptual and sensory ones [8]. 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 for desirable future conditions, description of future conditions and the like. Therefore, it can be said that prediction encompasses any expression of future conditions; but, in scientific dimensions, it is defined as the expression of actual events before their occurrence based on analyzing available information and scientific and logical rules and principles with specified probability [9].

In this paper, Gray prediction model which is one of the quantitative methods was used to predict track and field records in 2012 Olympic Games. Then, 2010 records were predicted and finally conclusion and results were presented.

2- Gray Prediction Model

A model refers to a framework of reality which shows the relationship between variables and can be used for prediction in decision making. To achieve the maximum return, optimization through the model is necessary. Decisions optimization model is affected by management science [1] which is of some types. Considering the

above-mentioned literature, Gray prediction model which was used in this paper is one of the quantitative methods in prediction and is one type of the mathematical models.

Gray prediction model is used for describing and analyzing future trend of a sequence of numbers according to the past and present results. This method only requires a limited number of data (at least 4 data or values are needed) to estimate behavior of an uncertain system and its calculation volume and complexity are low. Gray model is shown by $GM(n,h)$ where n is differential order in equation and h means the number of variables in that equation. Although high order differential equations obtain better prediction results in a series of situations, they will cause higher expenses in terms of computational resources. In addition, a high order differential equation may obtain fictitious results due to its mathematical calculation [10].

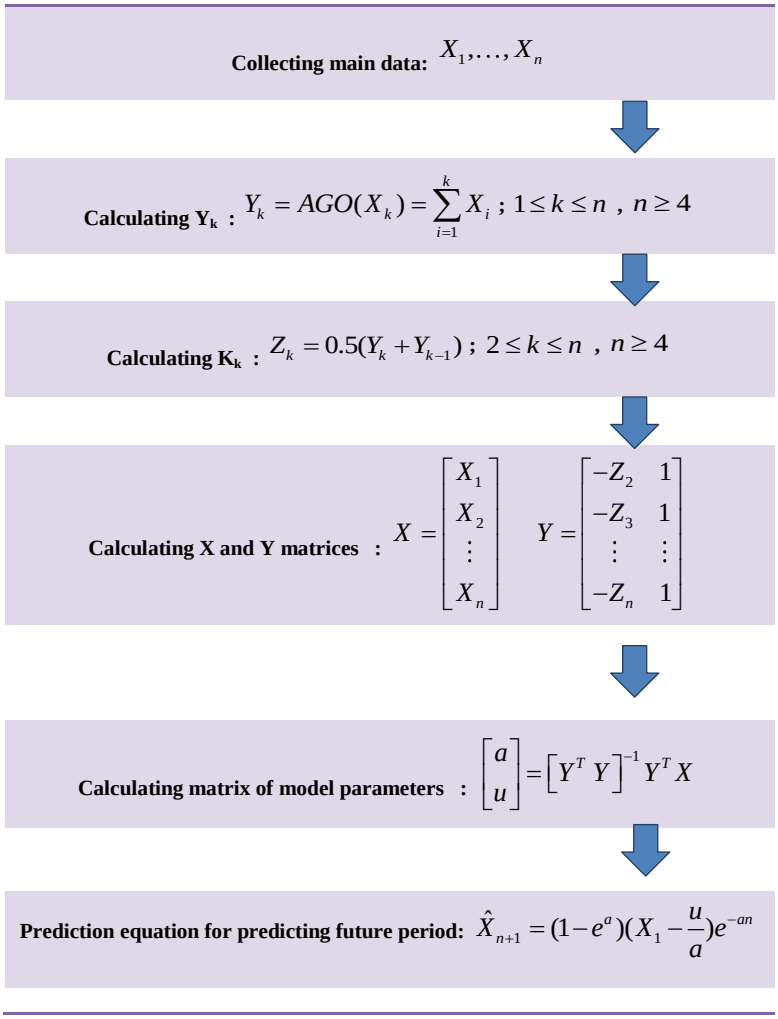

Figure 1: Work stages of Gray prediction model

The important and essential assumption of Gray model is that discrete data series pattern should be exponential or should be converted into an exponential pattern through data pre-processing. The goal of Gray model is description of this exponential pattern [11]. In other words, this model does not directly use main data. Gray predictability is resulted from its ability in prediction of future using only few data. $GM(1,1)$ is the most common model which was also applied in this paper. The required steps in Gray prediction model are summarized in Figure 1.

As mentioned before, Gray modeling requires an exponential pattern of data series and, in case this condition is not provided, it can be created through data pre-processing. The action of converting series of main data into an

exponential pattern is called accumulated generating operation (AGO), which is originally the generation of series of partial sum from series of main data. In fact, this conversion is done to determine trend of data pattern with lower randomness and noise in their trend. In other words, this action helps to reduce roughness and randomness of data and finally clarifies their trend [10].

Matrix of prediction model parameters was calculated using Least Squares method, the result of which is shown in Figure 1.

4. Predicting Track and Field Records

The required data which were the records related to track and field events were collected via the Internet and included records of all the events relating to track and field for men and women from 1896 to 2008.

Using Gray prediction model which was described before, records relating to track and field events for both women and men were predicted in 2012 Olympic Games. To this end, it was necessary to calculate prediction equation for each of the track and field events for women and men and this important issue was done by calculating the model parameters. This equation is given in Figure 1 and values of the parameters required for writing this equation are given in Table 1.

The important point in production of these parameters is that all the data for all the events were calculated in terms of second and used for production of these parameters. To perform these calculations, Excel and MATLAB software were used. Prediction equations were obtained for each of the above events for men and women using the above parameters and were used in the prediction of 2012 records. The results are given in Table 1.

Table 1- Values of parameters of Gray prediction model

A		U		field
women	Men	Women	men	
0/0071	0/0025	63/14	66/12	Discus throw
0/0087	0/0015	65/91	86/19	Javelin throw
0/0012	0/0107	19/92	20/75	Shot put
-	0/0016	-	77/72	Hammer throw*
0/0021	0/0011	6/97	8/21	Long jump
0/0072	0/0095	15/06	17/14	Triple jump
0/0091	0/0087	2/01	2/31	High jump
0/0075	0/0031	4/99	6/01	Pole vault

* Because hammer throw has been added to women Olympic competitions in recent three periods of games, values of parameters were not calculated for its record prediction.

Table 2: Values predicted by Gray prediction model

(meter) x_{2012}		(meter) x_{2012}		field
women	men	Women	men	
69/26	70/34	69/26	70/34	Discus throw
72/96	92/151	72/961	92/151	Javelin throw
20/985	21/90	20/985	21/905	Shot put
-	83/32	-	83/32	Hammer throw*
7/12	8/41	7/124	8/416	Long jump
15/40	17/91	15/40	17/91	Triple jump
2/074	2/36	2/0742	2/361	High jump
5/07	6/07متر	5/0742	6/075	Pole vault

The information in Table 2 shows that competition records were predictable for all 8 events of men's competition in 2008 Olympic Games. It can be also observed in this table that 7 out of 8 events of women's track and field competitions were predictable using Gray prediction model. Table 3 defines some degrees for the model accuracy. Results of applying this method for predicting the results of track and field records in 2012 for men and women are given in Table 4.

5- Testing the Model and Determining Accuracy Rate of Prediction

Prediction is an action based on prior studies and is carried out to comment on future. It is obvious that prediction is always accompanied by errors. So, accuracy and precision of the model by which prediction is made should be investigated using different criteria. The more the criteria which could be responded by the model, the more would be the confidence in applying the model [12].

In this study, since a model was used for prediction, several indices were applied for measuring error and finally testing the model and determining prediction accuracy.

One of the methods used for measuring errors in this study was based on Chebyshev's theorem in statistics and probability [13]. Other methods were conventional methods in prediction texts including mean absolute error (MAE), mean squared error (MSE) and root mean squared error (RMSE).

Table 3 defines some degrees for the model accuracy. The results of applying this method for predicting results of track and field records in 2010 Olympic Games for both men and women are given in Table 4.

Table 3: Grading values of indices for measuring the model accuracy

Model accuracy	C	p
Degree 1	0/35<	>0/95
Degree 2	*<0/50*	>0/80
Degree 3	<0/65	0/70>
Degree 4	≥0/65* (0/65)	0/70≤ *>0/70
Degree 5	≥ 0/65	≤0/70

Table 4: Values of indices for measuring the model accuracy

Model accuracy		P		C		field
Women	**Men**	**Women**	**Men**	**Women**	**men**	
Degree 1	**Degree 1**	0/981162	0/987951	0/000951	0/004112	Discus throw
Degree 1	**Degree 1**	0/976251	0/989991	0/001265	0/000791	Javelin throw
Degree 1	**Degree 1**	0/9721670	0/989872	0/007192	0/000472	Shot put
-	**Degree 1**	-	0/988721	-	0/003172	Hammer throw*
Degree 1	**Degree 1**	0/980011	0/989975	0/000918	0/001298	Long jump
Degree 1	**Degree 1**	0/971216	0/991127	0/004973	0/000371	Triple jump
Degree 2	**Degree 1**	0/916175	0/960012	0/072819	0/031761	High jump
Degree 1	**Degree 1**	0/951617	0/971215	0/021719	0/019791	Pole vault

Table 4 shows that measuring prediction accuracy of records of all 8 events of men in 2012 Olympic Games had first degree accuracy.

For women, 7 events and only 1 event (high jump) had first degree and second degree measurement accuracy, respectively.

Table 5: Values of error measurement index

TS		* (meters) $\overline{E}$		* (meters) MAD		field
Women	**Men**	**Women**	**Men**	**Women**	**men**	
0/8578227	0/8227563	1/211691	1/001719	1/412519	1/217516	Javelin throw
0/9166768	0/8548005	0/391927	0/317914	0/427552	0/371916	Shot put
-	0/9926051	-	1/000141	-	1/007592	Hammer throw
0/7594	0/8023104	0/221498	0/201619	0/291675	0/251298	Long jump
0/7735739	0/7063946	0/527514	0/301995	0/681918	0/427516	Triple jump
0/8813078	0/8322105	0/081751	0/059295	0/092761	0/071250	High jump
0/6922651	0/63341876	0/191475	0/121615	0/276592	0/191765	Pole vault

* *In field competitions (jumping and throwing), the unit is in meter.*

Table 6: Final values of error measurement indices

TS *		±3MAD (meters) *		field
women	**Men**	**Women**	**men**	
0/8969460	0/8522095	±3/353085	±2/58142	Discus throw
0/8578227	0/8227563	±4/237557	±3/652548	Javelin throw
0/9166768	0/8548005	±1/282658	±1/115748	Shot put
-	0/9926051	-	±3/022776	Hammer throw
0/7594	0/8023104	±0/875025	±0/753894	Long jump
0/7735739	0/7063946	±2/045754	±1/82548	Triple jump
0/8813078	0/8322105	±0/278283	±0/21375	High jump
0/6922651	0/63341876	±0/829776	±0/575295	Pole vault

**In field competitions (jumping and throwing), the unit is in meter.*

Table 6 shows that values of error measurement for all 8 events for men and 7 events for women were within 99.7% range and all of them were under control. Considering that all values of error measurement indices for men and women were in the reliable limit, therefore, prediction model was controllable for these competitions. In addition, it is observed that the highest error was related to hammer throw in men's competitions. The highest prediction error was related to shot put in women's competitions.

* For women, prediction accuracy of 6 cases was of first order type and only one case was of second order type.

Table 7: Comparing actual records and predicted records for men in 2008 Olympic Games

field	**Men's real record**	**Men's prediction record**	**Fault percent**
Discus throw	68/82	71/41	0/037
Javelin throw	90/57	88/08	0/0274
Shot put	21/51	21/55	0/0018
Hammer throw	82/08	84/15	0/0252
Long jump	8/34	8/66	0/0383
Triple jump	17/76	17/94	0/0101
High jump	2/34	2/38	0/0170
Pole vault	5/96	6/06	0/0167

Table 7 demonstrates that predicting record of 3 events of track and field competitions in Beijing 2008 Olympic competitions for men had predication error of 1 to 2% and prediction of record of 4 events had error of 2 to 4%. In total, all the predictions had error of below 4%.

Table 8- Comparing actual and predicted records of 2008 Olympic Games for women

field	**women's real record**	**Women's prediction record**	**Fault percent**
Discus throw	67/74	68/5	0/0112
Javelin throw	71/42	73/07	0/0231
Shot put	20/56	20/01	0/0267
Hammer throw	-	-	-
Long jump	7/04	7/15	0/0156
Triple jump	15/39	15/31	0/0051
High jump	2/05	2/08	0/0146
Pole vault	5/05	5/06	0/0019

Table 9: Latest actual and predicted records in 2012 Olympic Games

predictions records2012		**The last olympic prediction record**		field
women	**men**	**women**	**men**	
69/26	*70/34	72/30	69/89	Discus throw
*72/96	*92/151	71/53	90/57	Javelin throw
20/98	21/90	22/41	22/47	Shot put
-	83/32	76/34	84/80	Hammer throw
7/12	8/41	7/40	8/90	Long jump
*15/40	17/91	15/29	18/09	Triple jump
*2/07	2/36	2/06	2/39	High jump
*5/07	*6/07	5/05	5/96	Pole vault

* *Records of these events will be broken in 2012 Olympic Games.*

Table 8 shows that, in the prediction of track and field records in Beijing 2008 Olympic competitions, in women's section, 2 events had error of below 1%, 3 events had prediction error of 1 to 2% , 2 events had prediction error of 2 to 3%. As a result, it is observed that prediction of 6 events had error of below 3%.

The information in Table 10 shows that, in London 2012 Olympic Games, men's track and field records would be broken in 3 events of discus throw, javelin throw, pole vaulting. Moreover, in women's Olympics, track and field records of 4 events of javelin throw, triple jump, high jump and pole vaulting would be broken.

CONCLUSION

In this study, besides stating the concept, importance and position 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. Due to necessity of at least 4 records in the recent competitions, records were predicted for 7 out of 8 events of women competitions in 2012 Olympic Games. Also, prediction was possible for all 8 events for men. In the study by Jiang et al. (2007) in which records of 2004 and 2008 Olympic games were predicted by Gray model, although prediction error of only 9 events in 2004 competitions was below 1% , all the predictions were under control. In predicting records of 2008 Olympic Games, 17 predictions were of first degree type; however, all the predictions were controllable. These results demonstrated Gray prediction model as a reliable method for predicting records in sport competitions. In the final step, a series of indices was defined and its calculation was done in order to test the model and determine accuracy of the predicted values. Considering these indices, reliability of the predicted values can be considered. In this regard, index TS indicates controllability or uncontrollability of the prediction model. TS values for all track and field events were between $-3MAD$ and $+3MAD$, which indicated controllability of the prediction model; i.e. trend of numbers related to each of the running events had a clear path over time without unexpected events. Index $\bar{E}$ suggests that the model prediction in general was either lower or higher than actual values for each of the track and field events.

For index $\bar{E}$, the maximum value was related to hammer throw in men's competitions and shot put in women's competitions. Index TS did not exceed any of control limits in the events of track and field in men's competitions, which indicated prediction controllability. According to the study conducted by Hemmati et al. (1999), prediction of all 25 events of track and field in both men's and women's competitions in 2010 Asian Games had first degree accuracy and they were all controllable. Therefore, considering accuracy rate of predictions and their adjustment toward actual values using ideas and judgments of experts, they can be used to predict future values of records for planning purposes.

As mentioned above, the term prediction means 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 principles with a certain probability. In general, wherever decision making is required for planning something, the issue of prediction is followed. So, these predictions can be considered as the guidance 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.

REFERENCES

[1] Seyed Javadein, Reza, **2005**, Fundamentals of organization and management, 2nd edition, Tehran, Negah Danesh Publication, pp. 249, 275, 231-232.
[2] Delurgio Stephan A., Forcasting principles and applications, McGrow hill edition, **1998**.
[3] Ezzati, Morteza, **2006**, *Journal of Mofid*, No. 13, pp. 140.
[4] Haj Shirmohammadi, Ali, **2005**, Principles of planning and controlling production and the inventory, 2nd edition, Arkan Publication, pp. 194.
[5] Song, Ch., Boulier, B.L., and Stekle. H.O., **2007**, *International Journal of Forecasting*, 23, 405- 413
[6] Lovalgia M.J., Lucus J.W., **2005**, *The Sport Journal*, 8(2).
[7] Del Corrala J., Rodriguez J. P., **2010**, *International Journal of Forecasting*, 26, 551–563
[8] Fatemi Qomi, Mohammad Taqi, **1998**, Planning and controlling production and the inventory, 4th edition, Tehran, Danesh Emrooz Publication, pp. 133.

[9] Poorbakhsh, Seyed Hamed, **2007**, Presenting a model for predicting price of crude oil with the approach of neural-fuzzy networks, MSc thesis, University of Guilan, pp. 34.
[10] Liu S., Dang Y., Fang Z., **2004**, *The Journal of Grey System* vol.1, no.1, pp.1-24.
[12] Lin K. H., **2004**, "The Study on the Optimization of Gray Model and the Implementation of Gray Prediction Fuzzy Controller", dissertation for the degree of Doctor of Philosophy, National Cheng Kung University Tainan, p.13.
[13] Wang X., et al., **2001**, "Gray system analysis and practical computational procedure", Wuhan: Hauzhong university of science & technology publishing company, 9.