ISSN : 0974 - 7435 Volume 10 Issue 5

BioTechnology
An Indian Journal

FULL PAPER

BTAIJ, 10(5), 2014 [1138-1143]

# Research for index weight of aerobics performance evaluation based on multiple regression

**Yuanqing Xia**

**Physical Education Department, Nanjing University of Chinese Medicine, Nanjing 210000,Jiangsu, (CHINA)**

## ABSTRACT

In the paper, the many indexes related aerobics sports performance are obtained by making a survey to aerobics specialist, eventually, from which nine indexes are selected. Experts score 9 indicators and give the total score. Scoring index results is just taken into account without considering the factors of special grade. On the basis of the 9 indexes data, multiple regressions is used to make fitting analysis to data using SPSS, and then forecasting model of Aerobics result is finally obtained. Results show that the model can better predict the total scores of aerobics performance, meanwhile, coefficient of index determine the weight of the Aerobics index in the total results. Multiple regression models can predict performance of Aerobics athletes reasonable and scientifically, and provide an important basis for Aerobics training. 

## KEYWORDS

Aerobics;
Performance prediction;
Multiple regression model;
SPSS analyzing fitting.

## INTRODUCTION

Aerobics originated in the end of 60s last century, the former two aerobics competitions were held in America and Japan, which made aerobics sports popular widely in the world. Like other sports, aerobics is fitness first, regardless of gender and age. With the improvement of people's living standard, aerobics sports are popular with people. Aerobics is a aesthetic movement of strong performance, which not only needs the physical quality, psychological quality, skills and so on, also requires that athletes have a strong sense of music, rhythm and performance ability. Many scholars have also done a lot of research on Evaluation of performance, Aerobics. For example, Shao Shuhe (2012) predicts the aerobics performance by using the BP neural network calculation method, which shows the features of accurate prediction and wide application in competitive aerobics performance evaluation and prediction. Wang Ni (2009), made the neural network nonlinear fitting towards special performance and test of aerobics, which led good results and constructed the prediction model of Aerobics performance on the premise of a special performance as variable. Liu Yang (2013) predicted the intention and behavior of the Aerobics athletes using the least squares method, and put forward suggestions for the aerobics sports training. Liu Fang (2012) selected maximum special skills greatly related to aerobics achievement from many aerobics exercises, and result-predicting model is established by using multiple regression, etc..

By making the best use of the results of previous studies, the total score of aerobics is predicted based on each index of the performance appraisal score, and

established the mathematical model of multiple regression. The prediction model can predict the results of aerobics athletes, and provide advice for the training of aerobics.

## THE DETERMINATION OF THE AEROBICS INDEXES

Aerobics is a kind of action performance done by the athletes in the music, which requires that the athletes have strong perforating ability, technical ability and sustainable ability. During it, the appropriate action, difficulty and music are chosen for the complete set of action performance made by the athletes and then the judges give the appropriate grades.

According to the aerobics competition standards, there are mainly 3 indexes and 9 secondary indexes under them. The scores were given respectively by the appearance of the 9 indices based on the grading principle of several experts, and total scores are given, too. Through the score of each index, total scores are predicted and the weights of first level index and secondary level index are determined of the. The evaluation index system of aerobics performance is shown as the following in TABLE 1.

**TABLE 1 : The aerobics indexes system table**

| performance | first level index | secondary level index |
|---|---|---|
| total result for aerobics | Step | accuracy |
| | | regularity |
| | | resilience |
| | Body gesture | harmony ability |
| | | stability |
| | | Control ability |
| | Music selection | health |
| | | unitarily |
| | | compatibility |

## THE ESTABLISHMENT OF AEROBICS PERFORMANCE PREDICTION MODEL

### The collection of index data

Some aerobics athletes are chosen to do sports performance, for which the specialists gave the relative grades and their total scores for the 3 first level indexes and 9 secondary level indexes. The dates are shown in TABLE 2 and TABLE 3.

### The establishment of Multiple regression models

Multiple regression models are built by the score value of first level index and the second level index using SPSS. There is multiple linear regression equation, and the two predicting equations are as follows:

**TABLE 2 : Scoring results of first level index for aerobics**

| total score $Y$ | Step $X_1$ | Body gesture $X_2$ | Music $X_3$ |
|---|---|---|---|
| 8.4 | 8.7 | 8.6 | 8.8 |
| 9.3 | 9.2 | 9.0 | 9.4 |
| 8.8 | 8.8 | 8.7 | 9.4 |
| 8.7 | 8.6 | 8.7 | 8.3 |
| 7.9 | 7.5 | 7.9 | 7.7 |
| 8.8 | 8.8 | 8.7 | 8.4 |
| 8.8 | 8.4 | 8.7 | 8.6 |
| 9.1 | 8.9 | 8.8 | 9.1 |
| 9.8 | 9.6 | 9.4 | 9.7 |
| 9.3 | 8.7 | 9.3 | 9.4 |
| 8.9 | 8.8 | 8.6 | 8.6 |
| 8.9 | 8.8 | 8.7 | 8.6 |
| 8.9 | 8.6 | 8.8 | 8.8 |
| 9.8 | 9.6 | 9.5 | 9.7 |
| 7.9 | 7.8 | 7.8 | 7.6 |
| 9.7 | 9.4 | 9.6 | 9.5 |
| 8.8 | 8.8 | 8.5 | 8.6 |
| 8.8 | 8.8 | 8.5 | 8.6 |
| 6.9 | 6.8 | 6.7 | 6.7 |
| 9.6 | 9.5 | 9.3 | 9.4 |
| 9.3 | 9.1 | 9.0 | 9.3 |
| 8.4 | 8.7 | 8.7 | 8.2 |
| 9.5 | 9.1 | 9.5 | 9.5 |
| 9.1 | 9.1 | 9.0 | 9.0 |
| 9 | 8.8 | 8.7 | 8.8 |
| 8.9 | 8.6 | 8.6 | 8.9 |
| 7.1 | 6.9 | 6.9 | 7.1 |
| 8.6 | 8.8 | 8.4 | 8.3 |
| 8.9 | 8.7 | 8.7 | 8.8 |
| 9 | 8.9 | 8.8 | 8.6 |

FULL PAPER

**TABLE 3 : Scoring results of second level index for aerobics**

| total score | harmony ability | stability | Control ability | health | unitarily | compatibility | accuracy | regularity | resilience |
|---|---|---|---|---|---|---|---|---|---|
| $Y$ | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ | $x_8$ | $x_9$ |
| 8.4 | 9 | 8.5 | 8.6 | 8 | 9.3 | 8.9 | 9.3 | 8.1 | 8.6 |
| 9.3 | 8.9 | 10.1 | 8.3 | 8.8 | 9.4 | 9.7 | 9.9 | 8.1 | 9.4 |
| 8.8 | 8.7 | 8.8 | 8.9 | 9 | 9.6 | 9.3 | 9.4 | 8.4 | 8.4 |
| 8.7 | 8.3 | 9.6 | 8.6 | 8 | 8.7 | 8.1 | 8.3 | 9 | 8.4 |
| 7.9 | 7.8 | 8.4 | 7.9 | 7.6 | 7.8 | 7.5 | 8 | 7.7 | 6.8 |
| 8.8 | 8.9 | 8.8 | 8.6 | 8.4 | 8.6 | 8.1 | 8.9 | 8.9 | 8.5 |
| 8.8 | 8.5 | 9.4 | 8.6 | 8 | 8.4 | 9.2 | 8.6 | 8.1 | 8.4 |
| 9.1 | 8.6 | 9.1 | 9 | 8.7 | 9.2 | 9.1 | 9 | 8.9 | 8.7 |
| 9.8 | 9.4 | 9.9 | 9.3 | 9.6 | 9.6 | 9.7 | 9.7 | 9.7 | 9.4 |
| 9.3 | 9.2 | 9.5 | 9.6 | 9.6 | 9 | 9.3 | 9 | 9 | 8.1 |
| 8.9 | 8.4 | 9 | 8.6 | 8.1 | 9.1 | 8.5 | 8.6 | 8.8 | 8.9 |
| 8.9 | 8.5 | 9.1 | 8.7 | 8 | 8.6 | 8.9 | 8.6 | 8.9 | 8.7 |
| 8.9 | 8.6 | 9.3 | 8.8 | 8.7 | 8.6 | 8.9 | 8.7 | 8.8 | 8.3 |
| 9.8 | 9.4 | 10.1 | 9.4 | 9.6 | 9.6 | 9.7 | 9.7 | 9.5 | 9.4 |
| 7.9 | 7.8 | 8.1 | 7.7 | 7.6 | 7.9 | 7.2 | 7.7 | 7.7 | 7.8 |
| 9.7 | 9.7 | 9.8 | 9.6 | 9.1 | 9.7 | 9.5 | 9.3 | 9.4 | 9.3 |
| 8.8 | 8.4 | 8.5 | 8.8 | 8.3 | 8.6 | 8.8 | 8.9 | 8.7 | 8.7 |
| 8.8 | 8.2 | 9.1 | 8.6 | 8.4 | 8.6 | 8.7 | 8.6 | 8.8 | 8.8 |
| 6.9 | 6.7 | 6.8 | 6.9 | 6.5 | 6.6 | 6.7 | 6.9 | 6.8 | 6.7 |
| 9.6 | 9.4 | 9.5 | 9.3 | 9.3 | 9.3 | 9.4 | 9.6 | 9.4 | 9.5 |
| 9.3 | 8.8 | 9.3 | 9.1 | 9.1 | 9.3 | 9.2 | 9 | 9.1 | 9.1 |
| 8.4 | 8.4 | 9.1 | 8.9 | 7.9 | 8.1 | 8.5 | 8.6 | 8.7 | 8.7 |
| 9.5 | 9.5 | 9.7 | 9.5 | 9.3 | 9.7 | 9.3 | 9.3 | 8.9 | 8.9 |
| 9.1 | 9.1 | 9.2 | 9 | 8.9 | 9.1 | 8.8 | 8.9 | 9 | 9.4 |
| 9 | 8.1 | 9.1 | 9.1 | 8.6 | 9.1 | 8.5 | 9.1 | 8.9 | 8.4 |
| 8.9 | 8.4 | 8.8 | 8.9 | 8.4 | 9 | 9 | 8.9 | 8.5 | 8.4 |
| 7.1 | 6.7 | 7.3 | 6.9 | 6.7 | 6.9 | 7.4 | 7 | 6.7 | 6.9 |
| 8.6 | 8.1 | 8.8 | 8.7 | 8 | 8.3 | 8.4 | 9.2 | 8.7 | 8.4 |
| 8.9 | 8.9 | 9.2 | 8.3 | 8.6 | 9 | 8.5 | 8.9 | 8.4 | 8.7 |
| 9 | 8.8 | 8.9 | 9.1 | 8.6 | 9 | 8 | 9 | 8.7 | 8.8 |

**TABLE 4 : model collecting table**

| model collecting | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| model | R | R square | adjust R | standard error of estimation | Changing statistics | | | | |
| | | | | | R square corrected | F corrected | df1 | df2 | Sig. F corrected |
| 1 | .990[a] | .979 | .970 | .11827 | .979 | 104.726 | 9 | 20 | .000 |

**a. predictive variables: (constants), x9, x3, x6, x2, x7, x1, x4, x5, x8.; b. the dependent variable : Y**

$$Y_1 = A_1X_1 + A_2X_2 + A_3X_3 + C_1 \quad (1)$$

$$Y_2 = \sum_{i=1}^{9} a_i x_i + C_2 \quad (2)$$

Among them, $Y_1$.$Y_2$ indicates respectively the predicting performance after the regression of first level index and the second level index., $X_i$ is the first level index score, $A_i$ is the coefficient of first level index, $C_1$ is the constant; $x_i$ shows the second level index score in aerobics sports, $a_i$ shows the coefficient of second level index, $C_2$ shows the constant.

First,the second level index dates are introduced into SPSS and performed multiple regression, what's more, prediction equations are built, after applying software SPSS, the results are as follows in TABLE4 :

Significant test of regression equation is as follows in TABLE 5 and TABLE 6.

From the calculation above, based on the second index for aerobics performance prediction, multiple linear regression equation can be obtained as follows:

$$Y_2 = 0.004x_1 + 0.208x_2 + 0.39x_3 + 0.258x_4 + 0.10x_5 + 0.074x_6 = 0.1x_7 + 0.191x_8 + 0.128x_9 + 0.226 \quad (3)$$

**TABLE 5 : Test**

| Anova[b] | | | | | |
|---|---|---|---|---|---|
| model | | square sum | df | mean square | F | Sig. |
| 1 | regression | 13.183 | 9 | 1.465 | 104.726 | .000[a] |
| | residuals | .280 | 20 | .014 | | |
| | total | 13.463 | 29 | | | |

**a. predictive variables: (constants), x9, x3, x6, x2, x7, x1, x4, x5, x8; b. the dependent variable: Y**

**TABLE 6 : The table on equations regression coefficient**

| coefficient | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| model | | Non-standardized coefficient | | standardized coefficient | t | Sig. | correlation | | |
| | | B | Standard error | trial version | | | zero-order | partial | section |
| 1 | (constant) | .226 | .315 | | .716 | .482 | | | |
| | x1 | .004 | .094 | .004 | .039 | .969 | .919 | .009 | .001 |
| | x2 | .208 | .072 | .221 | 2.872 | .009 | .923 | .540 | .093 |
| | x3 | .039 | .116 | .038 | .337 | .740 | .914 | .075 | .011 |
| | x4 | .258 | .089 | .289 | 2.893 | .009 | .943 | .543 | .093 |
| | x5 | .100 | .091 | .111 | 1.094 | .287 | .920 | .238 | .035 |
| | x6 | .074 | .074 | .083 | 1.010 | .325 | .882 | .220 | .033 |
| | x7 | -.010 | .090 | -.010 | -.108 | .915 | .894 | -.024 | -.003 |
| | x8 | .191 | .107 | .194 | 1.777 | .091 | .909 | .369 | .057 |
| | x9 | .128 | .081 | .137 | 1.583 | .129 | .887 | .334 | .051 |

**a. the dependent variable: Y**

**TABLE 7 : Model collecting table**

| model | R | R square | adjust R square | standard error of estimation |
|---|---|---|---|---|
| 1 | .984[a] | .968 | .965 | .12820 |

**a. predictive variables: (constants), X3, X1, X2.**

**TABLE 8 : Coefficient**

| model | | Non-standardized coefficient | | Standardized coefficient | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | standard error | trial version | | |
| 1 | (constant) | .039 | .322 | | .121 | .905 |
| | X1 | .302 | .111 | .295 | 2.725 | .011 |
| | X2 | .459 | .134 | .441 | 3.435 | .002 |
| | X3 | .251 | .100 | .269 | 2.518 | .018 |

**a. the dependent variable: Y**

FULL PAPER

Through Predicting value test, standardized residuals accord with the following chart, and are close to normal distribution, which indicates residuals distribution of prediction values is proper and the accuracy of the model is good. The test Histogram is shown in following Figure 1:

Similarly, according to the above method, multiple regression equation can be obtained through the regression calculation between the first index and total grade. They are shown as in TABLE 7 and TABLE 8.

Based on the first level index for multivariate regression aerobics performance prediction, multiple lin-

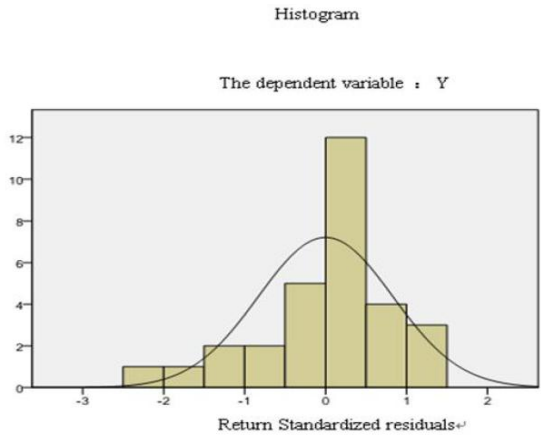


**Figure 1: Standardized residuals distribution**

**TABLE 9 : Actual prediction value comparison table**

| actual result | Predicting result | Error (secondary index) | Predicting result | Error (the first level index) |
|---|---|---|---|---|
| 8.4 | 8.6 | 0.0206 | 8.8 | 0.0502 |
| 9.3 | 9.3 | 0.0036 | 9.3 | 0.0007 |
| 8.8 | 9.0 | 0.0221 | 9.0 | 0.0282 |
| 8.7 | 8.8 | 0.0156 | 8.7 | 0.0014 |
| 7.9 | 7.9 | 0.0039 | 7.9 | 0.0048 |
| 8.8 | 8.8 | 0.0054 | 8.8 | 0.0003 |
| 8.8 | 8.7 | 0.0145 | 8.7 | 0.0083 |
| 9.1 | 9.1 | 0.0037 | 9.0 | 0.0056 |
| 9.8 | 9.8 | 0.0001 | 9.7 | 0.0116 |
| 9.3 | 9.3 | 0.0048 | 9.3 | 0.0007 |
| 8.9 | 8.8 | 0.0079 | 8.8 | 0.0111 |
| 8.9 | 8.8 | 0.0110 | 8.8 | 0.0059 |
| 8.9 | 9.0 | 0.0065 | 8.9 | 0.0019 |
| 9.8 | 9.8 | 0.0007 | 9.7 | 0.0069 |
| 7.9 | 7.9 | 0.0023 | 7.9 | 0.0023 |
| 9.7 | 9.6 | 0.0112 | 9.7 | 0.0033 |
| 8.8 | 8.7 | 0.0102 | 8.8 | 0.0050 |
| 8.8 | 8.9 | 0.0090 | 8.8 | 0.0050 |
| 6.9 | 6.9 | 0.0063 | 6.8 | 0.0074 |
| 9.6 | 9.5 | 0.0059 | 9.5 | 0.0068 |
| 9.3 | 9.3 | 0.0024 | 9.3 | 0.0052 |
| 8.4 | 8.7 | 0.0317 | 8.7 | 0.0377 |
| 9.5 | 9.5 | 0.0046 | 9.5 | 0.0033 |
| 9.1 | 9.2 | 0.0129 | 9.2 | 0.0084 |
| 9 | 8.9 | 0.0057 | 8.9 | 0.0114 |
| 8.9 | 8.8 | 0.0134 | 8.8 | 0.0094 |
| 7.1 | 7.1 | 0.0000 | 7.1 | 0.0041 |
| 8.6 | 8.6 | 0.0013 | 8.6 | 0.0040 |
| 8.9 | 8.9 | 0.0027 | 8.9 | 0.0036 |
| 9 | 8.9 | 0.0137 | 8.9 | 0.0085 |
| Average error value | | 0.0085 | | 0.0088 |

ear regression equation can be obtained from the above calculation as follows:

$$Y_1 = 0.302X_1 + 0.459X_2 + 0.251X_3 + 0.39 \quad (4)$$

## Comparison test of predictive value

by analyzing the two prediction models for the aerobics performance, comparing and selecting better regression equation, the actual results, the prediction results and the error values are shown in TABLE. 9

Error analyses show, regressed equation error is smaller than the equation of the value adopting the second index, which indicates that the prediction accuracy of the second index is more reliable. In the regression equation test of second index, R square value is greater than that in the first level index regression equation, which also shows that the equation 3 has higher fitting precision than equation 4. Therefore, it is the best way to predict the aerobics sports performance using the second level index score. The error is less than 0.85%, which indicates that the model can predict the aerobics grades. In three indexes of the first level indexes, the body posture coefficient of regression equation is maximum, which indicates that the weight is maximum for body posture in aerobics.

## CONCLUSION

In the paper, the linear regression equations are established through, the first level index and the second level index in aerobics sports to carry on the forecast to the aerobics performance, after analysis, it can be concluded that the prediction model built by the two indexes can predict more accurately the performance of aerobics sports, and the prediction precision is high, which proves that the model is available in aerobics sports performance prediction.

"Posture" is the most important factor in terms of aerobics performance contribution rate in the first level index, while "control" takes up the largest rate in terms of contribution in the second level index. Therefore, in order to improve the performance of aerobics athletes, the indexes whose contribution rate is great should be paid more attention in the regular training,

## REFERENCES


[1] Wang Kun, Wei Wen-Yi; Biomechanical Research on Specific Ability of Takeoff in Long Jump[J]. China Sport Science, **25(1)**, 42-45 **(2005)**.

[2] Li Hong-Bo, Liv Hao; Research development of special physical competence theory of aerobics[J]. Journal of Sports Adult Education, **27(2)**, 55-57 **(2011)**.

[3] Yang Fengjuan; Researches on Traumas of Competitive Aerobic Dancing Athletes[J]. Journal of Beijing Sport University, **4**, **(1998)**.

[4] Dai Li-Ping; Biomechanical Analysis on Jumping Typical Difficulty Elements in Sports Aerobics[J]. Fujian Sports Science and Technology, **31(3)**, 27-30 **(2012)**.

[5] Shan Xinhai, Dai Yusheng, Cai Guojun, Jin Jichun; The comparison of biomechanical variables of the takeoff performances of three atheltes with different jumping abilities[J]. Sports & Science, **18(4)**, 22-26 **(1997)**.

[6] Cheng Wan-Xiang et al; Changing Character of the Ground Reaction Force and Joint Torque of Lower Limbs During Landing from Different Height[J]. Journal of Chengdu Physical Education Institute, **36(3)**, **(2010)**.