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Scree as a Criteria of Development of Motional Skills

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Abstract

In this article we examine different analytical relations, describing the process of development motional skill in sports. It is shown, that this process can be described as an exponential function where changes of results in sports depend on duration of training or amount of training, as Pareto distribution and Verhulst logistic function.

As a result of the research of power functions, which approximate competitive results of four mini-golf players within 5 years, we established a criteria of development of motional skills in the form of scree.

It is found, that the power function is the best one for describing improvements of sport achievements on the stage of primary training (1-2 years of training), and exponential function better fits for stages of perfecting of skills and sport mastery (more than 4 years of training). During the immersed training both models have precise enough approximation from 10-th to 70-th competitive round. Besides, all the data on sport results, starting from the very beginning of training, must be taken in the account during the process of modeling and forecasting of sport achievements.

Offered models and criteria can be used for establishing of rated norms and forecasting of results in kinds of sport with primary demonstration of coordinating capabilities of accurate performance of purposeful motions.

Keywords: criteria of scree, regularity of development of motional skills, Hirsch index, Pareto distribution, Verhulst equation, golf, mini-golf.

Introduction

Development of skills and abilities is the most discussed issue in different pedagogical researches. In the scientific online library ‘eLibrary’ there are over 800 publications related to the key-word “motional skill”. Terms of “skill” and “ability” as well as different aspects of their development in different kinds of activities and in different conditions of testees [1, 2, 3, 5, 6, 8, 12] are discussed in these researches.

Even so, despite many publications about this issue, regularity of development of motional skills and abilities in the form of analytical relations practically was not revealed. It was V.A. Plahtienko [11], who first established a graphical form of regularity of development of motional skill depending on the amount of training exercises. The form of the graph resembled a hyperbola, which values declined whereas the amount of training grew up, what proofed the improvement of

sport results and increase the extent of maturity of motional skill. It is mentioned in monograph of V.G. Nikitushkin [10], that the form of this graph can be described with exponential function of time.

In the work of O.N. Khudoley [13] there are given similar analytical expressions for extent of development (level of training) of motional skill of gymnasts depending on the amount of completed work, the number of repeats and other parameters of training affects in the form of Verhulst logistic function [14].

Materials and methods

In our works [5, 6] after long-term observation of improvement of the result in golf and mini-golf it was established that relation of the result R on the amount of played competitive rounds X looks like (figure 1):

$$R=R_0 e^{-kX}, \qquad (1)$$

where R_0 stands for the result of mini-golf player, defined by inborn and obtained coordinating abilities to perform accurate actions; k stands for a coefficient, which describes educability of a sportsman, and which is equal in number to average increment for one round of game.

Those relations were set for results given by three sportswomen on official competitions held on the same golf field during 2009-2015 years. Overall for this period those sportswomen played from 79 to 107 rounds with 18 holes in each round in 20-25 competitive matches.

Similarly to exponential decay, which completely looks like (1), k is a probability of improvement of the result during the round relatively to initial result R_0. Similarly to technical systems k, which stands for sensitivity of the system, is a value reversed to period of time, in which the signal (reaction of the system) changes in e times.

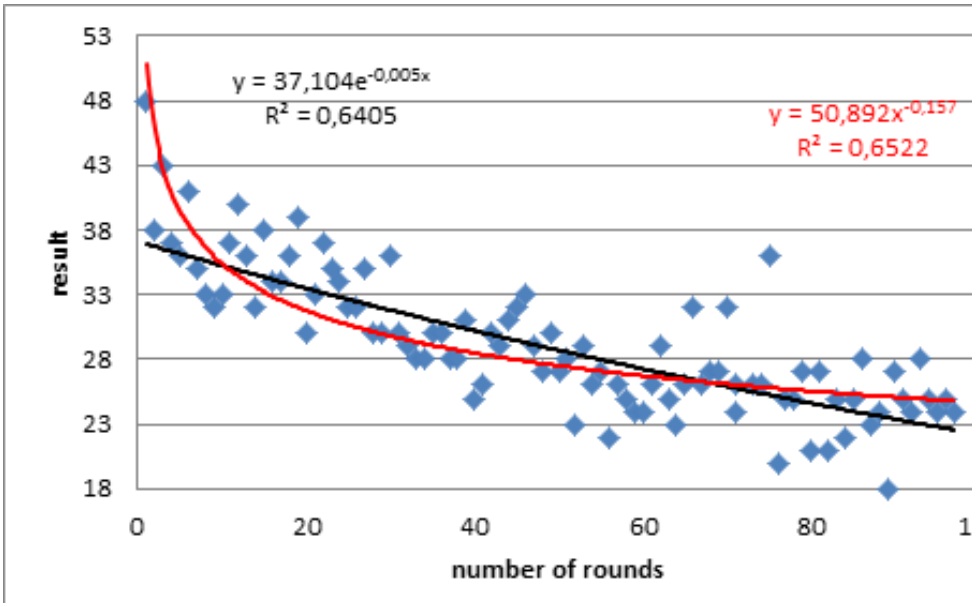

Figure 1. Alteration of the results in mini-golf depending on the number of rounds played (on the example of one sportsman 2009-2015 years)

Organization of the research

At the same time, approximation of given long-term observations of sport achievements with the power function like $R=(X_m/x)^k$ is as accurate as approximation with the exponential function. Unlike exponential function, power one better describes increment of the results on the stage of primary training, which is the stage of development of special motional skills. A distribution, also known as Pareto distribution, describes many different facts with good approximation: distribution of cities depending on the number of inhabitants, frequency of using of words in different languages, ratio of mastery and mass character in sports, dependence of quantity of muscular moment of force

on stimulation frequency, dependence of maximal value of excitation of heart muscle on duration of stimulation, dependence of labor efficiency on tiredness during the training etc. [7].

Results and discussion

Graph R(x) has two distinctive sectors. Typical feature of the first one is a fast decline of values of R(x) from left to right till some point, tangent to which crosses axles oX and oY with angle 135° (pic.2). On the second sector gradient of decrease of R(x) declines. Derivative of R(x) at this point equals to -1. In factorial analysis coordinates of this point are named criteria of scree (Cattell, 1966 [4]), and in analysis of publication activity this point is named Hirsch index [10]. Location of this point on the graph, which describes alteration of sports performance depending on the amount of training exercises, will match to the moment of regress of sports results. In the mini-golf location of this point matches to II-III junior rank, to the amount of training affects needed to develop special motional skills. Usually it takes a year of training to fulfill those sport standards, if a sportsman trains 2-3 times a week.

X_m equals to minimal amount of training affects needed to achieve the absolutely best result: 18 hits in 18 holes, within which the researched system stops reacting on further increase of impetus **x**. For example, of impetus on pic. 2, where X_m=74 200 000 000 (seventy four billions competitive rounds). If a sportsman participates in several dozens of competitions annually, it will take him several billions years of sport career to achieve such results. That is why mathematical model of achieving high results in mini-golf in the form of power function is unsuccessful. Of course, in real life it takes much less time to achieve the absolutely best result. It takes around 6-8 years of regular training.

If we use an exponential model, than the number of competitive rounds needed to achieve an absolute result X_m equals:

$$X_m=-1/k(\ln 18-\ln R_o). \quad (2)$$

And for the sportsman, whose results are described by the graph, X_m equals to 145 competitive rounds, what accords to 7 years of competitive activities.

Basing on pic.1, graphs of power and exponential functions cross somewhere within 70-th round. It matches to approximately 5-th year of training and completing (attestation) of I senior rank. It means that intersection point of those two functions can serve as a criteria of development motional skill or, in other words, of the extent of mastering of the motions, that are performed vastly automatically, unconsciously [1, 6].

Summary

To sum it all up, that the power function is the best one for describing improvements of sport achievements on the stage of primary training (1-2 years of training), and exponential function better fits for stages of perfecting of skills and sport mastery (more than 4 years of training). During the immersed training both models have precise enough approximation from 10-th to 70-th competitive round. Besides, all the data on sport results, starting from the very beginning of training, must be taken in the account during the process of modeling and forecasting of sport achievements. As we didn't make such observations (starting from the first year of training) in our research, we haven't succeeded in approximating of alterations of sport results during the period of time using sigmoid logistic function [14].

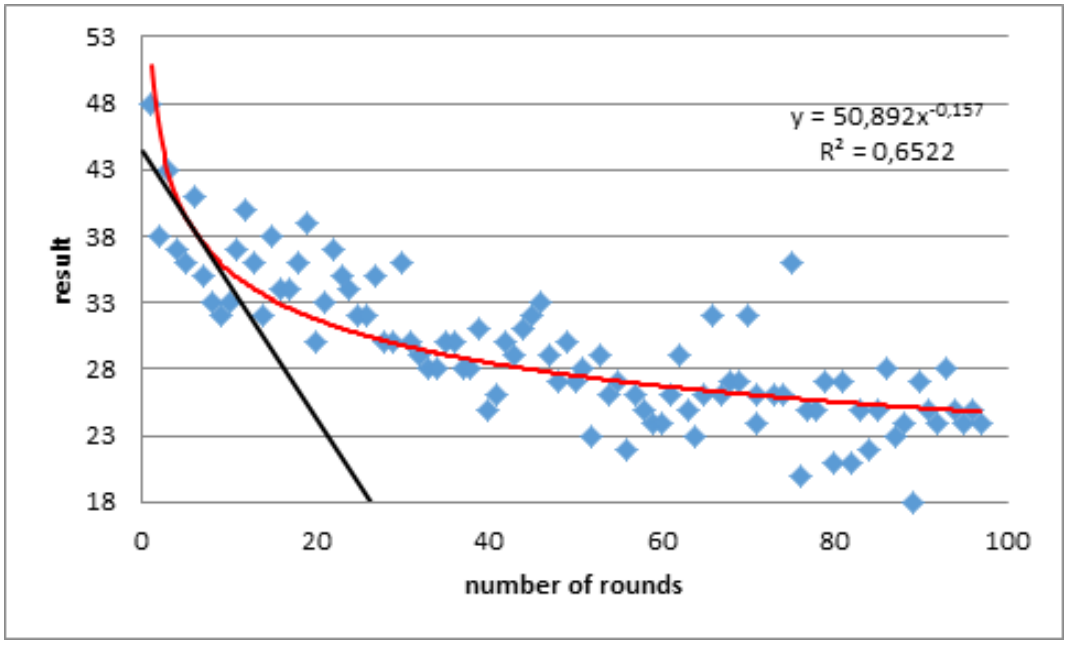

Figure 2. Location of criteria of scree on the graph of alteration of sport results

Offered models and criteria can be used for establishing of rated norms and forecasting of results in kinds of sport with primary demonstration of coordinating capabilities of accurate performance of purposeful motions.

References:

1. Goncharov V.I. One more time about the terms of “motional ability” and “motional skill” / Scientific notes of university of P.F. Lesgaft. 2008. №3. P. 30-33.
2. Goncharov V.I. Phenomenon of reproduction of motional skills / Scientific notes of university of P.F. Lesgaft. 2012. №7 (89). P. 39-43.
3. Gurskiy A.V. Recovery of motional skill of racers-luzhniki / Herald of sport news. 2013. №4. P. 20-22.
4. Kim J.-O., Muller C.U. “Factor analysis: statistical methods and practical questions” / digest of works “Factor, discriminant and clustered analysis”: translated from English; Edited by I.S. Enukov. M.: “Finances and statistics”, 1989. P. 215.
5. Korolkov A.N. Regularities of development of motional skill of junior mini-golf players / Physical education: upbringing, education, training. 2011. №6. P. 36-37.
6. Korolkov A.N. Different didactic features of assimilation of gaming actions in golf / Physical education: upbringing, education, training. 2012. №6. P. 40-43.
7. Korolkov A.N. Ratio of mastery and mass character in sports in the form of Pareto distribution / Scientific notes of university of P.F. Lesgaft. 2013. №2 (96). P.81-83.
8. Malceva D.D. Psycho-pedagogical factors of development of operational form of action / Herald of Moscow State Linguistical university. 2014. №7 (693). P. 109-117.
9. Nikitushkin V.G. Hirsch index of teachers in Moscow higher educational institutions in comparative evaluation of scientific efficiency of Russian sport higher educational institutions / V.G. Nikitushkin, G.N. Germanov, A.N. Korolkov // Theory and practice in physical education. 2015. №2. P. 94-97.
10. Nikitushkin V.G. Long-term training of junior sportsmen: monograph / V.G. Nikitushkin. – M.: Physical education, 2010. P.230: table

11. Plahtienko V.A. Different regularities of development of motional skill / Theory and practice in physical education. 1968. №12. P.10-13.

12. Sidneeva A.N. Development of writing skill by third type of orientation (modified method of N.S. Pantina) / Historically-cultural psychology. 2014. T. 10. №2. P.58-68.

13. Khudoley O.N. Regularities of development of motional skills of junior gymnasts / Science in Olympic sports. 2012. №1. P.36-46.

14. Mitchell, Tom M. Machine Learning. WCB-McGraw-Hill, 1997. ISBN 0-07-042807-7.