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MATHEMATICAL MODEL FOR PREDICTION OF SPORTS PERFORMANCE

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SUMMARY
The paper presents a mathematical model and the issues related to the dynamic series adjustment in order to determine the probability to reach preset values of performance, in the stated period of time and of known statistical chronological series. Each dynamic series represents values of the physical tests monitored over a training phase, so over a stated period of time.
The proposed mathematical model is based on the statistical extrapolation for determine the weight of the different criterions of probabilistic evaluation of the desired sportive performance. The yield of probability will be determined as sum of probabilities composed based on the weights, for a reset prediction, of the statistical extrapolation trend functions

INTRODUCTION
With almost 40 years ago, Keller [1, 2] formulated a simplistic model to predict potential race times over a variety of distances.
Prendergast (1990) applied the average speeds of world record times, in athletics, to determine a mathematical model for world records.
Now, there are two distinct approaches for the sports performance prediction: situational plays and statistical base model. In the first occurrence, the situational plays are more difficult to measure for prediction because they usually involve the motivation of a team. In the second occurrence, mathematical statistical models are based on past performances or on a set of physical and technical tests measured in training.

METHODS
The factors, internal or external, which influence the sportive performance, can be numerically evaluated, in most of the situations, and their chronological evolution lead to getting dynamic series.
The chronological or dynamic series used in the individual sports represents the numerical indicators which characterize the process of physical, medical and psychic training of a sportsman, at successive time intervals.
In a dynamic series, represented by a graphic, we can see a certain trend function, and a continuously developed tendency, upwards, downwards or constant. The particular or hazardous changes are not compatible with the idea of the trend function. Within a trend function there are periodical oscillations, which take place through the effect of the year irregularities, and also hazardous oscillations (incidental), which appear as the result of the action of hazardous factors.
The proposed algorithm was developed respecting the following general phases:
- The first step of the prediction algorithm was that of determining the prediction horizon, in order to extrapolate the trend functions .Thus, for this particular case the interval was set to 7 days, verified afterwards through physical tests in January 2012.
- The second step of the prediction algorithm was that of identifying, for all physical factors analyzed, the trend functions. Thus we have the graphics of the values for each physical factor, as well as the analytical trend functions, corresponding to these physical factors. With the help of the trend factors we then determined, by extrapolation, the prediction horizon of 7 days, the values of the monitored physical factors.
- The third step of the prediction algorithm was establishing a hierarchy of the training physical factors, and of the dynamic series, respectively, upon the performance criterion (high jump with take-off). For this purpose we had equal shares for all physical factors involved (1/14 = 0, 0714285), assuming at the beginning that all physical factors had the same influence during the training, in order to attain the ideal performance.
- The fourth step of the prediction algorithm was establishing a calculation expression for the probability of getting the performance criterion (high jump with take-off, short – HJT), taking into account the quantified dynamic series, and the training physical factors, respectively. To this purpose, the HJT probability was seen as the probability of an intersection of several events, where the events are the quantified physical factors, in equal shares in order to get the HJT probability.
- The fifth step of the prediction algorithm was numerically establishing the HJT probability, by verifying the predicted value for the high jump. The bigger the probability value of the performance criterion chosen and obtained, the closer the value of the probabilistic model gets to the reality.
- The sixth step of the prediction algorithm was modifying the share of physical factors upon the performance criterion, successively decreasing or increasing the value of each training physical factor, and of each dynamic series, respectively, in their influence upon the chosen performance criterion. The practical difficulty, for this phase, was that of determining the analytical calculation expression of the

probability of event intersections with different degrees of influence.

- The seventh step of the prediction algorithm was recalculating the HJT probability for different shares of the F events and displaying a probability field corresponding the hierarchy modifications of the dynamic series. In the present, we are working at the numerical processing in order to show the coach on which physical factor he should work more intensely with the sportsman in order to get a higher probability of the desired performance criterion.

RESULTS AND DISCUSSION

In this paper we only considered the following physical factors, corresponding to an athlete executing a high jump:

- sprint training, with high start: 30 meters speed running; 50 meters speed running;
- jump training (expansion): standing long jump (s.l.j.); standing hop step (s.h.s.); standing penta-jump (s.p.j.); vertical expansion – one step take-off (v.e.o-s.); vertical expansion – four steps take-off (v.e.f-s.);
- force training: genuflections with barbells (g.b.); semi-genuflections with barbells (s.g.b.); snatch with barbells (s.b.); supine and push with barbells (s.p.b.);
- technical training: high jump with take-off (h.j.t-o.); high jump without take-off (h.j.w.t-o.); optimal performance of the jump (o.p.j.); high jump with shearing (h.j.s.).

The values obtained within a month, during the precompetition training period, are presented in table 1.

In the figures 1 and 2 are represented two graphics for the values of some physical factors.

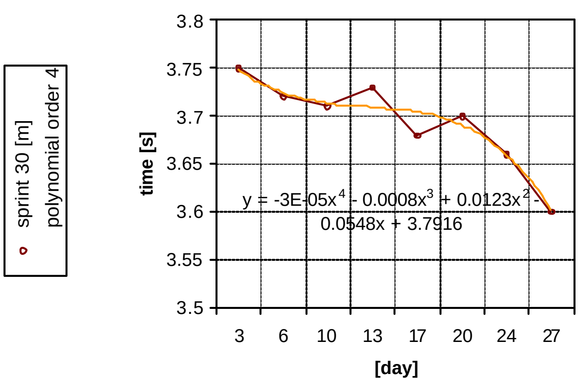

Figure 1: The trend function for 30 meters sprint training

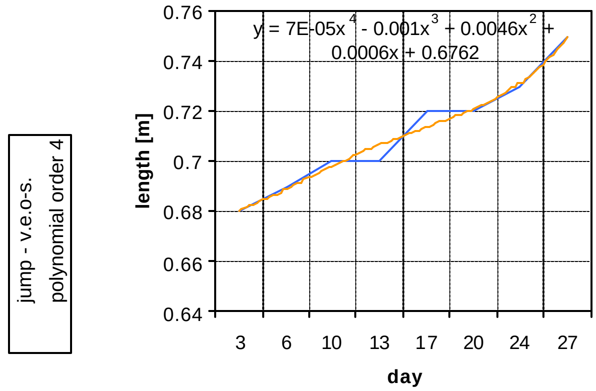

Figure 2: The trend function for vertical expansion training

After prediction algorithm implementation to find the probability value 0.721 for the athlete to get a jump 2.06 meters on the next 7 days. Probability became certainty when the athlete jumped 2.07 meters in the forecasted timeframe.

CONCLUSIONS

This research may also be extended to the medical and psychological factors, in order for the coach to have a detailed analysis of the influence of temporal series upon of the desired performance criterion, in order to continue by differentiating the training, according to the degree of achieving a certain factor.

REFERENCES

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Table 1: Values of physical factors trai ning.

The days in	Sprint training		Jump training					Force training				Technical training			
December 2011	30 m [s]	50 m [s]	s.l.j. [m]	s.h.s.	s.p.j.	v.e. o-s.	v.e. f-s.	g.b. [kgf]	s.g.b.	s.b.	s.p.b.	h.j. t-o. [m]	h.j.w. t-o.	o.p.j.	h.j.s.
1	2	3	4					5				6			
03.12.2011	3.75	5.92	2.80	8.70	14.59	0.68	0.95	105	150	45	65	1.55	1.95	2.00	1.82
06.12.2011	3.72	5.90	2.77	8.73	14.62	0.69	0.97	110	160	48	70	1.56	2.00	2.02	1.83
10.12.2011	3.71	5.92	2.82	8.80	14.70	0.70	0.97	115	165	50	75	1.58	1.98	2.00	1.85
13.12.2011	3.73	5.91	2.87	8.85	14.81	0.70	1.00	120	180	55	75	1.57	1.98	2.01	1.88
17.12.2011	3.68	5.87	2.95	8.90	15.11	0.72	1.02	115	170	52.5	80	1.59	2.03	2.05	1.91
20.12.2011	3.70	5.90	2.95	8.92	15.20	0.72	1.05	110	175	50	75	1.60	2.02	2.04	1.90
24.12.2011	3.66	5.85	2.98	9.00	15.31	0.73	1.08	115	165	55	70	1.60	2.06	2.10	1.92
27.12.2011	3.60	5.85	3.02	9.03	15.42	0.75	1.10	110	170	50	75	1.57	1.98	2.00	1.88