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The trends of best results of sprint and jumping events of Track and Field World Championships (1983-2017)

A sprint- és ugrószámok legjobb eredményeinek trendjei az atlétikai világbajnokságokon (1983-2017)

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Abstract: The purpose of this study is to present the results of the winners, the 8th, and the best non-qualifier athletes of the athletic world championships. The polynomial trend line was used to show data trends, with the best approximation. It was displayed by the equations of all used data sets. All the data were collected from the IAAF World Championships London 2017 Handbook, and it was completed with the latest data of the 2017 IAAF World Championships. It was found that future results in the athletics world championships cannot be predicted except for one or two special cases. The results are influenced by so many components and tendencies that it is the best to find and classify the strongest and some other influencing factors and focus on them.
Keywords: track and field, world athletics championships, sprint and jumping events, performance prediction, result trends
Absztrakt: A tanulmány célja az atlétikai világbajnokság nyerteseinek, a nyolcadik és a legjobb nem kvalifikált sportolók eredményeinek bemutatása. A polinomiális trendvonalat az adatok tendenciáinak bemutatására használtuk, a legjobb megközelítéssel. Az összes használt adatkészlet egyenleteit jelenítettük meg. Az összes adatot az IAAF London 2017 Bajnokság Kézikönyvéből gyűjtöttük, és kiegészítettük a 2017. évi IAAF Világbajnokság legfrissebb adataival. Megállapítást nyert, hogy az atlétikai világbajnokság jövőbeli eredményei - egy vagy két különleges eset kivételével - nem jósolhatók meg. Az eredményeket annyi tényező és tendencia befolyásolja, hogy a legjobb megtalálni és osztályozni a legerősebb és néhány más befolyásoló tényezőt, és rájuk összpontosítani.
Kulcsszavak: atlétika, atlétikai világbajnokság, sprint és ugró rendezvények, teljesítmény-előrejelzés, eredménytrendek

Introduction

Predictions and trend calculations are not unknown among track & field researches. These are mainly longitudinal studies with the help of which they try to guess which particular athlete will have good results in the future (Zaar and Szlachta, 2016), or show the possibility for coaches and trainers to predict or calculate the future form of a given group, calculated from previous test or selected competition performances (Béres, Csende, Lees and Tihanyi, 2014).

There are experiments predicting competition performances (Xu, Tang, Xing and Jin, 2014) which tried to predict the men's 100m sprint Olympic champion performance from the last six results of the original data by using the GM(1,1) prediction model of the Gray system theory at the 31st Olympic Games.

Duncan and Király (2015) used performance prediction on individual level exposing the phenomenology of individual athletic performance in the form of a low-rank model dominated by the individual power law. They show that many documented factors in quantitative sports science, such as the form of scoring tables, the success of

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existing prediction methods including Riegel's formula, the Purdy point's scheme, the power law for world record performances and the broken power law for world record speeds, may be explained by their findings in a unified way.

Liu and Schutz (1998) tried to identify the best mathematical model and the best data set to predict men's future world-best track and field performance and ultimate performances for seven selected track and field events, with developing a new "random sampling" model for those events that have exhibited asymptotic-like behaviour over the last 15 years. Linear and non-linear models were used to match world record and best performance per year data to identify the best fitting model. The extreme value theory and the Monte Carlo simulation methods were applied to derive predicted future performances with the random sampling model for the 1500m event. They found that an exponential model related to running time and historical year with yearly best performance data, is the most valid deterministic model to predict world records and ultimate performance. The random sampling model is an effective method to predict future world records for the 1500m event, the only event to exhibit asymptotic performance over the last 15 years.

Sands, Wurtz, Stone, McNeal and Jemni (2007) investigated the Olympic gold medal performances. Their study is a historical trend analysis. This represented a preliminary, exploratory, hypothesis generating method designed to assess historical trends in Track and Field gold medal performances at the Olympic Games. They used linear regression calculations of the complete historical data set, two times with the standard errors of estimation. They found that historical track and field data of the gold medallist men and women track and field events show the expected long-term trends of modest improvement in performances over time until the last gold medal performances. It was also found that if the long-term trends are compared to the recent ones from 1980 to 2004, they often show difference. It is problematic that most of the trends indicate a decline in the rate of improvement.

The change in trends may indicate a variety of disturbing factors e.g. from reduced drug use to a ceiling effect on human performance. They have finally found that a large percentage of the events in track and field and other sports display the same trends, while some sports do not.

Huang, Sheen and Zhao (2009) combined the Gray modelling methods with the study established GM (1,1) gray prediction model group and prepared a residual model test. They found that: "(1) The forecasting model group had high-precision; three models had the accuracy of 100%, 27 models had an over 99.5% and the rest of the models had a 98.05% accuracy in prediction; (2) The models had wide adaptation range and might provide help for individual performance or group score prediction; (3) The study predicted the 30th London Olympic track and field performances by using the multidimensional Grey prediction model, and defined the top and bottom limits of most projects for the top three results, numerically. Huang et. al. (2009) stated that their research result would provide the theoretical basis and reference for the relevant department decision-makers or coaches and athletes at the next Olympic Games.

Other scientist stated (Su, 2016) that due to the randomness and fluctuation of sport performances, prediction results turned out to be unreliable and low in precision when a single model is adopted. They supposed that the prediction model using the Grey model and the correction of the residual error of Grey model together with the Markov model, improved the prediction precision of sport performances.

Methods

All athletics world championships data were used from the beginning to the last championships of London. These data comprised the results of the winner, the 8th of the finals (if available, - except for the dns, dqf etc.), and the best non-qualifier athlete's result (the 9th) in the sprint (100m, 200m, 400m) and jumping (long, triple, high jumps and pole vault) events. As jumping events have 12 qualifiers in the final, the result of the winners and the 13th athletes were used. These data show us an overall view about the actual form of the world best athletes'– and about the leading performance characteristics of the selected event.

After data collection the Microsoft Excel 2013 was used. The polynomial trend line is a trend line variable in Excel 2013. It can vary the number of data or the number of curves (mountains and

valleys) on the curve. The second-degree polynomial trend line generally has only one tip and a bend. The polynomial trend line of the third degree has one or two pairs of wings or buds, with a maximum of three in the quarter. A polynomial trend line is based on the least squares method, which computes the most fitting curve with the following equation:

$$y = b + c_1x + c_2x^2 + c_3x^3 + ... + c_6x^6$$

where b and x variables are constant. The 2; 3; 4 most suitable, most expressing variants of the polynomial equation of the given event were used.

Results

All the trend lines have to be handled with a strong consideration. The most suitable polynomial trend line was sought after with the best approach, but in some cases (for example in case of world records) some data were far beyond the average trend. Therefore to find the "smoothing" method (to choose the correct polynomial equitation) was not easy. It was intended to find the simplest equation for the given event or given data group. The more uniform the data were, the more equitable the equation was.

With this method the result of the expected winner, the 8th, and the best non-qualifier athlete of the 2019 Athletics World Championships were estimated. Although this approach is very rough, in some cases it had a large probability, a great reality.

It has to be considered that the aim of this study is to show, analyze and predict the result trends of world championships, and not to show, analyze or predict the expected athletics results in general. The world ranking lists give us analyzable results, but the athletics world championships are unique events with many special exceptions, sport innovations, special background, historical happenings, and outstanding results of top athletes.

Long Jump trends

The trend in men's long jump is slightly decreasing. As a result of that no remarkable result can be expected in the coming years. The results of the 8th jumpers fluctuate in the last occasions, but on average it has been slightly decreasing from 2005. It is true in case of the 13th competitors as well, except the 2017 London World Championships, where the result was significantly lower.

The winner's results in women long jumpers show a very massive start, and then a strong and gradual decreasing trend until 1993. From this point there is no significant change. The results are fairly homogeneous till 2005. After this year the scatter of the winner's results is getting wider. The results of the 8th and the best non qualifier (13th) athletes are close to each other and show a stabile unchangeable trend line.

Triple Jump trends

The men's triple jump results are highly fluctuating, then rising in 2005, and declining in 2017, although the world record was almost hit at the Olympics. The results of the 8th athletes are generally significantly lower than that of the winner, but the shape of the trend line is almost the same, just as in case of the 13th jumper. The results of the 8th and 13th athletes are closer than those of the 1st and 8th jumper in general. The greatest difference between the 8th and the 13th competitors was 72cm in 1985, and the closest was only 5cm in 2009.

The trends in the women's triple jump results are gradually decreasing till 2009, then it is slightly increasing, but the best non-qualifying results strongly vary. No well-definable trend line can be observed.

High Jump trends

The performance is almost constant except for the men winner's result in 2013, but in case of the best non finalist performances a gradually improving series of data can be observed. In 1995, 2009, 2015 and in 2017 the result of the best non-qualifiers (which were not surely the best 13th) is better than that of the 8th athlete's result. This is because during the semi-finals the results of the best non-qualifier were better than the 8th athlete in the final.

The results of women high jumpers show a highly waving performance in the beginning, but in case of the last 7 world championships it seems to be stabilised. The differences between the 1st and 8th placing competitors are significant, except in year 1997 where the difference between the 1st and the best non-qualifier was only 4cms.

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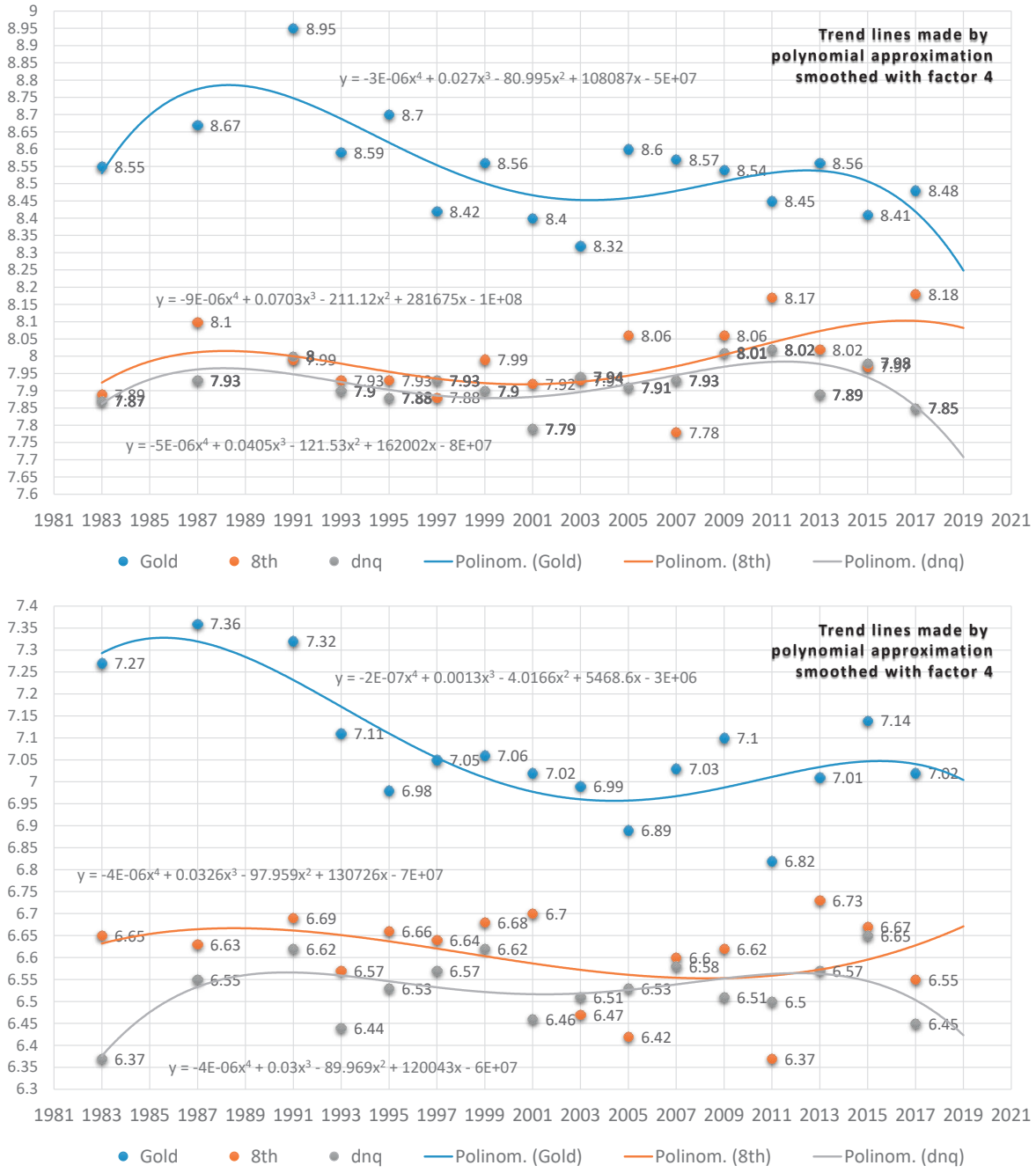


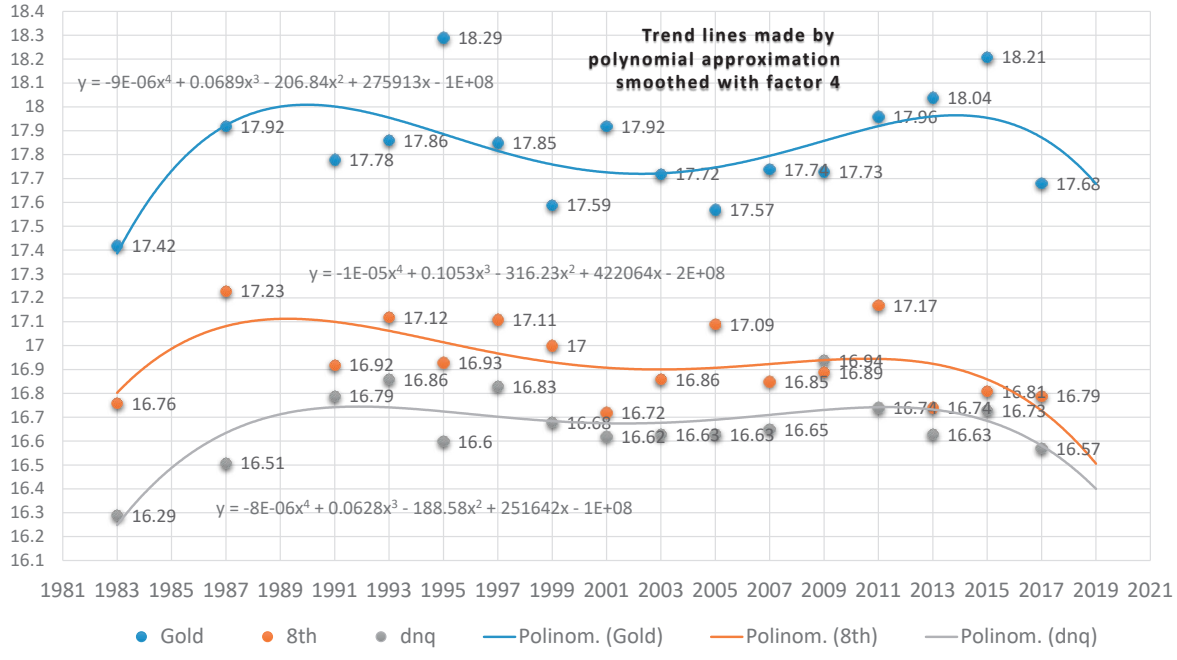
Figure 1 Trends in long jump results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

Pole Vault trends

The men's pole vault results are gradually and consistently increasing till 2001. After the "Bubka era" the trend in the winners' performances remains on the same level for 8 years, but in 2003 it sharply decreases. After that it is stagnating with a moderate non-significant elevation in year 2017. Lavillenie's new world record in 2014 shows a small good influence on the further progress. The results of the 8th athletes show a very stable picture, but the results of the best non- qualifiers extensively vary. No future trends can be predicted.

Women pole vault was introduced as a new event at the world championships in 1999. So far we had only 10 championships, so not the same amount of data are available to calculate the trends. Beside the peak performance of Isinbayeva in 2005, the performance of women pole vault winners is gradually

increasing, but the 8th finalist result recoils in the last three championships. Assumingly it can be stated, that the winners results show an increasing trend. The qualification results were 5 cm lower in 2013 and 2015, but overall it became higher during the time.



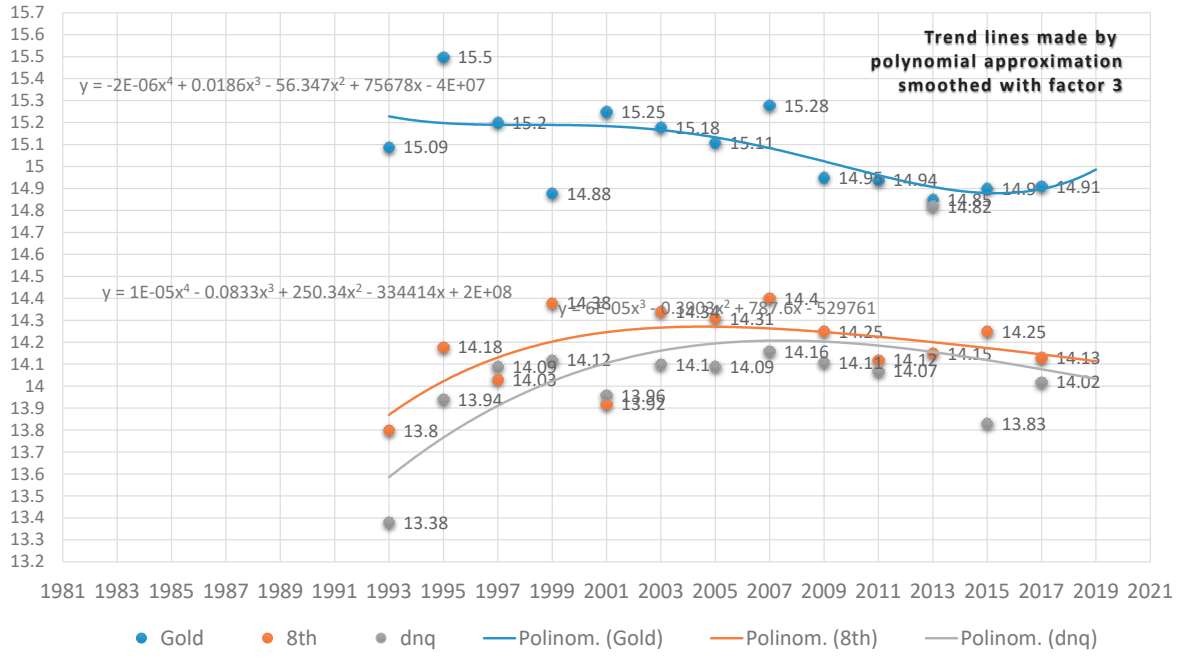


Figure 2 Trends in triple jump results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

100m trends

The results of the winner in 100m men sprint show slight fluctuations until 2009. In 2009 Usain Bolt set up the astonishing world record, and after that the results dropped back, compared to the years before 2009 but not significantly. Due to the increasingly strict doping controls - as the trend shows - it is likely that the winning and the best non- qualifier results will get worse in the next world championships.

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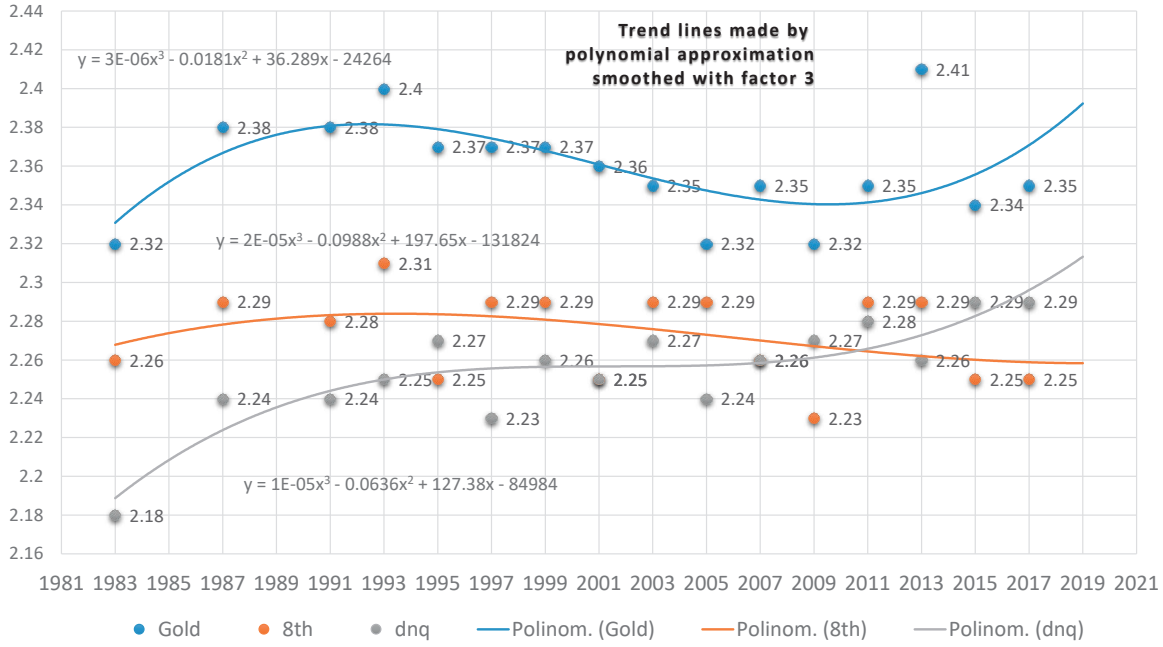
The women 100m best results are strongly fluctuating with both the winner and the best non-qualifiers, with a very slight improving tendency in general, although it can be seen that the results of the winners are declining in the last three world championships. The result of the 8th best in the final shows significant improvement in general.



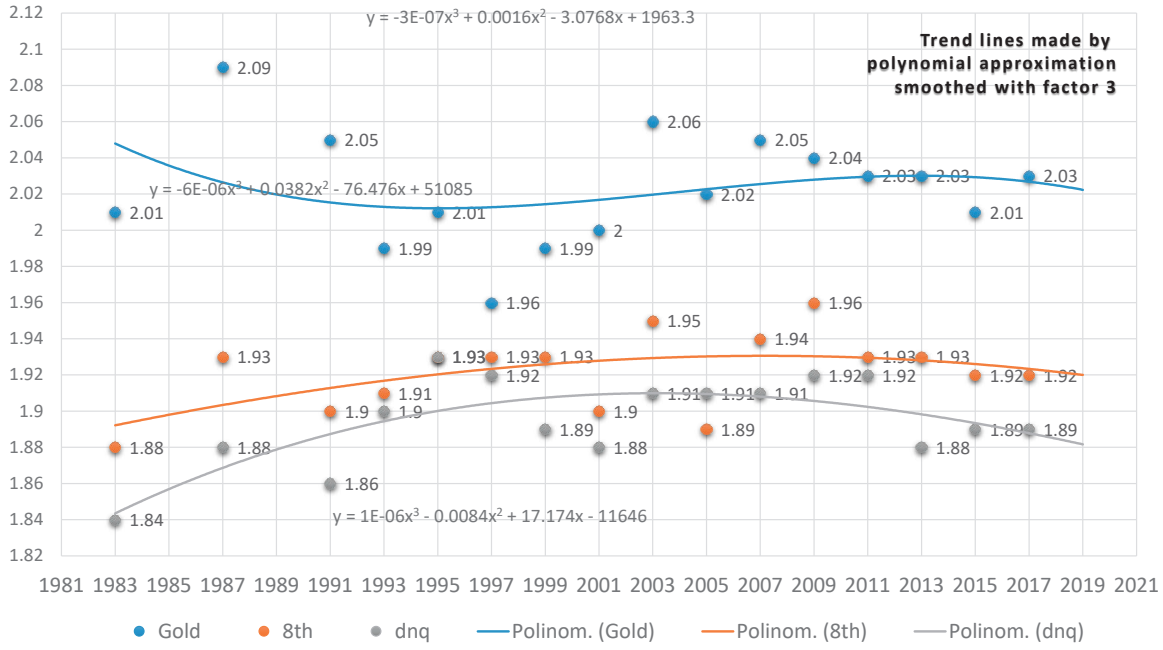


Figure 3 Trends in high jump results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

200m trends

The results of the 200m men sprint winners are improving till the middle of the 90's, but from that point they show a strong decline. From 2003 there is a sharp and strongly significant improvement until 2009. After 2009 the times show a strongly significant setback. The results of the 8th and the best non-qualified athletes show a weak gradual

improvement. No well-definable tendency can be found in the results of the winner in the women 200m. The best years are 1987, 1999 and 2015. In 1991 in Tokyo the results (winner, 8th, best non-qualifier) are significantly lower than in other cases. The IAAF did not report about the wind and reaction time data, therefore the background of these results cannot be traced back (Quin, 2003). It might be the shape of the curve or the quality of the track surface or the weather circumstances that had effects on them.

The results of the women 200m winner show a very strong and significant fluctuation during the world championships. The results of the 8th and the best non-qualifiers are much more homogenous, except in 2015 when Sherone Simpson had the best ever 8th world championships result. There is no reliable way of predicting women's 200m results in the near future in case of the winners.

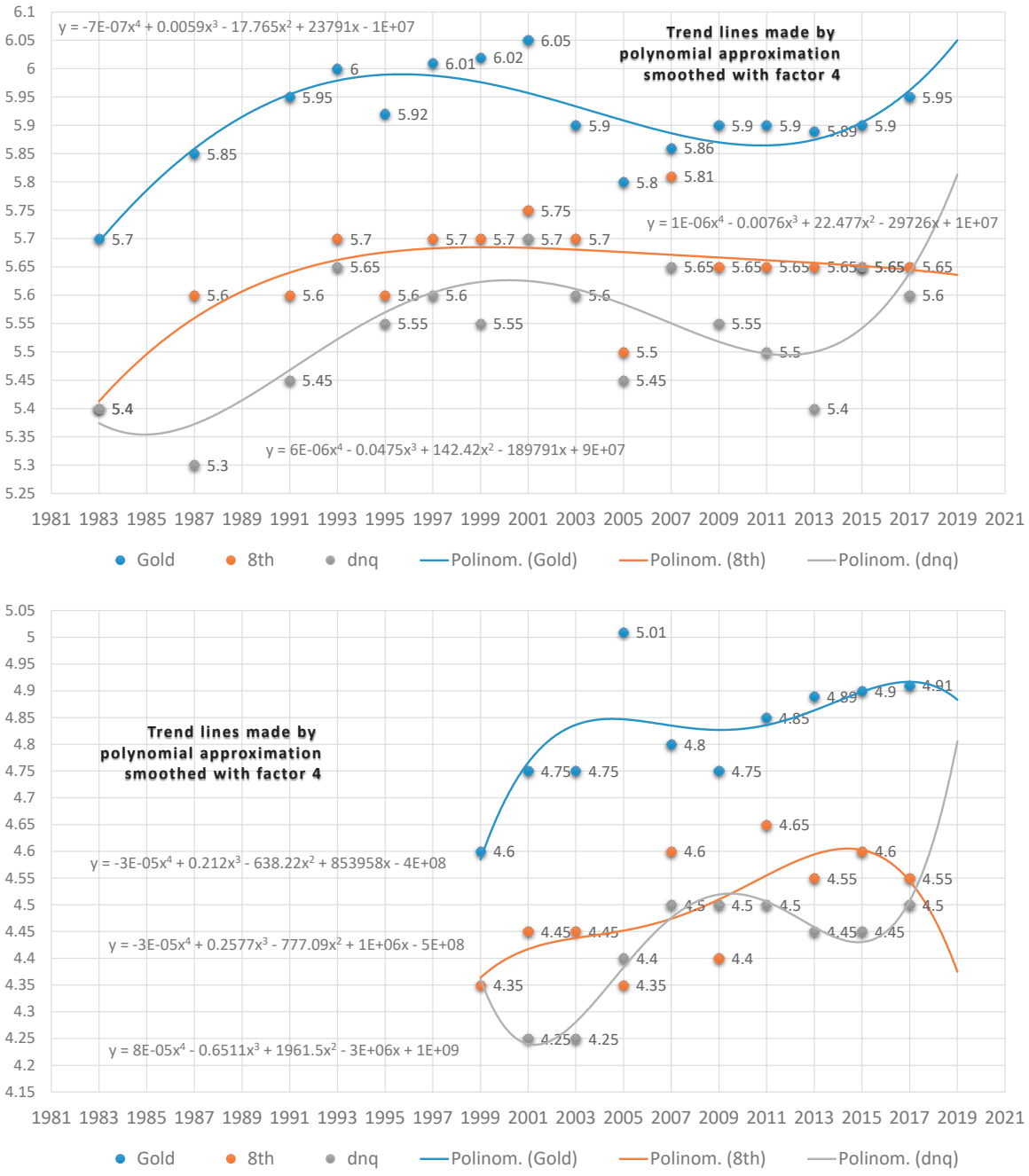


Figure 4 Trends in pole vault results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

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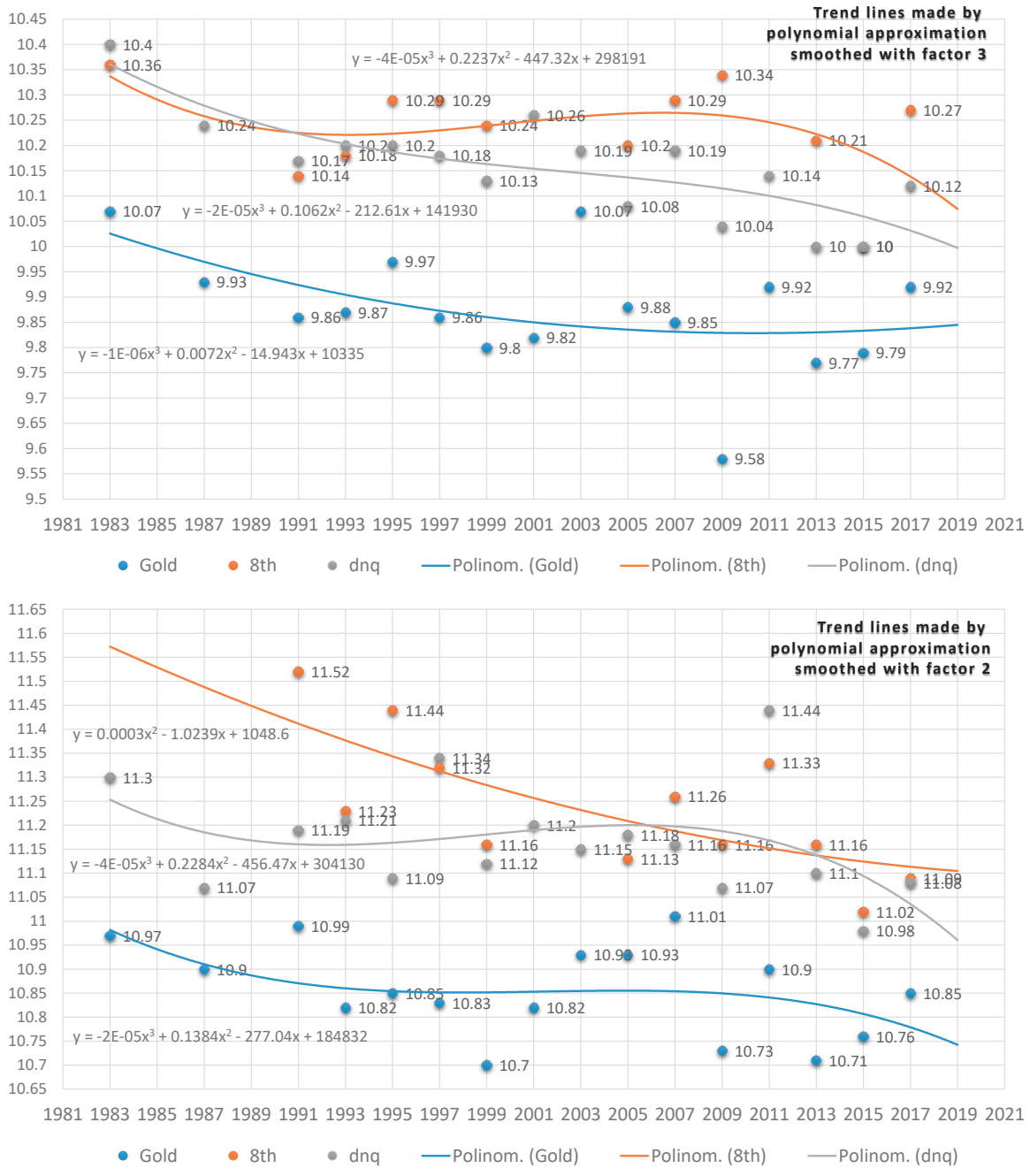

Figure 5 Trends in 100 m sprint results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

400m trends

The results of the men 400m event show an improving tendency till 1999. After that a stagnation period follows. In some cases no results of the 8th athlete can be found because they were disqualified (e.g. in 1997 for leaving the lane/track, etc.). Although the trend line shows better predictable results for the future, the men 400m result of the last World Championships in London was significantly lower than those two or four years before. The result of Wayde Van Niekerk was born in a battle when the winner took the lead and was so much ahead of the field in the last 50m of the race that he stopped running in the last 15m. Apart from that, the trend line in the results of the 8th and best non-qualifiers shows similar tendencies, however the gap between the 1st and 8th is significantly bigger than the one

between the 8th and the 13th. The women 400m results show the opposite trend as it is with the men - with declining results until 2001 -; after that a stagnation period is found.

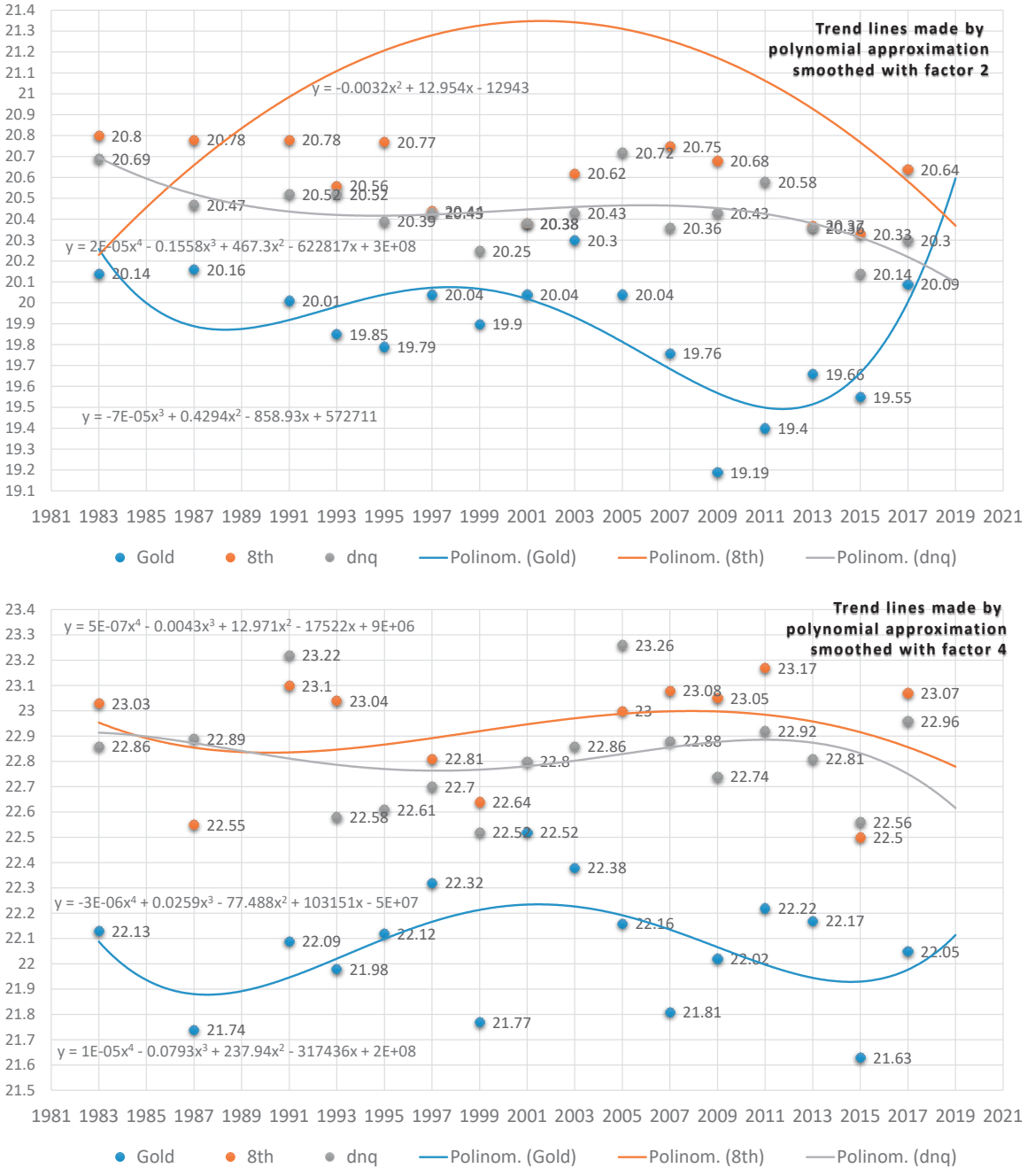

Figure 6 Trends in 200 m sprint results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

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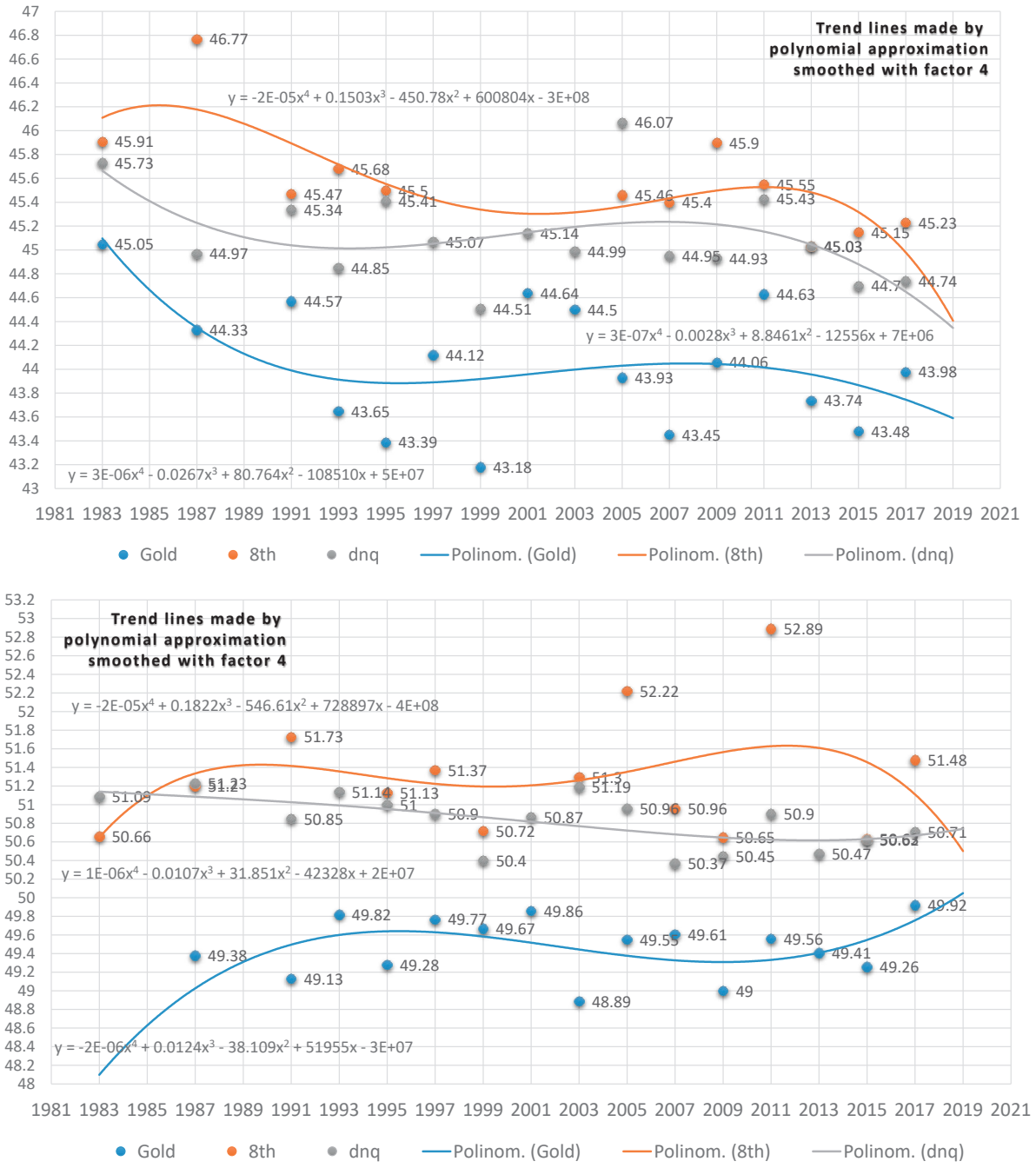

Figure 7 Trends in 400 m sprint results (winner, 8th and the best non-qualifier athlete) in athletics world championships (1983-2017) a. men, b. women

Discussion

In this study the best results from all athletics world championships were collected since 1983, finished with the 2017 London data. The question was if we could find any trend in a given athletic event based on the data that could be predicted for the next world championship. The trend lines must be treated with reservation in certain events (women triple jump 13 times and pole vault 10 times) because of the late introduction in world athletics championship and because of the relatively limited utilization of the data,.

The trends in results of the winners, the 8th and the best non-qualifiers have very few cases of well-defined processes by sprint (100m, 200m, 400m) and jumping events (long and triple jump). Therefore the polynomial approximation

was used apart from one or two cases to determine the trend. The most suitable (second or third degree polynomial trend line) form of polynomial approximation was searched so we used the idea of Liu (1998) to find events which exhibit asymptotic performance. Only in 2017 in two cases (200m men, and men triple jump) were found that the winning result of the Olympics fitted the method.

Apart from the above mentioned it can be stated that there are well- definable cases between the winners, the 8th finalist or the best non- qualifiers results data, which significantly predict the next athletics world championship results at sprint and jumping events.

Sue (2016) can be agreed with, that future results in the athletics world championships cannot be predicted with the chosen method from only the results of the winners, the 8th best finalists or from the best non-qualifiers. The results are influenced by so many components and tendencies that it is the best to find the strongest influencing factors classify the others and focus on them. The assumption is that they can most likely be found around sports politics, use of illegal drugs and their banning in the future, but the proof of this is already the subject of another research.

Apart from these it is obvious that trends and tendencies can be calculated only from more data. Therefore next time it needs to be calculated from all the finalist results, which will give a better understanding what are the new, general lines in human athletics (sprint and jumping) performances.

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