

# Rio gold medal run was one of the best ever – according to statisticians

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Statisticians have created a model to work out the answers to one of the biggest questions asked by sports fans around the world – what were the best track athletics performances of all time?

After analysing the times of performances across all Olympic track distances between 1908 and the Rio Olympics for male athletes and from 1928 to Rio for female athletes, statisticians at Lancaster University (UK) and CSIRO Data Analytics (Australia) found that the world-record shattering run by Ethiopian long-distance runner Almaz Ayana in the women's 10,000 metres at Rio ranks as the fifth best run ever by a woman track athlete.

Ayana chopped 14 seconds off the previous record set in 1993 by Chinese runner Wang Junxia and beat her own personal best by 43 seconds – making it a truly stand-out performance.

The statisticians' model has concluded that the best male performance of all [time](#) is the 1968 world record of American Lee Evans in the 400 metres. The best female run of all time is the controversial current 1988 world record of fellow American Florence Griffith-Joyner in the 100 metres.

Using a branch of statistics called extreme value theory (which has also been used by Lancaster's statisticians in optimising the UK's coastal flood defences, and developing internationally adopted design standards for bulk carrier ships) the researchers compared performances in

relation to other best times ran by athletes during the same year – to achieve a comparison of the best runs against contemporary expectations. For example, the 800 metres runs of Rudolf Harbig in 1939 and Seb Coe in 1981 were well below the expected annual best times for that event at that time, making them stand out as exceptional.

These exceptional best annual times were used as they provide better information, and therefore more accuracy, than just using the smaller number of world records. Their technique identified an exponential trend over time to account for performance benefits accrued through changes in technology and advances in nutrition and training regimes.

A 'global model' was created, which allowed athletics data over all seven distances and times to be compared. The events that were compared include the 100, 200, 400, 800, 1,500, 5,000 and 10,000 metres distances. Records were discounted if they were not ratified, wind assisted or if the athlete had been found to have doped – for example, Ben Johnson's 100 metres World Records in 1987/88.

Jonathan Tawn, Professor of Statistics at Lancaster University, said: "Many sports fans, and statisticians alike, have pondered and debated about the best athletics track performances of all time. We have created a model that for the first time is able to provide a comparison of the best male and female runs across time and across all of the Olympic track distances.

"Our model is based on the generalised 'extreme value distribution' for annual fastest times and describes how this distribution changes over time. This allows us to determine which performances were better than expected under our model, and to rank these performances to establish which is best.

"People will still have their favourite performances in mind, however

this study provides a way of comparing the best ever performances across all the track disciplines for the first time and adds new evidence to the debate."

Lee Evans' 1968 400 metres record stood as the World Record for 20 years until it was broken by his compatriot Harry 'Butch' Reynolds in 1988, who appears fifth in the list of top track performances compiled by the researchers. Harry Reynold's record survived until 1999 when it was beaten by Michael Johnson. Johnson's record lasted for 17 years until it was broken by South Africa's Wayde van Niekerk at this year's Rio games. Van Niekerk's run is ranked as the 20th best male performance of all time.

The second best male track performance ever was by Australian Ron Clarke, who improved his own record in the 10,000 metres by 39 seconds in 1965. Jamaican sprint sensation Usain Bolt appears twice in the top ten of male performances – in third and eighth place – for his current World Records in the 200 metres and 100 metres, both achieved in 2009. Britain's Seb Coe is ninth for his 1981 800 metre record, which stood for sixteen years.

Sprinter Florence Griffith-Joyner's 1988 100 metre World Record tops the female list as it was officially ratified. However, this run was controversial because it was assisted by a strong tail wind that was not picked up by the official wind gauge. 'Flo-Jo' also appears in sixth position in the top ten female list for her 200 metre record from the same year, which also still stands.

The second best female track performance of all time was the 800 metre world record set in 1928 by Lina Batschauer-Radke, which stood until 1944. The 2015 1500m [world record](#) of Genzebe Dibaba is third. Three Chinese athletes also make the top ten with Qu Yunxia and Wang Junxia in fourth and sixth places for their 1993 records in the 1,500 and 10,000

metres. Jiang Bo (seventh) is the only performance in the list that was not a World Record, obtaining the second fastest time for the 1,500 metres. Tatyana Kazankina, who ran for the Soviet Union, appears in the list three times for her middle-distance performances in 1976 and 1980. Her career ended in 1984 after she was suspended for refusing a drug test.

Alec Stephenson from CSIRO Data Analytics said: "Our analysis compares performances across different distances, and adjusts for periods of time where performances were affected by persisting circumstances, such as the state sponsored doping programs of the 1980s, when drug testing was in its infancy."

The study showed that performances were exceptional in the 1970s and 1980s, particularly for women's events. Evidence of widespread drug use during this period could provide one possible explanation. These periods were taken into account by the researchers and the model was adapted to penalise performances in time periods when recorded times in all track events were exceptional.

The research authors were Professor Jonathan Tawn from Lancaster University and Dr Alec Stephenson, who is now at CSIRO Data Analytics.

### Top ten male track athletics performances

1. L. Evans (USA) 400 m 1968
2. R. Clarke (AUS) 10,000 m 1965
3. U. Bolt (JAM) 200 m 2009
4. P. Nurmi (FIN) 10,000 m 1924
5. H. Reynolds (USA) 400 m 1988
6. R. Harbig (GER) 800 m 1939
7. T. Smith (USA) 200 m 1968

8. U. Bolt (JAM) 100 m 2009
9. S. Coe (GBR) 800 m 1981
10. M. Johnson (USA) 200 m 1996

Top ten women track athletics performances (now includes A Ayana)

1. F. Griffith-Joyner (USA) 100 m 1988
2. L. Radke (GER) 800 m 1928
3. G. Dibaba (ETH) 1500 m 2015
4. Q. Yunxia (CHN) 1500 m 1993
5. A. Ayana (ETH) 10,000 m 2016
6. W. Junxia (CHN) 10,000 m 1993
7. F. Griffith-Joyner (USA) 200 m 1988
8. J. Bo (CHN) 1500 m 1997
9. T. Kazankina (SOV) 1500 m 1976
10. T. Kazankina (SOV) 800 m 1976

The model has been updated with recent results up to and including the Rio Olympics 2016.

**More information:** More information about Mathematics and Statistics at Lancaster University is available by visiting [www.lancaster.ac.uk/maths/](http://www.lancaster.ac.uk/maths/)

Alec G. Stephenson et al. Determining the Best Track Performances of All Time Using a Conceptual Population Model for Athletics Records, *Journal of Quantitative Analysis in Sports* (2013). [DOI: 10.1515/jqas-2012-0047](https://doi.org/10.1515/jqas-2012-0047)

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