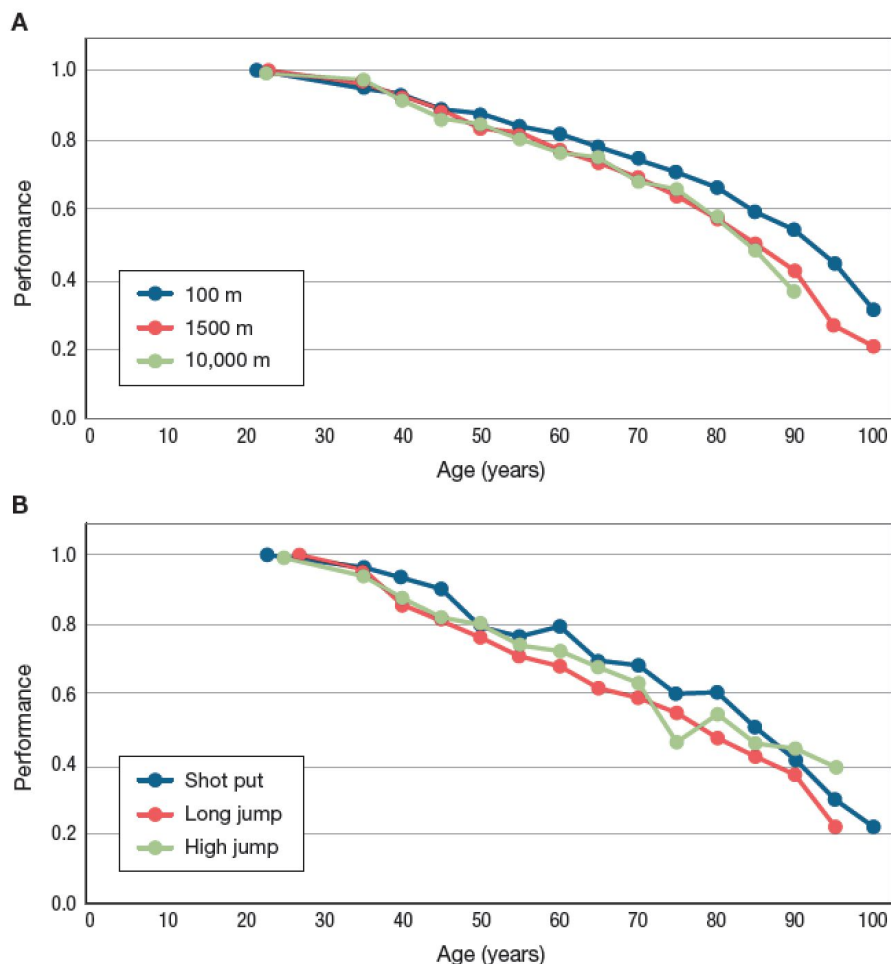


World records as measures of senescence

In a section of the book *Evolutions* ([Bergstrom and Dugatkin \(2016\)](#)) that deals with the evolution of senescence, authors note that not only does mortality increase and fertility decrease with age, but individuals undergo a decline in physical performance with age as well. In an attempt to illustrate this point, they provided graphs of world record performances in six track and field events, for different age groups. In these visualizations, reproduced below, performance is scaled relative to the world record for any age. In track events, performance is quantified as average speed; in field events, performance is quantified as distance or height.



In this exercise, your goal is to critique the premise that the curves plotted here are good representations of the physical decline humans undergo with age.

Hypotheses:

1. The graphs represent the extremes of human performance. They only tell us what happens to the performance of the most elite athletics undergoing rigorous training. The curves illustrated here don't tell us a whole lot about what happens to the physical performance of ordinary humans. It would be unsurprising if the majority of us experienced even sharper declines with age, for example.
2. The curves plotted in these graphs do not represent the performance of any single individual. The athletes setting records at age 30 are rarely those who continue to set records in their 50s, 60s, or 70s. This curve, which sketches out the upper limit of human performance as a function of age, may not reflect the performance trajectory of any individual person.
3. *"The problem with that graph is that the sample sizes are very different for different ages," one of my students pointed out. "How many 30-year-olds run the 1500 meters competitively? How many 80-year-olds? Far, far fewer. Moreover, these world records are outliers. So from the data provided, we don't really know how much of the decline in performance is due to decreases in sample size, and how much of the decline is due to actual senescence."*

Hypothesis 3 is a brilliant argument, particularly if the distribution of human performance is long-tailed. In principle, the entire decline shown in the figure could occur even if the distribution of performances is the same across all ages but the sample size decreases with increasing age.

To convince ourselves that the argument is plausible, we can simulate this effect, drawing scores from the same distribution but for populations of size 10^6 , 10^5 , etc., down to 10^1 . For each population, take the highest score (again scaled relative to the highest score overall) and plot it.