The False Start Rule in Track and Field: Its Flaws and Alternatives

Michael C. Rotkowitz

I. Introduction

A sprinter is considered to have false started, not if s/he starts prior to the firing of the starter's pistol, but if s/he starts within 0.1 seconds of its firing. Since this rule was implemented, runners have indeed been disqualified for starting after the gun but prior to this threshold, famously including a defending Olympic gold medalist. The justification is that it would be extremely unlikely or impossible for a human to react that quickly if s/he had waited for the gun.

One reason for skepticism, is that the vast majority of cases involve the runners having reaction times just under this threshold, around 90 milliseconds(ms). If they were actually jumping the gun, wouldn't we expect some of them to be starting in 20 or 30ms?

Two key statistical errors seem to be potentially underlying this rule. One is the lack of consideration of the alternative hypothesis: indeed it is unlikely for someone to start fairly in 90ms, but it may be even less likely for them to false start in 90ms. The other is the lack of consideration of the costs of the Type I error vs the Type II error: the probability of allowing someone to get away with a false start needs to be low, but the probability of disqualifying someone after a fair start needs to be infinitesimal.

In this work we consider the modeling of perceived reaction times given that a false start occurred, and then compare the likelihoods of false and fair starts for the range of times out of the blocks. We also explore how these change across various races. We then revisit this rule to discuss its fairness and possible alternatives.

II. Methods

We have used starting time data from the Olympics and World Championships between 1997 and 2011. For the finals, we use all of the runners, and for earlier rounds, we remove the top two finishers, since runners who know they will be able to advance often ease up at the start to avoid a potential disqualification.

We fit a shifted lognormal distribution to our data to model fair start times. We then model someone trying to anticipate the gun as getting a jump which follows an exponential distribution. Taking the convolution of these then gives a model of false start times. For certain ranges of the parameters, we explore the comparison of the likelihoods of fair and false starts.

M. C. Rotkowitz is with the Institute for Systems Research and the Department of Electrical and Computer Engineering, The University of Maryland, College Park, MD 20742 USA, mcrotk@umd.edu.

III. Results

We first find that the different methods used to determine reaction times in different races results in widely varying distributions, where uniformity is an underlying assumption of a rule with a fixed threshold. We also demonstrate a clear relationship between the distance being run (from 100 to 400 meters) and the reaction times; a previously heralded paper had determined that the current threshold is acceptable (and even conservative), but had reached that conclusion by lumping data together from 100, 200, and 400 meter races. Our work shows this previous approach to be fatally flawed.

We find that the breakeven point, at which it is equally likely that a runner did or did not anticipate the gun, varies from 73 to 92ms for the range of parameters of our aforementioned anticipation density.

IV. Conclusion

The work results in three layers of recommendations. In the event that the framework of the rule is preserved; that is, if we must simply choose a fixed threshold below which runners are disqualified, and above which they are not, then we find that the threshold should be dropped about 30ms. If the binary nature of the decision is preserved, but the threshold need not be fixed, then we recommend allowing the threshold to vary with the different equipment and different techniques that are used to detect the starting time across various elite races, since we have found them to behave far from uniformly. Our strongest recommendation is a departure from this type of binary decision, so that instead of either declaring a clean start or a disqualification, a runner whose starting time is ambiguous (based on the various factors we consider in the paper, and with a recommended initial range of 70-100ms) will result in the runners being called back, but not in a disqualification. This will prevent runners from being disqualified after possibly clean starts, while also removing the incentive to try to anticipate the gun.