Sports Leagues Not Efficiently Structured, Scientists Say

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According to a pair of statistical physicists, sports leagues as they are typically set up – with each team playing an equal number of games and the one with the most wins declared league champion – too often allow a weak team to come out on top.

In the August 13 online edition of *Physical Review E*, Eli Ben-Naim and Nick Hengartner of Los Alamos National Laboratory suggest an alternate structure for league competition in which teams play in preliminary rounds consisting of a small number of games and then a final round played according to standard league format. As the rounds progress, the weaker teams are weeded out and the winner of the championship round is far more likely to actually be the strongest team.

“Current league format is an ineffective way of determining the best team,” Ben-Naim said to *PhysOrg.com*. “A more efficient and fair way to play leagues is to sequentially eliminate teams from the bottom up.”

The foundation underlying the inefficiency of leagues is that the outcome of a single competition is not predictable. For example, as Ben-Naim and Hengartner note in their paper, over the last 100 years in baseball lower-seeded teams have had an “astounding” 44 percent chance of defeating their better-ranked opponents.

“This inherent randomness has profound consequences in sports,” Ben-Naim said.

To understand how randomness affects the outcome of multiple competitions, he and Hengartner studied an idealized system with an arbitrary number of teams, denoted N, ranked from best to worst so that in each game there is a clear favorite and underdog. They calculate that in a standard league, the number of games needed to reach an efficiency of 70 percent – the best team winning the championship 70 percent of the time – can be approximated by N^3. That means, for example, that a league with 20 teams would need to play about 20^3, or 8,000, games to reach 70 percent efficiency.

As this is obviously not practical, the scientists investigated the use of rounds to increase the likelihood that the most worthy team wins the league over a reasonable number of games.

Based on the rules of competition probability and randomness, they crafted a formula to determine the least number of games that would need to be played in the rounds structure to allow the best team to win as often as in the N^3 case. The variables in their formula are the number of teams, N, and the number of rounds played, denoted k.

The formula predicts that in a league containing 10 teams, the N^3 scenario of 1,000 games could be reduced more than 10-fold, down to about 63 games, by playing just one preliminary round before the championship playoffs. If two preliminary rounds were played, only about 26 games would be needed.

Ben-Naim and Hengartner ran three simulations based on their formula, corresponding to league sizes of 10, 100, and 1000 teams. The best team won 70 percent of the time and was among the top three 98 percent of the time. The rounds structure yields the same outcome but with far fewer games.

Citation: E. Ben-Naim and N. Hengartner, “Efficiency of competitions”

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