Commentary on *Bootstrapping Inferential Statistics with a Spreadsheet*

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This article and associated spreadsheets represent a very valuable addition to the suite of resources at sportsci.org, providing an excellent introduction to bootstrap resampling methods. Particularly useful, perhaps, is the content relating to modeling quadratic relationships to derive confidence intervals for X values at either maxima or minima. I urge readers wishing to delve deeper into the theory and practice of bootstrap resampling to consult the classic text of Efron and Tibshirani (1993). Bootstrap resampling methods are available in many commercial statistical software packages including IBM SPSS (as an add-on module), Stata, SAS, and R. There is also specialized resampling software such as Resampling Stats, available as a very flexible Excel Add-in. However, I know of no other user-friendly, free-to-use resources for resampling with the flexibility of the spreadsheets at sportsci.org. From an educational perspective, I applaud the open nature of the spreadsheets that allows readers to access the formulae and get into the "black box" between data input and results output. This characteristic of the resources provides a very powerful learning tool.

The spreadsheets construct confidence intervals using a simple percentile method which, as stated in the resources, is adequate for most purposes given a large enough original sample size and a reasonably well behaved distribution. However, in some circumstances the percentile method can lead to confidence intervals with unsatisfactory coverage properties (too narrow), as it cannot address either bias with respect to the original effect estimate or a standard error that varies with the value of the estimate. In short, the percentile method can underestimate the tails of the distribution. To address these issues, the bias corrected and accelerated (BCa) method was developed to improve coverage. The BCa bootstrap adjusts for both bias and skewness in the bootstrap distribution (Efron and Tibshirani, 1993), and is available as an option in the software packages mentioned above. In most cases, however, the coverage properties and associated magnitude-based inferences derived from the simple percentile method will be correct with sufficient N and appropriate transformation of severely skewed data.

Efron B, Tibshirani RJ (1993). An Introduction to the Bootstrap. Chapman and Hall: London

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