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Optimally estimating the sample standard deviation from the five-number summary

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Abstract

When reporting the results of clinical studies, some researchers may choose the five-number summary (including the sample median, the first and third quartiles, and the minimum and maximum values) rather than the sample mean and standard deviation (SD), particularly for skewed data. For these studies, when included in a meta-analysis, it is often desired to convert the five-number summary back to the sample mean and SD. For this purpose, several methods have been proposed in the recent literature and they are increasingly used nowadays. In this article, we propose to further advance the literature by developing a smoothly weighted estimator for the sample SD that fully utilizes the sample size information. For ease of implementation, we also derive an approximation formula for the optimal weight, as well as a shortcut formula for the sample SD. Numerical results show that our new estimator provides a more accurate estimate for normal data and also performs favorably for non-normal data. Together with the optimal sample mean estimator in Luo et al., our new methods have dramatically improved the existing methods for data transformation, and they are capable to serve as "rules of thumb" in meta-analysis for studies reported with the five-number summary. Finally for practical use, an Excel spreadsheet and an online calculator are also provided for implementing our optimal estimators.

Keywords

Author Keywords: interquartile range; five-number summary; range; sample mean; sample size; SD

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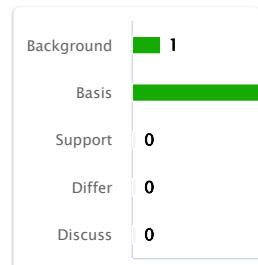
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