Meta-analysis of Medians

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Abstract

1 Medians pose a problem in meta-analyses

Software tools for meta-analysis, such as Cochrane's RevMan or the R package `metafor::` , require an estimate of effect and variance of that effect. However, the sample variance for the effect is not always available. When the reported statistics are medians, measure of spreads commonly provided are the range or interquartile range. This leads to the omission of studies that report medians from the meta-anaysis. In this manuscript we present a method for estimating the variance of the sample median so that studies reporting medians may be included in meta-analyses.

do this later RevMan citation

do this later metafor citation

more words people would like to meta-analyse medians, but they can't

more words expand this section, demonstrate how to do a meta-analysis

1.1 A motivation example

more words Find a meta-analysis of medians where this estimator elicits a difference in results.

2 Existing methods for meta-analysing medians

There are several existing methods for meta-analysing medians. Many of these are evolutions of Han et al.'s methods for approximating the sample mean and standard deviation from the median and the interquartile range . Bland extended this method for the case where all quartiles, including minimum and maximum are available . Wan et al. compared and contrasted Han and Bland's methods under simulation, and also introduced some estimator's extending on Han et al.'s method .

do this later Range or interquartile range?

do this later Han citation

do this later bland citation

do this later Wan

*The authors are appreciative for the insights and comments from Emily Kothe, Kerrie Mengersen, and Kate Smith-Miles.

more words Go through each method: what set of summary statistics does each do? Look at table of equations in original overleaf, perhaps.

3 An estimator for an approximation of the variance of the sample median

We provide a solution to meta-analysing medians by adapting this approximation for the variance of the sample median, M,

$$\text{var}(M) \approx (4nf(\nu))^{-2},$$

drawn from population with density function f and population median ν.

4 Performance of estimator in coverage probability simulations

Now that we have defined an estimator for meta-analysing medians, let us explore the efficacy of this estimator under simulation, for different numbers of studies, distributions, and different assumptions about variation between studies and efficacy of intervention.

4.1 Simulation methodology

One approach for exploring the efficacy of a statistical estimator is to simulate *coverage probability*. In a coverage probability simulation, each trial requires randomly generated data.

more words See `simeta::` and varameta::

4.2 simulation results

5 Meta-analysis of medians

Our motivating problem was meta-analysis of medians. In so doing, this manuscript raises the question if examining research software engineering methodology, of exploring the efficacy of an estimator, in the context of rapidly evolving statistical tools for simulation and analysis, is of research merit in its own right.

more words Now we can walk through a meta-analysis

more words It is not immediately apparent what the best way to confer analyses.

more words metaresearch context