DOWNLOAD PDF METHODS OF META-ANALYSIS

Chapter 1 : Methods of Meta-Analysis - John E. Hunter, Frank L. Schmidt - Google Books

"This text is the primary source text for psychometric meta-analysis methods This is the only comprehensive resource available for researchers interested in conducting psychometric meta-analysis methods.

Approaches[edit] In general, two types of evidence can be distinguished when performing a meta-analysis: The aggregate data can be direct or indirect. AD is more commonly available e. This can be directly synthesized across conceptually similar studies using several approaches see below. On the other hand, indirect aggregate data measures the effect of two treatments that were each compared against a similar control group in a meta-analysis. For example, if treatment A and treatment B were directly compared vs placebo in separate meta-analyses, we can use these two pooled results to get an estimate of the effects of A vs B in an indirect comparison as effect A vs Placebo minus effect B vs Placebo. IPD evidence represents raw data as collected by the study centers. This distinction has raised the need for different meta-analytic methods when evidence synthesis is desired, and has led to the development of one-stage and two-stage methods. Two-stage methods first compute summary statistics for AD from each study and then calculate overall statistics as a weighted average of the study statistics. By reducing IPD to AD, two-stage methods can also be applied when IPD is available; this makes them an appealing choice when performing a meta-analysis. Although it is conventionally believed that one-stage and two-stage methods yield similar results, recent studies have shown that they may occasionally lead to different conclusions. Models incorporating study effects only[edit] Fixed effects model[edit] The fixed effect model provides a weighted average of a series of study estimates. Consequently, when studies within a meta-analysis are dominated by a very large study, the findings from smaller studies are practically ignored. This assumption is typically unrealistic as research is often prone to several sources of heterogeneity; e. Random effects model[edit] A common model used to synthesize heterogeneous research is the random effects model of meta-analysis. This is simply the weighted average of the effect sizes of a group of studies. The weight that is applied in this process of weighted averaging with a random effects meta-analysis is achieved in two steps: Inverse variance weighting Step 2: Un-weighting of this inverse variance weighting by applying a random effects variance component REVC that is simply derived from the extent of variability of the effect sizes of the underlying studies. This means that the greater this variability in effect sizes otherwise known as heterogeneity , the greater the un-weighting and this can reach a point when the random effects meta-analysis result becomes simply the un-weighted average effect size across the studies. At the other extreme, when all effect sizes are similar or variability does not exceed sampling error , no REVC is applied and the random effects meta-analysis defaults to simply a fixed effect meta-analysis only inverse variance weighting. The extent of this reversal is solely dependent on two factors: Indeed, it has been demonstrated that redistribution of weights is simply in one direction from larger to smaller studies as heterogeneity increases until eventually all studies have equal weight and no more redistribution is possible. One interpretational fix that has been suggested is to create a prediction interval around the random effects estimate to portray the range of possible effects in practice. These advanced methods have also been implemented in a free and easy to use Microsoft Excel add-on, MetaEasy. Thus it appears that in small meta-analyses, an incorrect zero between study variance estimate is obtained, leading to a false homogeneity assumption. Overall, it appears that heterogeneity is being consistently underestimated in meta-analyses and sensitivity analyses in which high heterogeneity levels are assumed could be informative. The authors state that a clear advantage of this model is that it resolves the two main problems of the random effects model. When heterogeneity becomes large, the individual study weights under the RE model become equal and thus the RE model returns an arithmetic mean rather than a weighted average. This side-effect of the RE model does not occur with the IVhet model which thus differs from the RE model estimate in two perspectives: The latter study also reports that the IVhet model resolves the problems related to underestimation of the statistical error, poor coverage of the confidence interval and increased MSE seen with the random effects model and the authors conclude that researchers should henceforth abandon use of the random effects model in meta-analysis. While their data is compelling, the ramifications in terms of the

magnitude of spuriously positive results within the Cochrane database are huge and thus accepting this conclusion requires careful independent confirmation. The availability of a free software MetaXL [56] that runs the IVhet model and all other models for comparison facilitates this for the research community. Models incorporating additional information[edit] Quality effects model[edit] Doi and Thalib originally introduced the quality effects model. The strength of the quality effects meta-analysis is that it allows available methodological evidence to be used over subjective random effects, and thereby helps to close the damaging gap which has opened up between methodology and statistics in clinical research. To do this a synthetic bias variance is computed based on quality information to adjust inverse variance weights and the quality adjusted weight of the ith study is introduced. In other words, if study i is of good quality and other studies are of poor quality, a proportion of their quality adjusted weights is mathematically redistributed to study i giving it more weight towards the overall effect size. As studies become increasingly similar in terms of quality, re-distribution becomes progressively less and ceases when all studies are of equal quality in the case of equal quality, the quality effects model defaults to the IVhet model â€" see previous section. A recent evaluation of the quality effects model with some updates demonstrates that despite the subjectivity of quality assessment, the performance MSE and true variance under simulation is superior to that achievable with the random effects model. Network meta-analysis methods[edit] A network meta-analysis looks at indirect comparisons. In the image, A has been analyzed in relation to C and C has been analyzed in relation to b. However the relation between A and B is only known indirectly, and a network meta-analysis looks at such indirect evidence of differences between methods and interventions using statistical method. Indirect comparison meta-analysis methods also called network meta-analyses, in particular when multiple treatments are assessed simultaneously generally use two main methodologies. First, is the Bucher method [62] which is a single or repeated comparison of a closed loop of three-treatments such that one of them is common to the two studies and forms the node where the loop begins and ends. Therefore, multiple two-by-two comparisons 3-treatment loops are needed to compare multiple treatments. This methodology requires that trials with more than two arms have two arms only selected as independent pair-wise comparisons are required. The alternative methodology uses complex statistical modelling to include the multiple arm trials and comparisons simultaneously between all competing treatments. These have been executed using Bayesian methods, mixed linear models and meta-regression approaches. To complicate matters further, because of the nature of MCMC estimation, overdispersed starting values have to be chosen for a number of independent chains so that convergence can be assessed. The complexity of the Bayesian approach has limited usage of this methodology. Methodology for automation of this method has been suggested [65] but requires that arm-level outcome data are available, and this is usually unavailable. Great claims are sometimes made for the inherent ability of the Bayesian framework to handle network meta-analysis and its greater flexibility. However, this choice of implementation of framework for inference, Bayesian or frequentist, may be less important than other choices regarding the modeling of effects [66] see discussion on models above. Frequentist multivariate framework[edit] On the other hand, the frequentist multivariate methods involve approximations and assumptions that are not stated explicitly or verified when the methods are applied see discussion on meta-analysis models above. For example, the mvmeta package for Stata enables network meta-analysis in a frequentist framework. Newer models of meta-analysis such as those discussed above would certainly help alleviate this situation and have been implemented in the next framework. Generalized pairwise modelling framework[edit] An approach that has been tried since the late s is the implementation of the multiple three-treatment closed-loop analysis. This has not been popular because the process rapidly becomes overwhelming as network complexity increases. Development in this area was then abandoned in favor of the Bayesian and multivariate frequentist methods which emerged as alternatives. Very recently, automation of the three-treatment closed loop method has been developed for complex networks by some researchers [55] as a way to make this methodology available to the mainstream research community. This proposal does restrict each trial to two interventions, but also introduces a workaround for multiple arm trials: It also utilizes robust meta-analysis methods so that many of the problems highlighted above are avoided. Further research around this framework is required to determine if this is indeed superior to the Bayesian or multivariate frequentist

frameworks. Researchers willing to try this out have access to this framework through a free software. Studies are then selected for the target setting based on comparison with this region and aggregated to produce a summary estimate which is tailored to the target setting. Validation of meta-analysis results[edit] The meta-analysis estimate represents a weighted average across studies and when there is heterogeneity this may result in the summary estimate not being representative of individual studies. Qualitative appraisal of the primary studies using established tools can uncover potential biases, [71] [72] but does not quantify the aggregate effect of these biases on the summary estimate. Although the meta-analysis result could be compared with an independent prospective primary study, such external validation is often impractical. This has led to the development of methods that exploit a form of leave-one-out cross validation , sometimes referred to as internal-external cross validation IOCV. A general validation statistic, Vn based on IOCV has been developed to measure the statistical validity of meta-analysis results. It can test if the outcomes of studies show more variation than the variation that is expected because of the sampling of different numbers of research participants. Thus some methodological weaknesses in studies can be corrected statistically. Other uses of meta-analytic methods include the development of clinical prediction models, where meta-analysis may be used to combine data from different research centers, [76] or even to aggregate existing prediction models. This is important because much research has been done with single-subject research designs. Considerable dispute exists for the most appropriate meta-analytic technique for single subject research. It emphasizes the practical importance of the effect size instead of the statistical significance of individual studies. This shift in thinking has been termed "meta-analytic thinking". The results of a meta-analysis are often shown in a forest plot. Results from studies are combined using different approaches. Larger studies and studies with less random variation are given greater weight than smaller studies. Other common approaches include the Mantelâ€”Haenszel method [79] and the Peto method. Different high throughput techniques such as microarrays have been used to understand Gene expression. MicroRNA expression profiles have been used to identify differentially expressed microRNAs in particular cell or tissue type or disease conditions or to check the effect of a treatment. A meta-analysis of such expression profiles was performed to derive novel conclusions and to validate the known findings.

Chapter 2 : Study Design - Meta-Analysis

Presents a new method for conducting second order meta-analysis, along with two exercises requiring application of this new method. Contains an updated discussion of SEM-based meta-analysis. A new discussion of how the results of meta-analyses should be presented in research reports has been added.

It explains the background to these methodologies, what is involved, and how to get started, keep going, and finish! What is a systematic review or meta-analysis? A systematic review answers a defined research question by collecting and summarising all empirical evidence that fits pre-specified eligibility criteria. A meta-analysis is the use of statistical methods to summarise the results of these studies. Systematic reviews, just like other research articles, can be of varying quality. They are a significant piece of work the Centre for Reviews and Dissemination at York estimates that a team will take months , and to be useful to other researchers and practitioners they should have: Plan carefully, and document everything. Why do a systematic review? Click here Step 2: Who will be involved? Click here Step 3: Has it been done before? Click here Step 4: Click here Step 5: Click here Step 6: Critical appraisal of studies quality assessment. Click here Step 8: Presenting results writing the report. Click here Step 9: Click here Useful Resources: If you have any useful resources that would be beneficial for this guide, please let us know contact Kate McAllister, ke. Acknowledgements and References Much of this advice is based on the excellent and extensive guidance from the Cochrane Collaboration http: If you are proposing to perform a systematic review these provide invaluable detailed advice, and useful examples.

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Chapter 3 : Meta-Analysis | RESEARCH METHODOLOGY

Meta-analysis is arguably the most important methodological innovation in the social and behavioural sciences in the last 25 years. This revision of Hunter and Schmidtâ€²s book, Methods of Meta-Analysis (SAGE), covers the important new developments in meta-analysis methods over the last 14 years.

Article by King, William R. There are four methods in conducting literature review, i. Look at the diagram at the end of this entry to view these methods in the qualitative-quantitative continuum. Meta-analysis is considered as the most rigor method; it is the one which closest to the positivist tradition. Here are the advantages of meta-analysis: The major difference between narrative reviews and quantitative meta-analyses may well be that narrative reviews primarily focus on the conclusions reached in various studies, whereas meta-analyses focus on data, as reflected by the operationalization of variables, the magnitude of effect sizes, and the sample sizes. Meta-analysis draw conclusion from the data characteristics i. Viewing from this point, meta-analysis result is generated from the richer data; therefore it offers more meaningful and robust findings. Meta-analysis enables researchers to sample studies that show insignificant effects note that in traditional methods, researchers are bound to select empirical studies that report significant effects only. With the powerful technique of meta-analysis method, studies with insignificant effects will be analyzed along with others that may at the end show significant effects. The end result is, of course, not necessarily significant, but one thing for sure, it is undoubtedly more accurate and more credible due to the sampling of studies that is not bias to studies with significant effects only. On the same basis as point 4 above, meta-analysis enables researchers to estimate the cumulative impact of insignificant results that may in turn at the end be significant. Meta-analysis enables and promotes researchers to search for moderator variables in the less subjective way. Despite the advantages listed above, it has its own limitations: Sampling Bias toward Empirical Studies â€" Meta-analysis is applicable to quantitative studies such as survey, laboratory experiment, field study, and field experiment that report the magnitude of the effect size only. Even if mixed-method studies are being sampled, meta-analysis will be based their findings on the quantitative part only. Garbage In, Garbage Out â€" Meta-analysis does not generally differentiate studies by their quality quality of research designs and approaches, sampling units, methods of measuring variables, data analysis methods, and presentations of research findings are not in consideration when sampling is carried out. This may lead meta-analysis to unfounded conclusions. Although some techniques have been introduced to correct this error, it is evident that application of such techniques had introduced other biases related to the selection and weighting of quality criteria. Apples and Oranges â€" All reviewing methods, not restricted to meta-analysis only, are based on the collection of past studies that have common characteristics. Small Sample Size â€" a meta-analysis should include at least 15 studies, otherwise the type I error accepting a false null hypothesis could be severely inflated. As point 4 above, it is very difficult to find 15 empirical studies that are the same!! The statistics that normally used and reported in IS studies are: In the literature, effects sizes are of various forms. Look at the diagram at the end of this entry to view them. There are two models of meta-analysis method available. There are three primary meta-analysis methods available, i. There is another method introduced in the IS domain, named Glass method. This paper does not provide complete procedure on each method, but the authors suggested readers to refer to Lipsey and Wilson for the thorough description of the whole process.

Chapter 4 : Meta-Analysis Research Methodology

Meta-analysis is arguably the most important methodological innovation in the social and behavioral sciences in the last 25 years. Developed to offer researc.

Chapter 5 : Methods of Meta-Analysis - SAGE Research Methods

are three pooled or meta-analysis estimates: one for all the studies combined, at the extreme right of the picture, and

one each for the case-control and the cohort studies, shown as blue or turquoise dots.

Chapter 6 : Meta-analysis - Wikipedia

Meta-analysis is arguably the most important methodological innovation in the last thirty-five years, due to its immense impact on the development of cumulative knowledge and professional practice. This edition, has been revised to cover the newest developments in meta-analysis methods, evaluation, correction, and more.

Chapter 7 : Systematic reviews and meta-analyses: a step-by-step guide | www.nxgvision.com

Part IV: General Issues in Meta-Analysis 9. General Technical Issues in Meta-Analysis Cumulation of Findings Within Studies Methods of Integrating Findings Across Studies and Related Software Locating, Evaluating, Selecting, and Coding Studies Availability and Source Bias in Meta-Analysis