**x.1 Approaches to formal sample size determination**

In order to perform formal sample size determination, researchers must specify an alternative hypothesis in sufficient detail to determine the sampling distribution of the test statistic under the alternative hypothesis. For relatively simple designs (e.g., for a comparison of the mean scores of two independent groups or correlational analysis) the specification of a single standardised effect size characterises the sampling distribution under the alternative hypothesis adequately for power analysis {Cohen, 1988 #562}. For more complex designs (e.g., when covariates are to be included or when repeated measures designs are used) additional parameters may need to be specified. One of the major difficulties often cited by researchers in performing a power analysis is that they have trouble developing appropriate parameters for use in power analysis [cite interviews and survey].

Importantly, sample size planning should occur with the researcher’s specific outcome in mind. If a researcher is planning to base their inference on an effect size estimate and confidence intervals, sample size determination should aim to develop sufficiently narrow confidence intervals. If inferences are to be based on a traditional statistical test, power analysis should be used to plan for a sample size which provides a sufficiently high probability of the statistical test to be used returning a significant result at a given effect sizes.

There are multiple recommended approaches to determining an effect size for power analysis or other formal sample size planning. One approach is to use the minimum interesting or clinically significant effect {Biau, 2008 #568}, another is to estimate the expected effect size from a given intervention {Anderson, 2017 #737}. Although it might be ideal for all studies would be adequately powered to detect the minimum effect size of interest, this may not be possible for practical reasons such as budget or time, especially in areas of basic research where the minimum effect may be extremely small. In either approach, effect sizes must be chosen appropriately in order for power analysis to provide meaningful results, this paper outlines the different approaches to selecting effect sizes for use in power analysis, and outlines how researchers can approach sample size planning with different goals in mind in order to

This paper is intended to provide enough detail for a researcher with graduate statistical training to perform a power analysis

This chapter outlines two main approaches to power analysis, discusses previously proposed benchmarks for effect sizes for use in power analysis, and provides a systematic review of previous studies which have attempted to give empirical of bodies of literature in order to show the average effect sizes in different areas of research. Although in most scenarios standardised effect size benchmarks should not be used as the sole basis for a power analysis, in some cases little other guidance is available. Towards this end, this chapter attempts to provide an intuitive guide to understanding effect sizes in order to facilitate researchers being able to estimate the effect sizes for use in sample size planning.

This paper introduces readers to power analysis and outlines the various methods for determining effect sizes for use in standard sample size planning software.