Intro Stat Outcomes for a World Beyond p<0.05 (Draft)

(Last updated June 18, 2021)

This is not a comprehensive set of outcomes for an introductory statistics class. These outcomes were all inspired by the editorial "Moving to a World Beyond 'p<0.05'" (Wasserstein, Schirm, & Lazar, 2019).

I. Interpretation of p-values

A. Interpret p-values as continuous probabilities.
   - Avoid common misinterpretations of p-values. For example, a p-value does not provide the probability that the null hypothesis is true.

B. Use p-values to describe the strength of evidence against a stated hypothesis.
   - Explain why a small p-value provides strong evidence against a stated hypothesis.

C. Predict how changes to the effect size or sample size will impact the p-value.

D. Understand what others mean when they use the term *statistically significant*.
   - Recognize common misunderstandings associated with this term.

II. Errors and power

A. Define type I error, type II error, and power, and apply these definitions in a given context.

B. In scenarios where binary decisions are necessary, make an informed choice of significance level based on the consequences of type I and type II errors.

C. Discuss how conducting multiple tests can increase the risk of type I errors.

D. Discuss strategies to reduce the risk of type II errors and increase power.
   - Describe the relationship between sample size and statistical power.
   - Given a study design, identify sources of unexplained variation (e.g., imprecise measurements, inadequate controls) that may negatively affect power.

III. Interpretation of confidence intervals

A. Explain why it is important to include a measure of uncertainty with each point estimate.

B. Describe how the width of a confidence interval is related to sample size.

C. Interpret a confidence interval in context, and consider whether the upper and lower limits have different practical implications.

D. Recognize a confidence interval as an estimate subject to error, and distinguish between random and non-random errors in a given context.

IV. Effect sizes

A. Use statistics taught in the introductory course as measures of effect size.

B. Define a meaningful effect size with justification based on context.

C. Calculate a p-value from a test of a pre-specified alternative, such as a minimal important effect size.

V. Understanding the research process and evaluating published reports

A. Define the term *selective reporting* and discuss the potential benefits of public pre-registration of methods and results-blind reviewing.
    - Critique selection bias within a given article. For example, recognize the tendency to focus on sub-groups that result in small p-values when overall evidence for a claim is weak.

B. Discuss the benefits of open science practices and explain why one study is rarely enough to establish full understanding.

C. Explain why different p-values in replication studies do not always imply inconsistent results.