Improving Your Statistical Questions

Workshop for the "Statistical Modeling in Psychology" training program. Freiburg, January 21 and 22, 2021

Abstract

This workshop aims to help you to draw better statistical inferences from empirical research, improve the statistical questions you ask when you collect data, design more informative and efficient studies, and improve your meta-analytic thinking. In practical, hands on assignments, you will learn techniques and tools that can be immediately implemented in your own research, such as equivalence testing, determining about the smallest effect size you are interested in, justifying your sample size, making your hypotheses falsifiable, evaluate findings in the literature while keeping publication bias into account, and perform small-scale meta-analyses.

Assumed quantitative knowledge

You should have some basic knowledge about calculating descriptive statistics, and how to perform *t*-tests, correlations, and ANOVA's.

Assumed computer background

We will use R in many of the assignments, but you don't need any previous knowledge of R - we will mainly use it as a fancy calculator.

Equipment and software requirements

Please <u>install R</u> and <u>install R studio</u> before the workshop. Please install these <u>R packages</u>. If needed, see this <u>help file</u> on how to run R code.

Day 1: Improving Your Statistical Questions

By far the biggest improvement most research can make is to more clearly specify their statistical questions. When you perform a study, what is it you really want to know? How would you falsify a prediction?

09:00-09:15	Reflection on Day 1
09:15-10:30	Guidance on how to <i>act</i> . Type 1 error control: Why it matters, and how it works in practice. What is 'p-hacking'? How can you recognize it, and prevent it in your own research?
10:30 – 10:45	Coffee break
10:45 – 12:00	<i>The</i> Question: What would falsify your hypothesis? How can we specify falsifiable predictions? How do you determine your smallest effect size of interest based on theory, practical relevance, or feasibility?
12:00-13:00	Lunch break
13:00-15:00	Interpret null-effects using equivalence testing, the Bayesian ROPE procedure, and Bayes factors. Practical assignment to analyze existing data reporting null-results.
15:00 – 15:15	Coffee break
15:15 – 17:00	What do results from single studies tell you? How important are statistics in research lines? Why are replication studies important? How can we ask better theoretical questions?

Day 2: Improving the Informational Value of Studies

Increased attention to the design of experiments has lead to journals starting to require sample size justifications and a-priori power analyses. How do you decide upon the sample size in studies? How can you design reliable but efficient studies? What can you expect in lines of research, and how do you deal with mixed results?

09:00-09:15	Reflection on Day 2
09:15-10:30	Type 2 error control: Statistical power. Which sample sizes do you need, and which effects can you study? How do you perform and report a power analysis using software such as g*power, and how can you perform power analyses using simulations?
10:30 – 10:45	Coffee break
10:45 – 12:00	Additional approaches to sample size justifications. Planning for accuracy, and limitations due to feasibility. How do you plan for both the presence, as the absence, of an effect? How do you justify the alpha level for your study?
12:00-13:00	Lunch break
13:00-15:00	There will be variation in single studies, and we need to think about science in more cumulative ways. We will discuss why not all studies can be expected to be significant in lines of research, even when there is a true effect, and how to deal with this when submitting research for publication.
15:00 – 15:15	Coffee break
15:15 – 17:00	Introduction to meta-analyses in R. Why is it important to think meta-analytically? Demonstrating meta-analyses through simulations. Explanation of heterogeneity in meta-analyses. Discussion of meta-analytic bias correction techniques, such as trim-and-fill, PET-PEESE meta-regression, the Test of Excessive Significance, and P-curve analysis.

In case this course is online, please adhere to this code of conduct

1) Please download all educational material before the start of the workshop.

2) Make sure you are working in a quiet place where you can focus.

3) You can share all educational material included in this course with anyone you wish as long as you adhere to the sharing license.

4) You have an attendance requirement, but if you have other obligations during the course (e.g., childcare) let me know and we will create a planning that works for you.

5) You can decide if you want to turn on your camera or not. Make sure you have a working microphone to ask and answer questions. Always mute your microphone if you are not talking (the teacher may mute your mic if needed).

6) You are not allowed to record or share anything fellow students say without their explicit consent. You are allowed to record or share anything the teacher says.

7) Be respectful to your fellow students. Feel free to voice any disagreements with what I teach – I appreciate it if people point out where I am wrong.