LESSON PLAN TEMPLATE:

This is a template for a lesson plan structure, so we can start turning our curated resources in the Table of activities into full lesson plans with learning outcomes. Please either create copies of this template and upload to our OSF project page or create your own lesson plan and paste it in the landing page. There’s an example here.

Name of the class: Interpreting effect sizes and confidence intervals

<table>
<thead>
<tr>
<th>Suitable context: (e.g., entry-level/undergraduate/postgraduate)</th>
<th>Undergraduate students/possibly postgraduate</th>
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| Total time: (e.g., 1 hour, 2 hours, 1 day) | ~ 1 hour |

| Pre-requisites: | - Basic research methods knowledge  
- Perhaps some basic introductory statistical knowledge  
- If running the seminar exercise (extra), basic familiarity with R |

| Related resources (e.g. slides, assignment materials, lecture recordings, etc) | Cohen’s d: [https://rpsychologist.com/cohend/](https://rpsychologist.com/cohend/)  

| Learning outcomes: | 1. Students understand that confidence intervals are an important addition to p-value research  
2. Students understand how to meaningfully interpret confidence intervals  
3. Students get hands-on experience with visualization  
4. Students understand the meaning of effect size and how it is calculated. |

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<tr>
<th>Time</th>
<th>Activity</th>
<th>Instructor notes</th>
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| 20 minutes | Introduction to effect sizes (e.g. through youtube: [https://www.youtube.com/watch?v=2AKTNvVN3Dk](https://www.youtube.com/watch?v=2AKTNvVN3Dk)) | Introduce the concept of effect size  
- What is effect size (measure of the magnitude of the difference) |
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- Introduce the difference between statistical significance and effect size (e.g., see Kirk, 1996)
- Introduce common measures of effect size (such as Cohen’s d)

### 10 minutes

| Visualize effect sizes using the shiny app for cohen’s d ([https://rpsychologist.com/cohend/](https://rpsychologist.com/cohend/)) | Ask students to imagine they are doing a reading intervention study where they are comparing a treatment group (receiving the intervention to improve their reading skill) to a control group (no intervention or placebo). The two distributions show the outcome variable (e.g., standardised reading performance after intervention).

Ask students to change the value of Cohen’s d to 3 values: 0.1, 0.5, and 0.75

Ask them to think about the following questions:
- How does the difference between the two distributions change with effect size?
- What does each effect size represent?
- How can we interpret the effect size in terms of the research question (i.e., evaluating the effectiveness of the reading intervention?) |
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| 20 minutes | Introduction to confidence intervals | - When to include them, how to interpret, e.g. [https://www.youtube.com/watch?v=tFWsuO9f74o](https://www.youtube.com/watch?v=tFWsuO9f74o)
- What are confidence intervals? (adds margin of error to the p-value)
- What do confidence intervals tell you that p-values do not? (see Cummings, 2014 for an overview of the “Dance of the CIs”)
- How to calculate and interpret confidence intervals (e.g. using bootstrapping) |
| 10 minutes | Visualize confidence intervals using the shiny app | [https://rpsychologist.com/d3/ci/](https://rpsychologist.com/d3/ci/)
Ask students to run the CI simulation and think about the following issues:
- What does the 95% CI coverage mean? (hint: that 95% of all confidence intervals will contain the true population mean)
- Can we say whether any single confidence interval contains the true mean (hint: NO! We can only interpret them as long-term probabilities)
Ask students to move the slider (CI coverage) to 50%:
- What proportion of all confidence intervals will now contain the true mean? (Hint: 50%)
Ask students to increase the sample size from 5 to 30:
- Does the width of the confidence intervals change? Why? (Hint: standard error decreases with sample size) |
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| Extra/ seminar (e.g. 1 hour) | Tutorial on how to compute Cohen’s d and confidence intervals in R | - Calculate Cohen’s d using the `effectsize` package. Use a dataset such as the mtcars for easy interpretation.  
- Calculate confidence intervals using bootstrapping (`Gboot` package) or as meta analysis (`metafor` package). This should also be possible using the mtcars dataset.  
Let students attempt to write their own code first, but have an example code ready. Pay special attention to how to interpret the results that are calculated.  
If students are not familiar with R, there are also some shiny apps for calculating effect sizes and their confidence intervals: [https://doomlab.shinyapps.io/mote/](https://doomlab.shinyapps.io/mote/) (Erin Buchanan) |

| References: |