EPsy 3264: Basic and Applied Statistics 11 pts.
Assignment 08

Swimming with Dolphins and Pigs!

Recall the experiment in which researchers examined if swimming with dolphins was therapeutic for patients suffering from clinical depression (Assignment #5). Of the 15 study participants who swam with dolphins, 10 showed substantial improvement in their depression symptoms at the end of the study compared to only 3 of the 15 participants who swam without dolphins. This result was not very compatible with the results produced by the no-effect model specified in the null hypothesis. A natural follow-up question is:

How much larger is the improvement rate for patients suffering from clinical depression who swim with dolphins than those that don't?

Observed Effect Size

When observed results are not compatible with the results produced by the no-effect model, applied researchers often want to know how much more effective the experimental condition is than the control. Statisticians refer to this quantity as an *effect size*. It is so called because it measures the effectiveness of the experimental condition—in this case, the improvement rate in depression for patients swimming with dolphins over and above the improvement rate in the control group.

1. Calculate and report the improvement rate for the 15 study participants who swam with dolphins and the improvement rate for the15 study participants in the control group.

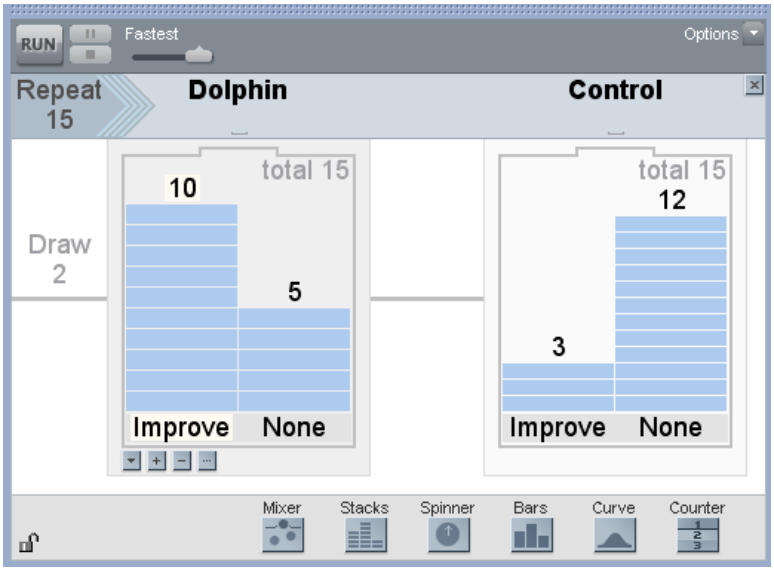
2. Use the values you reported in Question #1 to compute the observed effect size and answer the research question for the 30 study participants. Show your work.

Estimating Uncertainty for the Effect Size

Much like any other estimate obtained from sample data, the effect size varies from sample to sample. It is thus important to estimate the uncertainty in the effect size that is due to sampling variation. To do this, we need to bootstrap 15 observations from each condition separately and compute the effect size many, many times. The distribution of bootstrapped effect sizes can then be used to obtain a measure of uncertainty.

Set up a sampler in TinkerPlots™ to bootstrap 15 observations from each condition separately. To do this:

- Drag a `Sampler` from the object toolbar into the blank document.
- Drag two `Stacks` sampling devices into the sampler so that they are linked.
- Name the first `Stacks` sampling device *Dolphins*. Name the second `Stacks` sampling device *Control*.
- In the *Dolphin* sampling device, create 10 elements labeled *Improve* and 5 elements labeled *None*.
- In the *Control* sampling device, create 3 elements labeled *Improve* and 12 elements labeled *None*.
- Change the Repeat value to 15 and the Draw value to 2. (This will sample 15 elements from each device.)
- Make sure both sampling devices sample **with replacement**.

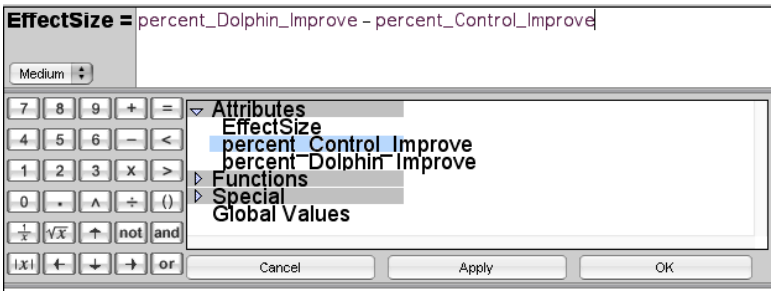


Click the `RUN` button to bootstrap 15 observations from each condition of the experiment. Although the bootstrapped elements are generated in the same case table, since the experimental and control observations are stored in separate columns they can be plotted independently.

- Plot the 15 bootstrapped observations for the experimental condition (`Dolphin`). Collect the percentage of the bootstrapped experiemental sample that improved.
- Plot the 15 bootstrapped observations for the control condition (`Control`). Collect the percentage of the bootstrapped control sample that improved.

Both statistics should be collected into the same collection table. In this table,

- Create a new column called `EffectSize`. That will include the effect size for the bootstrapped samples. To calculate this from the collected data use a formula to compute the difference between the two collected attributes.



- Click the RUN button from the sampler again to be sure that everything works. If it works, another 15 observations will be bootstrapped from each condition and the effect size will be calculated and saved in the collection table.
- Carry out 498 more trials (500 trials total) using `Collect`.

3. Create a plot of the 500 bootstrapped effect sizes. Copy-and-paste this plot into your word-processed document.

4. Compute and report the mean of the bootstrap distribution. Explain why you could have predicted this values based on the model depicted in your TinkerPlots™ sampler.

5. Compute and report the standard error for the bootstrap distribution.

6. Compute and report the compatibility interval for the effect size. Show your work.

7. Based on your compatibility intervals, does this study provide evidence to suggest that swimming with dolphins yields a higher percentage of improvement, on average, than swimming without dolphins? Explain your reasoning.

8. There is a huge amount of uncertainty in the size of the effect. The compatibility interval suggests the effect on improvement from swimming with dolphins might be very small, or it might be very large (we can't be sure). Comment on the statistical properties of the sample that give rise to so much uncertainty.

Interval Estimate: Dolphins vs. Pigs

In a critique of Dolphin Therapy Studies, Marino & Lilienfeld (2007)[1] argue that research on dolphin therapy fails to take into account whether swimming with other large animals improves depression. Marin & Lilienfeld suggest that the active ingredient is not swimming with dolphins, but rather swimming with any animal in water. To investigate whether swimming with dolphins is better than swimming with other animals, suppose that researchers also randomly assigned patients suffering from clinical depression to swim with dolphins (experimental condition) or to swim with pigs (control condition). (Exuma in the Bahamas is known to have friendly wild pigs that join tourists on the beach and will join them for a swim in the water; see: https://www.youtube.com/watch?v=O89DvVdthDY#t=42).

Suppose after collecting their data the researcher found that the participants who swam with dolphins had an improvement rate of 62% and the participants who swam with pigs had an improvement rate of 45%. The researchers used a bootstrap analysis to determine the standard error for the effect size, which they reported as 13%.

9. Based on these results, compute and report the observed effect size for the study.

10. Based on these results, compute and report the compatibility interval for the effect size.

11. Based on your compatibility interval, does this study provide evidence to suggest that swimming with dolphins yields a higher percentage of improvement, on average, than swimming with pigs? Explain your reasoning.

[1] Marino, L., & Lilienfeld, S. O. (2007). Dolphin-assisted therapy: More flawed data and more flawed conclusions. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*, *20*(3), 239-249.