PSY 626: Bayesian Statistics in Psychology
Homework 1: Computing power and sample sizes
Due: Monday, 2 September at 5 pm

Practice computing power and identifying appropriate sample sizes. Here, you do it for several types of tests.

1. Age of Acquisition: In a lexical decision task, people need to quickly identify whether a string of letters form a word (e.g., STRING) or not (e.g., FLORFT). Studies show that response times are faster for words generally learned early in life (e.g., 6 or younger) compared to words generally learned later in life (e.g, 7 or older). An online experiment gathered data from around 20,000 students and found the following response times:

Condition	Mean RT	SD
Early AoA	803.466	243.001
Late AoA	830.974	247.346
Diff	27.508	94.896

The difference in the Early and Late AoA response times is the Age of Acquisition effect.

Use the online calculator for Two Dependent Means Power at the IntroStats Online site to estimate the sample size needed to have 80% power to detect a significant Age of Acquisition Effect. Repeat for 90% power.

Suppose you wanted to investigate whether the Age of Acquisition effect is smaller for people raised by a single parent. If we suppose the Age of Acquisition effect is half the size of the typical effect (Diff, in the table above), what sample size is needed to have 80% power with a two-sample independent t-test that compares the typical effect with the expected half size effect? Use the Power for Independent Means calculator at IntroStats Online. Repeat for 90% power.

2. Link word for memory: The link word method is a tool for learning foreign language vocabular words. An image is shown and the student forms a vivid mental image that incorporates both the foreign words and its English translation. An online experiment gathered data from around 30,000 students who learned 50 French words and their English translations. Half of the trials included an image (using the Link Word method) and the other half of the trials did not. The experiment found the following for a subsequent test of translating the French vocabulary:

Condition	Mean number of correct translations	SD
Using Link Word	14.081	6.478
Not using Link Word	13.023	6.576
Diff	1.058	2.721

The difference in the scores is the benefit of using the Link Word method.

Use the online calculator for Two Dependent Means Power at the IntroStats Online site to estimate the sample size needed to have 80% power to detect a significant effect of the Link Word method. Repeat for 90% power.

Suppose you wanted to investigate whether the Link Word benefit is smaller for people who claim to not experience visual images (aphantasia). If we suppose the benefit is half the size of the typical effect (Diff, in the table above), what sample size is needed to have 80% power for a two-sample independent t-test that compares the typical effect with the expected half size effect? Use the Power for Independent Means calculator at IntroStats Online. Repeat for 90% power.

3. Memory span: In an immediate serial recall task, a participant is shown a sequence of items and then asked to report them back in the same order they were presented. An online experiment (n=107,706) varied whether the items were digits (numbers), letters, or words. After multiple trials, the final list length for each condition that could be reported back correctly is the estimate of memory span for that condition.

Condition	Mean final list length
Digits	6.638
Letters	5.883
Words	4.293

Across participants, the correlation between final list lengths across the conditions is around r=0.67. The standard deviation is around 1.5.

Use the online calculator for One-Way ANOVA for Dependent Mean Power calculator at the IntroStats Online site to estimate the sample size needed to have 80% power to detect all of the following effects (add contrast tests):

- A significant ANOVA
- A significant contrast between Digits and Letters.
- A significant contrast between Digits and Words.
- A significant contrast between Letters and Words.

Repeat for 90% power.

Show all of your work and send everything to: gfrancis@purdue.edu