

Assignment 5

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Statistical Power

You are planning a study on the effects of alcohol on reaction times in the context of driving using a driving simulator to mimic the necessity to apply the brakes when objects appear in front of the moving car. Your hypothesis is that as blood alcohol level increases, reaction times will also increase. You plan on testing three groups of participants (it will be a between-subjects design): placebo, low blood alcohol, and high blood alcohol.

You don't find any similar studies in the literature (good news! your study will be novel!) and so you will have to use more tangential findings from the literature to estimate effect size, so that you can perform a power analysis to determine how many participants you will need for your study to detect the effect of alcohol on reaction time.

You find a study in which low blood alcohol levels increased reaction times to simple visual stimuli from around 300 ms (baseline) to 350 ms (low blood alcohol).

You find a second study using high blood alcohol levels that showed an increase in reaction time to auditory stimuli from 300 ms (baseline) to 400 ms (high blood alcohol).

The average within-group standard deviation in these other studies was about 100 ms.

For the questions below, convert n values to integer values using the round function in R. Hint: be careful about the difference between variance and standard deviation and in particular what values the R function `power.anova.test` expects.

1. Perform a power analysis to determine how many participants you would need to detect the effect of drug on reaction time, at a significance level of 0.05, with a power of 0.80. (2 points)
2. How many participants per group for a significance level of 0.01 and power of 0.80? (1 point)
3. What about a significance level of 0.01 and power=0.90? (1 point)
4. If you reduce the within-group standard deviation to 75 ms how many participants would you need for a significance level of 0.05 and power=0.90? (1 point)
5. If you were to use $n=12$ participants per group, and you wanted to detect a smaller change in reaction time from 300 ms (baseline) to 325 ms (low blood alcohol level) to 350 ms (high blood alcohol level), and within-group standard deviation is 100 ms, significance level is 0.05, what would be your statistical power? (2 points)