

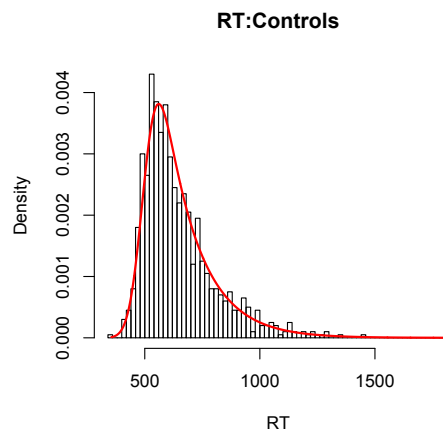
Assignment 6—Introduction to Statistics Using R

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* Due Friday Mar 31

Power Calculations

You are planning a new reaction time study. You plan to have a main experimental condition and a control condition. The control condition has been used previously in your lab, and when you look at the previous data across many subjects, the reaction time data are best characterized using an *ex-gaussian*¹ distribution with the following parameters: $\mu = 600$, $\sigma = 60$, $\nu = 200$. Note that in R, the function `rexGAUS()` in the `gamlss.dist` package can be used to generate random samples from the ex-gaussian distribution.



Nobody has tried the experimental condition that you're planning, but other studies in the literature that use reaction time as a measure typically see changes in reaction time that correspond to a decrease in the μ parameter of the ex-gaussian of about -50 milliseconds (50 ms faster than controls). You plan to use a Mann-Whitney U test to compare differences in mean

¹http://en.wikipedia.org/wiki/Exponentially_modified_Gaussian_distribution

reaction time between your control group and your experimental group.

Note that the `rexGAUS()` function runs slow in R. Instead you can implement random sampling from an ex-gaussian distribution by taking the sum of random values from a gaussian distribution and an exponential distribution. For example for the purposes of speed in this assignment, you can assume that `rnorm(1000,600,60) + rexp(1000,1/200)` will give you 1000 random values from an ex-gaussian distribution, just as if you were to get them using: `rexGAUS(1000,600,60,200)`.

1. Use parametric bootstrapping to estimate how many subjects you would require in each group (assume equal group sizes) in order to detect a difference of -50 milliseconds at least 80% of the time; in other words, to get a statistical power of 0.80. Assume an alpha level of 0.05.
2. How would your answer change if you used an alpha level of 0.01?
3. If the effect is only -25 milliseconds, how many subjects would you need for a power of 0.80 (using alpha 0.05)?

Hypothesis Testing

After running an experiment with a control group and an experimental group, your data look like this: ²

control		experimental	
935	508	857	801
557	571	511	772
607	564	694	635
767	713	541	1207
717	611	719	663
515	972	1143	613
498	438	680	579
557	641	1161	1128
492	653	837	475
803	714	609	883

4. Use non-parametric bootstrapping to test the null hypothesis that the two groups were sampled from the same population with the same mean.

²<http://www.gribblelab.org/stats/data/A04data.txt>