13.3 Sample Size for Multiple Mints

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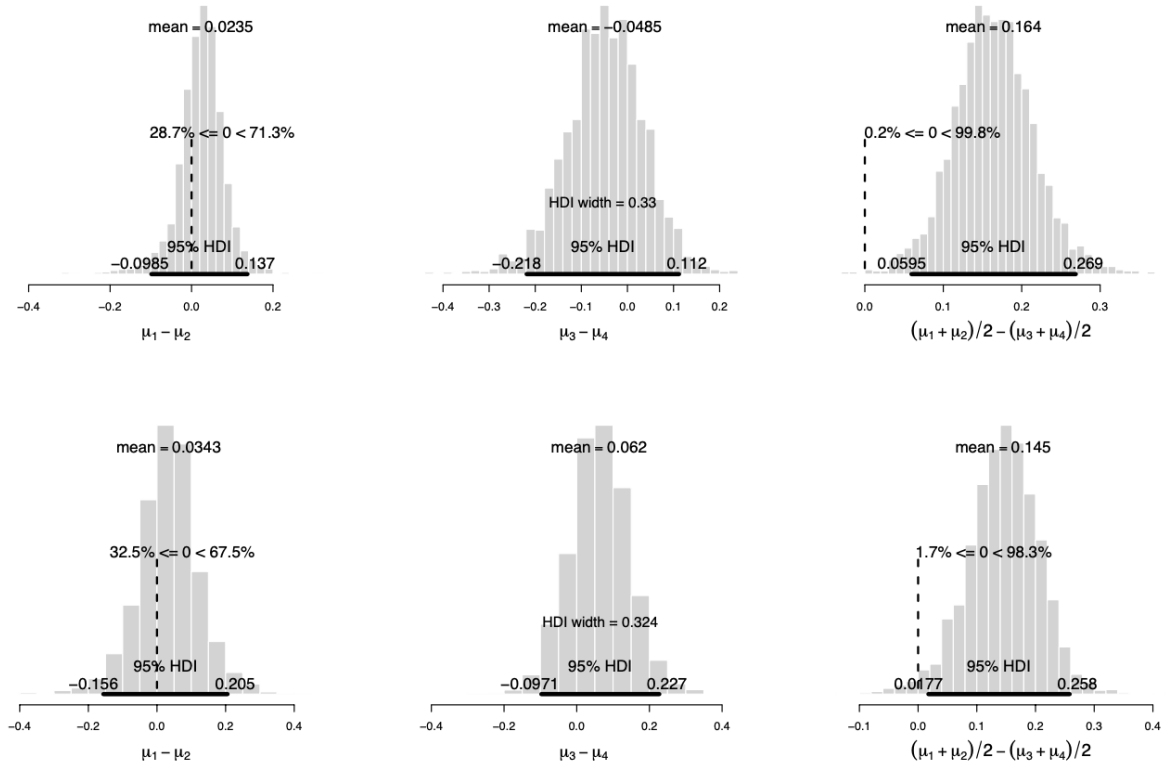
Suppose the goal of experimenter is to show that the mean of the filtration groups exceeds the mean of the condensation groups. Specifically, we suppose that the goal is achieved if the 95% HDI of $(\mu_1 + \mu_2)/2 - (\mu_3 + \mu_4)/2$ excludes 0. It turns out that using merely $N = 6$ in each of the groups achieves over 80% power for this goal.



The plot above shows examples of the posteriors for two runs of simulated data with $N = 6$ per group. The upper row shows a case in which the posterior for $(\mu_1 + \mu_2)/2 - (\mu_3 + \mu_4)/2$ excludes 0.

The lower row shows a case in which that goal is not achieved. Across many simulated runs, over 80% achieved the goal.

Suppose that the goal of the experimenter was, instead, to show that there was a difference between the two filtration groups. Specifically, we suppose that the goal is achieved if the 95% HDI of $\mu_1 - \mu_2$ excludes 0. Notice that this goal was not achieved in either simulated run shown in the plot above. It turns out that

using $N = 6$ in each of the groups achieves a power of only 4% for this goal. What is the power for this goal if N = 40, as used in the actual experiment? It turns out that the power is only 43%.

Table 13.3: Types of power analysis, including replication probability.

Analysis Type	**Data Generator**	**Data Sample**	**Prior for Bayesian Analysis**	**Posterior**
Actual	Real World	Observed Once	Skeptical Audience	Actual
Prospective Power	Hypothesis	Simulated Repeatedly	Skeptical Audience	Anticipated
Retrospective Power	Actual Posterior	Simulated Repeatedly	Skeptical Audience	Anticipated
Replication Power	Actual Posterior	Simulated Repeatedly	Actual Posterior	Anticipated

Finally, suppose that the goal of the experimenter was to achieve a minimal precision on the difference between the two condensation groups. The motivation for this goal is as follows: Theory suggests that the two condensations groups should not differ much. Therefore the goal cannot be to show that the difference exceeds zero. Instead, the goal should be to achieve some desired degree of precision regarding the difference. Suppose we want the 95% HDI on $\mu_3 - \mu_4$ to have a width less than 0.20. To achieve this goal at least 80% of the time, i.e., with a power of 80%, we would need a sample size (per group) of approximately $N = 32$.