Midterm Revisions - DanCher

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Problem 2f

Confidence Interval = [0.76, 1.095]

If we were to repeat this experiment many times and get a sample estimate each time, then 95% of the time our test-statistic will be between 0.76 and 1.095.

Problem 4

```r
# Calculate power through simulations.

set.seed(42)

# Params
n <- 30
alpha <- 0.05
treatment_effect <- 0.4
simulations <- 1000
set.seed(42)

trial_sim <- function(n, treatment_effect) {
  control <- rnorm(n, mean = 0, sd = 1)
  treatment <- rnorm(n, mean = treatment_effect, sd = 1)

  test_result <- t.test(control, treatment, var.equal = TRUE)

  rejection_rule <- test_result$p.value < alpha

  return(rejection_rule)
}

rejections <- numeric(simulations)
for (i in 1:simulations) {
  rejections[i] <- trial_sim(n, treatment_effect)
}

power <- mean(rejections)
cat("Power :", power, "\n")
```

```
## Power : 0.32
```

Problem 5

```
typeI_sim <- function(n) {
  control <- rnorm(n, mean = 0, sd = 1)
  treatment <- rnorm(n, mean = 0, sd = 1)

  test_result <- t.test(control, treatment, var.equal = TRUE)

  rejection_rule <- test_result$p.value < alpha

  return(rejection_rule)
}

rejections <- numeric(simulations)
for (i in 1:simulations) {
  rejections[i] <- typeI_sim(n)
}

type_I_error_rate <- mean(rejections)

type_II_error_rate <- 1 - power

# Output the results
cat("Type I Error Rate:", type_I_error_rate, "\n")
```

```
## Type I Error Rate: 0.055
```

```
cat("Type II Error Rate:", type_II_error_rate, "\n")
```

```
## Type II Error Rate: 0.68
```

Type I error rate is the probability of rejecting the null hypothesis when it is true. In this instance that would be the probability of concluding there is a significant treatment effect when there actually isn't. Given our inputs, we see that 5.5% of the time, we incorrectly conclude there is a treatment effect when there actually isn't one.

Type II error rate is the probability of failing to reject the null hypothesis when it is false. We fail to detect a significant effect (effect = 0.4 in our case) when it does actually exist. Given our inputs, 68% of the simulations show the test failed to reject the null hypothesis despite there being a true effect.