Gerber and Green Chapter 9 Problem 6

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This script shows how to conduct the randomization inference procedure in Gerber and Green (2012) Chapter 9 Problem 6 two different ways: using the `ri2` package and by hand with a loop. We can't use the `ri` package for this problem.

Chapter 9 Problem 6

Rind and Bordia studied the tipping behavior of lunchtime patrons of an "upscale Philadelphia restaurant" who were randomly assigned to four experimental groups. One factor was server sex (male or female), and a second factor was whether the server draws a "happy face" on the back of the bill presented to customers.

(a) Suppose you ignored the sex of the server and simply analyzed whether the happy face treatment has heterogeneous effects. Use randomization inference to test whether Var(ti) = 0 by testing whether Var(Yi(1)) = Var(Yi(0)). Construct the full schedule of potential outcomes by assuming that the treatment effect is equal to the observed difference-in-means between Yi(1) and Yi(0). Interpret your results.

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(b) Write down a regression model that depicts the effect of the sex of the waitstaff, whether they write a happy face on the bill, and the interaction of these factors.
(c) Estimate the regression model in (b) and test the interaction between waitstaff sex and the happy face treatment. Is the interaction significant?

NOT SHOWN

```
# Data from http://isps.yale.edu/FEDAI
library(haven)
data9.6 <- read_dta("datasets/9.6.dta")

# Number of sims the same for all three methods
sims <- 1000
```

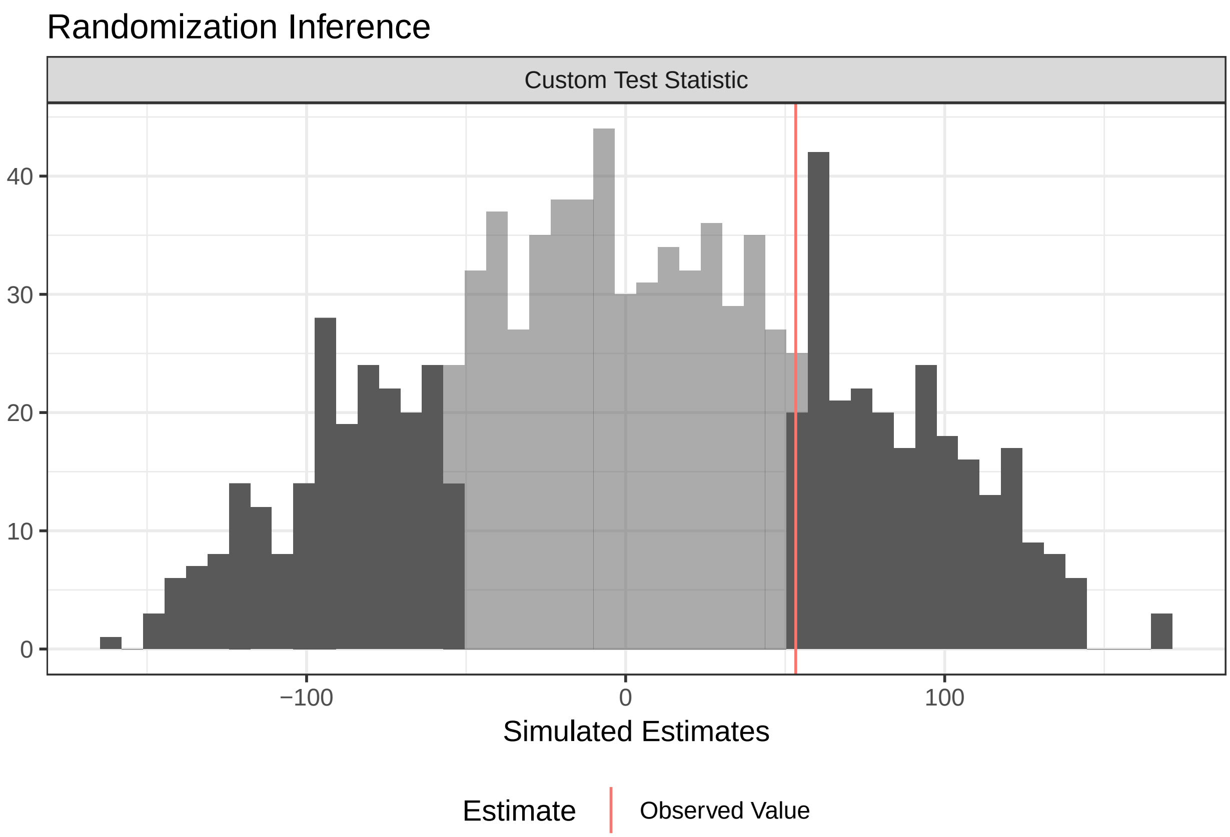
In ri2

```
library(ri2)

# Declare randomization procedure
declaration <- declare_ra(N = 89, m = 45)
observed_ate <- with(data9.6, mean(tip[happyface == 1]) - mean(tip[happyface == 0]))

# variance function
diff_in_variances <- function(data) {
  with(data, var(tip[happyface == 1]) - var(tip[happyface == 0]))
}

# Conduct Randomization Inference
ri2_out <- conduct_ri(test_function = diff_in_variances,
```

```
                      declaration = declaration,
                      assignment = "happyface",
                      outcome = "tip",
                      sharp_hypothesis = observed_ate,
                      data = data9.6)

summary(ri2_out)
```

```
##              coefficient estimate two_tailed_p_value null_ci_lower
## 1 Custom Test Statistic 53.30769               0.48     -124.3194
##   null_ci_upper
## 1      124.9919
```

```
plot(ri2_out)
```



By hand

```
library(randomizr)

observed_var <- with(data9.6, var(tip[happyface == 1]) - var(tip[happyface == 0]))
observed_ate <- with(data9.6, mean(tip[happyface == 1]) - mean(tip[happyface == 0]))

# Create full schedule potential outcomes
data9.6$Y0_star <- with(data9.6, (1-happyface)*tip + happyface*(tip+observed_ate))
data9.6$Y1_star <- with(data9.6, happyface*tip + (1-happyface)*(tip+observed_ate))
```

```r
simulated_var <- rep(NA, sims)

for (i in 1:sims){
  data9.6$Z_sim <- complete_ra(89, 45)
  simulated_var[i] <- with(data9.6, var(Y1_star[Z_sim == 1]) - var(Y0_star[Z_sim == 0]))
}

p_two_tailed <- mean(abs(simulated_var) >= abs(observed_var))
p_upper <- mean(simulated_var >= observed_var)
p_lower <- mean(simulated_var <= observed_var)

c(observed_var, p_two_tailed, p_upper, p_lower)
```

```
## [1] 53.30769  0.48000  0.25200  0.74800
```

```r
hist(simulated_var, breaks = 10)
abline(v = observed_var, col = "red")
```