Hypothesis_Testing

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Scenario: Use this R Markdown file as a guide to testing hypotheses. In this example, you will assume that you've run a clinical trial to compare an Old treatment and a New treatment. Both treatments have two possible outcomes — either the treatment works (is successful) or does not work (is not successful).

##Step 1: Determine your null hypothesis.

You saw a result of 27/52 recoveries in the New treatment and 22/51 recoveries in the Old treatment. This gives you a sample statistic of 27/52 - 22/51 = 8.8%, and you want to choose between two hypotheses: (i) the two treatments work equally well, i.e. their population success rates are the same; (ii) the two treatments have different success rates in the population.

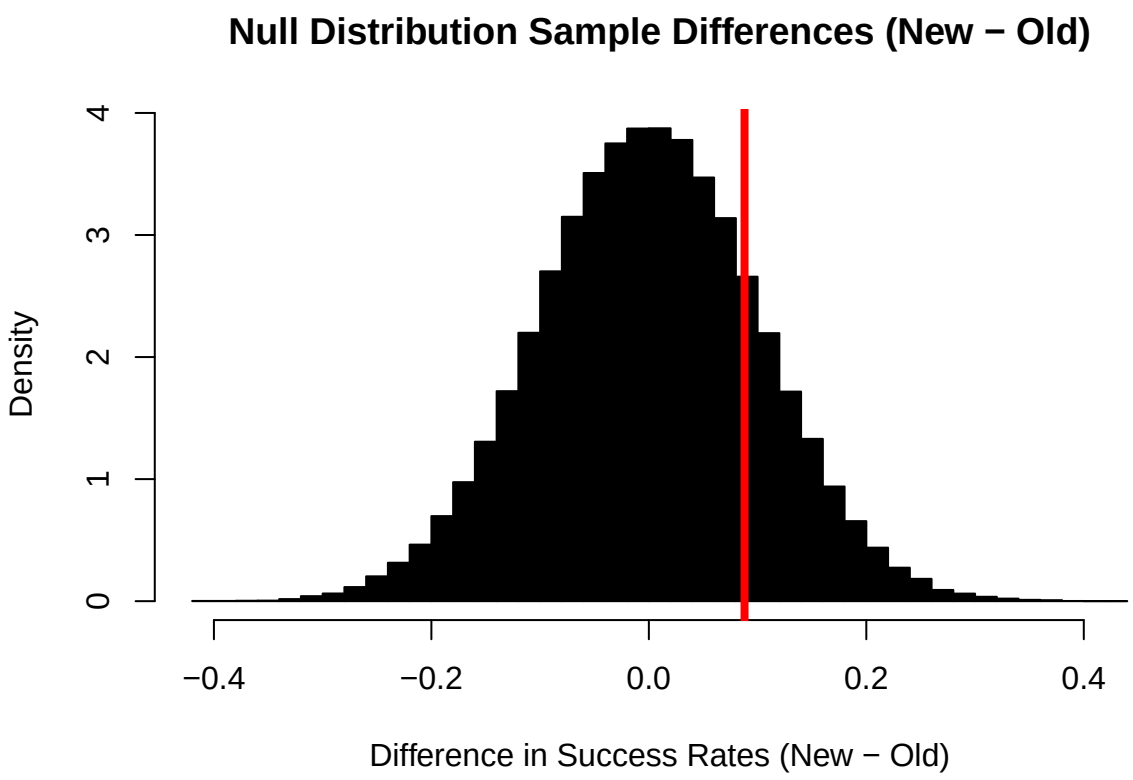
The null hypothesis is that each treatment works equally well, so you expect (27+22)/(52+51) = 47% of individuals to recover.

Step 2: Simulate the null distribution of the statistic.

```
# Both New and Old treatments have the same chance of success: (27+22)/(52+51) = 47.6%
set.seed(1) # Set the seed so your results are reproducible

outcome = c("Worked", "Did not Work") #possible outcomes

# Run the simulation:
nsim = 100000
store_p_diff = rep(0, nsim)

p_new = 27/52 # Observed proportion of New treatment success
p_old = 22/51 # Observed proportion of Old treatment success
p_all = (27+22)/(52+51) # Proportion of successful treatments under the null hypothesis (27+22)/(52+51)

for (i in 1:nsim){
 result_new = sample(outcome, 52, replace = TRUE, prob = c(p_all, 1-p_all))
 p_new_sim = mean(result_new == "Worked")

 result_old = sample(outcome, 51, replace = TRUE, prob = c(p_all, 1-p_all))
 p_old_sim = mean(result_old == "Worked")

 p_diff = p_new_sim - p_old_sim
 store_p_diff[i] = p_diff

}
```

##Step 3: Determine where the observed statistic falls along the null distribution. Create a histogram of the simulation results, then use the `abline()` command to examine where your observed (sample) statistic falls.

```r
hist(store_p_diff, breaks = 40, freq = FALSE, col = "black",
     main = 'Null Distribution Sample Differences (New - Old)',
     xlab = 'Difference in Success Rates (New - Old)')

# Use this line to see where your sample statistic of 8.8% falls:
abline(v = 0.088, lwd = 4, col = "red") #In this function, v specifies that the line is vertical, lwd s
```



Step 4: Calculate the p-value.

Assuming the null hypothesis holds (new = old), how often do we see sample statistics that are larger than the observed statistic 8.8%?

```r
# calculate p-value
mean(store_p_diff > 0.088)
```

```
## [1] 0.18146
```

18% (roughly 1 in 5)

We see that if the null hypothesis were true (both treatment had the same 47.6% success rate in population), there is an 1 in 5 chance of seeing that the new treatment has a 8.8% or higher success rate compared with the old treatment. So it does look like there is some evidence in favor of the alternative, but it is not very strong.