

Paired Data

Learning Outcomes

- Given a research question, construct the null and alternative hypotheses in words and using appropriate statistical symbols
- Describe and perform simulation-based hypothesis tests
- Interpret and evaluate a p-value
- Construct and interpret a theory-based confidence interval
- Use a confidence interval to determine the conclusion of a hypothesis test

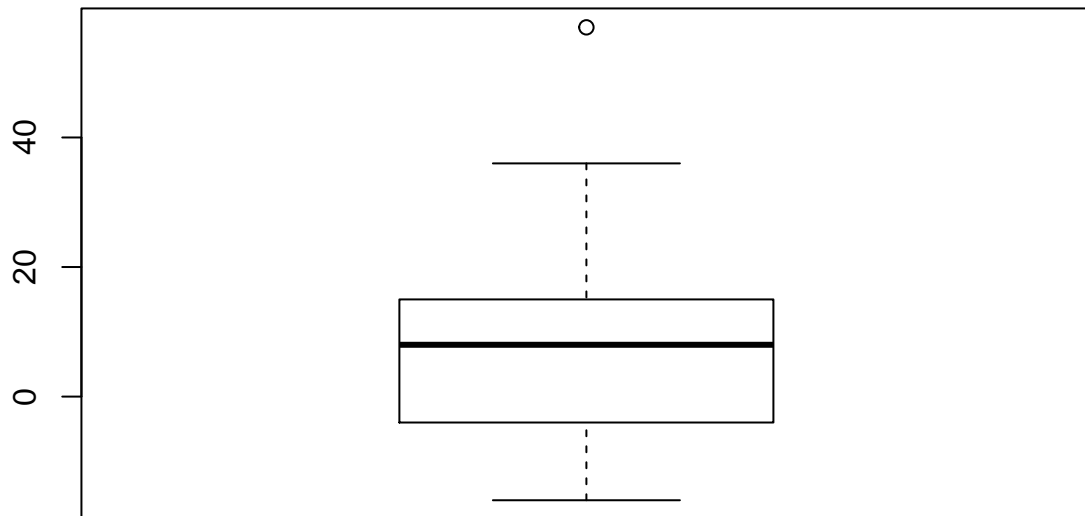
Mean Difference in Heart Rates for Jumping Jacks and Bicycle Kicks

Which exercise, jumping jacks or bicycle kicks will raise your heart rate more? Students in an introductory statistics class were asked to participate in an experiment to answer this question. Each student flipped a coin to determine which exercise to complete first. If the coin landed on heads the student would do jumping jacks for 30 seconds and then measure their heart rate. After a 2 minute break the student would do bicycle kicks for 30 seconds and then record their heart rate. If the coin landed on tails the student would complete bicycle kicks first followed by jumping jacks using the same times as above.

Review

```
heartrate <- read.csv("../data/HeartRates.csv")
boxplot(heartrate$Diff,
        main="Boxplot of the Differences in Heart Rates for Jumping Jacks minus Bicycle Kicks")
```

xplot of the Differences in Heart Rates for Jumping Jacks minus Bicycl



```
fav_stats(heartrate$Diff)
```

```
##  min Q1 median Q3 max    mean    sd  n missing
## -16 -4      8 15  57 7.604651 15.91666 43      0
```

1. What is the sample size?
2. Identify the variables in this study. What role do each have?
3. Why is this treated as a paired study design and not two independent samples?
4. What is the purpose of randomizing the order of jumping jacks and bicycle kicks before measuring heart rates?

Frame the research question in terms of hypotheses.

5. What are the two competing possibilities to run a hypothesis test?

6. Write the null hypothesis in words.

7. What is the research question?

8. Write the alternative hypothesis in notation.

Collect data

9. Report the summary statistic for the data.

10. What notation is used for the value in question 9?

Model the randomness as if the null hypothesis was true.

Add simulation here

Analyze the data.

..What proportion of samples are beyond the sample mean difference in heart beats for jumping jacks minus bicycle kicks?

Form a conclusion.

.. Write out the parameter of interest in context of the study.

.. Calculate the