Inferential Data Analysis

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In this project, we are going to explore the ToothGrowth R dataset and do inferential data analysis for our hypotheses

Setup

Load the ToothGrowth data and perform some basic exploratory data analyses.

Provide a basic summary of the data

Loading required packages and data set

```
require(tidyverse)
```

```
## Loading required package: tidyverse
```

```
## -- Attaching packages ---------------------------------------------------------------------------
```

```
## v ggplot2 3.3.0     v purrr   0.3.4
## v tibble  3.0.1     v dplyr   0.8.5
## v tidyr   1.0.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0
```

```
## -- Conflicts ------------------------------------------------------------------------------------ tid
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
data <- ToothGrowth
```

Exploratory Data Analysis

Summary of the data

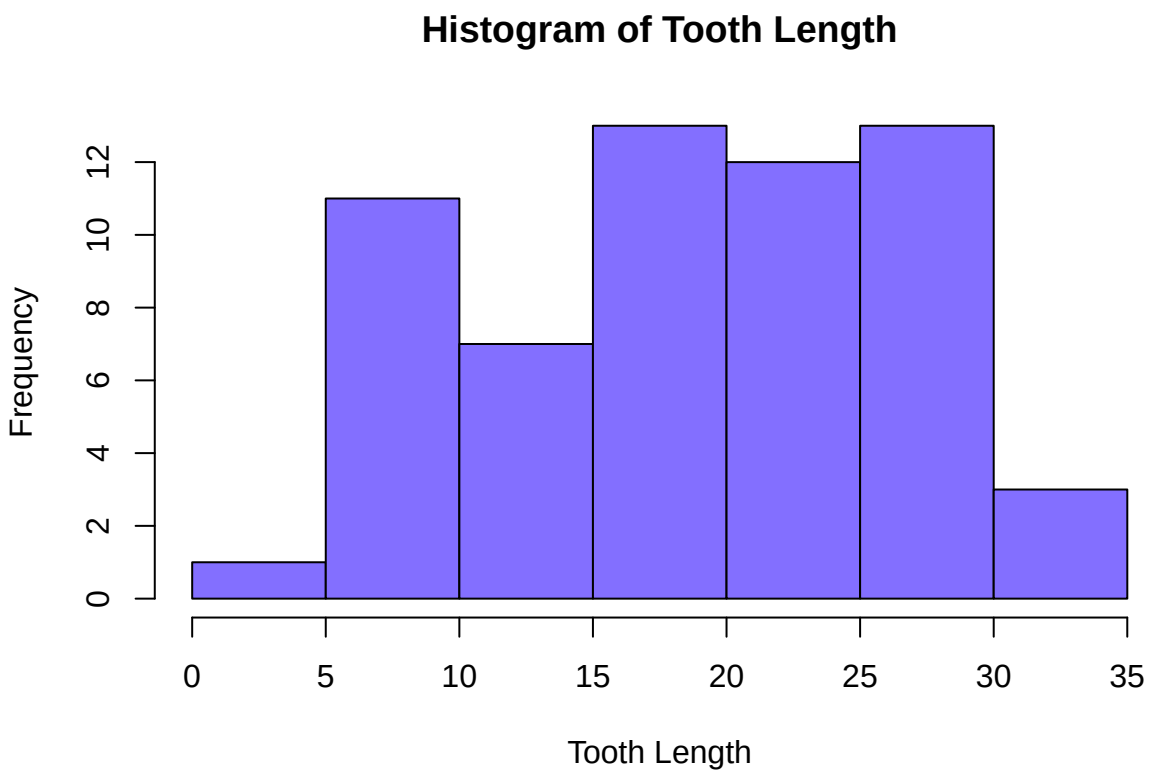
```
means <- data %>%
    group_by(supp, dose) %>%
    summarize(tooth.length = mean(len))

means
```

```
## # A tibble: 6 x 3
## # Groups:   supp [2]
##   supp   dose tooth.length
##   <fct> <dbl>        <dbl>
## 1 OJ      0.5         13.2
## 2 OJ      1           22.7
## 3 OJ      2           26.1
```

```
## 4 VC      0.5          7.98
## 5 VC      1           16.8
## 6 VC      2           26.1
```

```r
# Classes
nclass = round(sqrt(length(data$len)))
hist(data$len, col = "slateblue1", main = "Histogram of Tooth Length", xlab = "Tooth Length", nclass = n
```




```r
# OJ - orange juice
# VC - vitamin C
```

Inferential Analysis

Use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose

Hypotesis 1 - Relation between tooth length and the supplement used

```r
# Separate value vectors for analysis
supp = data$supp

len_by_OJ = data$len[supp == "OJ"] # Mean
len_by_VC = data$len[supp == "VC"]

# T-test: non-paired, variance based on approx of df, t < mean
t.test(len_by_VC, len_by_OJ, conf.level = .95, var.equal = FALSE, paired = FALSE, alternative = "less")
```

```
##
##  Welch Two Sample t-test
##
## data:  len_by_VC and len_by_OJ
```

```
## t = -1.9153, df = 55.309, p-value = 0.03032
## alternative hypothesis: true difference in means is less than 0
## 95 percent confidence interval:
##        -Inf -0.4682687
## sample estimates:
## mean of x mean of y
##  16.96333  20.66333
```

The p-value shows strong evidence to reject the null hypothesis (pval < 0.05), indicating there is correlation between the tooth length and the supplement used.

Hypothesis Conclusion

We can confirm with a 95% confidence interval that the tooth length by using Vitamin C across all dosages is less than that of Orange Juice, implying that the tooth length is directly affected by the supplement used.

Hypothesis 2 - Comparing tooth growth by dose

```
# Separate value vectors for analysis
half = data$len[data$dose == .5]
one = data$len[data$dose == 1] # Mean
two = data$len[data$dose == 2]

# Dose one is considered the mean sample for testing

# T-test, non-paired, var by approx of df, t < mean
t.test(half, one, alternative = "less", paired = FALSE, var.equal = FALSE, conf.level = .95)
```

```
##
##  Welch Two Sample t-test
##
## data:  half and one
## t = -6.4766, df = 37.986, p-value = 6.342e-08
## alternative hypothesis: true difference in means is less than 0
## 95 percent confidence interval:
##       -Inf -6.753323
## sample estimates:
## mean of x mean of y
##    10.605    19.735
```

The p-value shows strong evidence to reject the null hypothesis (pval < 0.05), indicating there is correlation between lower supplement doses and tooth length.

```
# T-test, non-paired, var by approx of df, t > mean
t.test(two, one, alternative = "greater", paired = FALSE, var.equal = FALSE, conf.level = .95)
```

```
##
##  Welch Two Sample t-test
##
## data:  two and one
## t = 4.9005, df = 37.101, p-value = 9.532e-06
## alternative hypothesis: true difference in means is greater than 0
## 95 percent confidence interval:
##  4.17387     Inf
## sample estimates:
```

```
## mean of x mean of y
##    26.100    19.735
```

The p-value shows strong evidence to reject the null hypothesis (pval < 0.05), indicating there is correlation between higher supplement doses and tooth length.

Hypothesis Conclusion

We can confirm with a 95% confidence interval that the supplement dosage rate interferes with tooth growth.

We can visualize this statement as the plot shows:

```
ggplot(data, aes(dose, len, group = supp, fill = supp)) +
    geom_bar(stat = "identity", position = "dodge", color = "white") +
    labs(
        x = "Dose",
        y = "Tooth Length",
        fill = "Supplement"
    ) +
    coord_flip() +
    theme_minimal()
```