ToothGrowth Analysis

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The instructions for this assignment are located here.

Built with R version 3.5.0 with the following system:

```
##           sysname           release           version          nodename
##         "Windows"          "10 x64"     "build 17134" "DESKTOP-TPCQ5AJ"
##           machine             login              user    effective_user
##          "x86-64"           "harla"           "harla"           "harla"
```

Load the required libraries

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

Analysis of ToothGrowth supp / dose

Load the Data

Load the data into object named "dat"

```
data("ToothGrowth")
dat <- ToothGrowth
```

Structure and summary of dat

Note: Use ?ToothGrowth to find information on the dataset.

```
str(dat)
```

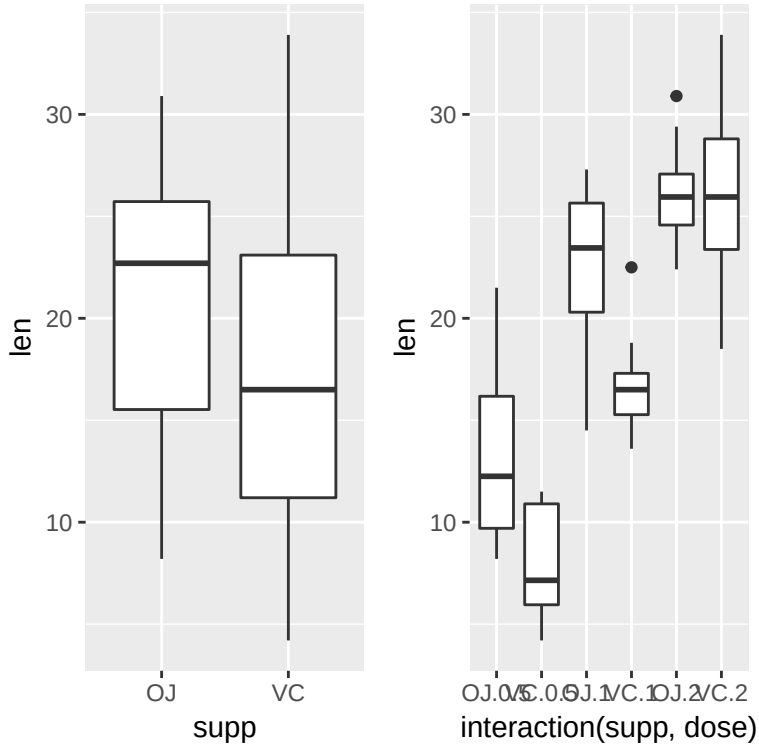

Figure 1: Comparison of Orange Juice and Ascorbic Acid on Tooth Growth Overall and by Doses

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```

```
summary(dat)
```

```
##       len        supp         dose
##  Min.   : 4.20   OJ:30   Min.   :0.500
##  1st Qu.:13.07   VC:30   1st Qu.:0.500
##  Median :19.25           Median :1.000
##  Mean   :18.81           Mean   :1.167
##  3rd Qu.:25.27           3rd Qu.:2.000
##  Max.   :33.90           Max.   :2.000
```

Exploratory Data Analysis

```
supplen <- ggplot(dat, aes(x = supp, y = len)) + geom_boxplot()
doselen <- ggplot(dat, aes(x = interaction(supp, dose), y = len)) + geom_boxplot()
grid.arrange(supplen, doselen, ncol = 2)
```

Figure 1 shows that Orange Juice may have increased tooth growth overall. The 1mg/day doseage shows a significant increase, which we will test.

Test of overall effect of Orange Juice and Ascorbic Acid on Tooth Growth

We test the null hypothesis that VC and OJ have a difference in means of 0:

```
##Group data by OJ and VC
datoj <- filter(dat, supp == "OJ")
datvc <- filter(dat, supp == "VC")
##Run t-test
t.test(datoj$len - datvc$len, mu = 0, paired = FALSE, alternative = "two.sided",
       conf.level = 0.95)
```

```
##
##  One Sample t-test
##
## data:  datoj$len - datvc$len
## t = 3.3026, df = 29, p-value = 0.00255
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  1.408659 5.991341
## sample estimates:
## mean of x
##       3.7
```

The results of the test indicate that we must reject the null hyopothesis due to the significance of OJ on tooth growth compared to VC.

Test 0.5 and 1.0 mg/day doseage to see which one is more significant.

Since we determined that OJ significantly affects tooth growth, we now want to test doseage levels. The 2 mg/day doseage looks like there is no effect, so we will test that first to confirm there is no significance:

```
##Group data by doseage
datojd1 <- filter(datoj, dose == 0.5)
datojd2 <- filter(datoj, dose == 1)
datojd3 <- filter(datoj, dose == 2)
datvcd1 <- filter(datvc, dose == 0.5)
datvcd2 <- filter(datvc, dose == 1)
datvcd3 <- filter(datvc, dose == 2)
##Run t.test on doseage of 2 mg/day
t.test(datojd3$len - datvcd3$len, mu = 0, paired = FALSE, alternative = "two.sided",
       conf.level = 0.95)
```

```
##
##  One Sample t-test
##
## data:  datojd3$len - datvcd3$len
## t = -0.042592, df = 9, p-value = 0.967
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -4.328976  4.168976
## sample estimates:
## mean of x
##     -0.08
```

This test indicates that there is not enough evidence to reject the null hypothesis, therefore the difference in means is 0.

Test of doseage 0.5 mg/day:

```
t.test(datojd1$len - datvcd1$len, mu = 0, paired = FALSE, alternative = "two.sided",
       conf.level = 0.95)
```

```
##
##  One Sample t-test
##
## data:  datojd1$len - datvcd1$len
## t = 2.9791, df = 9, p-value = 0.01547
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  1.263458 9.236542
## sample estimates:
## mean of x
##      5.25
```

Test of doseage 1 mg/day:

```
t.test(datojd2$len - datvcd2$len, mu = 0, paired = FALSE, alternative = "two.sided",
       conf.level = 0.95)
```

```
##
##  One Sample t-test
##
## data:  datojd2$len - datvcd2$len
## t = 3.3721, df = 9, p-value = 0.008229
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  1.951911 9.908089
## sample estimates:
## mean of x
##      5.93
```

Both these test show that OJ significantly improved tooth growth. The null hypothesis that the difference in means between OJ and VC is 0 should be rejected.

When comparing both, the doseage of 1 mg/day looks like a more effective treatment due to the significance of the test.

Conclussion and Assumptions

After identifying potential significant treatments for tooth decay during our exploratory analysis, we ran T-Tests on the data to confirm whether or not OJ is a better treatment than Ascorbic Acid, and which doseage was more effective.

We can conclude that OJ does improve tooth growth in guinea pigs with a 95% significance level.

We can also conclude that OJ in a 1 mg/day doseage is the most significant treatment doseage.
Alternatively, we can say that increasing doseage to 2 mg/day reduces the effectiveness of OJ on tooth growth.

The test performed assume that the variances were not equal and that the data was normally distributed.