Statistical Inference Course Assignment Part 2

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Overview

The report analyzes the ToothGrowth data in the R datasets package. The following would be the main objectives of this course assignment:

1.Load the ToothGrowth data and perform some basic exploratory data analyses 2.Provide a basic summary of the data. 3.Use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose. (Only use the techniques from class, even if there's other approaches worth considering) 4.State your conclusions and the assumptions needed for your conclusions.

Analysis

First load the necessary libraries

```
library(ggplot2)
```

Now we will load the data and give a summary

```
# Load ToothGrowth data
data("ToothGrowth")
```

Display a summary of the data

```
summary(ToothGrowth)
```

```
##       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
```

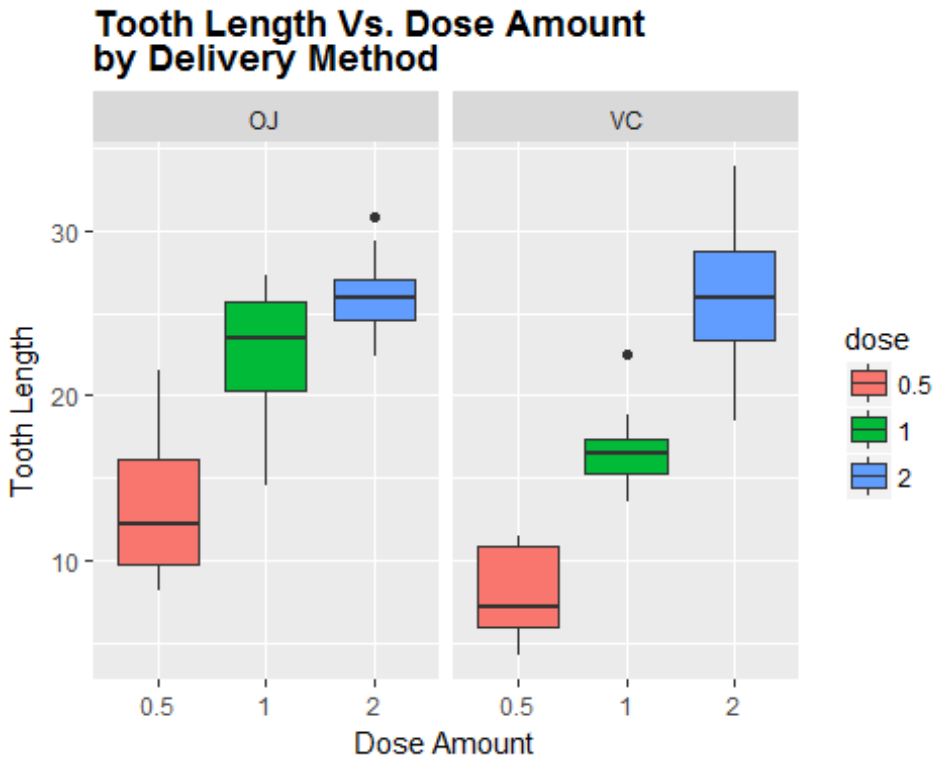
```
#Display the fisrt few rows of data
head(ToothGrowth)
```

```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
```

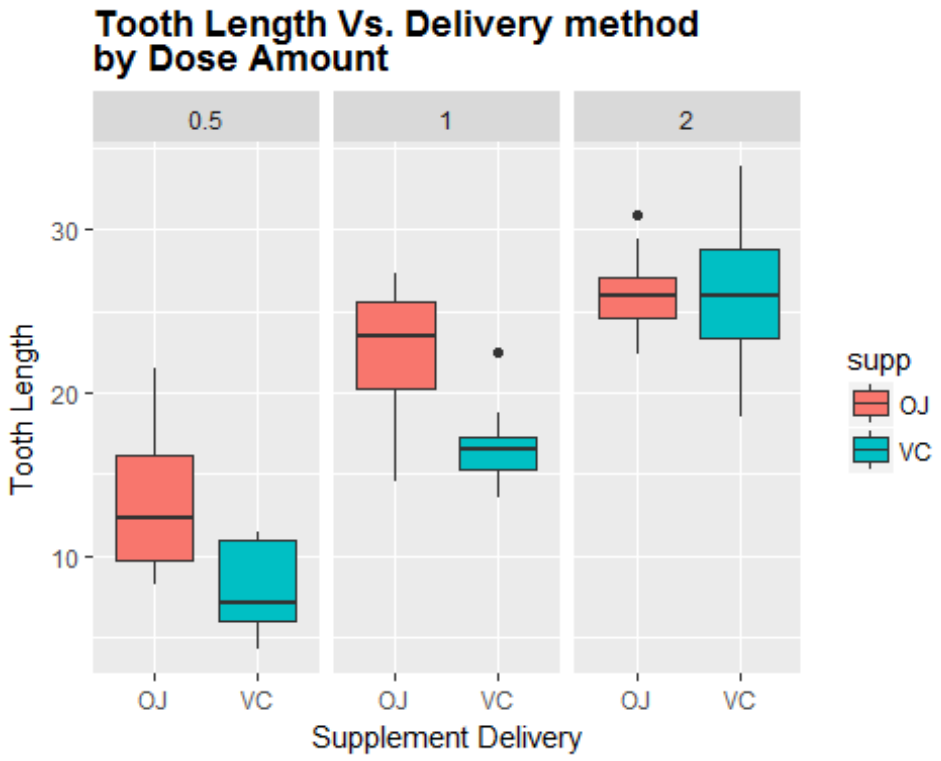
```
## 4  5.8   VC  0.5
## 5  6.4   VC  0.5
## 6 10.0   VC  0.5

# Unique Values
unique(ToothGrowth$len)

##  [1]  4.2 11.5  7.3  5.8  6.4 10.0 11.2  5.2  7.0 16.5 15.2 17.3 22.5 13.6
## [15] 14.5 18.8 15.5 23.6 18.5 33.9 25.5 26.4 32.5 26.7 21.5 23.3 29.5 17.6
## [29]  9.7  8.2  9.4 19.7 20.0 25.2 25.8 21.2 27.3 22.4 24.5 24.8 30.9 29.4
## [43] 23.0

unique(ToothGrowth$supp)

## [1] VC OJ
## Levels: OJ VC

unique(ToothGrowth$dose)

## [1] 0.5 1.0 2.0
```

Now we will create some plots to explore the data

```
#Convert dose to factor
ToothGrowth$dose <- as.factor(ToothGrowth$dose)

#Plot tooth length ('len') vs. the dose amount('dose'), broken out by
supplement delivery method ('supp')
ggplot(aes(x=dose, y=len), data=ToothGrowth) + geom_boxplot(aes(fill=dose)) +
xlab("Dose Amount") + ylab("Tooth Length") + facet_grid(~ supp) +
ggtitle("Tooth Length Vs. Dose Amount \nby Delivery Method") +
theme(plot.title = element_text(lineheight = 0.8, face="bold"))
```




```
#Plot tooth length ('len') vs. supplement delivery method ('supp'), broken
out by the dose amount ('dose')
ggplot(aes(x=supp, y=len), data=ToothGrowth) + geom_boxplot(aes(fill=supp)) +
xlab("Supplement Delivery") + ylab("Tooth Length") + facet_grid(~ dose) +
ggtitle("Tooth Length Vs. Delivery method \nby Dose Amount") +
theme(plot.title = element_text(lineheight = 0.8, face="bold"))
```



Now we will compare tooth growth by supplement using a t-test.

```
# run t-test
t.test(len~supp, data=ToothGrowth)

##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 1.9153, df = 55.309, p-value = 0.06063
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1710156  7.5710156
## sample estimates:
## mean in group OJ mean in group VC
##         20.66333         16.96333
```

The p-value obtained was 0.06 and the confidence interval of the test contains zero. So we can say that supplement types seems to have no impact on Tooth Growth based on this test.

Now, we will compare by dose, looking at the different pairs of dose values.

```
# run t-test using dose amounts 0.5 and 1.0
ToothGrowth_sub <- subset(ToothGrowth, ToothGrowth$dose %in% c(1.0,0.5))
t.test(len ~ dose, data=ToothGrowth_sub)

##
##  Welch Two Sample t-test
```

```
##
## data:  len by dose
## t = -6.4766, df = 37.986, p-value = 1.268e-07
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.983781  -6.276219
## sample estimates:
## mean in group 0.5   mean in group 1
##            10.605            19.735
```

```
# run t-test using dose amounts 0.5 and 2.0
ToothGrowth_sub <- subset(ToothGrowth, ToothGrowth$dose %in% c(0.5,2.0))
t.test(len ~ dose, data=ToothGrowth_sub)
```

```
##
##  Welch Two Sample t-test
##
## data:  len by dose
## t = -11.799, df = 36.883, p-value = 4.398e-14
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -18.15617 -12.83383
## sample estimates:
## mean in group 0.5   mean in group 2
##            10.605            26.100
```

```
# run t-test using dose amounts 1.0 and 2.0
ToothGrowth_sub <- subset(ToothGrowth, ToothGrowth$dose %in% c(1.0,2.0))
t.test(len ~ dose, data=ToothGrowth_sub)
```

```
##
##  Welch Two Sample t-test
##
## data:  len by dose
## t = -4.9005, df = 37.101, p-value = 1.906e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -8.996481 -3.733519
## sample estimates:
## mean in group 1 mean in group 2
##          19.735          26.100
```

As we can see the p-value of each test was essentially zero and the confidence interval of each test does not not cross over zero.

Based on this, we can assume that the average tooth length increases with an increasing dose, and so the null hypothesis can be rejected

Conclusions

Given the following assumptions

1. The sample is representive of the population
2. The distribution of the sample means follows the Central Limit Theorem.

So from the t-test analysis from above, we can conclude that delivery method has no effect on tooth growth/length, however increased dosages do result in increased tooth length.