Coursera Statistical Inference Project

Part 2: Basic Inferential Data Analysis

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Coursera Statistical Inference Course Project

This is a project for the Coursera Statistical Inference Class. The project consists of two parts:

- Simulation Exercise to explore inference
- Basic inferential analysis using the *ToothGrowth* data in the R datasets package

Part 2

This report aims to analyze the ToothGrowth data in the R datasets package. Per the course project instructions, the following items should occur:

- Load the ToothGrowth data and perform some basic exploratory data analyses
- Provide a basic summary of the data.
- 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).
- State your conclusions and the assumptions needed for your conclusions.

Analysis

```r
#load library
library(ggplot2)

#load data
data("ToothGrowth")

#show the 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  
```

```r
#Display the first 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
```

```r
#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
```

```r
unique(ToothGrowth$supp)
```

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

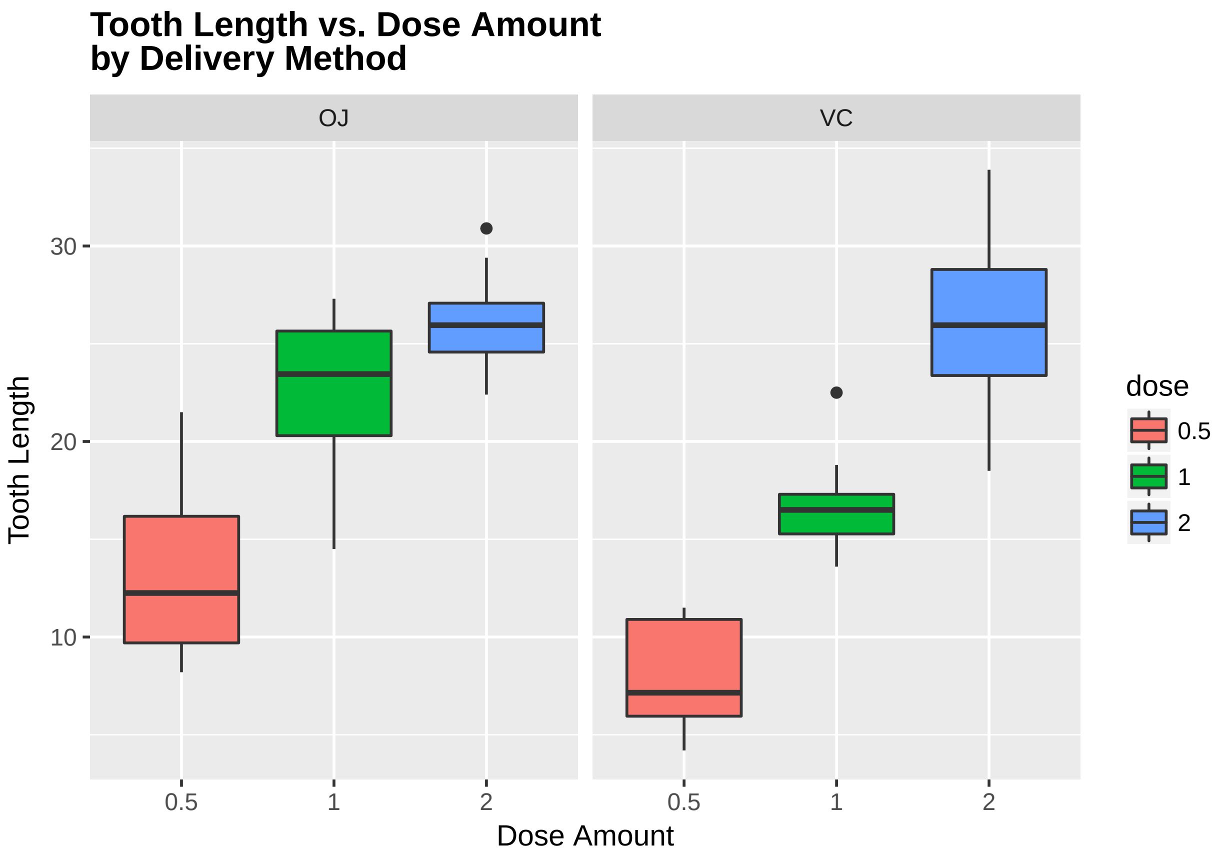
```r
unique(ToothGrowth$dose)
```

```
## [1] 0.5 1.0 2.0
```

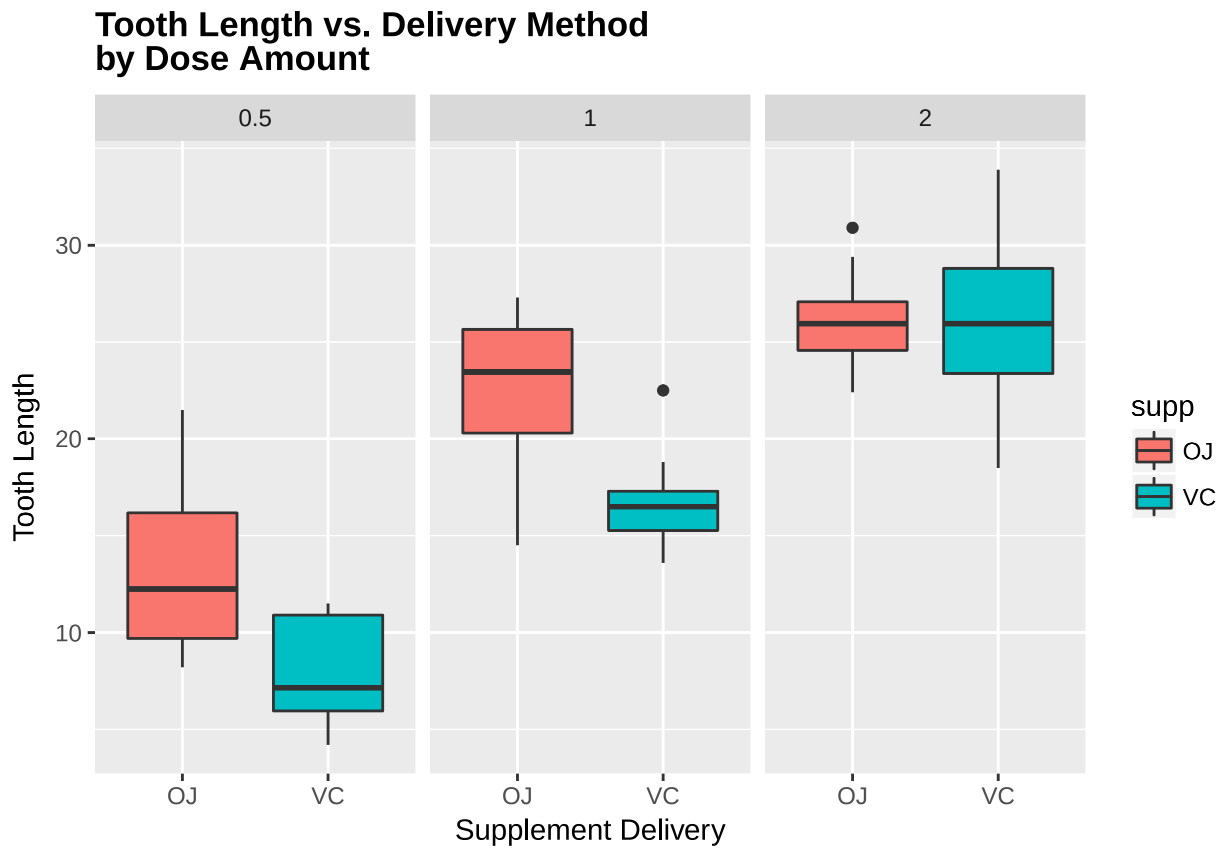
Visulization

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

# Plot tooth length vs. the dose amount by supplement delivery method
ggplot(aes(x=dose, y=len), data=ToothGrowth) + geom_boxplot(aes(fill=dose)) + xlab("Dose Amount") + yla
```




```r
# Plot tooth length vs. supplement delivery method by the dose amount
ggplot(aes(x=supp, y=len), data=ToothGrowth) + geom_boxplot(aes(fill=supp)) + xlab("Supplement Delivery
```



Comparison Test

Now we will compare tooth growth by supplement using a 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
```

t = 1.9153, df = 55.309,p-value = 0.06063

95 percent confidence interval: -0.1710156 7.5710156

Since the p-value is greater than 0.05 and the confidence interval of the test contains zero we conclude that supplement types seem to have no significant impact on Tooth growth based on this test.

Now we will compare tooth growth 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
```

From all three tests above, the p-value of each test was really close to 0 and the confidence interval of each test does not cross over 0.

Based on this result we can assume that the average tooth length increases with an inceasing dose, and therefore the null hypothesis can be rejected.

Conclusion

Given the following assumptions:

- The sample is representative of the population
- The distribution of the sample means follows the Central Limit Theorem

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