Statistical Inference Course Project: Part 2

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Overview:

In this project I will analyze the ToothGrowth data contianed withing the R datasets package. This analysis will include four (4) main steps.

- 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.
- State your conclusions and the assumptions needed for your conclusions.

Load the ToothGrowth Data

In this section we will load the ToothGrowth data and perform some basic exploratory data analyses.

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

# Set the dose as a factor instead of the default num class. This is done for
# future plots.
ToothGrowth$dose <- as.factor(ToothGrowth$dose)
```

Summary of the ToothGrowth data

In this section we will provide a basic summary of the ToothGrowth data.

```
# Use summary to display a summary of the data
summary(ToothGrowth)
```

```
##       len        supp     dose   
##  Min.   : 4.20   OJ:30   0.5:20  
##  1st Qu.:13.07   VC:30   1  :20  
##  Median :19.25           2  :20  
##  Mean   :18.81                   
##  3rd Qu.:25.27                   
##  Max.   :33.90                   
```

```
# Use str to display the structure of the data
str(ToothGrowth)
```

```
## '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: Factor w/ 3 levels "0.5","1","2": 1 1 1 1 1 1 1 1 1 1 ...
```

```r
# Use head and tail to show the first six (6) and last six(6) rows of data.
head(ToothGrowth)
```

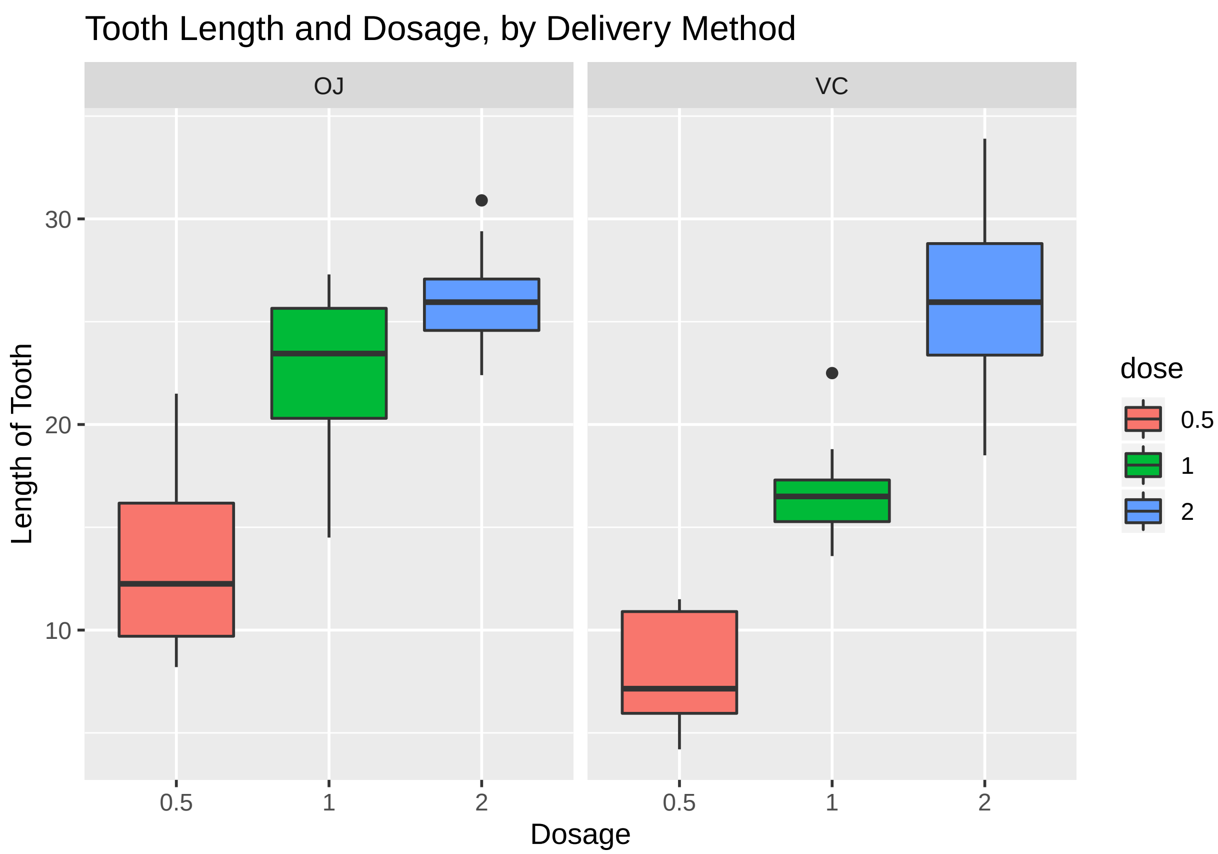
```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
## 4  5.8   VC  0.5
## 5  6.4   VC  0.5
## 6 10.0   VC  0.5
```

```r
tail(ToothGrowth)
```

```
##     len supp dose
## 55 24.8   OJ    2
## 56 30.9   OJ    2
## 57 26.4   OJ    2
## 58 27.3   OJ    2
## 59 29.4   OJ    2
## 60 23.0   OJ    2
```

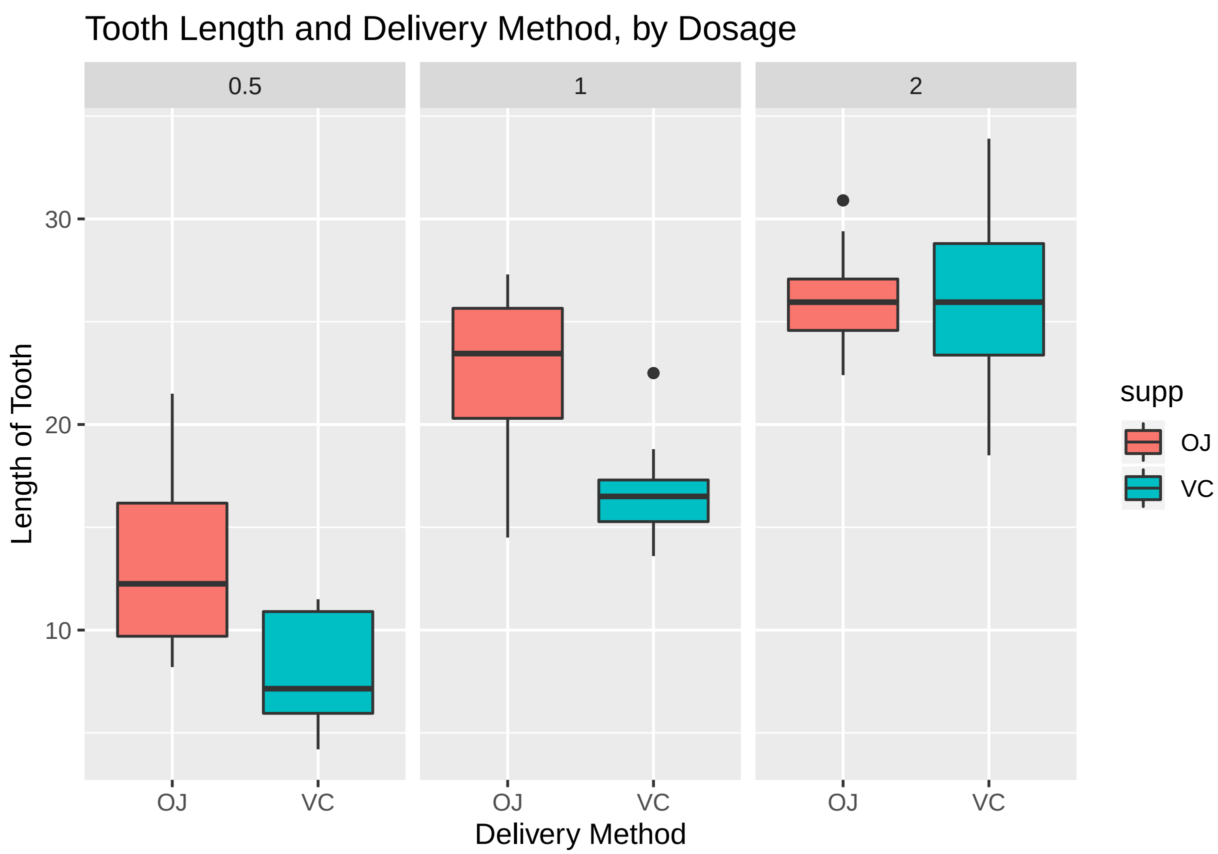
The following chart displays the total tooth length compared to the dose amount, split by the method of delivery

```r
# Plot of tooth lenth vs dosage, by delivery method
g_len_dose <- ggplot(ToothGrowth, aes(dose,len))+geom_boxplot(aes(fill = dose))+
        facet_grid(~supp) + ylab("Length of Tooth") + xlab("Dosage") +
        ggtitle("Tooth Length and Dosage, by Delivery Method")

g_len_dose
```



The following chart displays the total tooth length compared to the delivery method, split by the dosage.

```
# Plot of tooth lenth vs supp, by dosage
g_len_supp <- ggplot(ToothGrowth, aes(supp,len))+geom_boxplot(aes(fill = supp))+
        facet_grid(~dose) + ylab("Length of Tooth") + xlab("Delivery Method") +
        ggtitle("Tooth Length and Delivery Method, by Dosage")

g_len_supp
```



Comparison of Tooth Growth by Supplement Delivery Type

I will use a T-test to compare the tooth growth length compared to the delivery method.

```
# Run T-test
supp_ttest <- t.test(data = ToothGrowth,len~supp)

supp_ttest
```

```
##
##  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
```

From this T-test we can see that a P-value of 0.0606345 was calculated.This is greater than 0.05 and the confidence interval crosses over zero. Therefore we can surmise that the impact of supplement type is not a significant factor in the tooth lengths observed.

I will use a T-test to compare the tooth growth length compared to the dosage amount. This will be done by comparing the three combinations:

Dosages: 0.5 and 1.0

```
# Run T-test, with dosages: 0.5 and 1.0
Subset_1 <- subset(ToothGrowth, ToothGrowth$dose %in% c(0.5,1.0))
Subset_1tt <- t.test(data=Subset_1,len~dose)
Subset_1tt
```

```
##
##  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
```

From this T-test we can see that a P-value of 1.2683007×10^{-7} was calculated.

Dosages: 0.5 and 2.0

```
# Run T-test, with dosages: 0.5 and 2.0
Subset_2 <- subset(ToothGrowth, ToothGrowth$dose %in% c(0.5,2.0))
Subset_2tt <- t.test(data=Subset_2,len~dose)
Subset_2tt
```

```
##
##  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
```

From this T-test we can see that a P-value of 4.397525×10^{-14} was calculated.

Dosages: 1.0 and 2.0

```
# Run T-test, with dosages: 1.0 and 2.0
Subset_3 <- subset(ToothGrowth, ToothGrowth$dose %in% c(1.0,2.0))
Subset_3tt <- t.test(data=Subset_2,len~dose)
Subset_3tt
```

```
##
##  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
```

From this T-test we can see that a P-value of 4.397525×10^{-14} was calculated.

After reviewing the results from these three T-tests, we can see that all p-value results are extremely small. The confidence intervals also do not cross over zero. Therefore we can surmise that the impact of the dosage is a significant factor in the tooth lengths observed.

Conclusions and Assumptions

Upon review of the data it can be seen taht the doseage amount will impact the tooth growth length. From the data it can also be seen that as the dosage increases, so too will the teeth length increase. However, the impact of the supplement type does not appear to be significant; it is possible that a large sample population would indicate otherwise.

The assumptions made during for this analysis are:
1. The sample observations are representative of the total population.
2. Dosages and the method of delivery were randomly assigned to participants.
3. The distribution of the means is normal and follows the Central Limit Theory