Statistical Inference Course Project - Part 2

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Overview

This is the second part of project for the statistical inference class. In this part, ToothGrowth dataset will be loaded and performed some basic exploratory analysis.

Load Dataset

```
library(datasets)
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 ...
```

```
ToothGrowth$dose <- as.factor(ToothGrowth$dose)
```

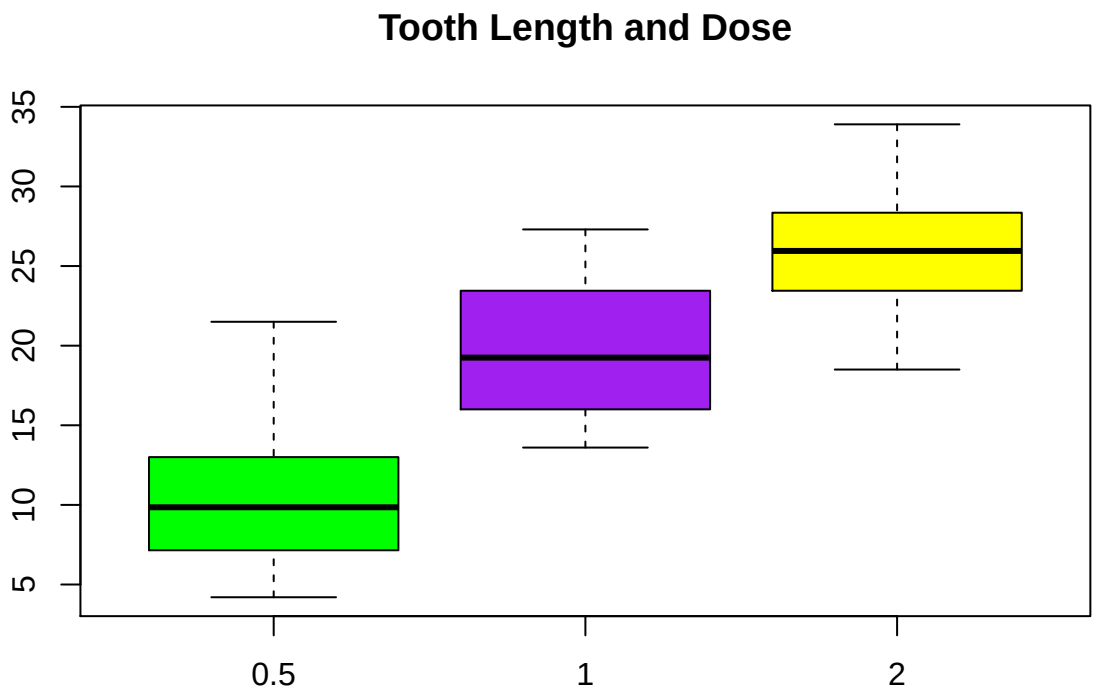
Basic Summary

```
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
```

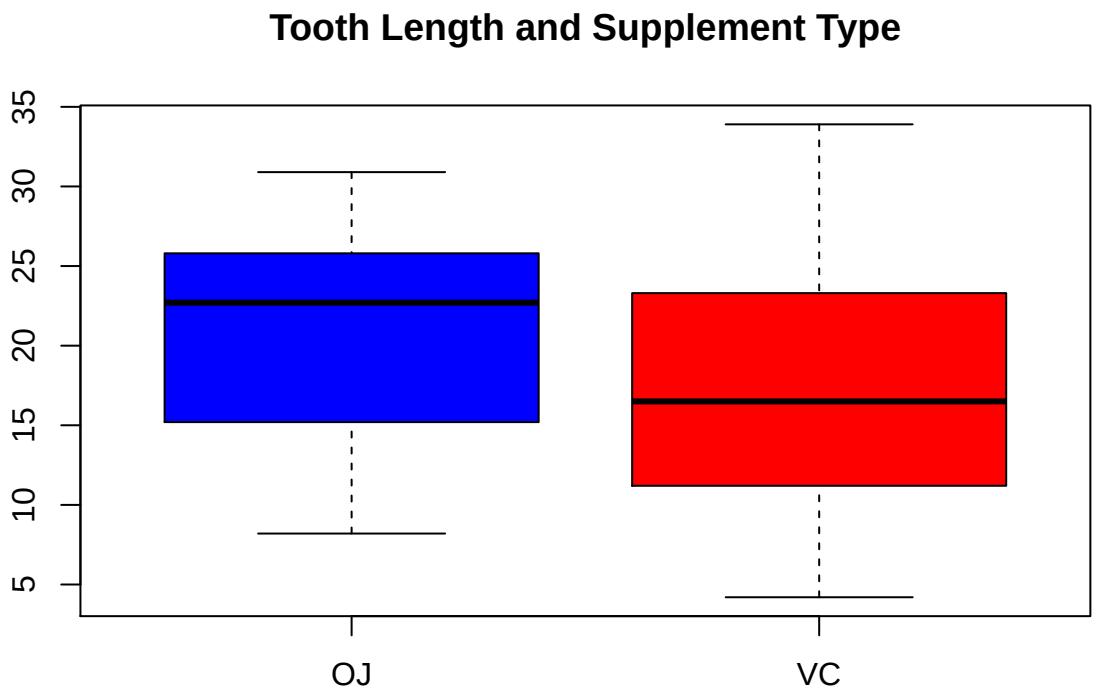
The below box plot shows tooth length with Dose. We can see there is a big difference there.

```
boxplot(len~dose,data=ToothGrowth,col=c("green","purple","yellow"),
        main="Tooth Length and Dose")
```



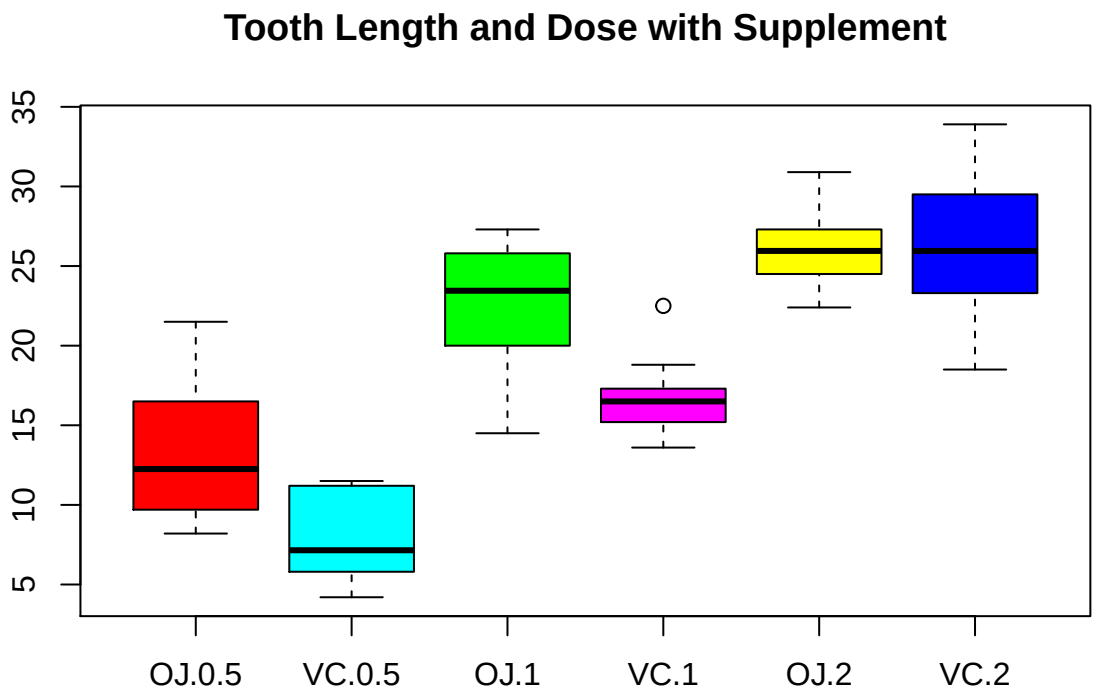
The below box plot shows tooth length with supplement type. There are not much difference between these 2 types of supplement.

```
boxplot(len~supp,data=ToothGrowth,col=c("blue","red"),
        main="Tooth Length and Supplement Type")
```



The below box plot shows interaction between dose and supplement type.

```
boxplot(len~interaction(supp,dose),data=ToothGrowth,
        main="Tooth Length and Dose with Supplement",col=sample(rainbow(6)))
```



From the above box plot we can see supplement types increases with the tooth length.

Confidence Interval & Hypothesis

From the above plots we can assume that for tooth length, there is probably a highly significant difference between dose, and not a significant difference between supplement type.

Below is the T test for supplement type. Then test the effect of supplement type on tooth length when have dose constant at each level.

```
oj <- ToothGrowth[ToothGrowth$supp=="OJ",]
vc <- ToothGrowth[ToothGrowth$supp=="VC",]
oj05 <- oj[oj$dose==0.5,]
oj10 <- oj[oj$dose==1.0,]
oj20 <- oj[oj$dose==2.0,]
vc05 <- vc[vc$dose==0.5,]
vc10 <- vc[vc$dose==1.0,]
vc20 <- vc[vc$dose==2.0,]

#t test vc and oj then dose = 0.5
vcoj0.5 <- t.test(len~supp,data=rbind(vc05,oj05),var.equal=FALSE)

#t test vc and oj then dose = 1.0
vcoj1.0 <- t.test(len~supp,data=rbind(vc10,oj10),var.equal=F)
```

```r
#t test vc and oj then dose = 2.0
vcoj2.0 <- t.test(len~supp,data=rbind(vc20,oj20),var.equal=F)
```

Here we can see the the summary:

For vc and oj at dose=0.5: the P value is 0.0063586, the conf int (-) is 1.7190573, the conf int (+) is 8.7809427

For vc and oj at dose=1.0: the P value is 0.0010384, the conf int (-) is 2.8021482, the conf int (+) is 9.0578518

For vc and oj at dose=2.0: the P value is 0.9638516, the conf int (-) is -3.7980705, the conf int (+) is 3.6380705

Here we are going to test the effect of dose on tooth length:

```r
#0.5 vs 1.0
vc0.5and1.0 <- t.test(len~dose,data=rbind(vc05,vc10),var.equal=TRUE)
oj0.5and1.0 <- t.test(len~dose,data=rbind(oj05,oj10),var.equal=TRUE)

#1.0 vs 2.0
vc1.0and2.0 <- t.test(len~dose,data=rbind(vc10,vc20),var.equal=TRUE)
oj1.0and2.0 <- t.test(len~dose,data=rbind(oj10,oj20),var.equal=TRUE)

#0.5 vs 2.0
vc0.5and2.0 <- t.test(len~dose,data=rbind(vc05,vc20),var.equal=TRUE)
oj0.5and2.0 <- t.test(len~dose,data=rbind(oj05,oj20),var.equal=TRUE)
```

Here we can see the summary:

For VC 0.5 and 1.0: P-value is 6.4922646×10^{-7}, conf int (-) is -11.2643455, conf int (+) is -6.3156545

For OJ 0.5 and 1.0: P-value is 8.3575593×10^{-5}, conf int (-) is -13.4108143, conf int (+) is -5.5291857

For VC 1.0 and 2.0: P-value is 3.3975779×10^{-5}, conf int (-) is -12.9689598, conf int (+) is -5.7710402

For OJ 1.0 and 2.0: P-value is 0.0373628, conf int (-) is -6.5005017, conf int (+) is -0.2194983

For VC 0.5 and 2.0: P-value is 4.9572857×10^{-9}, conf int (-) is -21.8328433, conf int (+) is -14.4871567

For OJ 0.5 and 2.0: P-value is 3.4018585×10^{-7}, conf int (-) is -16.2782226, conf int (+) is -9.3817774

Conclusion

From the analysis above, we can conclude there is a definite dependence on the dose level on tooth growth. P-value are less than threhold and confidence intervals don't include zero. This indicate that the when supplement dose increase, the tooth growth will increase significantly.