Tooth_Growth

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Statistical Inference Course Project: Part 2

Problem Statement - Statistics Inference 2

Now in the second portion of the class, we're going to analyze the ToothGrowth data in the R datasets package. 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 hypothesis tests to compare tooth growth by supp and dose. (Use the techniques from class even if there's other approaches worth considering)
4. State your conclusions and the assumptions needed for your conclusions.

Load Data

```r
data(ToothGrowth)
head(ToothGrowth)
```

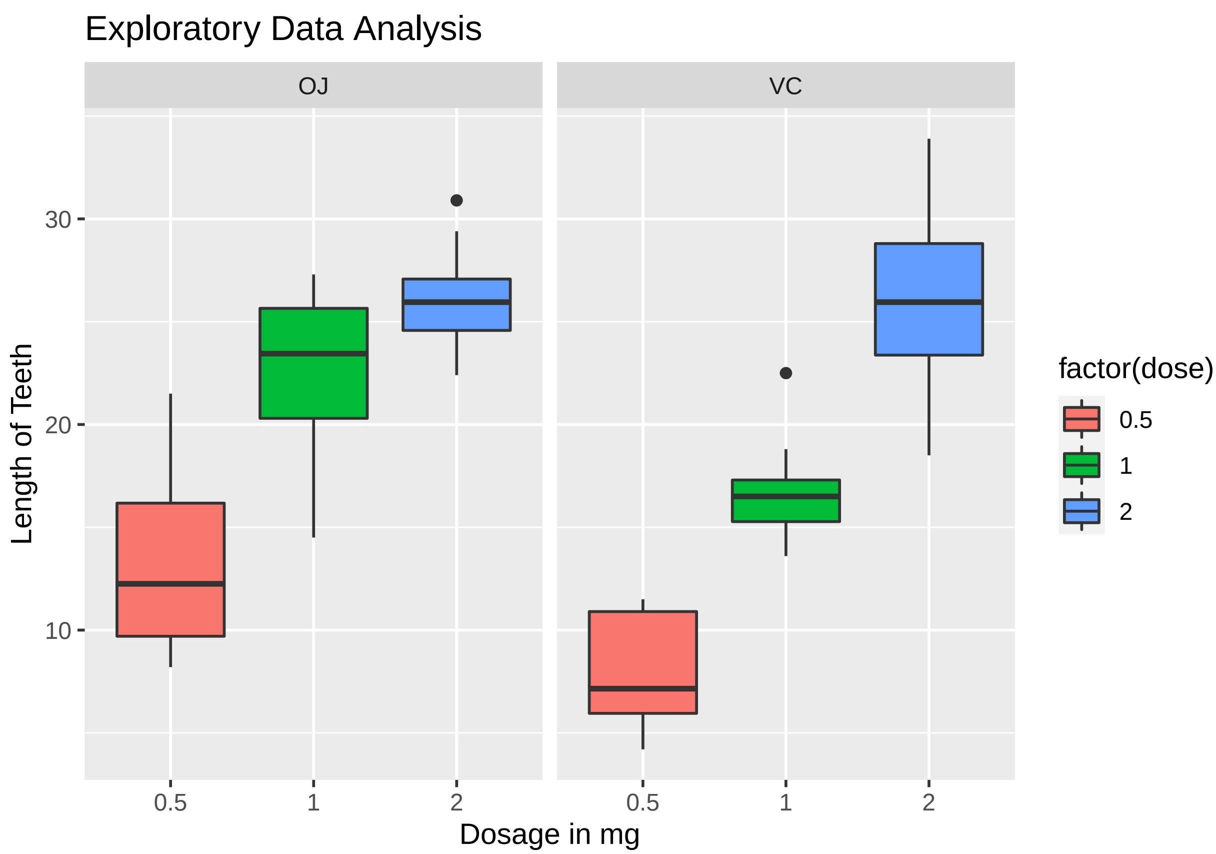
```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
## 4  5.8   VC  0.5
## 5  6.4   VC  0.5
## 6 10.0   VC  0.5
```

Solution for Q1

```r
require(ggplot2)
```

```
## Loading required package: ggplot2
```

```r
g1 <- ggplot(ToothGrowth, aes(x = factor(dose), y = len,fill = factor(dose)))
g1 + geom_boxplot() + facet_grid(.~supp) +
    scale_x_discrete("Dosage in mg") +
    scale_y_continuous("Length of Teeth") +
    ggtitle("Exploratory Data Analysis")
```



Solution for Q2

Basic summary of the data.

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

```
table(ToothGrowth$supp, ToothGrowth$dose)
```

```
##
##      0.5  1  2
##   OJ  10 10 10
##   VC  10 10 10
```

Solution for Q3

We perform Null Hypothesis Test

```
supp.t1 <- t.test(len ~ supp, paired = F, var.equal = T, data = ToothGrowth)
supp.t2 <- t.test(len~supp, paired = F, var.equal = F, data = ToothGrowth)
supp.result <- data.frame("p-value" = c(supp.t1$p.value, supp.t2$p.value),"Conf-Low" = c(supp.t1$conf[1
                          "Conf-High" = c(supp.t1$conf[2],supp.t2$conf[2]), row.names = c("Equal Var","
supp.result
```

```
##                 p.value   Conf.Low Conf.High
## Equal Var   0.06039337 -0.1670064  7.567006
## Unequal Var 0.06063451 -0.1710156  7.571016
```

p-values for both equal and unequal variance t test > 5%. We can neither accept nor reject the Null hypothesis. So it is not clear that the difference exists between OJ and VC groups.

```
dose.05 <- ToothGrowth[which(ToothGrowth$dose == .5),1]
dose.10 <- ToothGrowth[which(ToothGrowth$dose == 1),1]
dose.20 <- ToothGrowth[which(ToothGrowth$dose == 2),1]
dose0510.t1 <- t.test(dose.05, dose.10, paired = F, var.equal = T)
dose0510.t2 <- t.test(dose.05, dose.10, paired = F, var.equal = F)
dose0510.result <- data.frame("p-value" = c(dose0510.t1$p.value, dose0510.t2$p.value),"Conf-Low" = c(do
dose0520.t1 <- t.test(dose.05, dose.20, paired = F, var.equal = T)
dose0520.t2 <- t.test(dose.05, dose.20, paired = F, var.equal = F)
dose0520.result <- data.frame("p-value" = c(dose0520.t1$p.value, dose0520.t2$p.value),"Conf-Low" = c(do
dose1020.t1 <- t.test(dose.10, dose.20, paired = F, var.equal = T)
dose1020.t2 <- t.test(dose.10, dose.20, paired = F, var.equal = F)
dose1020.result <- data.frame("p-value" = c(dose1020.t1$p.value, dose1020.t2$p.value),"Conf-Low" = c(do
dose.result <- rbind(dose0510.result,dose0520.result,dose1020.result)
dose.result
```

```
##                   p.value   Conf.Low  Conf.High     Dose
## Equal Var    1.266297e-07 -11.983748  -6.276252 0.5 to 1
## Unequal Var  1.268301e-07 -11.983781  -6.276219 0.5 to 1
## Equal Var1   2.837553e-14 -18.153519 -12.836481 0.5 to 2
## Unequal Var1 4.397525e-14 -18.156167 -12.833833 0.5 to 2
## Equal Var2   1.810829e-05  -8.994387  -3.735613   1 to 2
## Unequal Var2 1.906430e-05  -8.996481  -3.733519   1 to 2
```

Above table shows that dosages significantly impacts tooth growth.

1. p-values are very small.
2. Confidence interval donot contain 0

So, we can reject the null hypothesis and state that higher dosage tends to result in higher tooth length

Solution Q4

We can conclude that across supplements for each dose :
1. 2mg dose has larger impact on tooth growth than 1mg and 0.5mg
2. 1mg dose has more impact than 0.5mg dose.
3. we cannot say that orange juice and vitamin C have obvious different impact on tooth growth

Conclusions

Both the confidence intervals and hypothesis tests indicate that at lower dosages, specifically 0.5 mg and 1 mg, the Orange Juice delivery method results in longer teeth than the Ascorbic Acid. However, at higher dosages, specifically 2 mg, there appears to be little difference and certainly not enough to reject the null hypothesis that they have the same effect.

However, the plot of means and confidence intervals does hint at a flattening out of effectiveness when using the Orange Juice method at a faster rate than when using the Ascorbic Acid method. This might warrant further exploration to see if Ascorbic Acid results in greater tooth length than Orange Juice and higher dosages.