Statistical Inference project part2

First of all we upload data and see how it looks like using funciton head() and str().

```
data(ToothGrowth)
str(ToothGrowth)
```

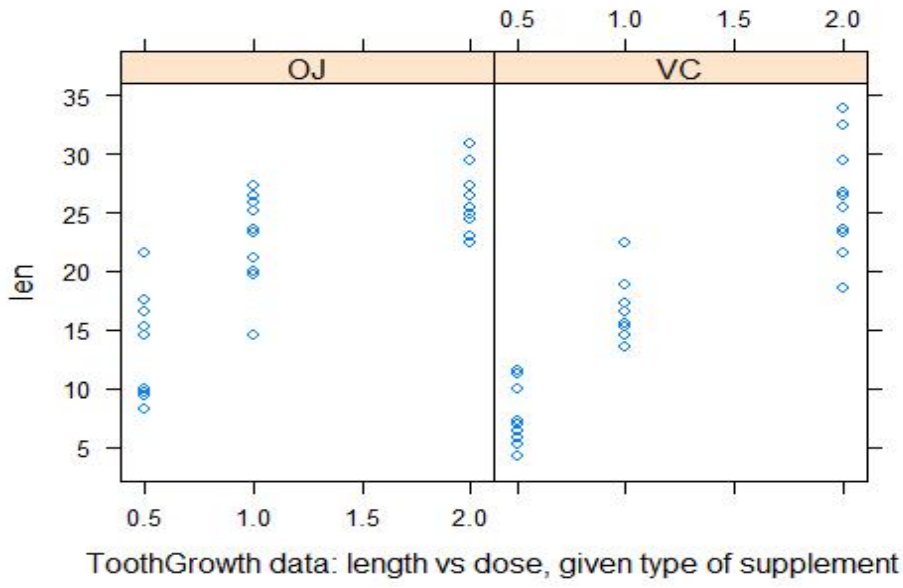
```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```

```
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
```

As we can there are 3 variables and 60 observations. Let us split the data by dose and supplement type and plot it to see what kind of statistical analysis we should perform.

```
oj0_5<-ToothGrowth[which(ToothGrowth$supp=="OJ"& ToothGrowth$dose==0.5),1]
oj1_0<-ToothGrowth[which(ToothGrowth$supp=="OJ"& ToothGrowth$dose==1.0),1]
oj2_0<-ToothGrowth[which(ToothGrowth$supp=="OJ"& ToothGrowth$dose==2.0),1]
vc0_5<-ToothGrowth[which(ToothGrowth$supp=="VC"& ToothGrowth$dose==0.5),1]
vc1_0<-ToothGrowth[which(ToothGrowth$supp=="VC"& ToothGrowth$dose==1.0),1]
vc2_0<-ToothGrowth[which(ToothGrowth$supp=="VC"& ToothGrowth$dose==2.0),1]
```



ToothGrowth data: length vs dose, given type of supplement

Length versus dose:

It is obvious from the plot that bigger dose results in bigger tooth length. The only one set of data which worth checking is 1.0 milligram vs 2.0 milligram dose in OJ case.

I make t-statistical test for randomized sample with unequal variances. I chose randomized test versus paired as we are not provided with id for each test animal. The test shows us confidence interval as well as other relevant information (such as p-value).

Let's do it for 1.0 milligram vs 2.0 milligram dose in OJ case.

```
t.test(oj1_0,oj2_0, paired=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  oj1_0 and oj2_0
## t = -2.2478, df = 15.842, p-value = 0.0392
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -6.5314425 -0.1885575
## sample estimates:
## mean of x mean of y
##     22.70     26.06
```

As we can see from the test the confidence interval is below zero and p-value ~=4% so we reject hypothesis that means are equal with 5% confidence level.

Length versus supplement type

It seems from the plot that OJ type provides slightly better results that VC type. However, the difference is not so big so it is worth doing t-test for all doses.

```
t.test(oj0_5,vc0_5, paired=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  oj0_5 and vc0_5
## t = 3.1697, df = 14.969, p-value = 0.006359
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.719057 8.780943
## sample estimates:
## mean of x mean of y
##     13.23      7.98
```

```
t.test(oj1_0,vc1_0, paired=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  oj1_0 and vc1_0
## t = 4.0328, df = 15.358, p-value = 0.001038
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  2.802148 9.057852
## sample estimates:
```

```
## mean of x mean of y
##     22.70     16.77
```

Test for 0.5 and 1.0 milligram doses show that confidence interval far from zero and p-value is very small so we reject hypothesis of equal means with high confidence.

```
t.test(oj2_0,vc2_0, paired=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  oj2_0 and vc2_0
## t = -0.0461, df = 14.04, p-value = 0.9639
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -3.79807  3.63807
## sample estimates:
## mean of x mean of y
##     26.06     26.14
```

However, test for 2.0 dose shows that we should accept our hypothesis. P-value is very big and confidence interval contains zero.

Conclusions: 1. Bigger dose results in bigger tooth length. 2. OJ type of supplement results in bigger tooth length in small doses (0.5 and 1.0) and is equal to VC type for 2.0 dose. In general it is worth making some more experiments to investigate relations between VC and OJ type for bigger doses.