A simple analysis about the ToothGrowth data set

Rick

September 27, 2015

Synopsis:

We used the ToothGrowth data to make a simple T-test analysis to compare tooth growth by supp and dose.

Data Processing

First, we load the data.

```
data(ToothGrowth)
```

Let us see a brief summary of this dataset.

```
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
```

```
levels(ToothGrowth$supp)
```

```
## [1] "OJ" "VC"
```

```
levels(as.factor(ToothGrowth$dose))
```

```
## [1] "0.5" "1"   "2"
```

```
tapply(ToothGrowth$supp, ToothGrowth$supp, length)
```

```
## OJ VC
## 30 30
```

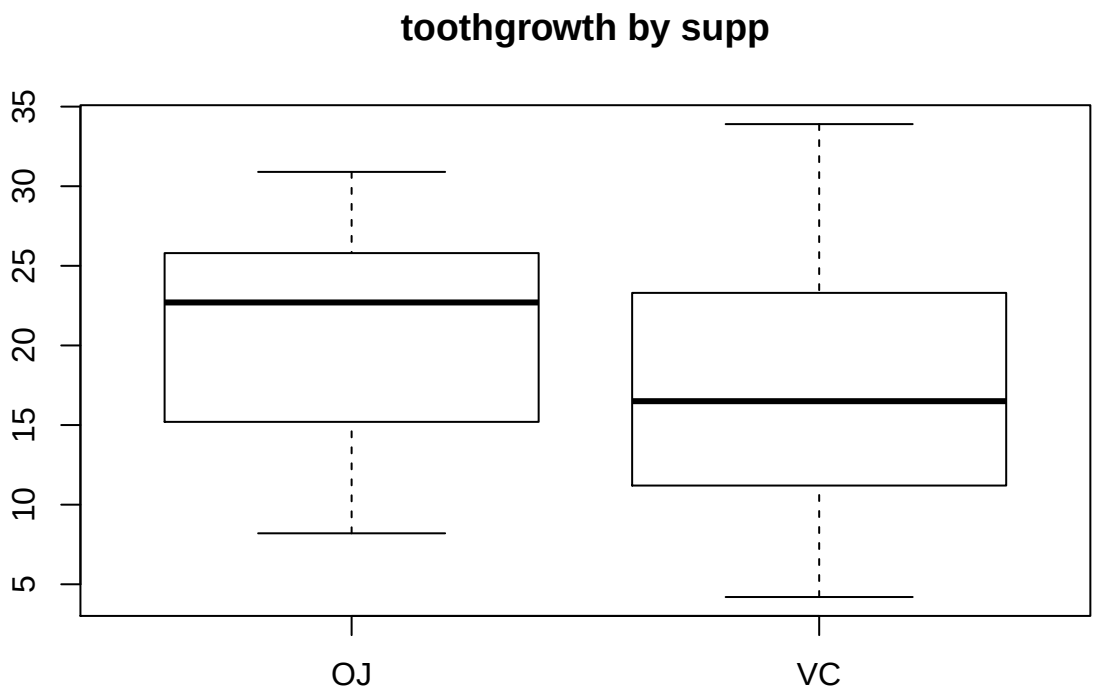
```
tapply(ToothGrowth$dose,ToothGrowth$dose,length)
```

```
## 0.5   1   2
##  20  20  20
```

To be more easy understanding, let us plot (boxplot) the Toothgrowth by dose and by supp, respectively.

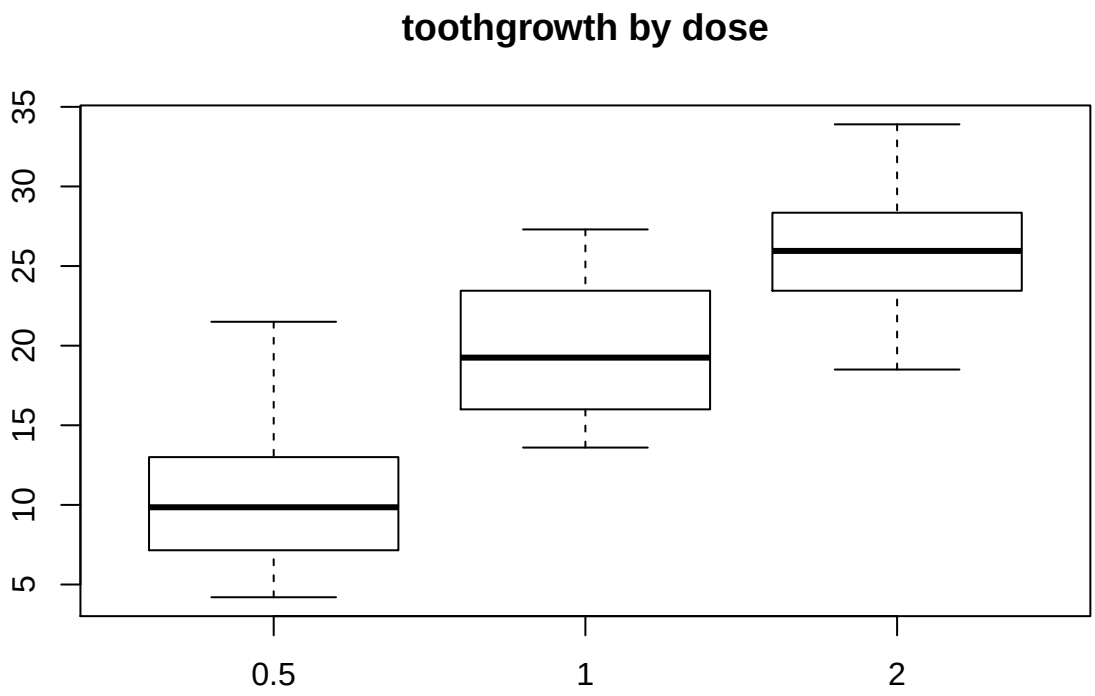
By supp:

```
with(ToothGrowth,plot(supp,len,type="p",main="toothgrowth by supp"))
```



By dose:

```
with(ToothGrowth,plot(as.factor(dose),len,type="p",main="toothgrowth by dose"))
```



T-test

As a big assumption at the first place, we assume that for both supp groups and dose groups, the samples are randomly chosen. Hence, in this analysis we will examine (1) the effect of different supp and (2) the effect of different dose on the true mean of toothgrowth, separately.

Then we make t test first by supp to test the hypothesis that: H0: supp has no effect on the mean of tooth growth. And we assume that the variance of each group is the same.

```
t.test(len~supp,paried=TRUE,var.equal=TRUE,data=ToothGrowth)
```

```
##
##  Two Sample t-test
##
## data:  len by supp
## t = 1.9153, df = 58, p-value = 0.06039
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1670064  7.5670064
## sample estimates:
## mean in group OJ mean in group VC
##         20.66333         16.96333
```

Hence, we fail to reject the hypothesis. We can conclude that using a 95 percent confidence interval, supp has no effect on the true mean of toothgrowth.

Then we make t test first by dose to test the hypothesis that: H0: does has no effect on the mean of tooth growth.

Because there are three different doeses. We compare them two by two.

```
split(ToothGrowth, ToothGrowth$dose)[[1]][["dose"]][1]
```

```
## [1] 0.5
```

```
dose1<-split(ToothGrowth, ToothGrowth$dose)[[1]][["len"]]
split(ToothGrowth, ToothGrowth$dose)[[2]][["dose"]][1]
```

```
## [1] 1
```

```
dose2<-split(ToothGrowth, ToothGrowth$dose)[[2]][["len"]]
split(ToothGrowth, ToothGrowth$dose)[[3]][["dose"]][1]
```

```
## [1] 2
```

```
dose3<-split(ToothGrowth, ToothGrowth$dose)[[3]][["len"]]
```

And we assume that the variance of each group is the same for all the tests.

(1) The t test between dose 0.5 and 1

```
t.test(dose1,dose2,paired=TRUE,var.equal=TRUE,data=ToothGrowth)
```

```
##
##  Paired t-test
##
## data:  dose1 and dose2
## t = -6.9669, df = 19, p-value = 1.225e-06
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.872879  -6.387121
## sample estimates:
## mean of the differences
##                   -9.13
```

(2) The t test between dose 1.0 and 2.0

```
t.test(dose2,dose3,paired=TRUE,var.equal=TRUE,data=ToothGrowth)
```

```
##
##  Paired t-test
##
## data:  dose2 and dose3
```

```
## t = -4.6046, df = 19, p-value = 0.0001934
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -9.258186 -3.471814
## sample estimates:
## mean of the differences
##                  -6.365
```

(3) The t test between dose 0.5 and 2.0

```
t.test(dose1,dose3,paired=TRUE,var.equal=TRUE,data=ToothGrowth)
```

```
##
##  Paired t-test
##
## data:  dose1 and dose3
## t = -11.291, df = 19, p-value = 7.19e-10
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -18.3672 -12.6228
## sample estimates:
## mean of the differences
##                 -15.495
```

For all the three tests, we reject the hypothesis under the 95 percent confidence interval. Hence, we can say that dose has very obvious effect on the tooth growth.

Conclusion

In our analysis, we assume that for both supp groups and dose groups, the samples are randomly chosen. Also we assume that the variance for all the compared groups are the same. After applying t tests, using a 95 percent confidence interval, we can say that supp has no effect on toothgrowth and dose has large effect on it.