Statistical inference course project | Part 2

Mick van Hulst

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1. Load the ToothGrowth data and perform some basic exploratory data analyses

Load data and libraries.

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.2.3
```

```
library(datasets)

x <- ToothGrowth
```

Convert dose to a factor

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

Show structure of object 'x'.

```
str(x)
```

```
## '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 ...
```

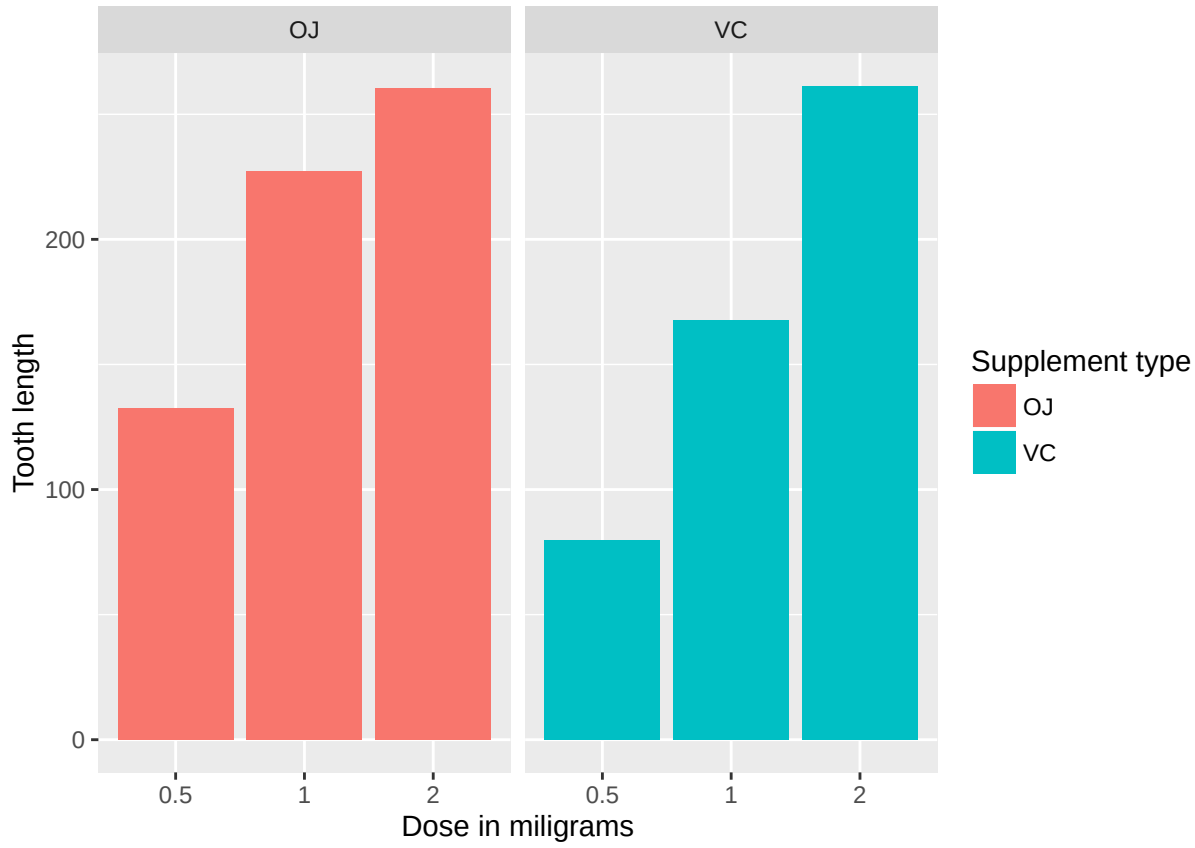
Show table

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

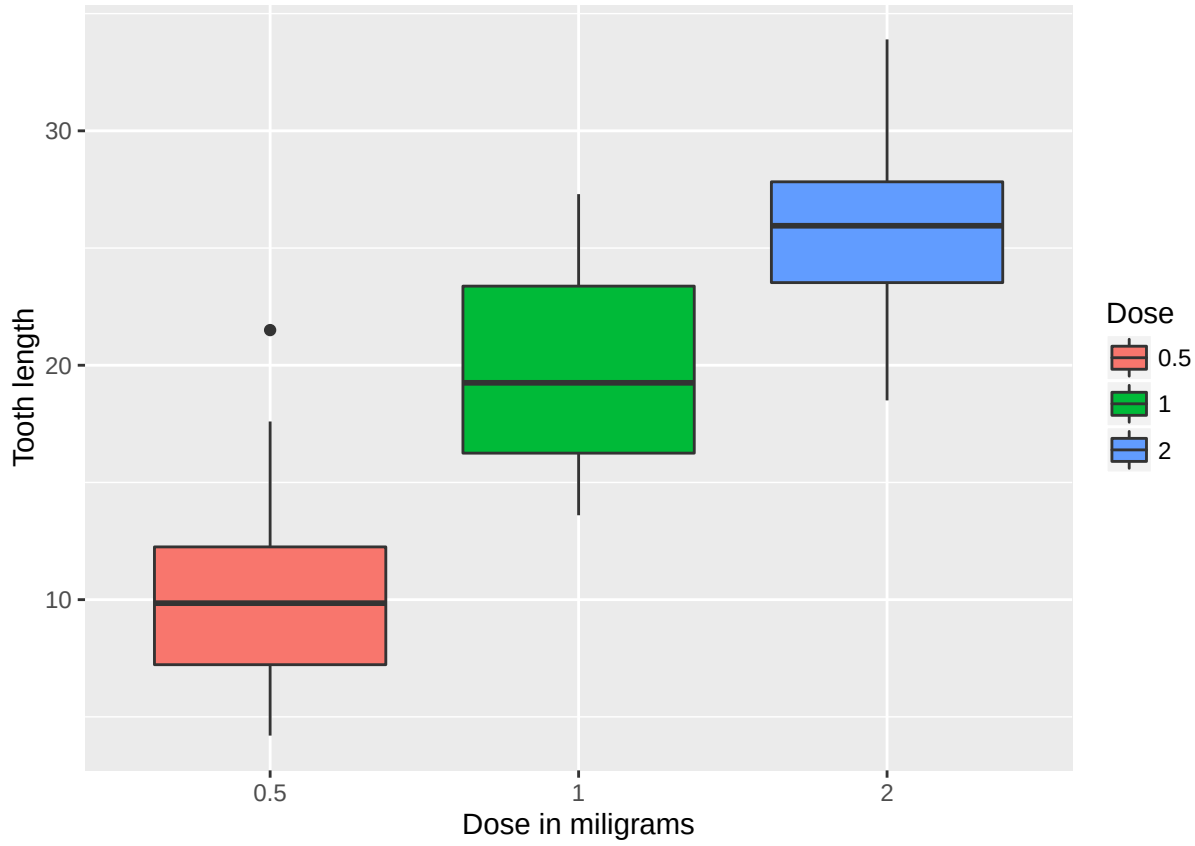
```
##
##       OJ VC
##   0.5 10 10
##   1   10 10
##   2   10 10
```

A few plots that show the tooth length in comparison with the supplement type and the dose of a certain supplement that is taken.

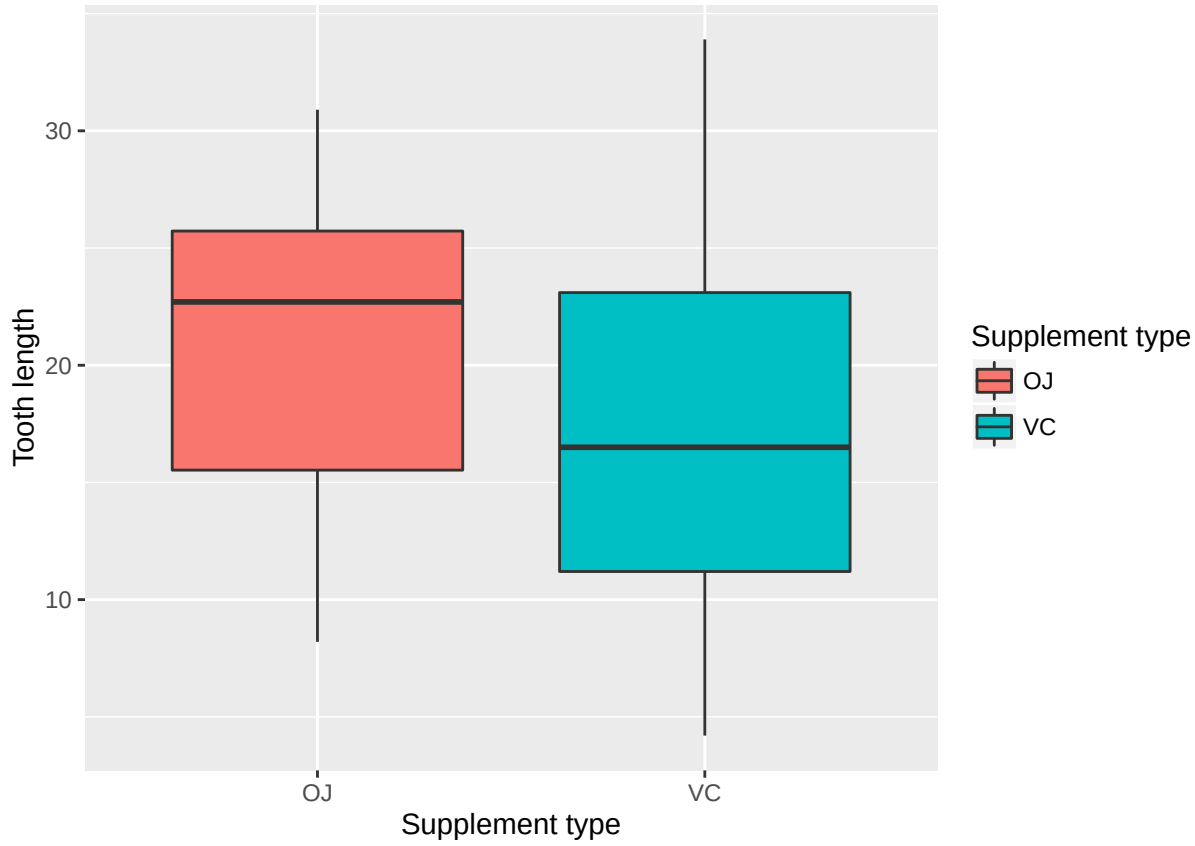
```
ggplot(data=x, aes(x=dose, y=len, fill=supp)) + geom_bar(stat="identity",) + facet_grid(. ~ supp) + xlab
```




```
ggplot(aes(x=dose, y=len), data=x) + geom_boxplot(aes(fill=dose)) + xlab("Dose in miligrams") + ylab("T
```




```
ggplot(aes(x=supp, y=len), data=x) + geom_boxplot(aes(fill=supp)) + xlab("Supplement type") + ylab("Too
```



##2. Provide a basic summary of the data Call the summary function to show a summary.

```
summary(x)
```

```
##       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
```

3. Use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose. (Only use the techniques from class, even if there's other approaches worth considering)

Perfm one and two sample t-tests on vector.

```
t.test(len ~ supp, data = x)
```

```
##
##  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
```

The null hypothesis cannot be rejected since confindence intervals contain zero and p-value is 0.06. So supplement types seem to have no impact on tooth growth.

Three groups as per dose level pairs

```
x.doses_0.5_1.0 <- subset (x, dose %in% c(0.5, 1.0))
x.doses_0.5_2.0 <- subset (x, dose %in% c(0.5, 2.0))
x.doses_1.0_2.0 <- subset (x, dose %in% c(1.0, 2.0))
```

Check for the (0.5,1.0) dose levels.

```
t.test(len ~ dose, data = x.doses_0.5_1.0)
```

```
##
##  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
```

Check for the (0.5,2.0) dose levels.

```
t.test(len ~ dose, data = x.doses_0.5_2.0)
```

```
##
##  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
```

Check for the (1.0,2.0) dose levels.

```r
t.test(len ~ dose, data = x.doses_1.0_2.0)
```

```
##
##  Welch Two Sample t-test
##
## data:  len by dose
## t = -4.9005, df = 37.101, p-value = 1.906e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -8.996481 -3.733519
## sample estimates:
## mean in group 1 mean in group 2
##          19.735          26.100
```

The p-value is less than 0.05 and confidence intervals don't contain 0. The average tooth length increases with an increasing dose. The null hypothesis can be rejected.

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

Conclusions 1. Increasing the dose leads to increased tooth growth. 2. Supplement type seems to have no impact on tooth growth.

Assumptions 1. Members of the sample population, i.e. the 60 guinea pigs, are representative of the entire population of guinea pigs. This assumption allows us to generalize the results.

2. The experiment was done with a random assignment of guinea pigs with different dose level categories and supplement type to control for confounders that might affect the outcome.
3. For the t-tests, the variances are assumed to be different for the two groups being compared. This assumption is less stronger than the case in which the variances are assumed to be equal.