# Coursera Statistical Inference Project Part 2

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

```
library(datasets)
x <- ToothGrowth
# convert dose to factor
x$dose <- as.factor(x$dose)
```

```
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 ...
```

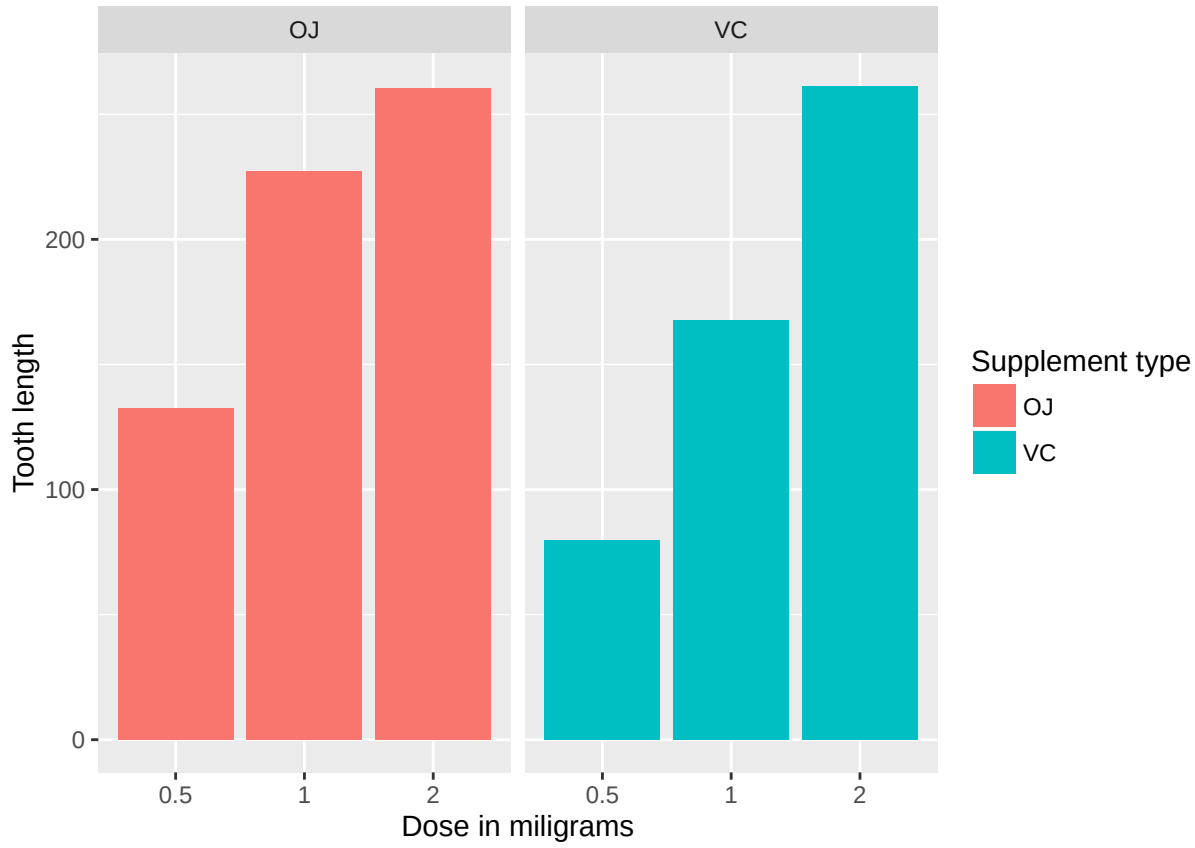
```
table(x$dose, x$supp)
```

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

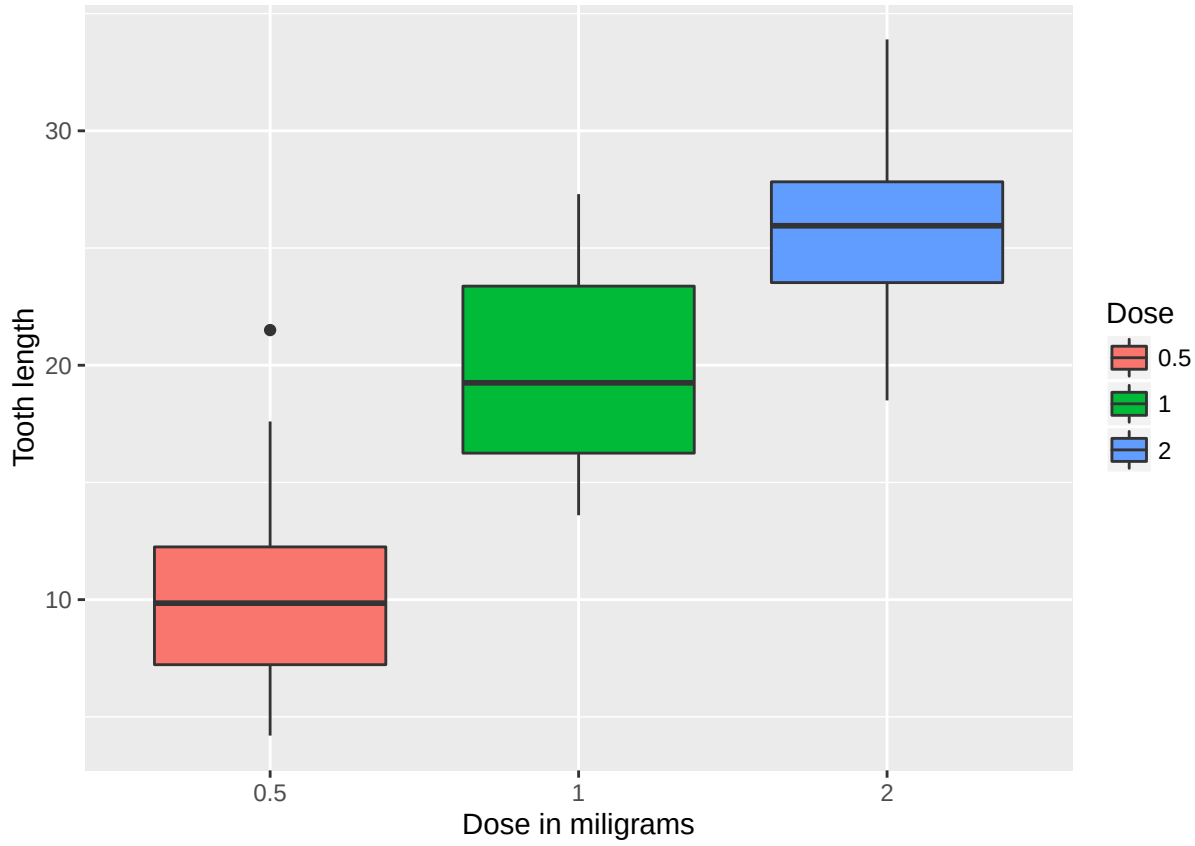
```
library(ggplot2)
```

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

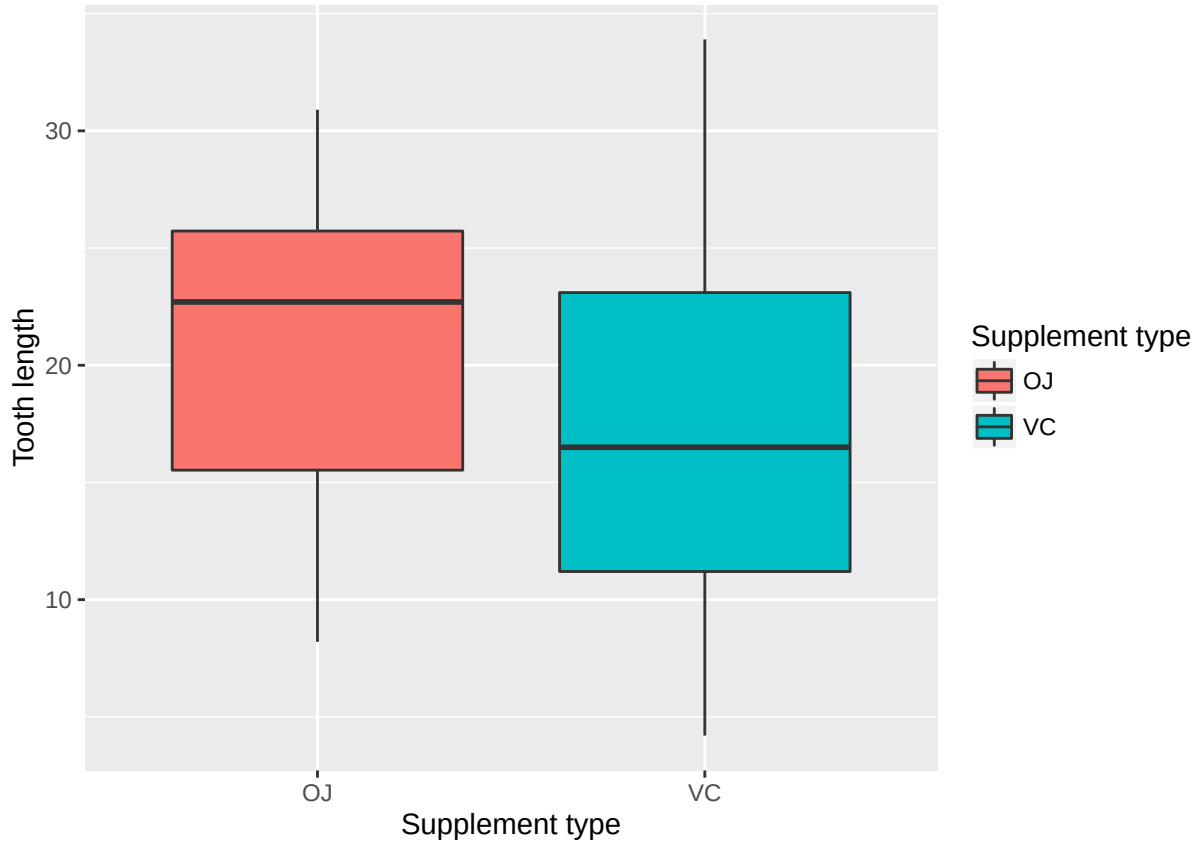
```
ggplot(data=x, aes(x=dose, y=len, fill=supp)) + geom_bar(stat="identity",) + facet_grid(. ~ supp) + xlab
```




```
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.

```
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.

```
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
```

Null hypothesis can not be rejected as confindence intervals contain zero and p-value is 0.06.

Supplement types seems 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 dose levels (0.5, 1.0)
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 dose levels (0.5, 2.0)
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 dose levels (1.0, 2.0)
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 confindence intervals don't contian 0. The average toot length increases with an inceasing dose. The null hypothesis can be rejected.

## 4.1 Conclusions

- Supplement type seem to have no impact on tooth growth.
- Inreasing the dose level leads to increased tooth growth as well.

## 4.2 Assumptions

- The experiment was done with random assignment of guinea pigs to different dose level categories and supplement type to control for confounders that might affect the outcome.
- 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.
- 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.