# Tooth Growth Analysis

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## Exploratory Analysis

Loading data

```
library(datasets)
library(ggplot2)
library(dplyr, quietly = TRUE, warn.conflicts = FALSE)
test_data <- ToothGrowth
str(test_data)
```

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

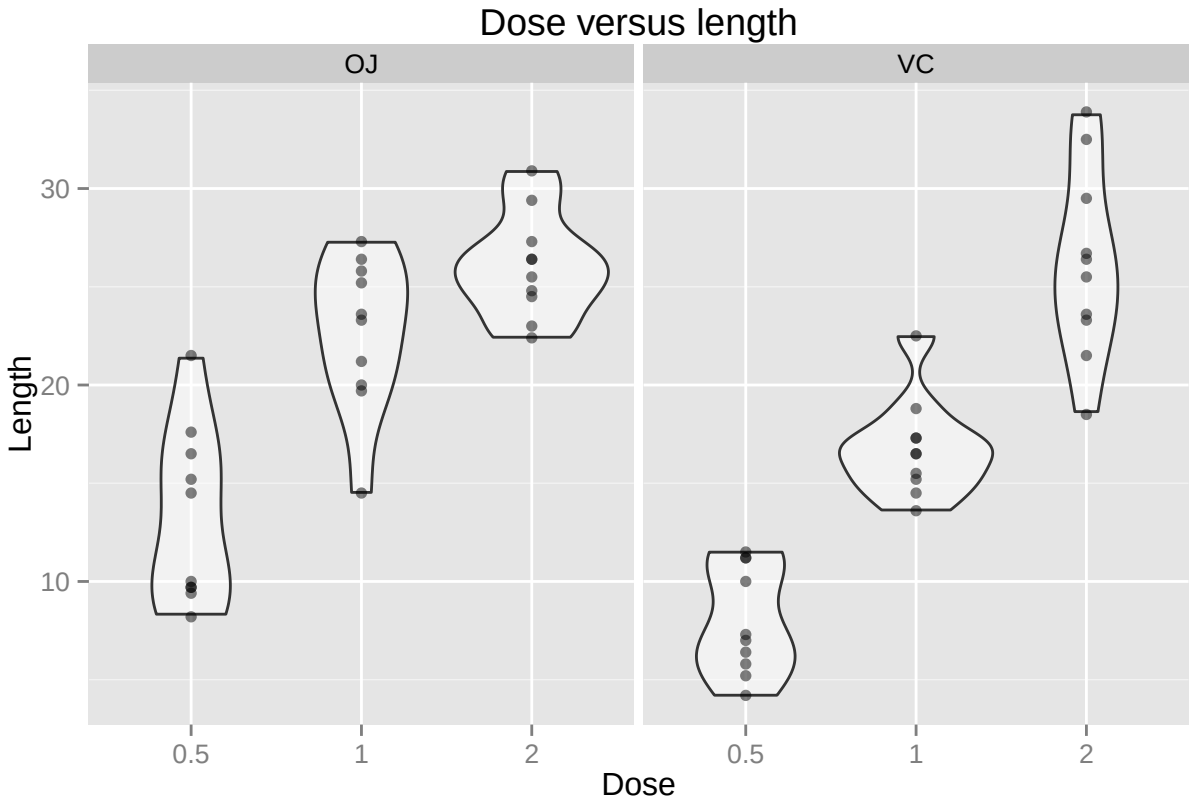
```
summary(test_data)
```

```
##       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
```

Dose data are categorical rather than continuous, so need to convert this to a factor variable.

```
test_data$dose <- factor(test_data$dose)
```

```
ggplot(test_data, aes(x=dose, y=len)) +
        geom_violin(alpha=0.5) +
        geom_point(alpha=0.5) +
        labs(x="Dose",y="Length") + facet_grid(.~supp) +
        ggtitle("Dose versus length")
```




From the above chart, we can see that variability is not consistent, which we will need to take account of when performing any tests.

## Compare tooth length and supplement type

```
len_OJ <- select(filter(test_data, supp == "OJ"), len)
len_VC <- select(filter(test_data, supp == "VC"), len)
test_supp <- t.test(len_OJ, len_VC, conf.level=.95, var.equal=FALSE, paired=FALSE, alternative ="two.si
test_supp
```

```
##
##  Welch Two Sample t-test
##
## data:  len_OJ and len_VC
## 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 of x mean of y
##  20.66333  16.96333
```

We can see that the p-value is 0.0606345 which is higher than 5% and the confidence interval contains zero, so we cannot reject the null hypothesis and we cannot say that the type of supplement alone will affect tooth

growth.

## Compare tooth growth and dose

```
#subset data based on dose
len_small_dose <- select(filter(test_data, dose == 0.5), len)
len_medium_dose <- select(filter(test_data, dose == 1), len)
len_large_dose <- select(filter(test_data, dose == 2), len)
```

### Compare effect on length of small dose (0.5) of supplement versus medium dose (1.0)

```
test_dose_1 <- t.test(len_small_dose, len_medium_dose, conf.level=.95, var.equal=FALSE, paired=FALSE, al
test_dose_1
```

```
##
##  Welch Two Sample t-test
##
## data:  len_small_dose and len_medium_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 of x mean of y
##    10.605    19.735
```

### Compare effect on length of medium dose (1.0) of supplement versus large dose (2.0)

```
test_dose_2 <- t.test(len_medium_dose, len_large_dose, conf.level=.95, var.equal=FALSE, paired=FALSE, al
test_dose_2
```

```
##
##  Welch Two Sample t-test
##
## data:  len_medium_dose and len_large_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 of x mean of y
##    19.735    26.100
```

### Compare effect on length of small dose (0.5) of supplement versus large dose (2.0)

```
test_dose_3 <- t.test(len_small_dose, len_large_dose, conf.level=.95, var.equal=FALSE, paired=FALSE, al
test_dose_3
```

```
##
##  Welch Two Sample t-test
##
## data:  len_small_dose and len_large_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 of x mean of y
##    10.605    26.100
```

## Conclusion

We have to reject the null hypothesis for all three t-tests and conclude that dosage of the supplements affect tooth growth.