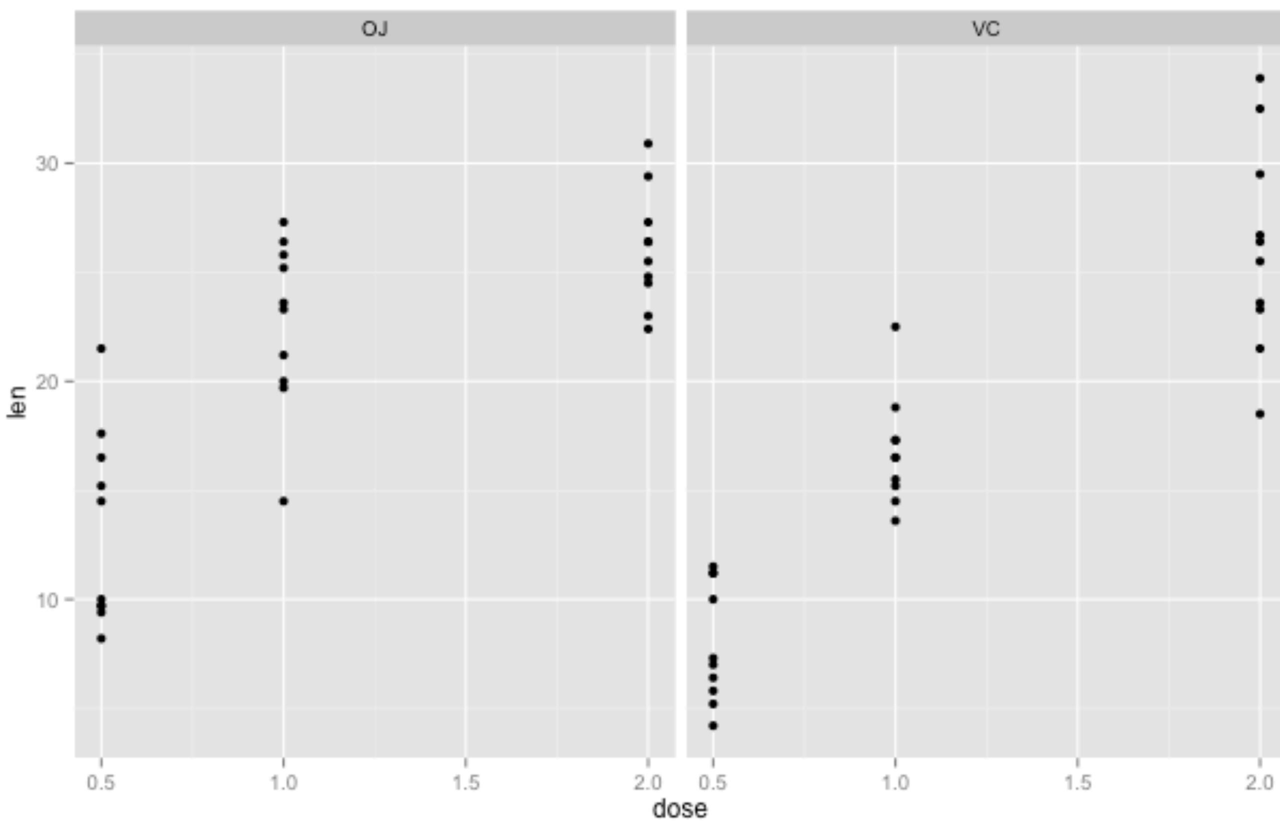
The goal of this document is to demonstrate the techniques of hypothesis testing using the ToothGrowth dataset.

The structure of this dataset is as follows

```
'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 ...
```

Here is a quick exploratory analysis of the dataset:



As you can see there are two different treatment approaches, denoted by OC and VC. Each treatment can be administered at three different dosages: .5, 1.0 and 2.0. The plotted data points show an up and to the right trend for both treatment types. As dosage increases for a given treatment type, the measured length increases as well.

The assignment asks us to: "*use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose*."

I would like to test, for each of the three dosages, which treatment (OJ versus VC) delivers more tooth growth (as measured by the variable "len"). From looking at the scatter plots above, I have a hypothesis that for the lower two dosages (0.5 and 1.0) the OJ treatment delivers the best results and that at the highest dosage (2.0) the VC treatment delivers the best results. Specifically:

> **H0**: there is no difference in results between the OJ and VC at any dosage level (neither 0.5, 1.0 nor 2.0).
> **H1**: the OJ supplement delivers better results at dosage 0.5 and dosage 1.0 and the VC supplement delivers better results at dosage 2.0

Because the sample size for each dosage level and supplement type is small (n<30) we will use a two-group t-test to evaluate the hypothesis. To do this, I'll subset the data into three groups, one for each dosage level. Then I'll run the t-test to compare results across the two supplement factors (OJ and VC).

Here is the t-test for the first dosage level.

```
d0.5<-subset(ToothGrowth, dose == 0.5)
t.test(d0.5$len~d0.5$supp)
```

```
Welch Two Sample t-test

data:  d0.5$len by d0.5$supp
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 in group OJ mean in group VC
        13.23            7.98
```

These results suggest that the first part of my hypothesis is true, e.g. that OJ yields a statistically significant increase in tooth growth relative to VC.

I will now repeat the same approach for the remaining two dosage levels.

```
d1.0<-subset(ToothGrowth, dose == 1.0)
d2.0<-subset(ToothGrowth, dose == 2.0)
t.test(d0.5$len~d0.5$supp)
```

```
Welch Two Sample t-test

data:  d1.0$len by d1.0$supp
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 in group OJ mean in group VC
         22.70            16.77
```

And…

```
t.test(d2.0$len~d2.0$supp)
```

```
Welch Two Sample t-test

data:  d2.0$len by d2.0$supp
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 in group OJ mean in group VC
         26.06            26.14
```

These three t-tests combine to confirm H1: the OJ supplement delivers better results at dosage 0.5 and dosage 1.0 and the VC supplement delivers better results at dosage 2.0