ToothGrowth by Vitamin C Supplement and Growth

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For the exercise would like to compare the results of tooth growth based on vitamin C supplement OJ and VC over the doses from 0.5 ml - 2.0 ml. I will explore using data summaries and charts. Then, I will leverage the t-test to summarize with confidence intervals.

```
# load datasets
library(datasets)
data(ToothGrowth)
attach(ToothGrowth)
# summarize data
head(ToothGrowth,10)
```

```
##     len supp dose
## 1   4.2   VC  0.5
## 2  11.5   VC  0.5
## 3   7.3   VC  0.5
## 4   5.8   VC  0.5
## 5   6.4   VC  0.5
## 6  10.0   VC  0.5
## 7  11.2   VC  0.5
## 8  11.2   VC  0.5
## 9   5.2   VC  0.5
## 10  7.0   VC  0.5
```

```
summary(ToothGrowth)
```

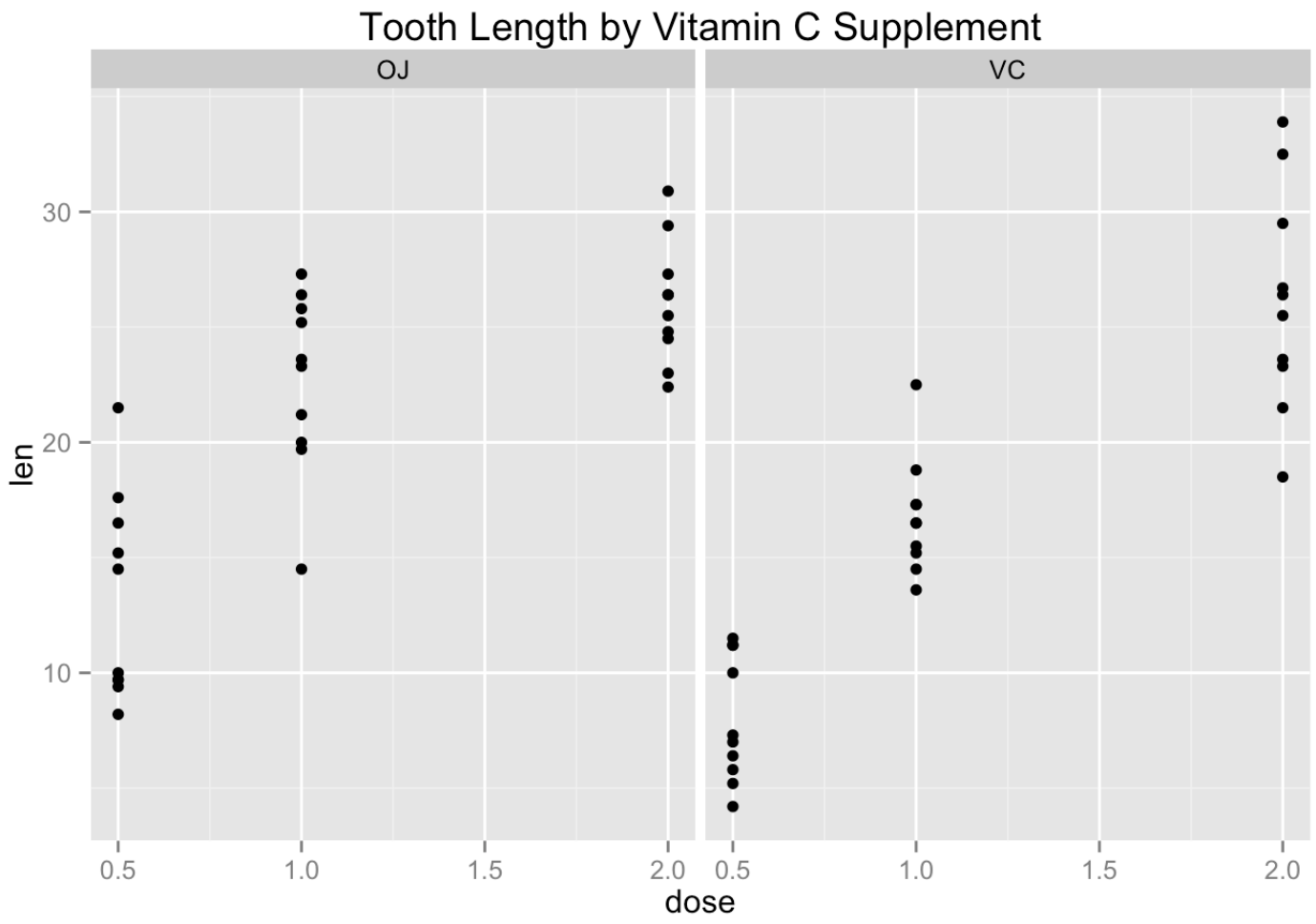
```
##       len        supp         dose
##  Min.   : 4.20   OJ:30   Min.   :0.500
##  1st Qu.:13.07   VC:30   1st Qu.:0.500
##  Median :19.25           Median :1.000
##  Mean   :18.81           Mean   :1.167
##  3rd Qu.:25.27           3rd Qu.:2.000
##  Max.   :33.90           Max.   :2.000
```

```
str(ToothGrowth)
```

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

As you can see in the plot below, supplement OJ and VC behaved very similar, but doses had the impact on tooth growth, with very minimul differences between the two. Therefore, I'll use dose for further analysis.

```
library(ggplot2)
qplot(dose, len, data = ToothGrowth, facets=~supp, main = "Tooth Length by Vitamin C Suppleme
nt")
```



I wanted to break up the data into three groups based on dose, then compare each dose to another to determine significance.

```
# ordered ToothGrowth as there are 20 observations per dose
order_tooth_growth <- ToothGrowth[with(ToothGrowth,order(dose)),]
g1 <- ToothGrowth$len[1:20]
g2 <-ToothGrowth$len[21:40]
g3 <- ToothGrowth$len[41:60]

head(order_tooth_growth, 25)
```

```
##     len supp dose
## 1   4.2   VC  0.5
## 2  11.5   VC  0.5
## 3   7.3   VC  0.5
## 4   5.8   VC  0.5
## 5   6.4   VC  0.5
## 6  10.0   VC  0.5
## 7  11.2   VC  0.5
## 8  11.2   VC  0.5
## 9   5.2   VC  0.5
## 10  7.0   VC  0.5
## 31 15.2   OJ  0.5
## 32 21.5   OJ  0.5
## 33 17.6   OJ  0.5
## 34  9.7   OJ  0.5
## 35 14.5   OJ  0.5
## 36 10.0   OJ  0.5
## 37  8.2   OJ  0.5
## 38  9.4   OJ  0.5
## 39 16.5   OJ  0.5
## 40  9.7   OJ  0.5
## 11 16.5   VC  1.0
## 12 16.5   VC  1.0
## 13 15.2   VC  1.0
## 14 17.3   VC  1.0
## 15 22.5   VC  1.0
```

First, I want to look at confidence interval for dose 0.5 to 1.0

```
t.test(g2, g1, paired = F)
```

```
##
##  Welch Two Sample t-test
##
## data:  g2 and g1
## t = 3.4253, df = 32.548, p-value = 0.001679
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   2.96585 11.65415
## sample estimates:
## mean of x mean of y
##    19.685    12.375
```

Next, I want to look at confidence interval for dose 1.0 to 2.0

```
t.test(g3, g2, paired = F)
```

```
##
##  Welch Two Sample t-test
##
## data:  g3 and g2
## t = 2.3814, df = 26.683, p-value = 0.02465
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.6474698 8.7425302
## sample estimates:
## mean of x mean of y
##    24.380    19.685
```

Finally, I want to look at confidence interval for the biggest jump of dose 0.5 to 2.0

```
t.test(g3, g1, paired = F)
```

```
##
##  Welch Two Sample t-test
##
## data:  g3 and g1
## t = 8.4406, df = 34.27, p-value = 6.956e-10
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   9.11539 14.89461
## sample estimates:
## mean of x mean of y
##    24.380    12.375
```

It’s clear the dosage amount has an impact on tooth growth. In the most extreme example (from 0.5 ml to 2.0 ml), we are 95% confident the mean of the sample will have a range of 9.1 to 14.9 increase in length.