# Tooth Growth Analysis

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## 1. Summary

Using the r Tooth Growth data I will make a judgement as to which delivery method and dose resulted in the most growth. This was done through plotting the results, and reviewing the t.test for the different methods and dosages.

## 2. Load the data and provide a summary

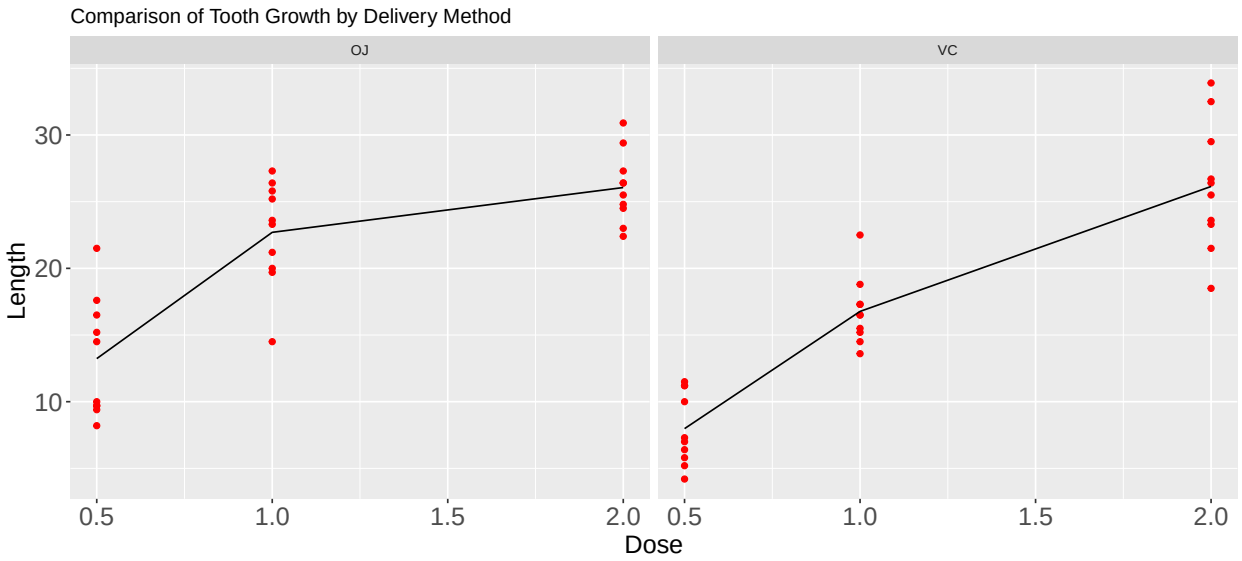
```
data(ToothGrowth)
summary(ToothGrowth)
```

```
##       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
```

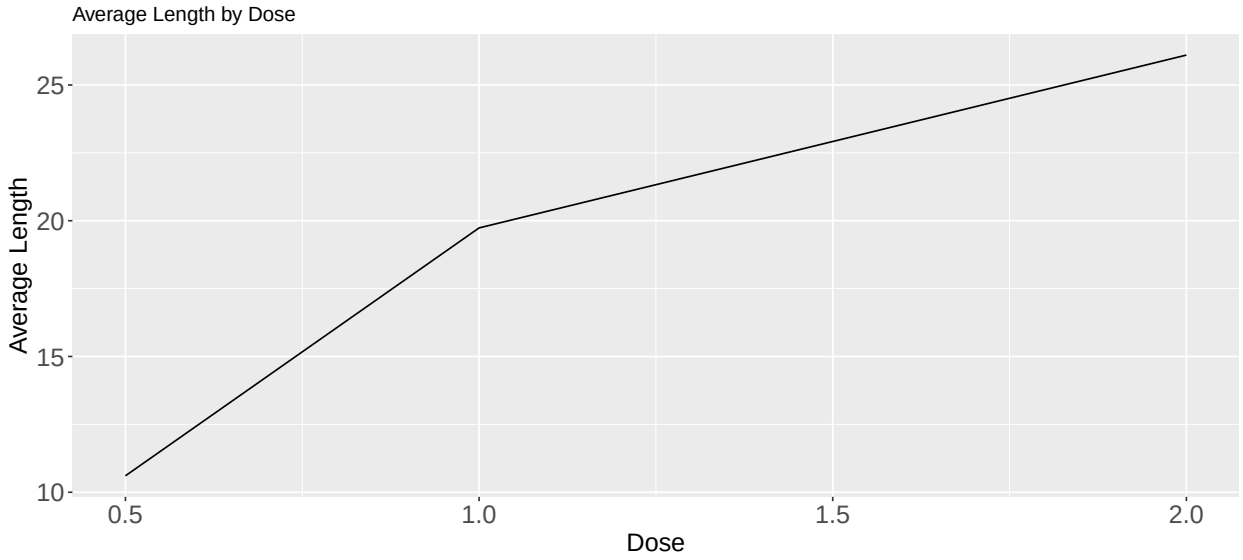
### Let's review the two delivery methods, VC and OJ

Mean of Tooth Growth by VC: 16.9633333 and by OJ 20.6633333

By plotting the data we can see that tooth growth increases consistently using VC, but tapers off a bit after 1.0 dose with OJ.



### Let's review the different dose types, 0.5, 1.0, 1.5, and 2.0




We can see here that a higher dosage seem to improve length, but starts to taper off at 1.0.

## 3. Use confidence intervals and/or hypothesis test to compare tooth growth by supp and dose

Using a 95% confidence level let's run some tests on the data.

Below we see that the mean of OJ is higher but the p-value is 0.06 which is higher than 0.05 resulting in not enough evidence to reject the null hypothesis.

```
t.test(subset(ToothGrowth,supp=="VC")[,"len"],
       subset(ToothGrowth,supp=="OJ")[,"len"],
       paried=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  subset(ToothGrowth, supp == "VC")[, "len"] and subset(ToothGrowth, supp == "OJ")[, "len"]
## 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:
##  -7.5710156  0.1710156
## sample estimates:
## mean of x mean of y
##  16.96333  20.66333
```

Now let's compare the different doses, starting with 0.5 to 1.0. Here you can see the mean is higher for 1.0 dose, and p-value is much lower, and the confidence interval doesn't include 0. Thus we can reject the null hypothesis

```
t.test(subset(ToothGrowth,dose==0.5)[,"len"],
       subset(ToothGrowth,dose==1.0)[,"len"],
       paried=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
```

```
##
## data:  subset(ToothGrowth, dose == 0.5)[, "len"] and subset(ToothGrowth, dose == 1)[, "len"]
## t = -6.4766, df = 37.986, p-value = 0.0000001268
## 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 1.0 to 2.0

```
t.test(subset(ToothGrowth,dose==1.0)[,"len"],
       subset(ToothGrowth,dose==2.0)[,"len"],
       paried=FALSE, var.equal=FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  subset(ToothGrowth, dose == 1)[, "len"] and subset(ToothGrowth, dose == 2)[, "len"]
## t = -4.9005, df = 37.101, p-value = 0.00001906
## 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
```

Here we can see the mean for 2.0 is higher then 1.0, but the change is less so then from 0.5 to 1.0. Also the p value is lower, but still, we cannot reject the null hypothesis as the confidence interval does not contain 0, and we have a very low p-value.

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

**Do delivery method and/or dosage affect tooth growth in guinea pigs?** Using the data provided and assuming there are no other factors in the different methods of supplement deliver and dosage I conclude that:

1) OJ delivery method may provide better results at 0.5 and 1.0 dosage, but there is not enough data to support that holistically, further more at a dosage of 2.0 the difference is no longer there.
2) Tooth growth increases at a dosage of 1.0 over 0.5. Tooth growth continues to increase at a dosage of 2.0, but tappers off.

## 5. Appendix

Code for plot 1

```
g<-ggplot(ToothGrowth, aes(dose, len))
g<-g+facet_grid(.~ supp)+geom_point(color="pink")
g<-g+stat_summary(fun.y=mean, geom="line")
g<-g+labs(title="Comparison of Tooth Growth by Delivery Method", x="Dose", y="Length")
g
```

Code for plot 2

```
tgSum<-summarise(group_by(ToothGrowth,dose), Avg_Len=mean(len))
g2<-ggplot(tgSum, aes(x=dose, y=Avg_Len))+geom_line()
g2<-g2+labs(title="Average Length by Dose", x="Dose", y="Average Length")
g2
```