toothGrowth

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Load the ToothGrowth data and perform some basic exploratory data analyses:

```
library(knitr)
data(ToothGrowth)
head(ToothGrowth)
```

```
##    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
```

```
summary(ToothGrowth)
```

```
##       len        supp         dose
##  Min.   : 4.2   OJ:30   Min.   :0.50
##  1st Qu.:13.1   VC:30   1st Qu.:0.50
##  Median :19.2           Median :1.00
##  Mean   :18.8           Mean   :1.17
##  3rd Qu.:25.3           3rd Qu.:2.00
##  Max.   :33.9           Max.   :2.00
```

```
vitaminCGrowth <- ToothGrowth[which(ToothGrowth$supp == "VC"),]
ojGrowth <- ToothGrowth[which(ToothGrowth$supp == "OJ"),]
```

Mean of Vitamin C tooth growth by dosage:

```
meanVCGrowthByDose <- aggregate(x = vitaminCGrowth$len, by = list(vitaminCGrowth$dose), mean)
colnames(meanVCGrowthByDose)[1:2] <- c("Dosage", "Tooth Growth")
kable(meanVCGrowthByDose, format = "pandoc")
```

```
##
##
##  Dosage   Tooth Growth
## -------  -------------
##     0.5           7.98
##     1.0          16.77
##     2.0          26.14
```

Mean of OJ tooth growth by dosage:

```
meanOJGrowthByDose <- aggregate(x = ojGrowth$len, by = list(ojGrowth$dose), mean)
colnames(meanOJGrowthByDose)[1:2] <- c("Dosage", "Tooth Growth")
kable(meanOJGrowthByDose, format = "pandoc")
```

```
##
##
##  Dosage   Tooth Growth
## -------  -------------
##     0.5          13.23
##     1.0          22.70
##     2.0          26.06
```

Execute T-test with "paired" since the same 10 guinea pigs were given three dose levels of Vitamin C (0.5, 1, and 2 mg) with each of two delivery methods (orange juice or ascorbic acid) (per TootGrowth docs). Also with such low sample sizes (10 each) a T-test would be most applicable here.

Confidence interval for tooth growth differnces between OJ and Vitamin C:

```
lowDosageTest <- t.test(ojGrowth[which(ojGrowth$dose == 0.5),]$len,
                        vitaminCGrowth[which(vitaminCGrowth$dose == 0.5),]$len,
                        paired=TRUE)
midDosageTest <- t.test(ojGrowth[which(ojGrowth$dose == 1.0),]$len,
                        vitaminCGrowth[which(vitaminCGrowth$dose == 1.0),]$len,
                        paired=TRUE)
highDosageTest <- t.test(ojGrowth[which(ojGrowth$dose == 2.0),]$len,
                         vitaminCGrowth[which(vitaminCGrowth$dose == 2.0),]$len,
                         paired=TRUE)
```

Below are the various confidence intervals and p-values for each dosage when comparing OJ to Vitamin C as it relates to tooth growth:

```
##
##
## Dosage        Paired t-test confidence interval     P value
## ------------  ----------------------------------  --------
## Low Dosage    1.26345831099417 9.23654168900583      0.0155
## Mid Dosage    1.95191088714728 9.90808911285271      0.0082
## High Dosage   -4.32897647734293 4.16897647734293     0.9670
```

Conclusions

The hypothesis test is below, where the value of **mu** is the mean of Vitamin C tooth growth for the low and mid dosage, so rejecting the NULL hypothesis would indicate that OJ leads to greather tooth growth than Vitamin C and vice versa. The reason for only evaluating the **low** and **mid** dosage is because these had p-values that have a high probability of rejecting the NULL hypothesis.

Assuming a low dosage p-value of **0.0155** and mid dosage p-value of **0.0082** we can **reject** the NULL hypotheseis and conclude that OJ leads to greather tooth growth than Vitamin C for these dosage levels, assuming a 0.05 level of signifigance (or 95% confidence level) .

Low Hypothesis Test

H0 = mu = **7.98**

HA = mu > **7.98**

Mid Hypothesis Test

H0 = mu = **16.77**

HA = mu > **16.77**