Analysis Of Tooth Growth Data

Author: Craig Anthony

Overview: This R Knitr pdf file presents a statistical analysis of the R tooth growth data set. A data set that measures the response length of odontoblasts (teeth) in each of 10 guinea pigs at each of three dose levels of Vitamin C (0.5, 1, and 2 mg) with each of two delivery methods (orange juice or ascorbic acid). The analysis includes:

1. Exploratory Data Analysis
2. Data Summary
3. Confidence intervals and hypothosis analysis of comparing tooth growth by supp and dose.
4. Conclusions base on data analysis.

1. Exploratory Data Analysis

Variables: len - tooth growth in response to changes in dose size and delivery method. dose - .5,1, or 2 milligrams of Vitamin C supp - delivery method either orange juice (OJ) or Ascorbic Acid (VC)

```
    length <- ToothGrowth$len
    summary(length)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    4.20   13.08   19.25   18.81   25.28   33.90
```

```
    length_sd <- sd(length)
    length_variance <-var(length)
```

The standard deviation of the sample mean growth length equals **7.6493152** The variance of the sample mean growth length equals **58.5120226**.

2. Comparison of tooth growth by delivery method and dose.

Generate confidence interval for the effects of delivery types on tooth length. HO - supplement types do not effect tooth growth.

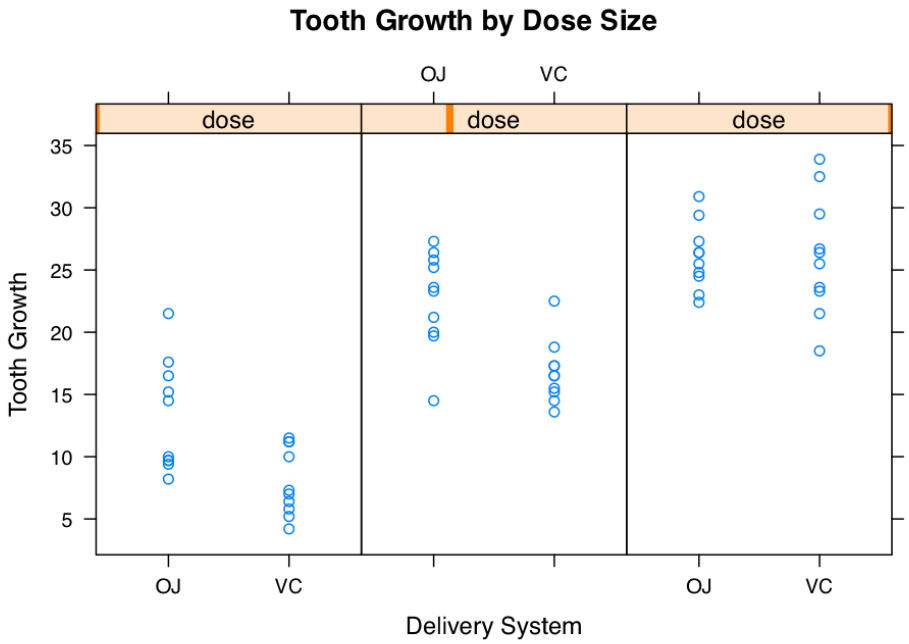
```
    t.test(len ~ supp, data = ToothGrowth)
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## 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 in group OJ mean in group VC
##         20.66333         16.96333
```

The interval contains 0 so HO cannot be rejected. However; the p-value is > 5% so this does not support HO. I interpret these results to be inconclusive.

Now test for the effects of dosage on tooth growth. The plot below indicates that an increase in dosage increases tooth growth.

```
library("lattice")
par(pin=c(1,1))
xyplot(len ~ supp | dose, data=ToothGrowth, main="Tooth Growth by Dose Size",xlab="Delivery System"
```



This plot indicates an increase in growth as the dose is increased regardless of the delivery system. So the null hypothosis is:

HO - Does dosing levels increase tooth growth.

Use paired T-tests to test hypothosis.

```
dose1 <- ToothGrowth[ToothGrowth$dose==.5,1]
dose2 <- ToothGrowth[ToothGrowth$dose==1,1]
dose3 <- ToothGrowth[ToothGrowth$dose==2,1]
paired1 <- t.test(dose1,dose2, paired=FALSE, var.equal=TRUE)
paired2 <- t.test(dose1,dose2, paired=FALSE, var.equal=FALSE)
paired12 <- data.frame("p-value"=c(paired1$p.value, paired2$p.value),"Lower"=c(paired1$conf[1],paired2$
paired3 <- t.test(dose1,dose3, paired=FALSE, var.equal=TRUE)
paired4 <- t.test(dose1,dose3, paired=FALSE, var.equal=FALSE)
paired13 <- data.frame("p-value"=c(paired3$p.value, paired4$p.value),"Lower"=c(paired3$conf[1],paired4$
paired5 <- t.test(dose2,dose3, paired=FALSE, var.equal=TRUE)
paired6 <- t.test(dose2,dose3, paired=FALSE, var.equal=FALSE)
paired23 <- data.frame("p-value"=c(paired5$p.value, paired6$p.value),"Lower"=c(paired5$conf[1],paired6$
```

```
pairs_out <- rbind(paired12,paired13,paired23)
pairs_out
```

```
##              p.value      Lower      Upper Doses..mg.
## paired1 1.266297e-07 -11.983748  -6.276252    [0.5,1]
## paired2 1.268301e-07 -11.983781  -6.276219    [0.5,1]
## paired3 2.837553e-14 -18.153519 -12.836481    [0.5,2]
## paired4 4.397525e-14 -18.156167 -12.833833    [0.5,2]
## paired5 1.810829e-05  -8.994387  -3.735613      [1,2]
## paired6 1.906430e-05  -8.996481  -3.733519      [1,2]
```

p-values are low and the confidence intervals do not contain zero so we fail to reject HO - dose levels increase tooth growth.

Conclusions

Increase Vitamin C to up to to mg to increase tooth growth but don't worry about which delivery method to use.