

The Effect of Vitamin C on Tooth Growth

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Overview

For this analysis the ToothGrowth data in the R datasets package will be used (Source: C. I. Bliss (1952) The Statistics of Bioassay. Academic Press.).

This data captures the response in the length of odontoblasts (cells responsible for tooth growth) in 60 guinea pigs, each receiving one of three dose levels of Vitamin C (0.5, 1.0, and 2.0 mg) with one of two delivery methods (orange juice or an aqueous solution of ascorbic acid).

The purpose of this analysis is to determine if there is a statistical difference in the length of odontoblasts due to the type of supplement used for a given dose.

Summary Of The Data

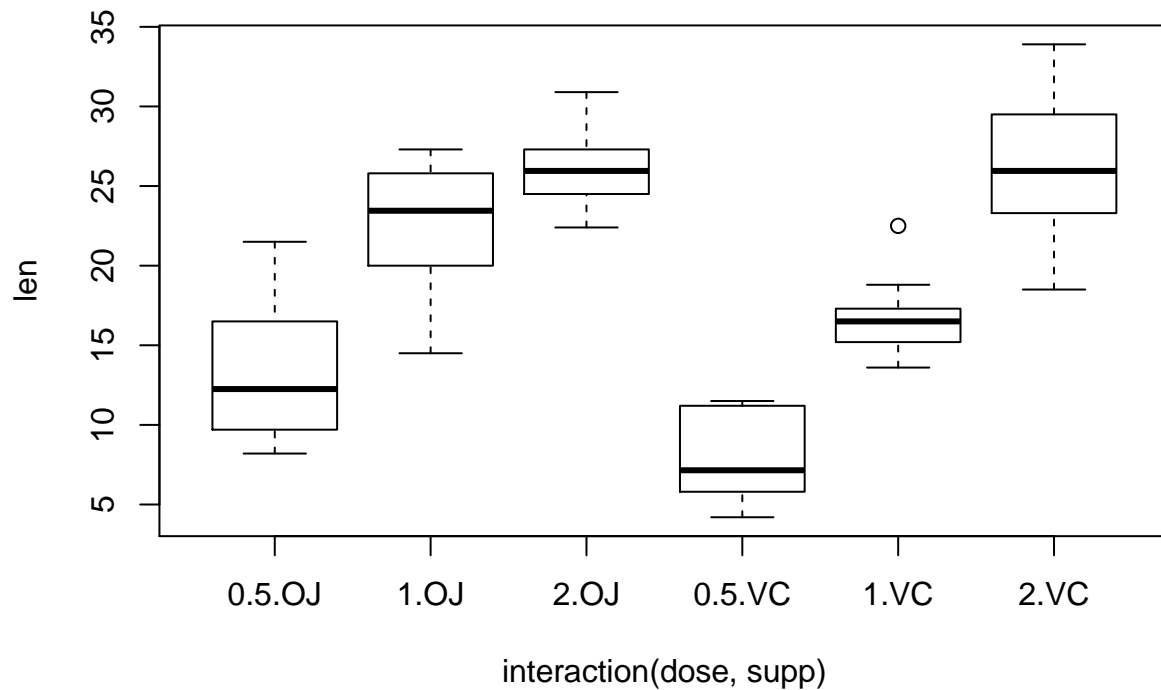
The data contains 60 observations on 3 variables. The format of the data is below.

Field Name	Mode	Description
len	numeric	Tooth length
supp	factor	Supplement type (VC or OJ).
dose	numeric	Dose in milligrams.

Exploratory Data Analysis

The boxplot below graphs the mean and variance of the tooth growth length grouped by dose and supplement type.

```
tg<-ToothGrowth
tg$dose <- factor(tg$dose) # treat dose as a factor
plot(len ~ interaction(dose,supp), data=tg)
```



Statistica Analysis

A visual inspection of the boxplot shows that there may be differences in the mean growth for the supplements at a given dose. A t-test will be performed to determine if there is a statistical difference. The two groups being analyzed, guinea pigs given doses of vitamin C and ascorbic acid, are independent. Therefore an Independent t-test will be performed.

Variance Analysis To test if the two groups exhibit homogeneity of variance, a Levene's test will be performed. The results are below.

```
library(car, warn.conflicts = FALSE, quietly = TRUE, verbose = FALSE)
```

```
## Warning: package 'car' was built under R version 3.2.1
```

```
leveneTest(len ~ supp*dose, data=tg)
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##      Df F value Pr(>F)
## group  5  1.7086 0.1484
##      54
```

The null-hypotheses for this test is homogeneity of variances. Based on the p-Value calculate the probability of obtaining this or a more extreme result is greater than 5%. Therefore the null-hypotheses is rejected and a t-test assuming different variances will be performed.

T-Tests The t-tests below are for the two supplements at a given dose.

```
library(dplyr,warn.conflicts = FALSE, quietly = TRUE,verbose=FALSE)
dVC05 <- filter(tg,supp=="VC",dose=="0.5")
dOJ05 <- filter(tg,supp=="OJ",dose=="0.5")
t05 <- t.test(dVC05$len,dOJ05$len,paired = FALSE, var.equal = FALSE)
```

T-Test for Vitamin and Ascorbic Acid at .5 mg Dose

```
dVC1 <- filter(tg,supp=="VC",dose=="1")
dOJ1 <- filter(tg,supp=="OJ",dose=="1")
t1 <- t.test(dVC1$len,dOJ1$len,paired = FALSE, var.equal = FALSE)
```

T-Test for Vitamin and Ascorbic Acid at 1 mg Dose

```
dVC2 <- filter(tg,supp=="VC",dose=="2")
dOJ2 <- filter(tg,supp=="OJ",dose=="2")
t2 <- t.test(dVC2$len,dOJ2$len,paired = FALSE, var.equal = FALSE)
```

T-Test for Vitamin and Ascorbic Acid at 2 mg Dose Below is summary of the t-test results.

```
tmerged <- rbind(t05,t1,t2)
df <- data.frame(matrix(unlist(tmerged), nrow=3),stringsAsFactors=FALSE)
n <- names(t1);n <- append(n,"conf.int.higher",after=4);n[4] <- "conf.int.lower"
names(df) <- n
row.names(df) <- dimnames(tmerged)[[1]]
library(data.table,warn.conflicts = FALSE, quietly = TRUE,verbose=FALSE)
df <- transform(df,statistic=round(as.numeric(statistic),5),p.value=round(as.numeric(p.value),5),conf.int.lower=round(as.numeric(conf.int.lower),5),conf.int.higher=round(as.numeric(conf.int.higher),5))
```

```
library(xtable,quietly=TRUE,warn.conflicts = FALSE,verbose=FALSE)
```

```
## Warning: package 'xtable' was built under R version 3.2.1
```

```
xt <- xtable(select(df,statistic,p.value,conf.int.lower,conf.int.higher),digits=c(5))
print(xt,type = "latex")
```

% latex table generated in R 3.2.0 by xtable 1.7-4 package % Sun Jul 26 10:06:21 2015

	statistic	p.value	conf.int.lower	conf.int.higher
t05	-3.16973	0.00636	-8.78094	-2.80215
t1	-4.03277	0.00104	-1.71906	-3.63807
t2	0.04614	0.96385	-9.05785	3.79807

Conclusion

At 0.5 mg and 1 mg doses, Ascorbic Acid is statistically associated with longer odontoblasts relative to Vitamin C. However, at a 2 mg dose there is not a statistical difference in observed odontoblasts length.