

## Statistical inference part2

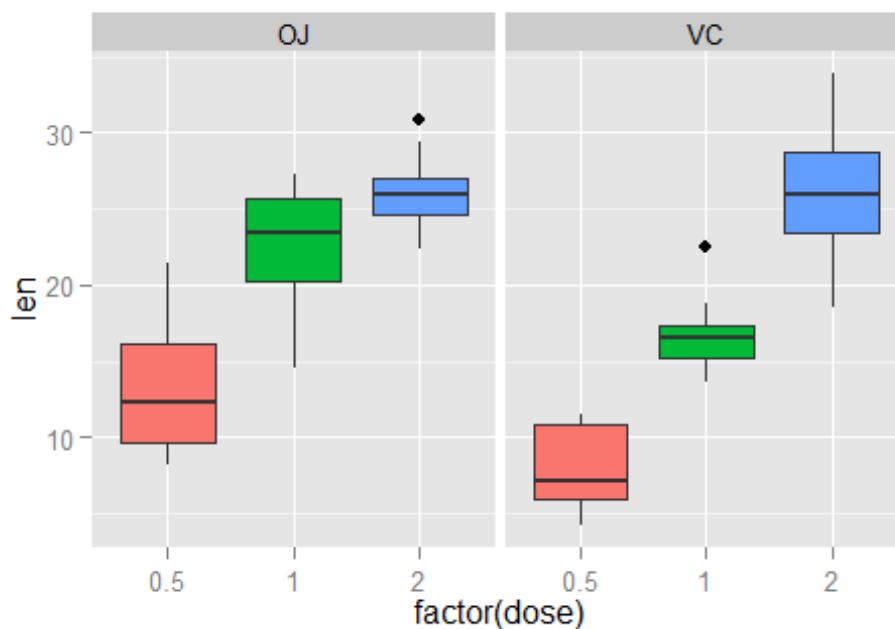
### Introduction

The response is the length of 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).

### Data Exploration

```
library(knitr)
library(ggplot2)
opts_chunk$set(eval = TRUE)
opts_chunk$set(echo = TRUE)
opts_chunk$set(fig.height = 3.5)

par(mfrow = c(1,2))
p1 <- ggplot(ToothGrowth, aes(x = factor(dose), y = len, fill = factor(dose)))
p1 + geom_boxplot() + guides(fill=FALSE) + facet_grid(. ~ supp)
```



After plotting the data as boxplots a number of correlations were observed. The length of the tooth increases as the dosage increases. The OJ delivery method yields a greater length than the VC (approximately 10mm) for smaller dosages but the difference is negligible by a 2mg dosage.

## Statistical inference

The tooth growth was compared by supplement for each dosage under the null hypothesis that each supplement has the same effect at a certain dosage on the tooth.

```
# split the data up by dosages
d0.5 <- subset(ToothGrowth, dose == 0.5)
d1.0 <- subset(ToothGrowth, dose == 1.0)
d2.0 <- subset(ToothGrowth, dose == 2.0)

# conduct a t-test between supplements
test0.5 <- t.test(len ~ supp, paired = FALSE, var.equal = FALSE, data = d0.5)
test0.5$p.value; test0.5$conf[1]

## [1] 0.006359
## [1] 1.719

test1.0 <- t.test(len ~ supp, paired = FALSE, var.equal = FALSE, data = d1.0)
test1.0$p.value; test1.0$conf[1]

## [1] 0.001038
## [1] 2.802
```

Dosages 1.0 and 1.5 have significant p-values of 0.006359 and 0.001038 respectively indicating that the difference in mean values between the supplements is significant. Dosage 1.0 has a confidence interval of 1.719-8.781 and dosage 2.0 has a confidence interval of 2.802-9.058.

```
test2.0 <- t.test(len ~ supp, paired = FALSE, var.equal = FALSE, data = d2.0)
test2.0$p.value; test2.0$conf[1]

## [1] 0.9639
## [1] -3.798
```

Dosage 3.0 has a very high p-value of 0.9639 and a confidence interval below zero -3.798-3.638. This indicates that there is no significance between the supplements at this dosage. This is also intuitive from the earlier boxplot.

## Conclusions

The supplements orange juice and ascorbic acid have different effects on tooth length for lower dosages of vitamin C according to the t-test. Orange juice yields a longer tooth for dosages of 0.5 and 1.0mg. However at a dosage of 3.0mg there is no change in tooth length.

## Assumptions

1. The supplements have a treatment effect and there are no other confounding factors.
2. Samples are unpaired, with unequal variances.
3. Guinea pigs are essentially identical - size, diet etc.