Statistical Inference Course Project Part 2

Pradeep K. Pant, ppant@cpan.org (mailto:ppant@cpan.org)

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Overview

Load the ToothGrowth data and perform some basic exploratory data analyses - Provide a basic summary of the data. - Use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose. (Only use the techniques from class, even if there's other approaches worth considering) - State your conclusions and the assumptions needed for your conclusions.

Load ToothGrowth data

```
# Load neccesary libraries
library(ggplot2)
library(datasets)
library(gridExtra)

# The Effect of Vitamin C on Tooth Growth in Guinea Pigs
data(ToothGrowth)
toothGrowth <- ToothGrowth
toothGrowth$dose <- as.factor(toothGrowth$dose) # convert to factor
```

Basic summary of data

From the ToothGrowth documentation.

```
?ToothGrowth
```

```
## starting httpd help server ...
```

```
##  done
```

Description

The response is the 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).

Format

A data frame with 60 observations on 3 variables:

len (numeric) Tooth length supp (factor) Supplement type (VC (ascorbic acid) or OJ (orange juice)) dose (numeric) Dose in milligrams

Let's have a closer look

```
str(toothGrowth)
```

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: Factor w/ 3 levels "0.5","1","2": 1 1 1 1 1 1 1 1 1 1 ...
```

```
summary(toothGrowth)
```
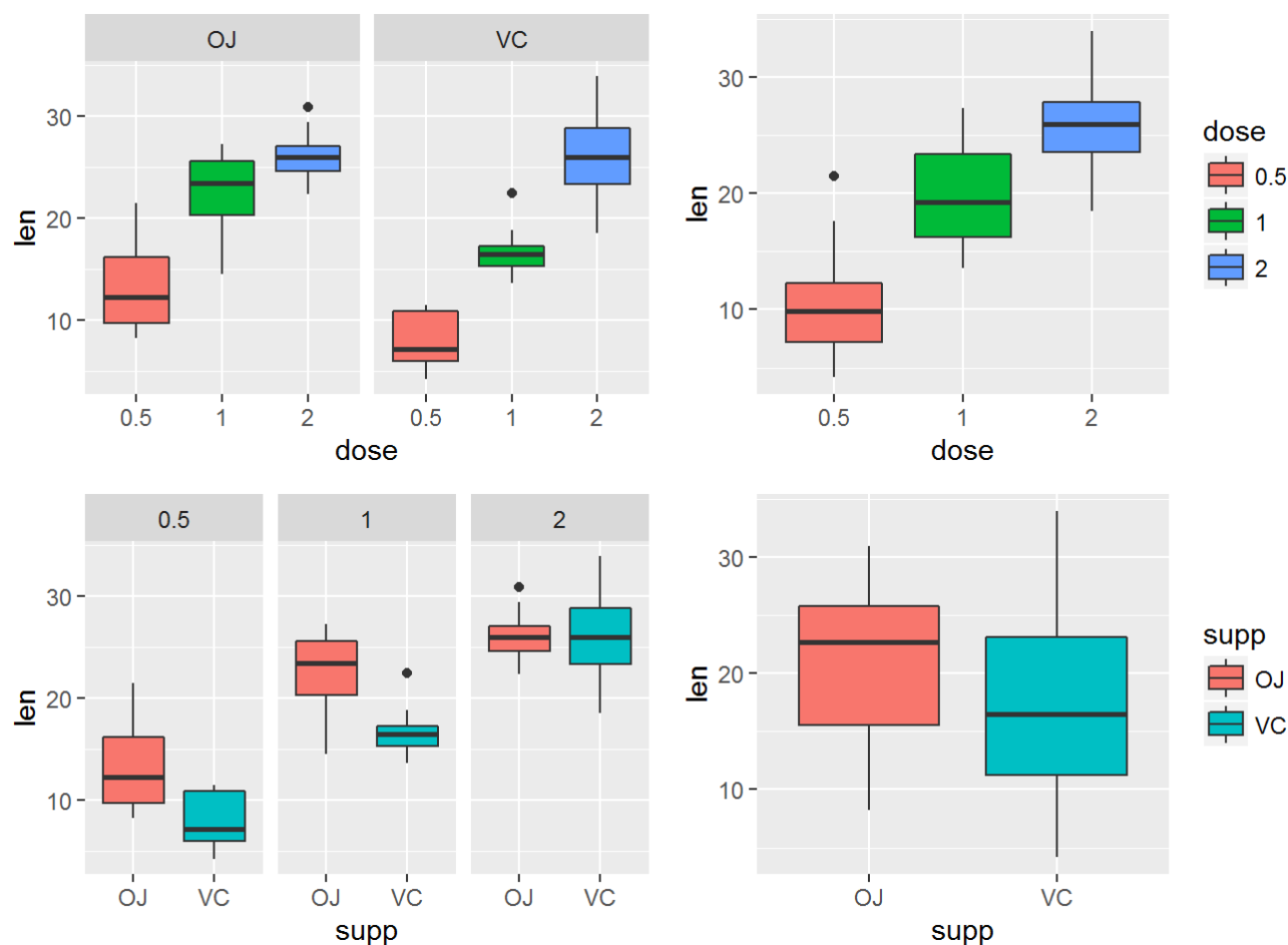
```
##       len          supp        dose
##  Min.   : 4.20   OJ:30   0.5:20
##  1st Qu.:13.07   VC:30   1  :20
##  Median :19.25           2  :20
##  Mean   :18.81
##  3rd Qu.:25.27
##  Max.   :33.90
```

```
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
```

```
# preparation for plot points
table(toothGrowth$supp, toothGrowth$dose)
```

```
##
##      0.5  1  2
##   OJ  10 10 10
##   VC  10 10 10
```

Do some analysis based on Analysis of Variance (ANOVA)

Comparing tooth growth by supp and dose

To analyze tooth growth, we carry out two-sample (orange juice vs. ascorbic acid) T-tests at each dosage level.

The T-test at 0.5 mg yields the following:

```
t.test(len ~ supp, ToothGrowth[ToothGrowth$dose == .5, ])
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 3.1697, df = 14.969, p-value = 0.006359
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   1.719057 8.780943
## sample estimates:
## mean in group OJ mean in group VC
##            13.23             7.98
```

The T-test at 1 mg yields the following:

```
t.test(len ~ supp, ToothGrowth[ToothGrowth$dose == 1, ])
```

```
## 
##  Welch Two Sample t-test
## 
## data:  len by supp
## t = 4.0328, df = 15.358, p-value = 0.001038
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   2.802148 9.057852
## sample estimates:
## mean in group OJ mean in group VC
##            22.70            16.77
```

The T-test at 2 mg yields the following:

```
t.test(len ~ supp, ToothGrowth[ToothGrowth$dose == 2, ])
```

```
## 
##  Welch Two Sample t-test
## 
## data:  len by supp
## t = -0.046136, df = 14.04, p-value = 0.9639
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   -3.79807  3.63807
## sample estimates:
## mean in group OJ mean in group VC
##            26.06            26.14
```

Conclusions

There are clear indications that both the supplement as the dosage have clear independent effects on the length of teeth guinea pigs. More those means on avarage longer teeth. Supplement type has a clear influence too, but OJ has a greater avarage teethgrowth in combination with dosages 0.5 and 1 then for the VC supplement, while teeth length for the VC supplement vs the OJ in combiantion with dosage 2 has no significant effect (almost same mean & same confidence interval)

From the T-test analysis above, we conclude from the statistically significant p-values that for dosages of 0.5 mg and 1 mg, orange juice is more effective at promoting tooth growth than just ascorbic acid. From the p-value for the 2 mg, we cannot conclude that orange juice promotes tooth growth more effectively than just ascorbic acid.

The fact remains however that these assumpionts are based on the facts:

- that the guinea pigs are repesentative for the population of guinea pigs,
- that dosage and supplement were randomly assigned and
- that the distribution of the means is normal.