Toothgrowth Experiment

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Executive Summary

The `ToothGrowth` dataset describes the effect of Ascorbic acid in the form of Vitamin C and Orange Juice on Tooth Growth in Guinea Pigs. Experiment showed that there is a significant increase in length on Guinea Pig's toothgrowth as dosage is increased.

Exploring data

```
data(ToothGrowth)
tg <- ToothGrowth
levels(tg$supp) <- c("Orange Juice","Vitamin C")
tg$dose <- as.factor(tg$dose)
```

Highlighting the basic features of the data, it has 3 sets of subjects for each dosage on the 2 supplements.

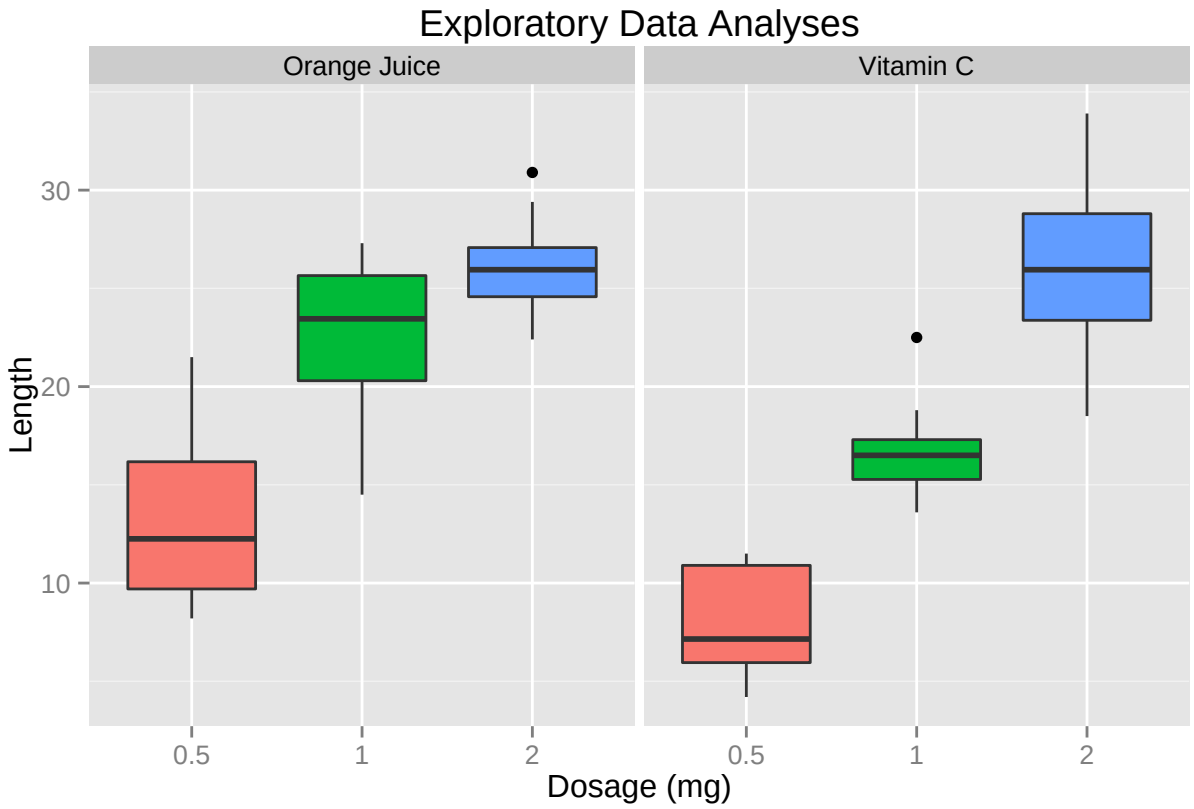
len	supp	dose
Min. : 4.20	Orange Juice:30	0.5:20
1st Qu.:13.07	Vitamin C :30	1 :20
Median :19.25	NA	2 :20
Mean :18.81	NA	NA
3rd Qu.:25.27	NA	NA
Max. :33.90	NA	NA

	0.5	1	2
Orange Juice	10	10	10
Vitamin C	10	10	10

The boxplot indicates that there is an increasing trend when administering higher dosage of Orange Juice or Vitamin C.

```
library(ggplot2)
plot <- ggplot(tg,
               aes(x=factor(dose),y=len,fill=factor(dose)))
plot <-plot + geom_boxplot(notch=F) +
      facet_grid(.~supp) +
       scale_x_discrete("Dosage (mg)") +
       scale_y_continuous("Length") +
       ggtitle("Exploratory Data Analyses") +
       theme(legend.position = "none")

print(plot)
```



Statistical Inference and Analysis

Dosage tests

At the first step, it is natural to verify whether the dosage of the supplement effects on toothgrowth. Since we have 3 dose sets, we will compare the effects of .5mg to 1.0mg dose, 1.0mg to 2.0 dose, and .5mg to 2.0 dose.

```
t1 <- filter(tg, dose == "0.5")$len #low dose group
t2 <- filter(tg, dose == "1")$len   #medium dose group
t3 <- filter(tg, dose == "2")$len   #large dose group

t1vt2 <- t.test(t1,t2, paired = FALSE, var.equal = FALSE, alternative="two.sided")
t2vt3 <- t.test(t2,t3, paired = FALSE, var.equal = FALSE, alternative="two.sided")
t1vt3 <- t.test(t1,t3, paired = FALSE, var.equal = FALSE, alternative="two.sided")
```

	low	high
0.5mg	-11.98	-6.276
1.0mg	-8.996	-3.734
2.0mg	-18.16	-12.83

All of the test doesn't contain 0 in their confidence intervals which can ultimately reject the null hypothesis and infer that these groups are all different. It indicates that administration of ascorbic acid will affect toothgrowth depending on tested dosage levels.

Supplement type effectivity tests

On this part, we check the effects of toothgrowth for the two supplement types.

```
t1OJ <- filter(tg, dose == "0.5",supp == "Orange Juice")$len #low dose group
t1VC <- filter(tg, dose == "0.5",supp == "Vitamin C")$len    #medium dose group
t1supp <- t.test(t1OJ,t1VC, paired = FALSE, var.equal = FALSE, alternative="two.sided")

t2OJ <- filter(tg, dose == "1",supp == "Orange Juice")$len #low dose group
t2VC <- filter(tg, dose == "1",supp == "Vitamin C")$len    #medium dose group
t2supp <- t.test(t2OJ,t2VC, paired = FALSE, var.equal = FALSE, alternative="two.sided")

t3OJ <- filter(tg, dose == "2",supp == "Orange Juice")$len #low dose group
t3VC <- filter(tg, dose == "2",supp == "Vitamin C")$len    #medium dose group
t3supp <- t.test(t3OJ,t3VC, paired = FALSE, var.equal = FALSE, alternative="two.sided")
```

	low	high
0.5mg	1.719	8.781
1.0mg	2.802	9.058
2.0mg	-3.798	3.638

Comparing the 2 types of supplements yields longer toothgrowth for Orange Juice. But at 2mg dose, the effects of the two supplements doesn't yield much of a difference. They have the same effect at this dosage level.

The p-value summarized in a table.

	Dose Level	Supplement type + Dose Level
0.5mg	0	0.0064
1.0mg	0	0.001
2.0mg	0	0.9639

Conclusion

The effects of Ascorbic acid on toothgrowth indicates considerable increase in length when administered at different dosage levels. However, comparing the supplement types seems to have different effects over the other at certain dosage level. At .5 and 1mg level, Orange Juice yields longer toothgrowth over Vitamin C. But at 2mg level, the effects seems to be similar. This could serve as a guide to the user when evaluating effects over cost in producing items.

Reproducible code: github