

The Vitamin C Effect on Tooth Growth of Guinea Pigs

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Overview

In this data analysis project, our goal is analysis of a dataset of Tooth Growth by comparing the the growth of guinea tooth based on the supplements and their dose.

This analysis can be divided as: (a) Performing exploratory data analysis on the dataset. (b) Doing the comparison with the confidence intervals in order to make conclusions about the tooth growth.

Load the ToothGrowth Dataset and Executing Exploratory Data Analyses

```
library(datasets)
data(ToothGrowth)
str(ToothGrowth)
head(ToothGrowth)
summary(ToothGrowth)
```

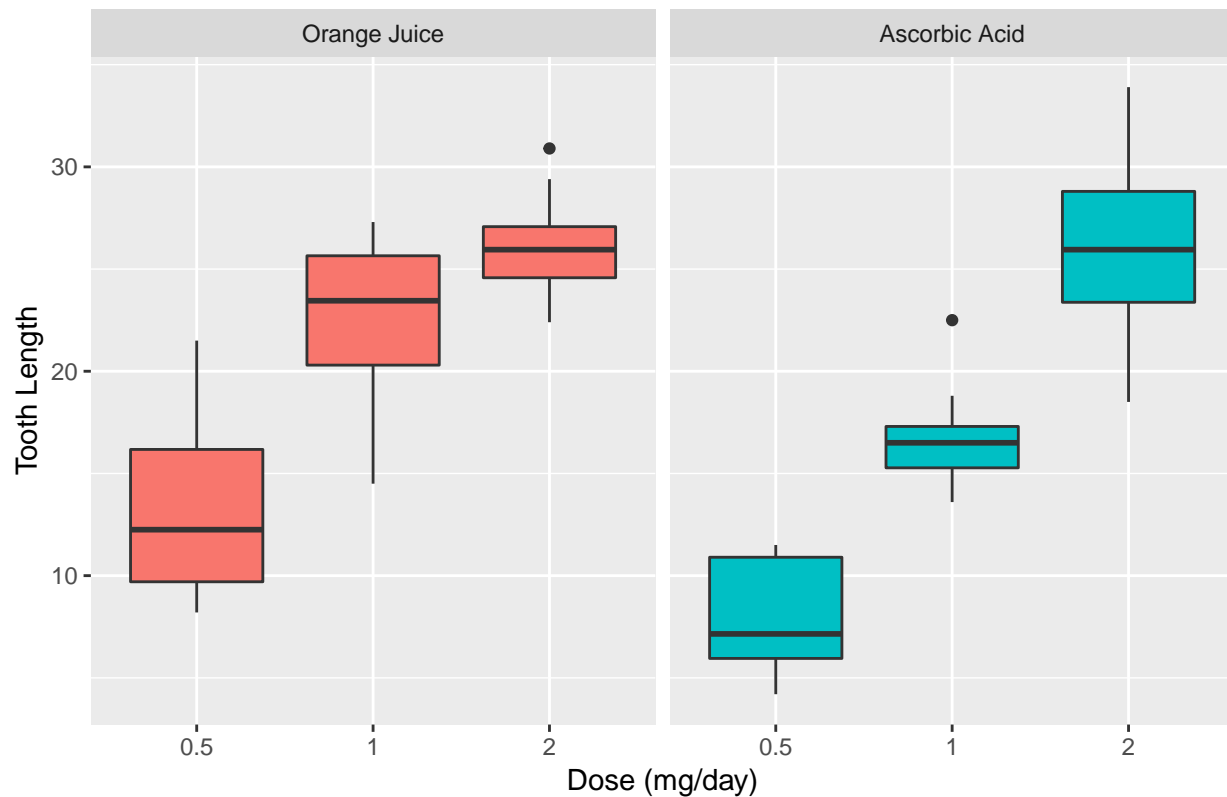
```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.5.3
```

```
t = ToothGrowth
levels(t$supp) <- c("Orange Juice", "Ascorbic Acid")
ggplot(t, aes(x=factor(dose), y=len)) +
  facet_grid(.~supp) +
  geom_boxplot(aes(fill = supp), show_guide = FALSE) +
  labs(title="Guinea pig tooth length by dosage for each type of supplement",
       x="Dose (mg/day)",
       y="Tooth Length")
```

```
## Warning: `show_guide` has been deprecated. Please use `show.legend`
## instead.
```

Guinea pig tooth length by dosage for each type of supplement



Basic Summary of the Data

We show the box plots that represent the increasing dosage leads to the improvement of the tooth growth. The orange juice has more effective outcome than ascorbic acid in the growth of tooth specifically when the dosage is from 0.5 to 1.0 milligrams per day. Both types of supplements are effective and useful similarly when the dosage is 2.0 milligrams per day.

Use Confidence Intervals and Hypothesis Tests for Comparison of Tooth Growth by Supplement and Dose

Hypothesis #1

Orange Juice and Ascorbic Acid provides the same tooth growth across the dataset.

```
hypothesis1<-t.test(len ~ supp, data = t)
hypothesis1$conf.int
```

```
## [1] -0.1710156  7.5710156
## attr(,"conf.level")
## [1] 0.95
```

```
hypothesis1$p.value
```

```
## [1] 0.06063451
```

The confidence intervals includes 0 and the p-value, greater than the threshold of 0.05! We cannot reject the null hypothesis in here.

Hypothesis #2

The dosage of 0.5 milligram/day for the two supplements deliver the same tooth growth.

```
hypoth2<-t.test(len ~ supp, data = subset(t, dose == 0.5))
hypoth2$conf.int
```

```
## [1] 1.719057 8.780943
## attr(,"conf.level")
## [1] 0.95
```

```
hypoth2$p.value
```

```
## [1] 0.006358607
```

- (a) We do not include the confidence interval of 0 and any p-value below the 0.05 threshold.
- (b) We do not reject the null hypothesis.
- (c) Alternative hypothesis is 0.5 milligram/day of dosage for orange juice. This caters the same tooth growth than ascorbic acid. This hypothesis is accepted.

Hypothesis #3

For the dosage of 1 mg/day. The two supplement deliver the same growth of tooth.

```
hypoth3<-t.test(len ~ supp, data = subset(t, dose == 1))
hypoth3$conf.int
```

```
## [1] 2.802148 9.057852
## attr(,"conf.level")
## [1] 0.95
```

```
hypoth3$p.value
```

```
## [1] 0.001038376
```

The confidence interval does not include 0 and the p-value. It is smaller than the given threshold of 0.05. We can reject the null hypothesis.

On the other hand, the alternative hypothesis of having 1 milligram/day dosage of orange juice with catering more tooth growth than ascorbic acid is accepted.

Hypothesis #4

Two supplements provide us with the same growth of tooth for the doosage of two milligram/day.

```
hypoth4<-t.test(len ~ supp, data = subset(t, dose == 2))
hypoth4$conf.int
```

```
## [1] -3.79807  3.63807
## attr(,"conf.level")
## [1] 0.95
```

```
hypo4$p.value
```

```
## [1] 0.9638516
```

The confidence interval includes the value of zero and the p-value greater than the threshold of 0.05. We cannot reject this null hypothesis.

Conclusions and Assumptions

With consuming orange juice, we obtain more tooth growth than ascorbic acid for the dosage of 0.5 and 1.0.

If we specify the dosage of 2.0 milligram/day for consumption of orange juice and scorbic acid, then the amount of growth for tooth will be the same.

Due to this diversity, we cannot conclude that the orange juice is more effective than ascorbic acid.

Assumptions:

- 1) The tooth lengths data have normal distribution.
- 2) The tooth length is not affected by any other unmeasured factors.