The Effect of Vitamin C on Tooth Growth in Guinea Pigs

Philip Wong

29/05/2022

Overview

Now in the second portion of the class, we're going to analyze the ToothGrowth data in the R datasets package.

1. Load the ToothGrowth data and perform some basic exploratory data analyses
2. Provide a basic summary of the data.
3. 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)
4. State our conclusions and the assumptions needed for our conclusions.

Load the ToothGrowth data and perform exploratory data analyses

```
# import libraries
library(datasets)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5      v purrr   0.3.4
## v tibble  3.1.6      v dplyr   1.0.8
## v tidyr   1.2.0      v stringr 1.4.0
## v readr   2.1.1      v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
# import data
data(ToothGrowth)
str(ToothGrowth)
head(ToothGrowth)
glimpse(ToothGrowth)
```

```
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") +
theme_bw()
```

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


Guinea pig tooth length by dosage for each type of supplement
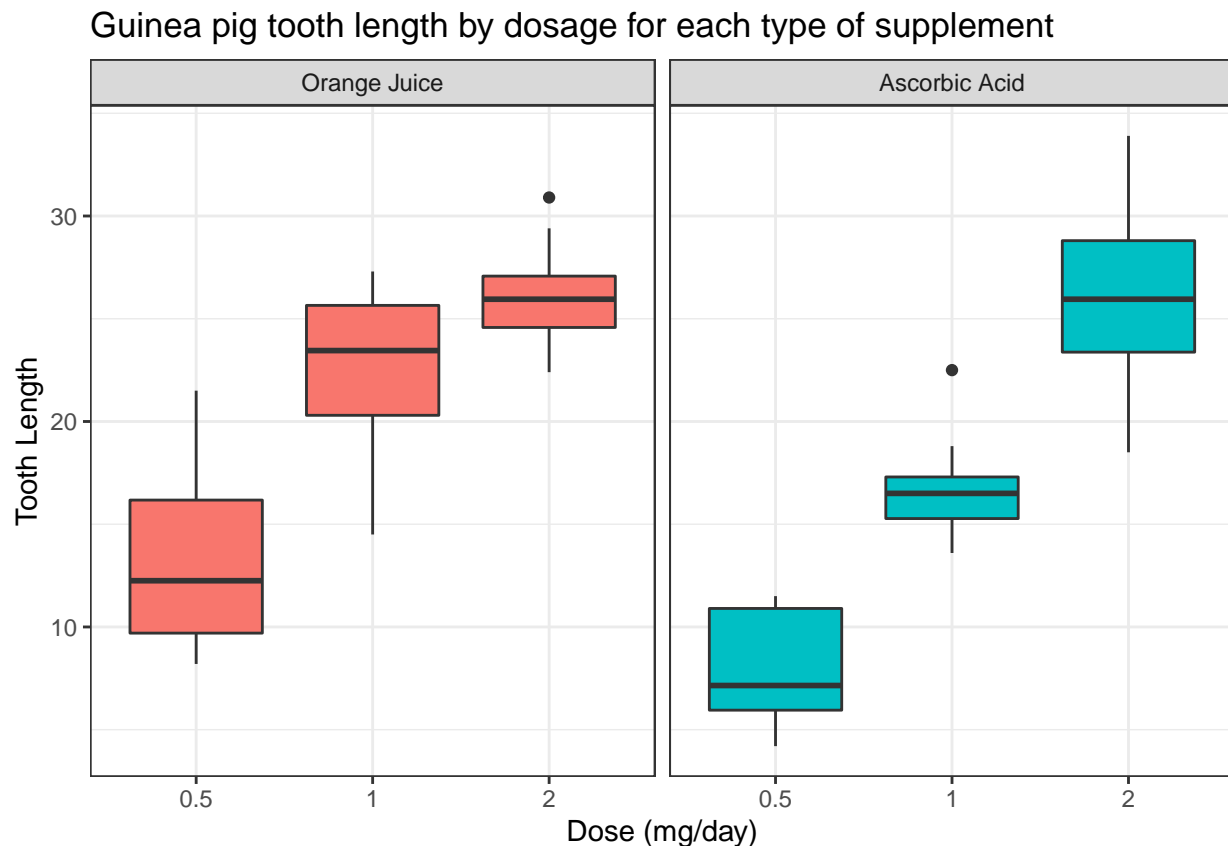
Basic summary of the data

The box plots seem to show, increasing the dosage increases the tooth growth. Orange juice is more effective than ascorbic acid for tooth growth when the dosage is .5 to 1.0 milligrams per day.

Use confidence intervals & hypothesis tests to compare tooth growth by supplement and dose

Hypothesis #1 Orange juice & ascorbic acid deliver the same tooth growth across the data set.

```
hypoth1<-t.test(len ~ supp, data = t)
hypoth1$conf.int
```

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

```
hypoth1$p.value
```

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

The confidence intervals includes 0 and the p-value is greater than the threshold of 0.05. The null hypothesis cannot be rejected.

Hypothesis #2   For the dosage of 0.5 mg/day, 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
```

The confidence interval does not include 0 and the p-value is below the 0.05 threshold thus the null hypothesis can be rejected.

Hypothesis #3   For the dosage of 1 mg/day, the two supplements deliver the same tooth growth

```
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 is smaller than the 0.05 threshold. The null hypothesis can be rejected.

Hypothesis #4   For the dosage of 2 mg/day, the two supplements deliver the same tooth growth

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

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

```
hypoth4$p.value
```

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

The confidence interval does include 0 and the p-value is larger than the 0.05 threshold. The null hypothesis cannot be rejected.

Conclusions & assumptions

Orange juice delivers more tooth growth than ascorbic acid for dosages 0.5 & 1.0. Orange juice and ascorbic acid deliver the same amount of tooth growth for dose amount 2.0 mg/day. For the entire data set we cannot conclude orange juice is more effective that ascorbic acid.

Assumptions

- Normal distribution of the tooth lengths
- No other unmeasured factors are affecting tooth length