

Impact of different vitamin C dose levels and supplement types on tooth lengths of Guinea pigs

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Overview

In this short report we are going to analyze the TootGrowth data of the R data sets package which describes the effect of vitamin C on tooth growth in guinea pigs

The ToothGrowth data set consists of 60 observations of 3 variables:

- len: Tooth length in millimeters (numeric variable)
- supp: Supplement type (factor variable with levels VC and OJ)
- dose: Dose in milligrams (numeric variable)

Even though dose is a numeric variable we will treat it as a factor in the subsequent analysis because only three dose levels of Vitamin C (0.5, 1, and 2 mg) were used.

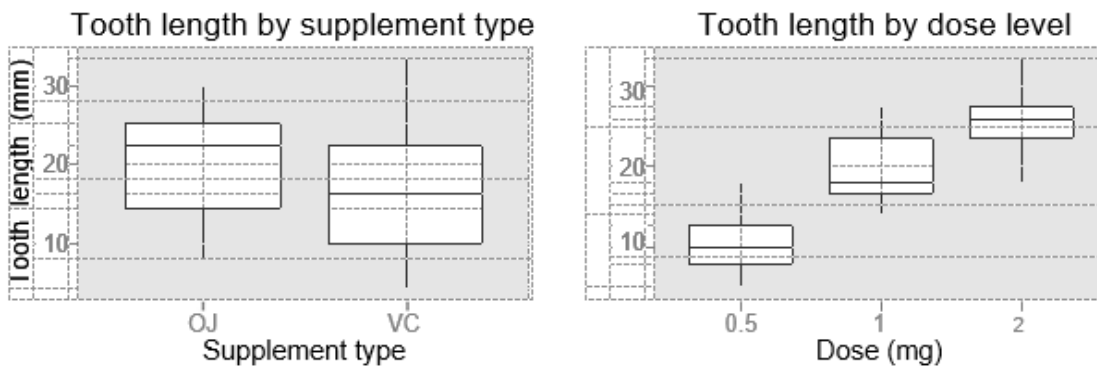
In total, we deal with 60 unique guinea pigs. Each pig was assigned to a group which received a specific dose level of vitamin C. In addition, in each of those groups two different delivery methods (orange juice or ascorbic acid) were applied leaving 10 pigs per subgroup:

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

Exploratory data analysis

The average guinea pig tooth length is 18.813 with a standard deviation of 7.649.

However, we are more interested in finding differences in tooth length across different groups of supplement types, dose levels and their respective combinations.

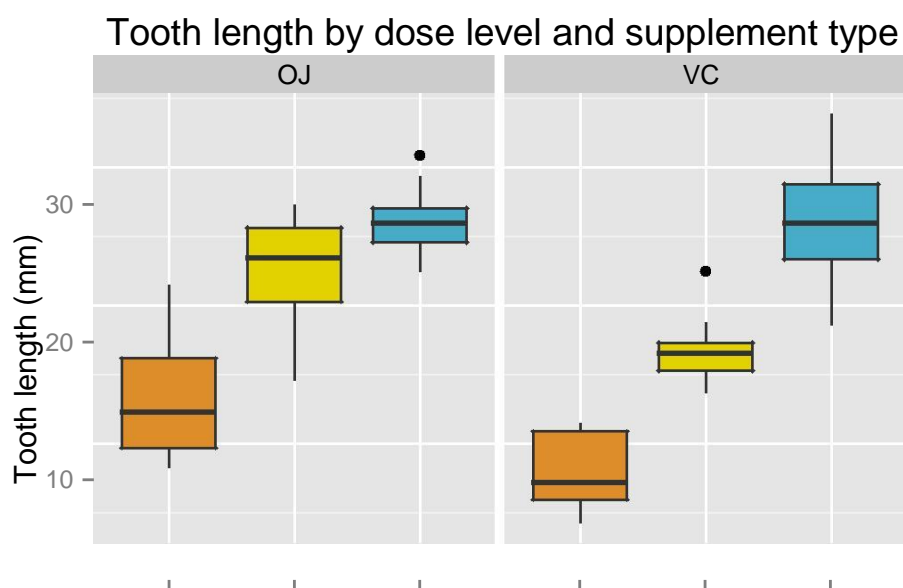


The left box plot above reveals that guinea pigs which received their dose of vitamin C using orange juice have on average a greater tooth length than those pigs which got their dose using ascorbic acid. The orange juice group distribution is skewed to the left whereas the ascorbic acid group seems to be fairly symmetric.

Grouping by dose level (right hand side box plot) reveals even greater differences in tooth length and their respective means. The differences between the dose level groups are so big that not even the interquartile range boundaries overlap:

```
## dose q25 q75
##1 0.5 7.225 12.250
##2 1.0 16.250 23.375
##3 2.0 23.525 27.825
```

Both trends can be further observed when examining tooth length differences across both groups at the same time.



0.5 1 2 0.5 1 2
Dose (mg)

Hypothesis tests

Conditions

Since we dealing with subsets of $n \leq 30$ our standard error estimate will generally not be accurate. Therefore, we will use the t distribution for our hypothesis tests and when constructing confidence intervals.

Based on the current information it is hard to check if the 2 necessary prerequisites for this setup are met:

1. Independence of the observations
2. Observations come from a nearly normal distribution.

However, we assume that the guinea pigs were randomly assigned to one of the groups (guarantees independence) and that they were sampled from a nearly normal population.