

Analysing the Tooth Growth dataset

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April 17, 2016

Synopsis

Vitamin C can affect the tooth growth. In this report we compare the effect of different doses of vitamin C, delivered in two methods on the tooth growth of guinea pigs. The sample are 60 guinea pigs. Each animal received 0.5, 1 or 2 mg/day vitamin C in the form of orange juice or ascorbic acid.

The study is done on the ToothGrowth dataset in R. The dataset contains 60 rows and 3 columns. Columns are “len”, “supp” and dose which indicate the length of odontoblasts (cells responsible for tooth growth), supplement method (“OG” for orange juice and “VC” for ascorbic acid) and the daily dose, respectively.

Summary of the data

The aim would be comparing the average effect of different doses of different delivery methods. So lets look at how they look like. First we load the data and summarise it based on supp and dose.

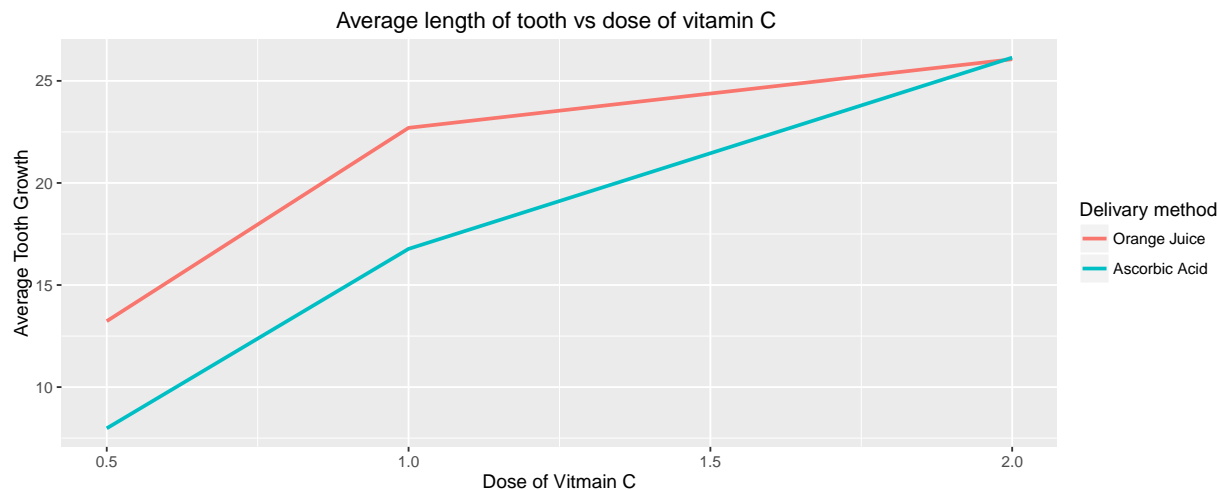
```
library(plyr)
data("ToothGrowth")
total <- ddply(ToothGrowth, .(supp, dose), summarise,
               Average_Growth = mean(len))
```

Lets look at the summarised table.

| ## | supp | dose | Average_Growth |
|------|------|------|----------------|
| ## 1 | OJ | 0.5 | 13.23 |
| ## 2 | OJ | 1.0 | 22.70 |
| ## 3 | OJ | 2.0 | 26.06 |
| ## 4 | VC | 0.5 | 7.98 |
| ## 5 | VC | 1.0 | 16.77 |
| ## 6 | VC | 2.0 | 26.14 |

It seems that the orange juice method shows better effect in 0.5 and 1 mg/day dose but ascorbic acid method fills the gap in 2 mg/day dose. This is shown in the diagram below.

```
library(ggplot2)
p <- ggplot(total, aes(dose, Average_Growth, color = supp)) +
  geom_line(stat = "identity", size = 1)
p + labs( title= "Average length of tooth vs dose of vitamin C ", x = "Dose of Vitmain C", y = "Average
```



Comparing average tooth growth

In this section we will test our observations in the last section. Exactly we are going to test the null hypothesis

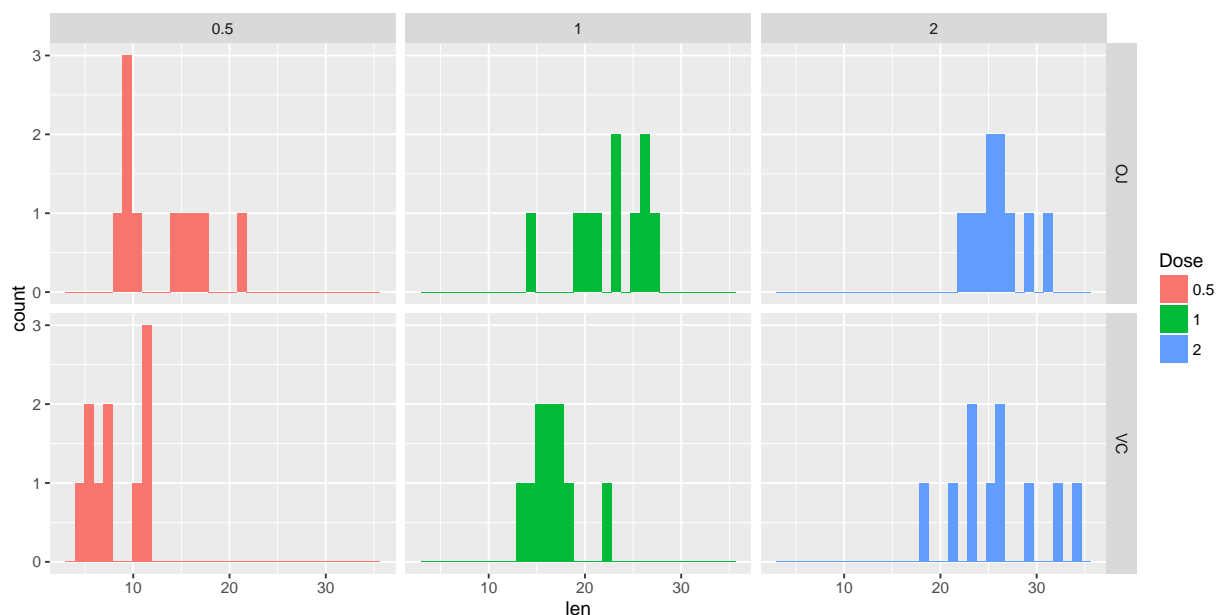
- H_0 : The average tooth growth in a similar dosage by both delivery methos are equal

against alternative hyphothesis

- H_1 : The average tooth growth in a similar dosage by both delivery methos are not equal

This will be done with two methods. First t-confidence inter and then permutation tests. ##t-confidence interval Note that the number of samples are small (10 for each case) so t-test would be the parametric test candidate. Also look at he histogram of len

```
qplot(len, data = ToothGrowth, geom = "histogram", facets = supp~dose, fill = as.factor(dose)) + scale_f
```



The distribution is acceptigly summetric so we allow ourselve to use the t-test function in R.

Comparing average growth when dsoe = 0.5

Here is the code

```
d <- 0.5
t <- t.test(ToothGrowth$len[ToothGrowth$supp == "OJ" & ToothGrowth$dose == d],
            ToothGrowth$len[ToothGrowth$supp == "VC" & ToothGrowth$dose == d], paired = F)
```

In this case the average tooth growth by orange juice method is 13.23 and by ascorbic acid 7.98. Also the confidence interval is (1.7190573, 8.7809427) which does not contain 0. Therefore we reject the null hyphotesis and the two averages are not equal.

Comparing average growth when dsoe = 0.1

Code is imilar. In this case the average tooth growth by orange juice method is 22.7 and by ascorbic acid 16.77. The confidence interval is (2.8021482, 9.0578518) which agian does not contain 0. Therefore we reject the null hyphotesis and the two averages are not equal.

Comparing average growth when dsoe = 2

In this case the story is different. The averae tooth growth using orange juice and ascorbic acic are resoectively 26.06 and 26.14 quite close. The confidence interval is (-3.7980705, 3.6380705) containing 0. Therefore we fail to reject the null hyphotesis and the effect of two methods in the 2 mg/day dose are probably similar.