Teeth and Vitamin C

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January 1, 2017

The dataset (ToothGrowth)

The set of "data sets" contains data sets used to make examples, in particular it contains the famous set Iris that was used by Fisher to exemplify and develop various statistical themes

On the other hand in this exercise we use the dataset ToothGrowth which registers the response to the length of the cells odontoblasts, which are responsible for the production of the substance dentin for tooth growth, In 60 Guinea pigs who Received three different doses of vitamin C administered in two forms (orange juice and ascorbic acid).

Figure 1: Guinea pigs

So, we load the dataset...

```
library(datasets)
data <- ToothGrowth
```

Exploratory analysis

The descriptive statistics of the variables in our data set are shown in Table 1. The descriptive statistics of the variables in our dataset are shown in Table 1.

```
kable(summary(data))
```

len	supp	dose
Min. : 4.20	OJ:30	Min. :0.500
1st Qu.:13.07	VC:30	1st Qu.:0.500
Median :19.25	NA	Median :1.000
Mean :18.81	NA	Mean :1.167
3rd Qu.:25.27	NA	3rd Qu.:2.000
Max. :33.90	NA	Max. :2.000

Table 1: Note the distribution of the vitamin C pathway, 30 individuals with orange juice (OJ) and 30 individuals given ascorbic acid (VC).

It is also worth noting the distribution of doses in the table, as can be seen in Table 2. Each group of the form of administration of vitamin C (OJ or VC) has 10 individuals to whom 0.5 or 1 or 2 mg / day, We would say it was a well-designed experiment.

```
kable(table(data$supp, data$dose))
```

	0.5	1	2
OJ	10	10	10
VC	10	10	10

Table 2: Distribution of the individuals in the sample by vitamin C pathway and dose.

On the other hand, in figure 1 (upper) is the distribution of the length of the teeth, in the sample, in the function of the administration route and also in figure 2 (down) is the distribution of the length Of the teeth depending on the dose administered.

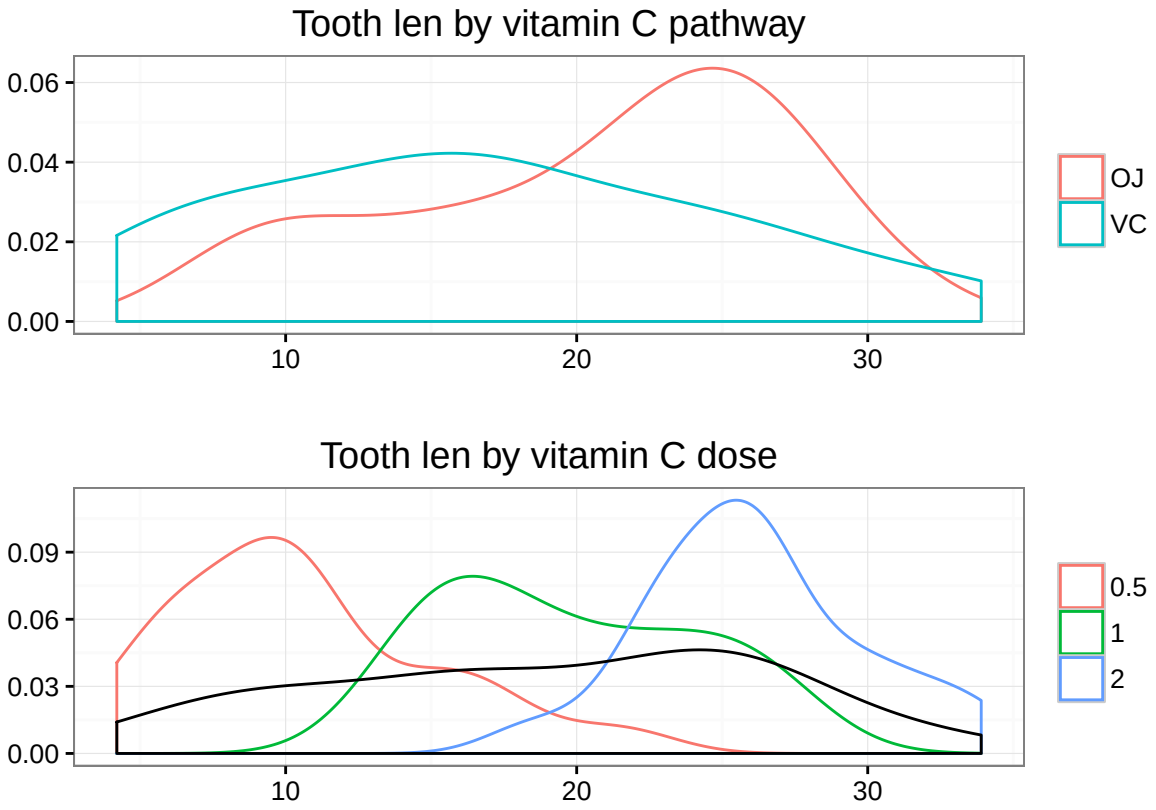

Figure 1: Tooth length distribution (upper) by pathway and (down) dose.

Hypothesis tests

We first used a student t test to contrast the hypothesis that the mean length of the cells in the sets formed by individuals to which the administration of vitamin C per juice is *equal* to the group given ascorbic acid.

```
t.test(len ~ supp, data = data)
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 1.9153, df = 55.309, p-value = 0.06063
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1710156  7.5710156
## sample estimates:
## mean in group OJ mean in group VC
##         20.66333         16.96333
```

Since the $ p-value $ of the test is greater than 0.05 then the **null hypothesis** that both groups have the same mean **is not rejected**, although this variable is distributed differently as we can see in figure 1 (upper), *so that in the context of the problem both administration routes showed similar results in terms of tooth growth.*

We now perform a Student's t test to test the hypothesis that the dose of vitamin C administered has the same results in the group receiving 0.5 mg / day and the group receiving 1 mg / day in tooth growth.

```r
t.test(len ~ supp, data = subset(data, dose %in% c(0.5,1) ))
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 3.0503, df = 36.553, p-value = 0.004239
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.875234 9.304766
## sample estimates:
## mean in group OJ mean in group VC
##           17.965           12.375
```

In this case, the $ p-value $ of the test is less than 0.05, thus rejecting the hypothesis that the length of the teeth is the same in both groups with a confidence of 0.95%. Then we repeated the test for the groups that received 1 mg / day and 2 mg / day

```r
t.test(len ~ supp, data = subset(data, dose %in% c(1,2) ))
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 1.8397, df = 31.273, p-value = 0.07533
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.3166175  6.1666175
## sample estimates:
## mean in group OJ mean in group VC
##           24.380           21.455
```

In this case, since $ p-value $ is less than 0.05, we do not reject the hypothesis that both groups have the same mean for the variable that measures the length of the teeth. As we can see in Figure 2 (below) the group receiving 1 mg / day has a less different distribution than the group receiving 2 mg / day (as they share the mean) with respect to the group receiving 0.5 mg / day Because with this does not share the average).

Conclusion

The route of administration does not affect the growth of the guinea pigs' teeth, this may be orange juice or ascorbic acid, however the dose does affect the average length, in the group where 2 mg / day was administered Greater growth however this is very similar to that of the group that only received 1 mg / day