Tooth Growth Study

Inferential Statistics Course - week 4 project - part 2

erickfis, 2017 maio, 29

Contents

1 Methodology

This is a study about the effects of vitamin C over the number of odontoblasts (cells responsible for tooth growth) of 60 guinea-pigs. If the number of odontoblasts grows, so does the teeth of the pigs.

Each pig received one of three different dosages of vitamin C: 0.5, 1 or 2 mg/day.

Each pig was treated by one of two different delivery methods: via orange juice or via ascorbic acid (VC)

We are going to test some hypothesis about the vitamin C influence over tooth growth.

There is not a control group.

2 Summary of the data

Here is a brief summary of data:

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```

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

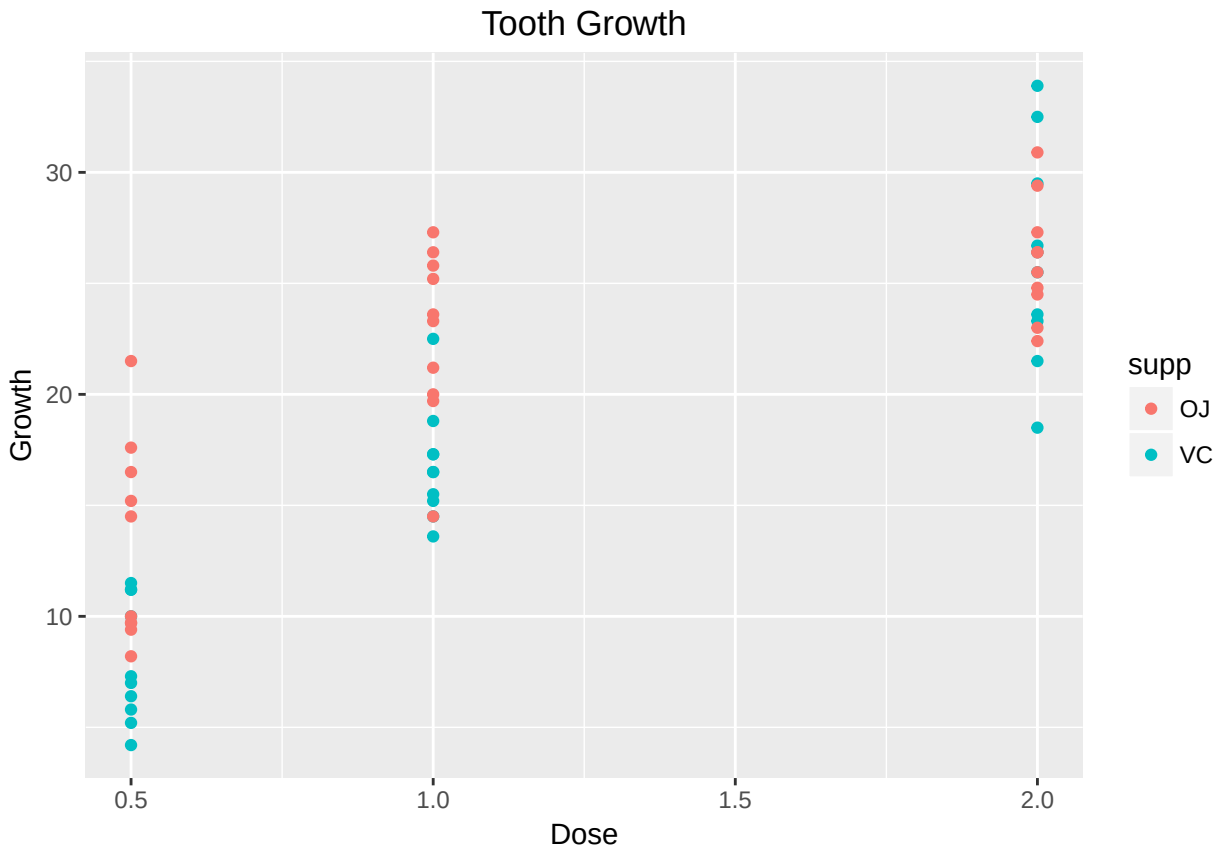

Figure 1: Tooth Growth data

3 Hypothesis testing

3.1 Vitamin C Dosis

Since the pigs were treated with different doses of Vitamin C, the first question we need to address is whether the amount of vitamin C administered to each pig does any difference in their tooth growth.

The different doses were:

```
## [1] 0.5 1.0 2.0
```

So, since there is not a control group, lets test the hypothesis that the doses matter: is the growth associated with the 2.0 mg doses greater than the growth associated with 0.5 doses?

$$H_0 : \mu_{0.5mg} = \mu_{2.0mg} \leftrightarrow H_\alpha : \mu_{2.0mg} > \mu_{0.5mg}$$

Lets split the 2 groups and test the hypothesis through a one-sided T-test

```
g05 <- subset(dados$len, dados$dose == 0.5)
g2 <- subset(dados$len, dados$dose == 2)

t.test(g2, g05, alternative = "greater", paired = FALSE, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  g2 and g05
## t = 11.799, df = 36.883, p-value = 0.00000000000002199
## alternative hypothesis: true difference in means is greater than 0
## 95 percent confidence interval:
##  13.27926      Inf
## sample estimates:
## mean of x mean of y
##    26.100    10.605
```

Notice the very small p-value.

Just for comparison, lets do this test *by hand* through its confidence interval:

```
n2 <- length(g2)
n05 <- length(g05)
sd2 <- sd(g2)
sd05 <- sd(g05)
se1 <- sqrt(((n2-1)*sd2^2 + (n05-1)*sd05^2) / (n2 + n05 -2))
se2 <- sqrt(1/n2 + 1/n05)
se <- se1*se2
ci <- mean(g2) - mean(g05) + c(-1,1)*qt(.95,df = (n2+n05 -2))*se
ci <- round(ci,2)
ci
```

```
## [1] 13.28 17.71
```

Notice that 0 isn't in the confidence interval, so $\mu_{0.5mg} - \mu_{2.0mg} \neq 0$, ever! The true difference of means will always be between 13.28, 17.71 mm.

We can infer by this 95% test that H_0 must be rejected and therefore, **a larger dosis results in larger tooth growth!**

3.2 Vitamin C Delivery Method

What is the best delivery method?

The delivery methods are:

```
## [1] VC OJ
## Levels: OJ VC
```

OJ means Orange Juice while VC means ascorbic acid.

Lets test the null hypothesis that the deliver methods yields the same results:

$$H_0 : \mu_{juice} = \mu_{acid} \leftrightarrow H_\alpha : \mu_{juice} \neq \mu_{acid}$$

The first thing to do is to separate the data between the two delivery methods and then run a two-sided T-test on the groups.

```
juicers <- subset(dados$len, dados$supp=="OJ")
trippin <- subset(dados$len, dados$supp=="VC")

t.test(juicers, trippin, paired = FALSE, var.equal = FALSE, alternative = "two.sided")
```

```
##
##  Welch Two Sample t-test
##
## data:  juicers and trippin
## 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 of x mean of y
##  20.66333  16.96333
```

Interesting enough, the T-test yields a confidence interval and a p-value that led us to **fail to reject H_0.**

Therefore, **the two delivery methods produces the same results**

4 Results

As we can see through the T-tests performed, we can infer that:

1. a larger doses results in larger tooth growth
2. the two delivery methods produces the same results