

Statistical Inference Project: Tooth Growth Hypothesis Testing

K Pascual

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Overview

This report aims to determine whether an ascorbic acid (VC) or orange juice (OJ) treatment have different effects on teeth growth in the case of the R data set ToothGrowth. For each level of dosage (0.5, 1.0, and 2.0 mg/day), tooth growth for Ascorbic acid and orange juice were compared.

Data loading and summary

Data was loaded from the package “datasets”. A summary of the data is shown below.

```
data(ToothGrowth)
summary(ToothGrowth)
```

```
##      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
```

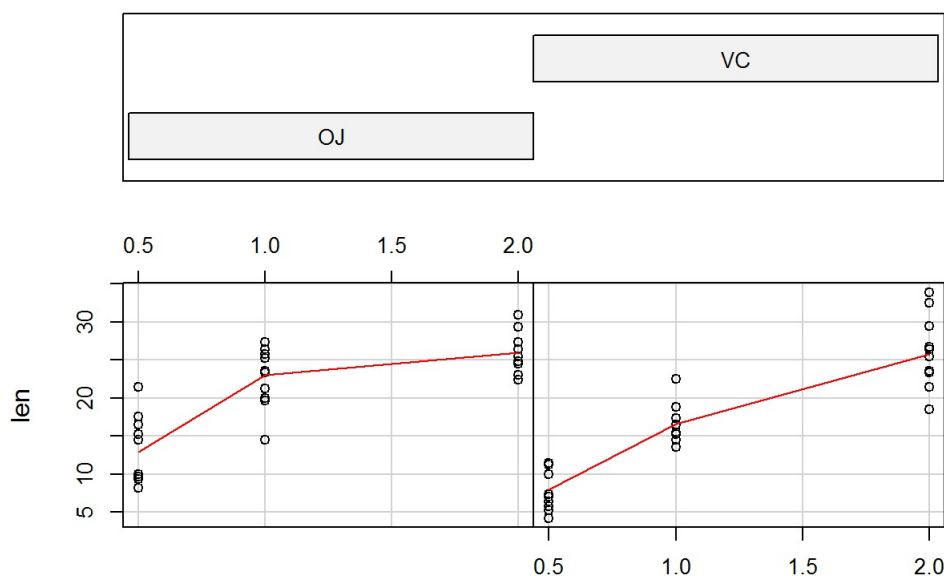
```
str(ToothGrowth)
```

```
## '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 ...
```

Initial comparison of the data using coplot:

```
require(graphics)
coplot(len ~ dose | supp, data = ToothGrowth, panel = panel.smooth,
       xlab = "ToothGrowth data: length vs dose, given type of supplement")
```

Given : supp



ToothGrowth data: length vs dose, given type of supplement

From the initial plot, OJ looks more effective than VC for doses 0.5 and 1.0, and no significant difference for dose 2.0.

Data processing and t-tests

First get the subsets for VC and OJ, and split each by dose.

```
vcSet = ToothGrowth[ToothGrowth$supp %in% "VC", ]
ojSet = ToothGrowth[ToothGrowth$supp %in% "OJ", ]
vcSplit = split(vcSet, vcSet$dose)
ojSplit = split(ojSet, ojSet$dose)
vcSplitDf = as.data.frame(vcSplit)
ojSplitDf = as.data.frame(ojSplit)
```

To verify whether the OJ supplement is more effective than the VC supplement, we use the t-test for unpaired values with uneven variance. These two values are unpaired because they are independent of each other. It is also assumed that there is unequal variance because there is no information indicating that there is equal variance.

Let our H_0 (null hypothesis) be that there is no significant difference between the tooth growth effects of ascorbic acid and orange juice.

At dosage rate **0.5 mg**, the 95% confidence interval is above 0, implying that OJ has more effect than VC. We reject the null hypothesis for this case.

```
t.test(ojSplitDf[,1], vcSplitDf[,1])$conf.int
```

```
## [1] 1.719057 8.780943
## attr(,"conf.level")
## [1] 0.95
```

At dosage rate **1.0 mg**, the 95% confidence interval is still below 0. OJ is still more effective than VC for this dosage rate. We again reject the null hypothesis for this case.

```
t.test(ojSplitDf[,4], vcSplitDf[,4])$conf.int
```

```
## [1] 2.802148 9.057852
## attr(,"conf.level")
## [1] 0.95
```

At dosage rate **2.0 mg**, the 95% confidence interval contains 0. From this, we can infer that there is no significant difference between the effects of OJ and VC for this dosage rate. We then accept the null hypothesis for this case.

```
t.test(ojSplitDf[,7], vcSplitDf[,7])$conf.int
```

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

Conclusion

The orange juice supplement shows more increase in teeth growth than ascorbic acid for dosages of 0.5 mg/day and 1.0 mg/day. However, for a dosage of 2.0, there is no significant difference between the effects of orange juice and ascorbic acid.

References

<https://stat.ethz.ch/R-manual/R-devel/library/datasets/html/ToothGrowth.html> (<https://stat.ethz.ch/R-manual/R-devel/library/datasets/html/ToothGrowth.html>)