Response Effect of Vitamin C on Odontoblast Length

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Overview

This study analyzes the length of odontoblasts (teeth) in each of 10 guinea pigs in response to three dose levels of Vitamin C (0.5, 1, and 2 mg) with each of two delivery methods (orange juice or ascorbic acid).

Basic Exploratory Analysis

The source data frame conta 60 observations on 3 variables:

```
head(ToothGrowth)
```

```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
## 4  5.8   VC  0.5
## 5  6.4   VC  0.5
## 6 10.0   VC  0.5
```

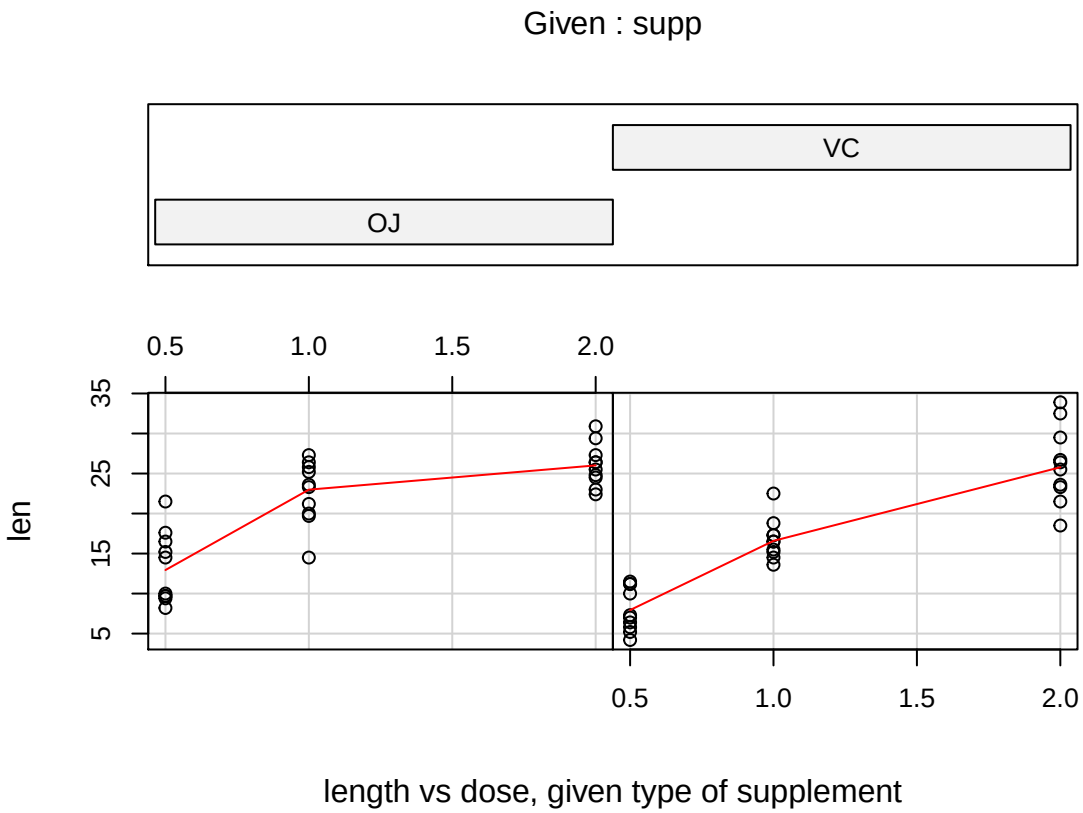
Where:

- [,1] len numeric Tooth length
- [,2] supp factor Supplement type (VC or OJ).
- [,3] dose numeric Dose in milligrams.

The response is the length of odontoblasts (teeth) in each of 10 guinea pigs at each of three dose levels of Vitamin C (0.5, 1, and 2 mg) with each of two delivery methods (orange juice or ascorbic acid).

The conditioning plot associated to the 2 sets of supplements, and by dose, gives some insight in the data:

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



We can see an increase of length given the type of supplement (ascorbic acid and orange juice), as well as we increase the dosage (from 0.5mg to 1.0mg to 2.0mg).

The plot does not show the quantification of this benefit as a hypothesys and a confidence to base on for the adoption of each treatment.

Hypothesis Testing

We will consider the hypothesis H_0 to indicate that the treatment brings no effect, i.e. the use of ascorbic acid or orange juice is irrelevant and μ_0 of the differences is zero. The alternative hypothesys H_1 will tell us that the mean of the differences is not close to zero, and the treatment is effective with a 95% chance.

$H_0 : \mu_0 = 0$

$H_1 : \mu_1 <> 0$

We will test or μ_0 for the difference for each of the doses computed as `diff05`, `diff10` and `diff20` for respectivelly 0.5, 1 and 2 mg dosages:

```
diff05 <- filter(ToothGrowth, as.character(supp)=='OJ' & dose==0.5)$len -
    filter(ToothGrowth, as.character(supp)=='VC' & dose==0.5)$len
diff10 <- filter(ToothGrowth, as.character(supp)=='OJ' & dose==1.0)$len -
    filter(ToothGrowth, as.character(supp)=='VC' & dose==1.0)$len
diff20 <- filter(ToothGrowth, as.character(supp)=='OJ' & dose==2.0)$len -
    filter(ToothGrowth, as.character(supp)=='VC' & dose==2.0)$len
```

And we test our hypothesis for each of the differences:

```
rbind(
    t.test(diff05, paired=FALSE)$conf,
    t.test(diff10, paired=FALSE)$conf,
    t.test(diff20, paired=FALSE)$conf
)
```

```
##           [,1]     [,2]
## [1,]  1.263458 9.236542
## [2,]  1.951911 9.908089
## [3,] -4.328976 4.168976
```

Conclusion

You can see that the confidence interval does not contain the hypothesized population $\mu_0 = 0$ in H_0 for 0.5mg and 1.0mg, so we can safely reject H_0 in those cases, and accept H_1:

- *Use of ascorbic acid instead of orange juice is expected to bring benefits for 0.5mg and 1.0mg dosages*

For one dose, 2.0mg, we cannot reject H_0:

- *Use of ascorbic acid instead of orange juice is irrelevant for 2.0mg dosages*