Study on the Effect of Vitamin C on Tooth Growth in Guinea Pigs

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Overview:

In this study, we will investigate the response in the length of dontoblasts (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).

ToothGrowth Datasets:

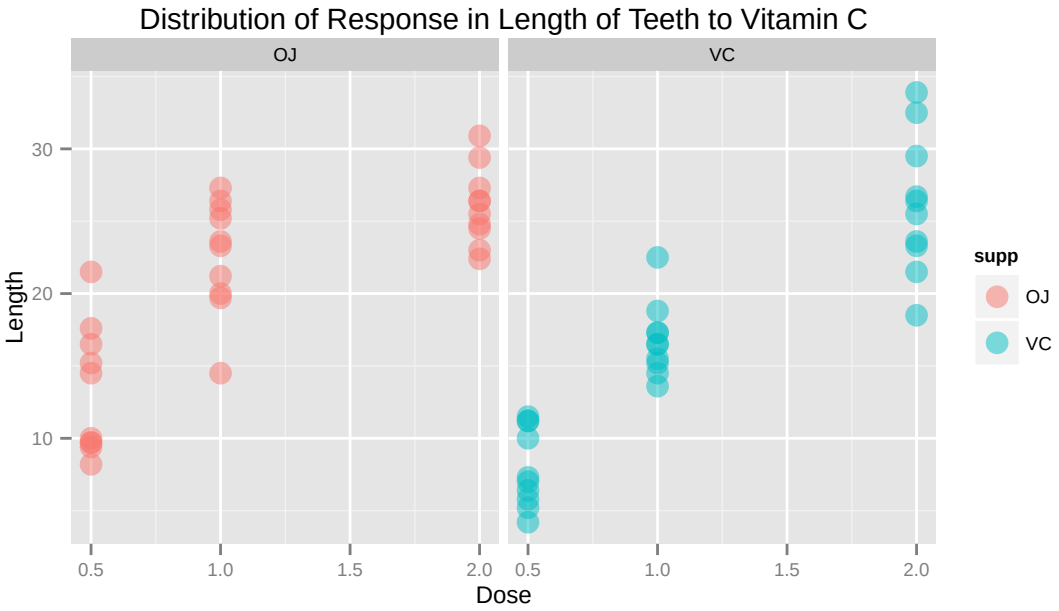
A data frame with 60 observations on 3 variables.

Name	Type	Description
len	numeric	Tooth length
supp	factor	Supplement type (VC or OJ)
dose	numeric	Dose in milligrams.

```
## load the ToothGrowth datasets
data(ToothGrowth)
head(ToothGrowth)
```

Sample data:

```
##    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
```



From the figure above, it shows that

- regardless of the delivery method, i.e. OJ or VC, the response in length of teeth is higher with higher dosage of Vitamin C given.
- for Vitamin C dosage of 0.5 and 1, the response in length of teeth is higher for OJ (orange juice) delivery method as compared to VC (ascorbic acid).

Hypothesis Test:

Test $H_0 : \mu_1 - \mu_2 = 0$ at 5% level test

Assumptions

- the test are conducted on 60 guinea pigs, i.e. results are not paired.
- as we do not know the variance for each distribution, we have assumed that the variance is unequal for our analysis.

1. Hypothesis Test on Delivery methods (orange juice or ascorbic acid)

We want to know, based on the sample data, if we have strong evidence of a difference in average response in length of teeth in the 2 delivery methods.

t-test result:

$$t(55.31) = 1.92, p = 0.0606345$$

(refer to Result 1 in Appendix for more details)

With a 95% confidence interval of [-0.17, 7.57], as p > 5%, we do not think there is sufficient evidence of a difference in the population and stick with the null hypothesis that there is no difference in average response in length of teeth resulting from different delivery method.

2. Hypothesis Test on Dosage

a. Dosage of 1mg and 0.5mg

We want to know, based on the sample data, if we have strong evidence of a difference in average response in length of teeth for Vitamin dosage of 1mg and 0.5mg.

t-test result:

$$t(37.99) = 6.48, p = 1.2683007 \times 10^{-7}$$

(refer to Result 2a in Appendix for more details)

With a 95% confidence interval of [6.28, 11.98], as p $<$ 5%, our sample difference is clearly quite unlikely given that the null-hypothesis is true, therefore we decide to reject our null hypothesis in favour of an alternative: that there is an actual difference in average response in length of teeth for Vitamin dosage of 1mg and 0.5mg.

b. Dosage of 2mg and 1mg

t-test result:

$$t(37.1) = 4.9, p = 1.9064295 \times 10^{-5}$$

(refer to Result 2b in Appendix for more details)

With a 95% confidence interval of [3.73, 9], as p $<$ 5%, our sample difference is clearly quite unlikely given that the null-hypothesis is true, therefore we decide to reject our null hypothesis in favour of an alternative: that there is an actual difference in average response in length of teeth for Vitamin dosage of 2mg and 1mg.

c. Dosage of 2mg and 0.5mg

t-test result:

$$t(36.88) = 11.8, p = 4.397525 \times 10^{-14}$$

(refer to Result 2c in Appendix for more details)

With a 95% confidence interval of [12.83, 18.16], as p $<$ 5%, our sample difference is clearly quite unlikely given that the null-hypothesis is true, therefore we decide to reject our null hypothesis in favour of an alternative: that there is an actual difference in average response in length of teeth for Vitamin dosage of 2mg and 0.5mg.

Conclusion:

Based on our study,

- there is no difference in average length of teeth resulting from different delivery method; and
- that there is an actual difference in average response in length of teeth for different Vitamin C dosage.