

Analysis of Vitamin C on Tooth Growth in Guinea Pigs

Synopsis

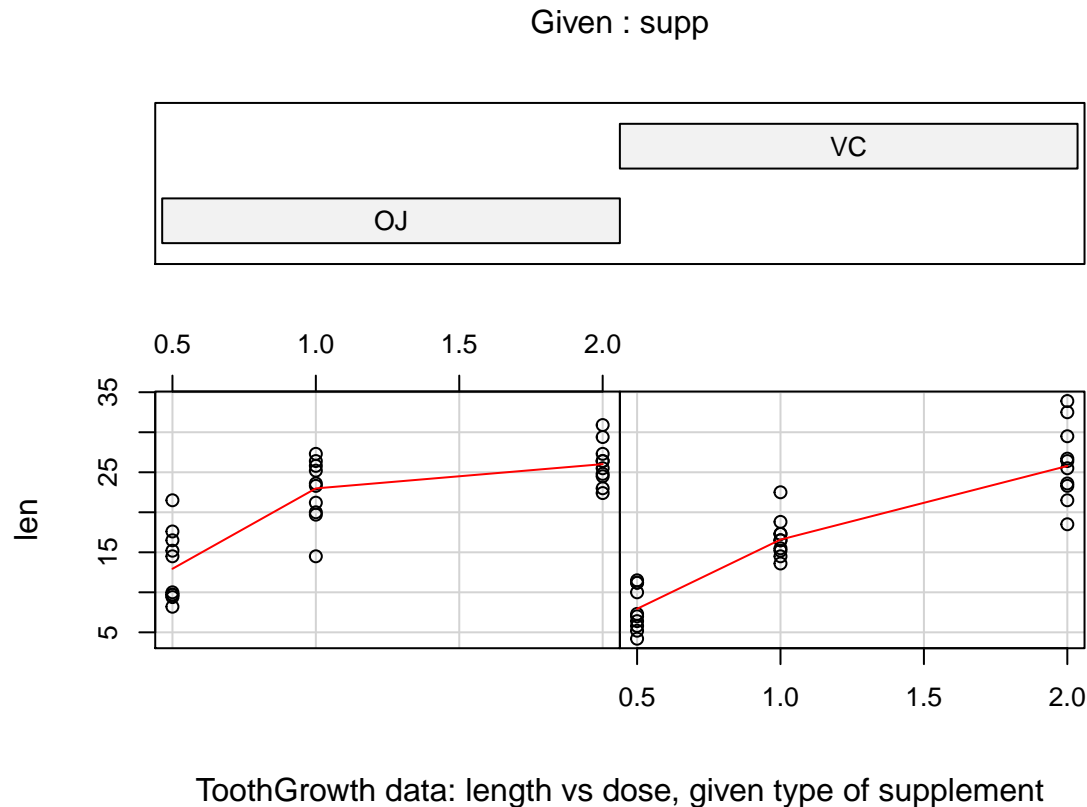
The purpose of this report is to analyze the effects of Vitamin C and delivery methods of Vitamin C on tooth growth in guinea pigs. The data set is provided within the datasets package provided by the R programming language.

Review of the data

The dataset contains 60 observations of tooth growth in guinea pigs. The observations are broken into six sets of ten, each set with a unique combination of dosage level (in milligrams) and supplement type (VC = ascorbic acid, OJ = orange juice). We are assuming each set of observations contains ten different guinea pigs, which means the data is not paired in any way. We also assume differing variances between each set of observations.

Using code provided with the help contents for the guinea pig data set, we plot the data and get a general overview of what it looks like:

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



A quick look at the data suggests that in both dosage types, larger levels of Vitamin C result in more tooth growth. Although not as obvious, it appears dosages delivered through orange juice may result in larger tooth growth.

Statistical Analysis

Because our samples sizes are small, we will perform the statistical analysis using t-confidence intervals. For each dosage type we will compare the the dosage pair levels 0.5/1.0 and 1.0/2.0. We assume that $2.0 > 0.5$ will transitively be true if the data shows that $1.0 > 0.5$ and $2.0 > 1.0$,

We will also analyze whether dosage types make a difference in tooth growth. For each dosage level we will compare across the two dosage types.

Each analysis will use a null hypothesis that the two two samples have the same mean.

Comparing Dosage Levels

Using the `t.test` function provided by R, we create a table that displays the t statistic values when comparing neighboring dosage levels for each dosage type.

##		t	df	p-value	conf interval	sample estimates
##	VC 1.0 vs 0.5:	7.463	17.86	6.811e-07	6.314, 11.266	16.77, 7.98
##	VC 2.0 vs 1.0:	5.470	13.60	9.156e-05	5.686, 13.054	26.14, 16.77
##	OJ 1.0 vs 0.5:	5.049	17.70	8.785e-05	5.524, 13.416	22.7, 13.23
##	OJ 2.0 vs 1.0:	2.248	15.84	3.920e-02	0.189, 6.531	26.06, 22.7

The data provides pretty strong evidence that our initial assumption is correct. For both dosage types, increasing the dosage results in larger tooth growth.

Comparing Dosage Levels

We now perform the same type of tests, except this time we are comparing dosage type across matching dosage levels.

##		t	df	p-value	conf interval	sample estimates
##	0.5 OJ vs VC:	3.170	14.97	0.006359	1.719, 8.781	13.23, 7.98
##	1.0 OJ vs VC:	4.033	15.36	0.001038	2.802, 9.058	22.7, 16.77
##	2.0 OJ vs VC:	-0.046	14.04	0.963852	-3.798, 3.638	26.06, 26.14

In this case, we see that there is strong evidence that larger tooth growth occurs for the OJ dosage type with 0.5 or 1 mg dosages compared to the VC dosage type. However, for dosage levels of 2 mg, we cannot say that there is any statistical difference in tooth growth between the two dosage types.

Summary

In summary, our tests show that higher dosage levels of Vitamin C result in larger tooth growth among guinea pigs. However, larger tooth growth is only affected by dosage type at the lower levels of dosage.

Complete Rmd File

The complete Rmd file for this report can be found at the following url: [tooth_growth_analysis.Rmd](#)