Inferential Data Analysis (Guinea Pig Tooth Growth)

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Overview

In this project, we investigate the impact that dosage levels and delivery methods of Vitamin C may or may not have on the growth of guinea pig teeth. The data comes from the "ToothGrowth" set in the {datasets} package in R.

Description

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).

Format

A data frame with 60 observations on 3 variables.

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

Source

C. I. Bliss (1952) The Statistics of Bioassay. Academic Press.

References

McNeil, D. R. (1977) Interactive Data Analysis. New York: Wiley.

Exploratory Analysis

First, load the ToothGrowth dataset.

```
library(datasets)
data("ToothGrowth")
```

Take a look at the dimensions.

```
dim(ToothGrowth)
```

```
## [1] 60  3
```

Use the `str` function to learn more about the variables.

```
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 ...
```

Notice that the "dose" variable is numeric, when it should be factorial. Correct this using `as.factor`.

```
ToothGrowth$dose <- as.factor(ToothGrowth$dose)
```

Data Summary

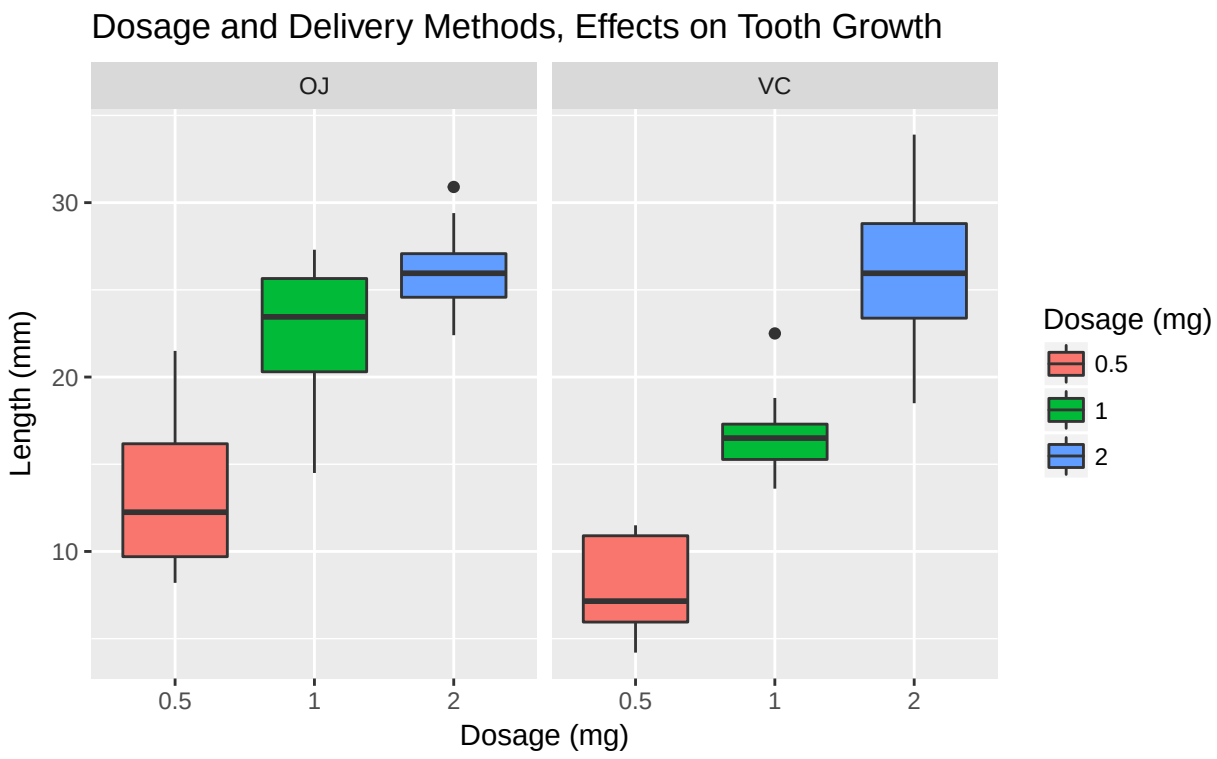
Use the `summary` function to learn a bit about the data.

```
summary(ToothGrowth)
```

```
##       len        supp     dose
##  Min.   : 4.20   OJ:30   0.5:20
##  1st Qu.:13.07   VC:30   1  :20
##  Median :19.25           2  :20
##  Mean   :18.81
##  3rd Qu.:25.27
##  Max.   :33.90
```

A boxplot may also provide information about how dosage and delivery method affects growth.

```
library(ggplot2)
ggplot(ToothGrowth, aes(x = dose, y = len, fill = dose)) +
        geom_boxplot() +
        facet_grid(.~supp) +
        labs(x = "Dosage (mg)", y = "Length (mm)") +
        scale_fill_discrete(name = "Dosage (mg)") +
        ggtitle("Dosage and Delivery Methods, Effects on Tooth Growth")
```



Comparing Tooth Growth by Dosage and Delivery Methods

For each of the following tests, we will use the t-distribution, as the sample size is small (less than or equal to 30).

Begin with the delivery method. This will be easy to plug into the `t.test` function, as the "supp" variable has just two factors.

```
t.supp <- t.test(len~supp, data = ToothGrowth)
```

p.value	ci.lower	ci.upper
0.06063	-0.171	7.571

Next, test the affect of dosage on growth.

```
t.dose.1 <- with(ToothGrowth, t.test(len[dose==1], len[dose==0.5]))
t.dose.2 <- with(ToothGrowth, t.test(len[dose==2], len[dose==1]))
```

	p.value	ci.lower	ci.upper
0.5 mg vs. 1 mg	1.268e-07	6.276	11.98
1 mg vs. 2 mg	1.906e-05	3.734	8.996

Conclusions

Using t-testing (again, because there are small sample sizes), we can draw the following conclusions with some level of certainty:

1. Delivery method did not have an impact on tooth growth. The p-value was greater than .05, and the confidence interval contained zero.
2. Dosage did have an impact on growth. As dosage increased, tooth growth was amplified. The difference between 0.5 mg and 1 mg had a greater impact than the difference between 1 mg and 2 mg. We can say this because, in both cases, the p-value was less than .05, and the confidence intervals did not contain zero.