Exploration and Analysis of the 'ToothGrowth Dataset'

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Introduction

This report is a brief exploration and analysis of the 'ToothGrowth' data-set in R. The data-set contains the results from an experiment conducted on (n = 60) rodents (Guinea Pigs) with the objective to ascertain the effects of Vitamin C on ondontoblast growth (cells responsible for tooth growth) as measured by the length of tooth growth.

```
##       len       supp         dose
##  Min.   : 4.2   OJ:30   Min.   :0.50
##  1st Qu.:13.1   VC:30   1st Qu.:0.50
##  Median :19.2           Median :1.00
##  Mean   :18.8           Mean   :1.17
##  3rd Qu.:25.3           3rd Qu.:2.00
##  Max.   :33.9           Max.   :2.00
```

The data is in the form of a data frame with 60 observations and three variables, 'len' (Tooth length), 'supp' (two types OJ or VC i.e. Orange Juice or Vitamin C - Ascorbic Acid), and 'dose' (0.5, 1, and 2 milligrams/day). Each dose level contains 10 observations per supplement type.

Exploratory Data Analysis

Figure 1.1 shows the density plots for the outcome variable of interest. There seems to be two distinct groups in the OJ group, and three distinct groups in the VC group. Figure 1.2 shows the boxplots for the same data. There seems to be a trend between dose and length. However, there doesn't seem to be much difference between supplement type at the 2mg/day dosage.

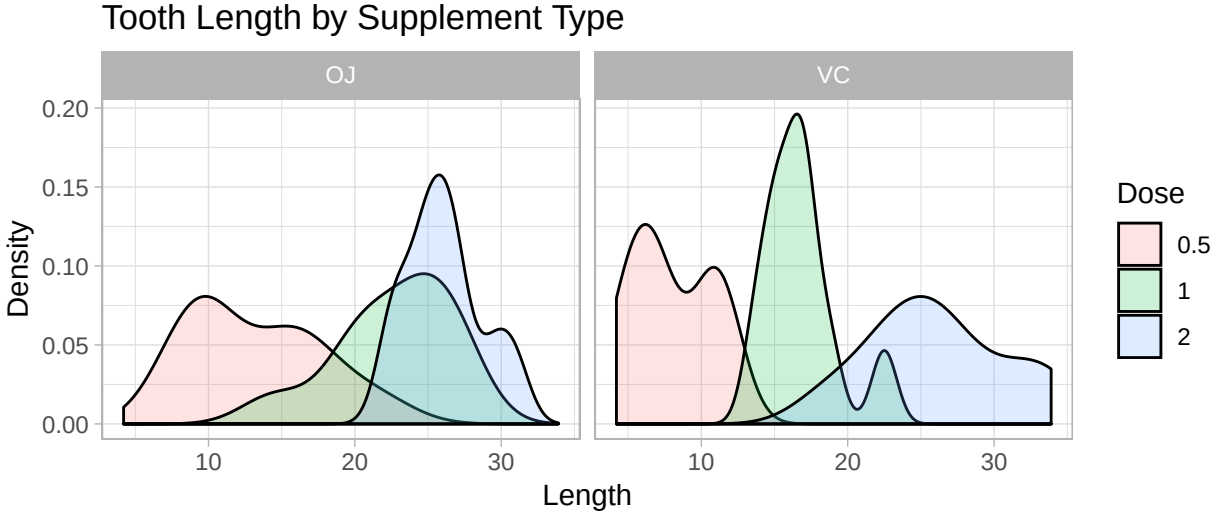

Figure 1.1

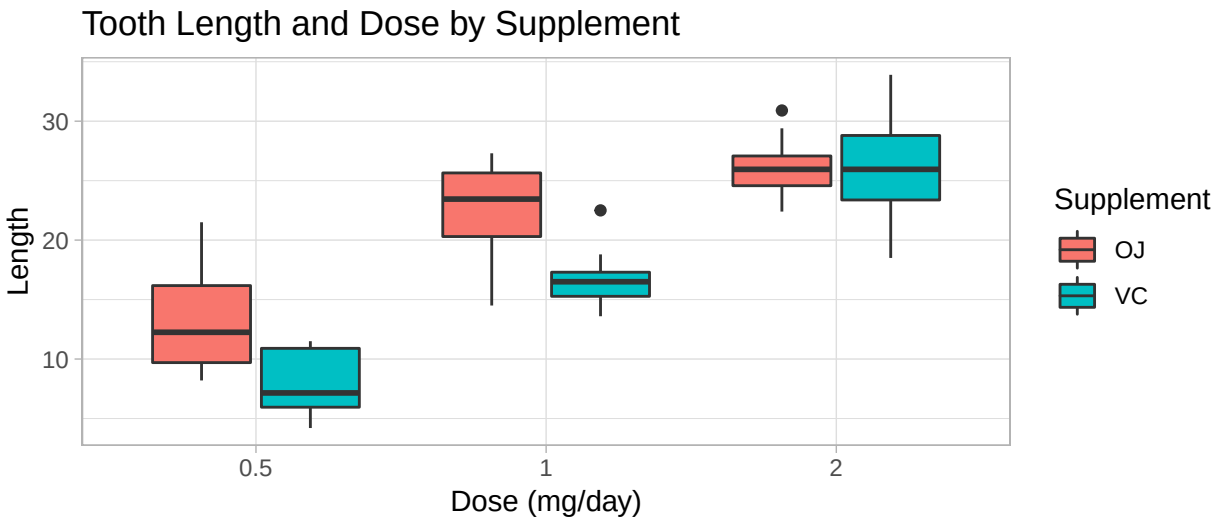

Figure 1.2

Analysis

Null Hypotheses

Given the potential trend identified in the EDA, the following null - hypotheses will be tested:

1. There is no difference in the average tooth length between the cohort administered supplements via orange juice vs the cohort administered Ascorbic Acid, at each dose level.
2. Increasing dosage of supplement via Orange Juice does not lead to a change in tooth growth.
3. Increasing dosage of supplement via Ascorbic Acid does not lead to a change in tooth growth.

Assumptions

- There was random assignment within the cohort between those that were given Orange Juice vs those that were given Ascorbic Acid. Furthermore, there was random assignment when deciding which subjects would receive larger doses of the supplement.
- The sample size is less than 10% of the population.
- Since the sample size is less than 30 in each test arm, t-intervals and hence t. tests will be used.
- Test subjects are not genetic clones.
- The response variable i.e. Tooth growth is iid (independent and identically distributed) i.e. the length of the tooth in one subject is not correlated to the length of the tooth in another subject - mutually exclusive - and that each subject belongs to the same population.

Results of the t.tests:

```
## Difference of means between supplement type by dose
```

```
##    p Value Lower CI Upper CI Est. OJ Mean Est. VC Mean Dose
## 1 0.006359    1.719    8.781        13.23         7.98  0.5
## 2 0.001038    2.802    9.058        22.70        16.77    1
## 3 0.963852   -3.798    3.638        26.06        26.14    2
```

```
## Difference of means between 0.5 and 1 mg dose supplement = Orange Juice
```

```
##     p Value Lower CI Upper CI Est. 0.5 Mean Est. 1 Mean
## 1 8.785e-05   -13.42   -5.524         13.23        22.7
```

```
## Difference of means between 0.5 and 1 mg dose supplement = Orange Juice
```

```
##   p Value Lower CI Upper CI Est. 1 Mean Est. 2 Mean
## 1  0.0392   -6.531  -0.1886        22.7       26.06
```

```
## Difference of means between 0.5 and 1 mg dose supplement = Orange Juice
```

```
##     p Value Lower CI Upper CI Est. 0.5 Mean Est. 2 Mean
## 1 1.324e-06   -16.34   -9.325         13.23       26.06
```

```
## Difference of means between 0.5 and 1 mg dose supplement = Ascorbic Acid
```

```
##     p Value Lower CI Upper CI Est. 0.5 Mean Est. 1 Mean
## 1 6.811e-07   -11.27   -6.314          7.98       16.77
```

```
## Difference of means between 0.5 and 1 mg dose supplement = Ascorbic Acid
```

```
##     p Value Lower CI Upper CI Est. 1 Mean Est. 2 Mean
## 1 9.156e-05   -13.05   -5.686       16.77       26.14
```

```
## Difference of means between 0.5 and 1 mg dose supplement = Ascorbic Acid
```

```
##     p Value Lower CI Upper CI Est. 0.5 Mean Est. 2 Mean
## 1 4.682e-08    -21.9   -14.42          7.98       26.14
```

Conclusion:

1. Increasing the dose of supplement regardless of supplement type leads to an increase in tooth growth.
2. Orange Juice leads to more tooth growth as compared to Ascorbic Acid when the supplement dose is 0.5 and 1 mg per day.
3. There is no difference in tooth growth between those subjects administered Orange Juice vs those subjects that were administered Ascorbic Acid at the 2 mg / day dose.

The code for generating this report can be found on github.