Statistical Inference: Course Project

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Part II: Tooth Growth

This paper will explore the `ToothGrowth` data in the R data sets package. In particular, the objective is to use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose.

Discussion of the Data and Experiment Design

The `?ToothGrowth` page gives insight into the data set, which originates from a study by C. I. Bliss in *The Statistics of Bioassay*, (1952). Three variables describe 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):

- **len:** Tooth length
- **supp:** Supplement type (VC or OJ)
- **dose:** Dose in milligrams

To begin the analysis, we load the data and plot each variable against the others:

```
library(datasets); data(ToothGrowth);
summary(ToothGrowth)
```

```
##       len        supp         dose
##  Min.   : 4.20   OJ:30   Min.   :0.500
##  1st Qu.:13.07   VC:30   1st Qu.:0.500
##  Median :19.25           Median :1.000
##  Mean   :18.81           Mean   :1.167
##  3rd Qu.:25.27           3rd Qu.:2.000
##  Max.   :33.90           Max.   :2.000
```

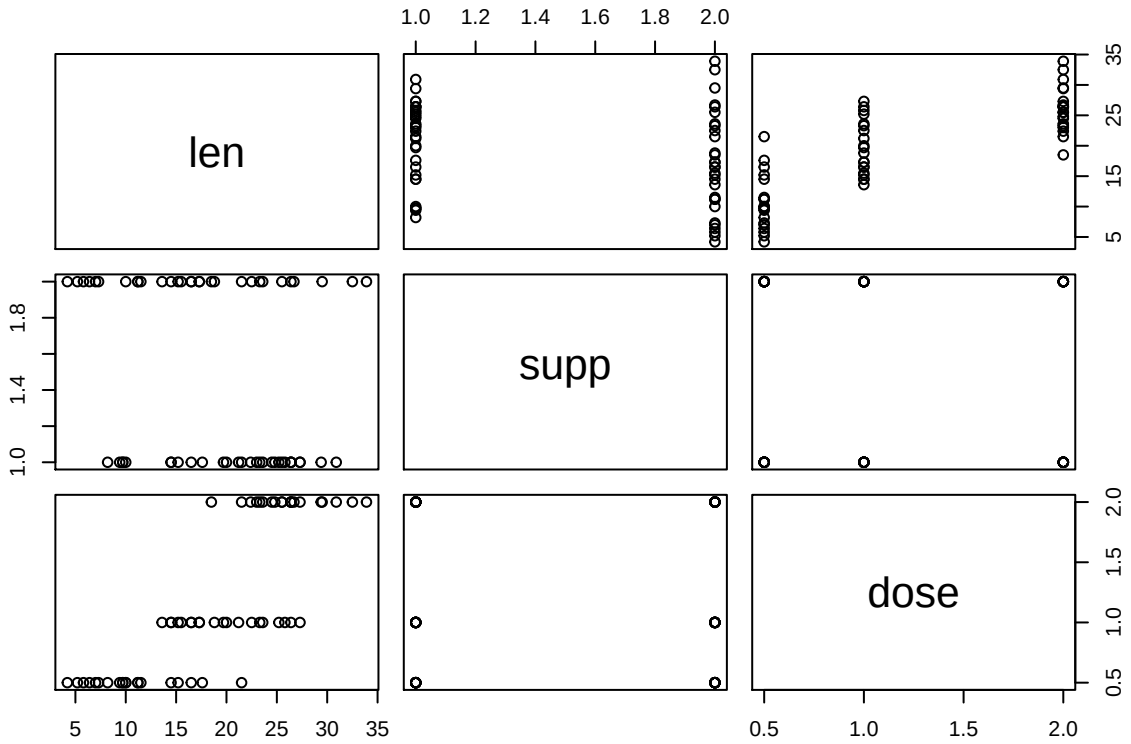
```
table(ToothGrowth$supp, ToothGrowth$dose)
```

```
##
##      0.5  1  2
##   OJ  10 10 10
##   VC  10 10 10
```

The data conforms to the expectations from reading the help file. In particular, we note that the sample sizes are equally distributed across the variables `supp` and `dose`. Although the help file mentions that there were only 10 guinea pigs, and that the data fits nicely into 10-sample subsets, there is no identifier variable for each guinea pig. As a result, it is safer to assume that the data is not structured in a paired order, and to conduct independent-group hypothesis tests. It is also assumed that data is independent and identically distributed (IID) *within groups*, and that the variance between these groups unequal (the more conservative assumption).

To begin the analysis, I plot the pairs of variables against one another:

```
pairs(ToothGrowth)
```



At first glance, it appears that there is a strong positive relationship between tooth length and dose. A potential relationship between the length and supplement type is less apparent.

Tooth Growth & Dose

In this section, we test whether tooth growth is correlated to dosage. According to the assumptions stated in the introductory paragraphs, my choice of test is a paired, two-sided t-test. Although the plot in the exploratory phase suggests that tooth growth increases directly proportionate to dosage, it would have been equally meaniful if (and plausible that) the inverse was true. In order not two bias the hypothesis test with a lower tolerance as a result of having already explored it visually, I justify the two-sided alternative as the desirable option.

The null hypothesis is that $H_0 : \mu_1 = \mu_2$, and our alternate hypothesis is $H_a : \mu_1 > \mu_2$. I set alpha at $\alpha = 0.05$.

```
#t.test(, alternative = "greater", paired = T)
```

Based on the results of the test, I conclude that...

Tooth Growth & Delivery Method

In this part, I will test whether tooth growth is correlated to the delivery method of a supplement (orange juice or ascorbic acid).

Other info

State your conclusions and the assumptions needed for your conclusions. Some criteria that you will be evaluated on Did you perform an exploratory data analysis of at least a single plot or table highlighting basic features of the data? Did the student perform some relevant confidence intervals and/or tests? Were the results of the tests and/or intervals interpreted in the context of the problem correctly? Did the student describe the assumptions needed for their conclusions?