Statistical Inference Course Project

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This is the project for the statistical inference class. In it, you will use simulation to explore inference and do some simple inferential data analysis. The project consists of two parts:

1. A simulation exercise.
2. Basic inferential data analysis.

Now in the second portion of the class, we're going to analyze the ToothGrowth data in the R datasets package.; 1.Load the ToothGrowth data and perform some basic exploratory data analyses 2.Provide a basic summary of the data. 3.Use confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose. (Only use the techniques from class, even if there's other approaches worth considering) 4.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?

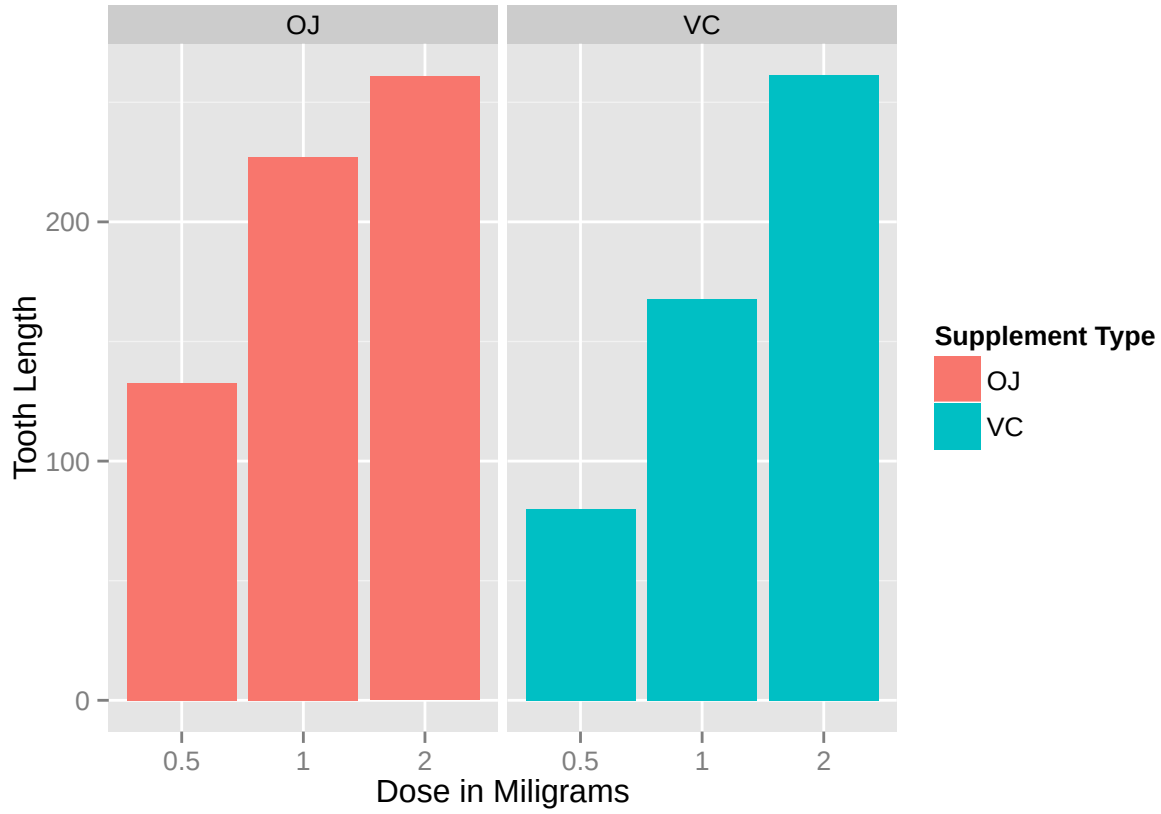
```
setwd("D:\\Data Scientist\\Statiscal Inference\\Project")
```

In the 2nd part of the project, analyze the `ToothGrowth` data in the R datasets package. The data is set of 60 observations, 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 vitamin C pills).

```
library(datasets)
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.2.1
```

```
ggplot(data=ToothGrowth, aes(x=as.factor(dose), y=len, fill=supp)) +
    geom_bar(stat="Identity",) +
    facet_grid(. ~ supp) +
    xlab("Dose in Miligrams") +
    ylab("Tooth Length") +
    guides(fill=guide_legend(title="Supplement Type"))
```



Clearly there is a positive correlation between tooth length and vitamin C dose for both delievery methods. for both delivery methods.

The effect of the dose also can be identifying using regression analysis. And can also be addressed on the supplement type (i.e. orange juice or ascorbic acid) has any effect on the tooth length. In other words, how much of the variance in tooth length, if any, can be explained by the supplement type below;

```
fit <- lm(len ~ dose + supp, data=ToothGrowth)
summary(fit)
```

```
##
## Call:
## lm(formula = len ~ dose + supp, data = ToothGrowth)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -6.600 -3.700  0.373  2.116  8.800
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   9.2725     1.2824   7.231 1.31e-09 ***
## dose          9.7636     0.8768  11.135 6.31e-16 ***
## suppVC       -3.7000     1.0936  -3.383   0.0013 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.236 on 57 degrees of freedom
```

```
## Multiple R-squared:  0.7038, Adjusted R-squared:  0.6934
## F-statistic: 67.72 on 2 and 57 DF,  p-value: 8.716e-16
```

The model explains 70% of the variance in the data. The intercept is 9.2725, meaning that with no supplement of Vitamin C, the average tooth length is 9.2725 units. The coefficient of `dose` is 9.7635714. It can be interpreted as increasing the delievered dose 1 mg, all else equal (i.e. no change in the supplement type), would increase the tooth length 9.7635714 units.

The last coefficient is for the supplement type. Since the supplement type is a categorical variable, dummy variables are used. The computed coefficient is for `suppVC` and the value is -3.7 meaning that delivering a given dose as ascorbic acid, without changing the dose, would result in3.7 units of decrease in the tooth length. Since there are only two categories, we can also conclude that on average, delivering the dosage as orange juice would increase the tooth length by 3.7 units. 95% confidence intervals for two variables and the intercept are as follows.

```
confint(fit)
```

```
##                 2.5 %    97.5 %
## (Intercept)  6.704608 11.840392
## dose         8.007741 11.519402
## suppVC      -5.889905 -1.510095
```

The confidence intervals mean that if we collect a different set of data and estimate parameters of the linear model many times, 95% of the time, the coefficient estimations will be in these ranges. For each coefficient (i.e.intercept, `dose` and `suppVC`), the null hypothesis is that the coefficients are zero, meaning that no tooth length variation is explained by that variable.

All p-values are less than 0.05, rejecting the null hypothesis and suggesting that each variable explains a significant portion of variability in tooth length, assuming the significance level is 5%.