Statistical Inference Project Part 2

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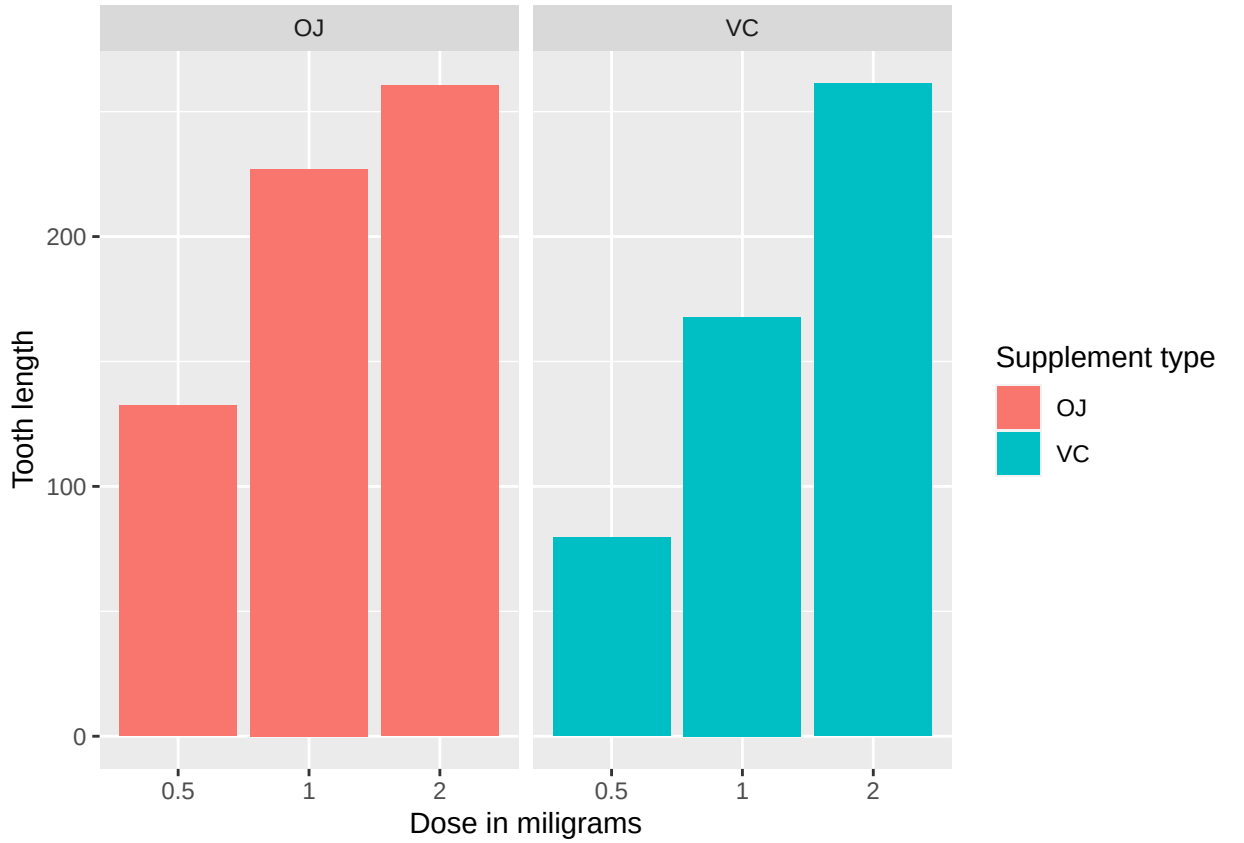
Github repo for the Course: Statistical Inference

Instructions

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.

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



There is a clear positive correlation between the tooth length and Vitamin C dosage levels for both delivery methods (as shown above).

The effect of the dose can also be identified using regression analysis. A potential subject for further investigation is what effect the supplement delivery type has on tooth length.

```
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 in 3.7 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%.