# Statistical Inference Course Project: Inferential Analysis with ToothGrowth Data

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*August 23, 2015*

Overview

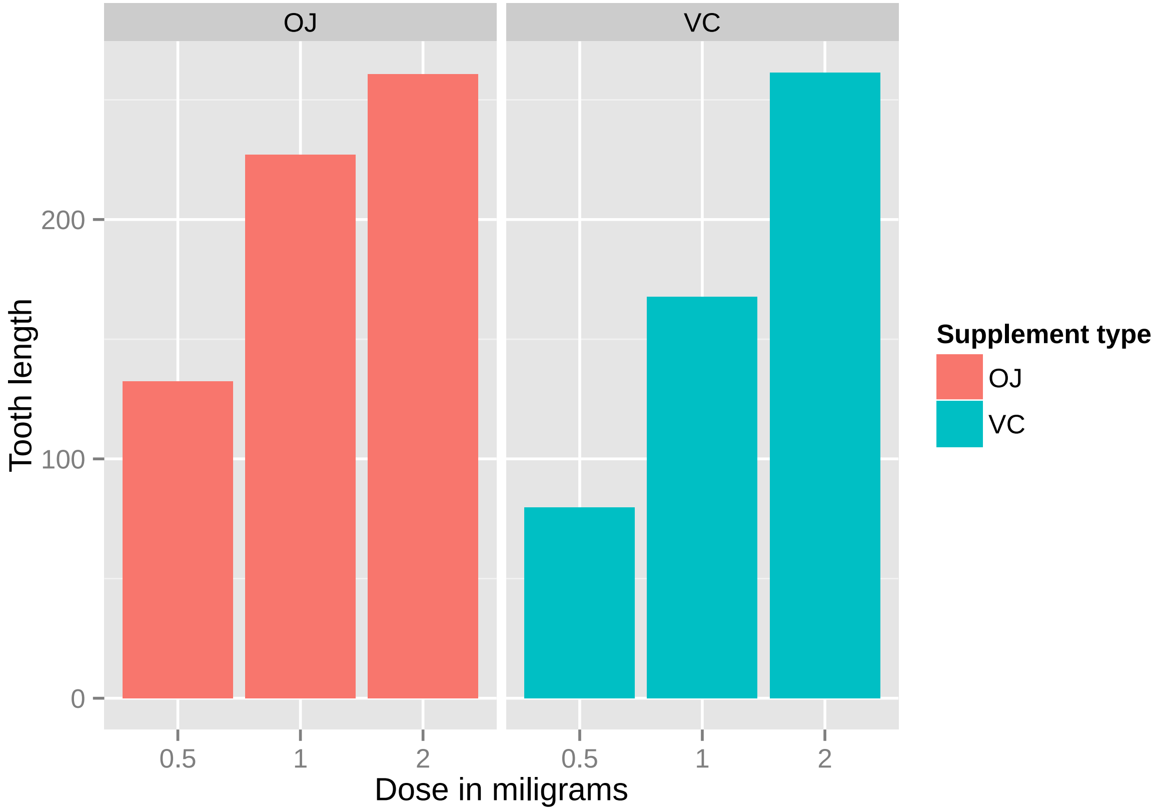
In the second part of the project, ToothGrowth data is analyzed in the R datasets package. The data is set of 60 observations, length of odontoblasts (teeth) in each of 10 guinea pigs at each of three dose levels of Vitamin C (0.5, 1 and 2 mg) with each of two delivery methods (orange juice or ascorbic acid).

Load Datasets and Plots

```
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"))
```



As can be seen above, there is a clear positive correlation between the tooth length and the dose levels of Vitamin C, for both delivery methods.

The effect of the dose can also be identified using regression analysis. One interesting question that can also be addressed is whether 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?

```
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
```

```
fit$coefficients[[1]] #intercept
```

```
## [1] 9.2725
```

```
fit$coefficients[[2]] # dose coefficient
```

```
## [1] 9.763571
```

```
fit$coefficients[[3]] # computed coefficient
```

```
## [1] -3.7
```

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 dose coefficient is 9.763571. This can be interpreted as increasing the delivered dose 1mg, all else equal would increase the tooth length by 9.763571 units.The last coefficient called the computed coefficient is for the supplement type.Since Supplement Type is categorical the computed coefficient of -3.7 implies that delivering a given dose of ascorbic acid without changing the dose would result in -3.7 units decrease in tooth length.

95% confidence intervals for two variables and 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 computed), 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%.

The complete report can be found at https://github.com/anakella/Statistical-Inference.git as stat_inf_project_part2.Rmd and stat_inf_project_part2.pdf