CP1 - ToothGrowth

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Tooth Growth

1. Load the ToothGrowth data and perform some basic exploratory data analysis

```
# load the dataset
library(datasets)
data(ToothGrowth)

# look at the dataset variables
head(ToothGrowth)
```

```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
## 4  5.8   VC  0.5
## 5  6.4   VC  0.5
## 6 10.0   VC  0.5
```

```
str(ToothGrowth)
```

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```

```
# convert variable dose from numeric to factor
ToothGrowth$dose <- as.factor(ToothGrowth$dose)

# review dataset variables after conversion
str(ToothGrowth)
```

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: Factor w/ 3 levels "0.5","1","2": 1 1 1 1 1 1 1 1 1 1 ...
```

```
# number of rows of dataset
nrow(ToothGrowth)
```

```
## [1] 60
```

2. Provide a high level summary of the data.

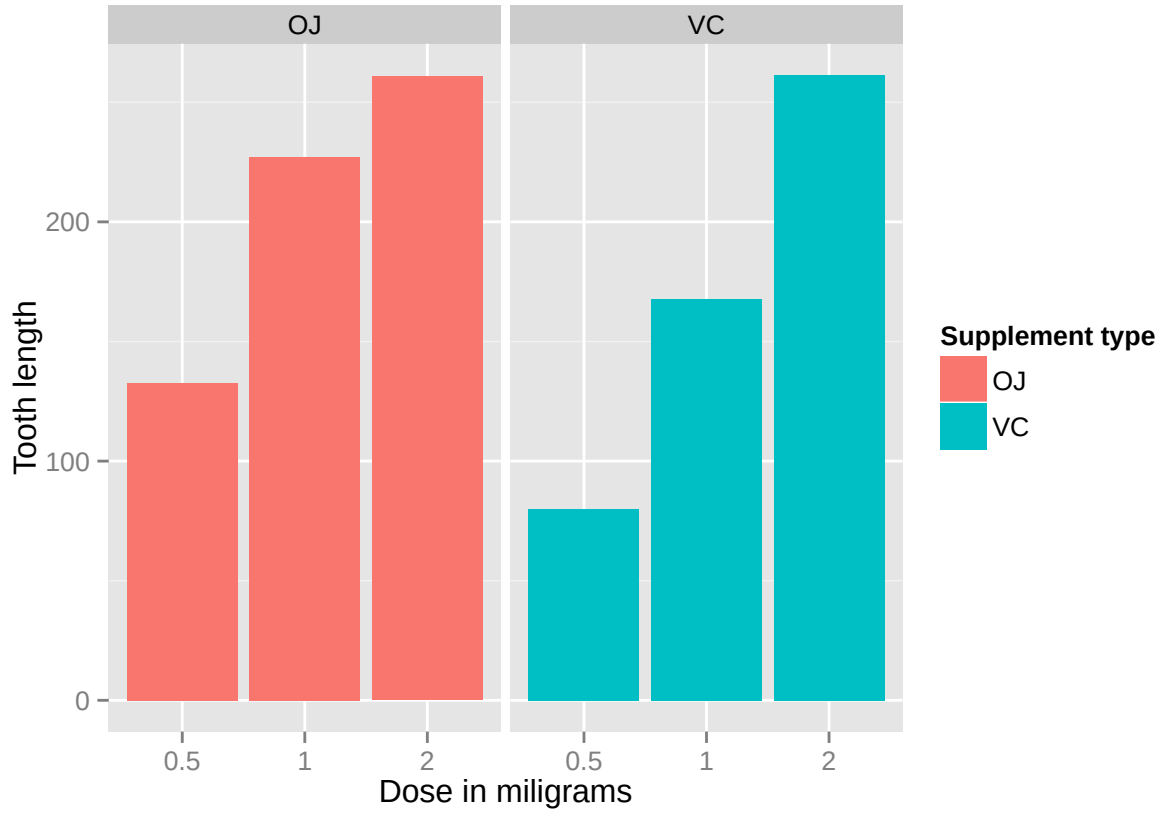
```
# summary statistics for all variables
summary(ToothGrowth)
```

```
##       len        supp     dose
##  Min.   : 4.20   OJ:30   0.5:20
##  1st Qu.:13.07   VC:30   1  :20
##  Median :19.25           2  :20
##  Mean   :18.81
##  3rd Qu.:25.27
##  Max.   :33.90
```

```
# split cases on different dose levels and delivery methods
table(ToothGrowth$dose, ToothGrowth$supp)
```

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

```
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"))
```



For both delivery methods, there is positive correlation between the tooth length and the dose levels of Vitamin C.

3. Use confidence intervals and hypothesis tests to compare tooth growth by supp and dose.

95% confidence intervals for two variables and the intercept are as follows:

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

```
##                 2.5 %    97.5 %
## (Intercept) 10.475238 14.434762
## dose1        6.705297 11.554703
## dose2       13.070297 17.919703
## suppVC      -5.679762 -1.720238
```

The confidence intervals suggest that 95% of the time, the coefficient estimations will be in these ranges. For each coefficient (i.e. intercept, `dose` and `suppVC`), the null hypothesis should be that the coefficients are zero which means that no tooth length variation is explained by that variable.

```
summary(fit)
```

```
##
```

```
## Call:
## lm(formula = len ~ dose + supp, data = ToothGrowth)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -7.085 -2.751 -0.800  2.446  9.650
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  12.4550     0.9883  12.603  < 2e-16 ***
## dose1         9.1300     1.2104   7.543 4.38e-10 ***
## dose2        15.4950     1.2104  12.802  < 2e-16 ***
## suppVC       -3.7000     0.9883  -3.744 0.000429 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.828 on 56 degrees of freedom
## Multiple R-squared:  0.7623, Adjusted R-squared:  0.7496
## F-statistic: 59.88 on 3 and 56 DF,  p-value: < 2.2e-16
```

The model explains 70% of the data variance. The intercept is 12.455, so without Vitamin C, the average tooth length is 12.455. The coefficient of `dose` is 9.13. It can be interpreted as increasing the delievered dose 1 mg, all else equal increases the tooth length 9.13.