Basic Inferential Data Analysis

preethi

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In the second portion of this project, we are going to analyse the toothgrowth data First Q1) load the tooth growth data and perform some basic exploratory analysis

```
##load data
library(datasets)
data("ToothGrowth")
##display structure of data
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 ...
```

```
##summarize data
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
```

Q2) Provide a basic summary of the data

```
##basic summary of data grouped by supplements
groups <- group_by(ToothGrowth, supp)
summary_groups <- summarise(groups, count = n(),
                            "Mean" = mean(len),
                            "Std dev" = sd(len))
print(summary_groups)
```

```
## # A tibble: 2 x 4
##   supp  count  Mean `Std dev`
##   <fct> <int> <dbl>     <dbl>
## 1 OJ       30  20.7      6.61
## 2 VC       30  17.0      8.27
```

The basic exploratory analysis show us that,

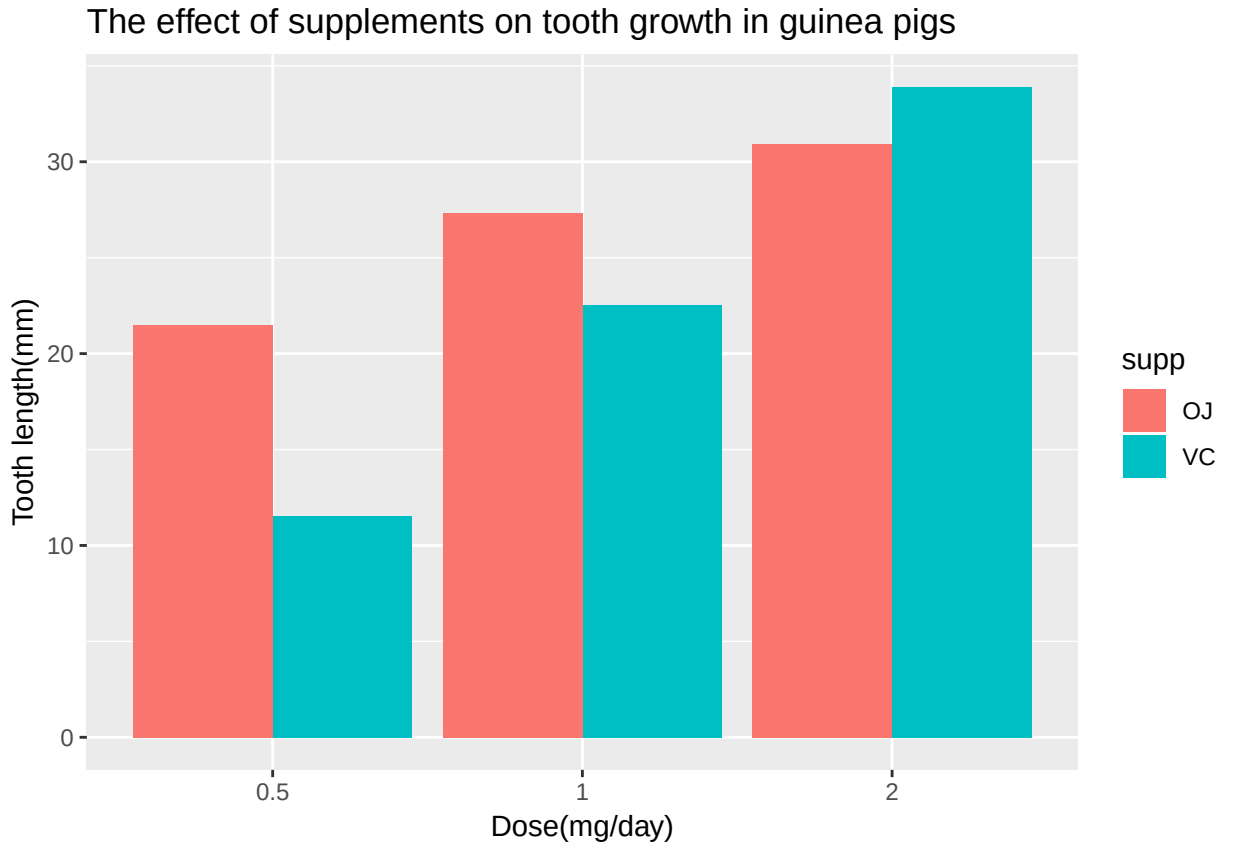
1. There were two supplements tested for growth of teeth (OJ & VC) at three concentrations (0.5, 1 & 2 mg/day).
2. There were an equal number of samples (30) for both supplements.
3. OJ showed greater tooth growth compared to VC.

Below is a graphical representation of the data

```r
##grouped by supplements & dose

groups <- group_by(ToothGrowth, supp)
summary_groups <- summarise(groups, count = n(),
                            "Mean" = mean(len),
                            "Std dev" = sd(len))
##creating a bar plot of the data grouped by supplements
tooth <- ggplot(data = ToothGrowth,
                aes(x=as.factor(dose),y=len,fill=supp))+
  geom_bar(stat='identity', position='dodge')+
  xlab("Dose(mg/day)")+ylab("Tooth length(mm)")+
  ggtitle("The effect of supplements on tooth growth in guinea pigs")

print(tooth)
```



Q3) 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)

Comparison by Supplement

Comparison of teeth length between supplements was done by a single T-test ($\alpha = 0.05$). The null hypothesis (H0) is: there is no difference in teeth length between the two supplements

```r
## t test for effect of supplements
hyp01<- t.test(len~supp, ToothGrowth)

hyp01
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 1.9153, df = 55.309, p-value = 0.06063
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1710156  7.5710156
## sample estimates:
## mean in group OJ mean in group VC
##         20.66333         16.96333
```

Conclusion: As one can see from the first table, there is no significant difference (0.06) between the two supplements and tooth growth.

In the tests that were split by dose, there was a significant difference between the two supplements for doses: 0.5 mg & 1mg (p-values of 0.006 &0.001 respectively)

Comparison by Dose

Comparison of teeth length between doses irrespective of supplement was done by three T-tests ($\alpha = 0.05$).

The null hypothesis (H0) is: there is no difference in tooth length between dose 0.5 & 2.

```
Split_Dose<-split(ToothGrowth, ToothGrowth$dose)

names(Split_Dose) <- c("half", "one","two")

hypdose <- t.test(Split_Dose$half$len, Split_Dose$two$len)

hypdose
```

```
##
##  Welch Two Sample t-test
##
## data:  Split_Dose$half$len and Split_Dose$two$len
## t = -11.799, df = 36.883, p-value = 4.398e-14
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -18.15617 -12.83383
## sample estimates:
## mean of x mean of y
##    10.605    26.100
```

Conclusion: The p-value is 4.397525e-14 and therefore we reject the null hypothesis in favor of the alternate hypothesis.

Q4: State your conclusions and the assumptions needed for your conclusions.

Assumptions:

1) It is assumed that the data is collected from a representative, randomly selected portion of the total population. 2)The second assumption is the data, when plotted, results in a normal distribution, bell-shaped distribution curve. 3)The final assumption is homogeneity of variance. Homogeneous, or equal, variance exists when the standard deviations of samples are approximately equal.

Conclusions:

1)As one can see from the first table, there is no significant difference (0.06) between the two supplements and tooth growth. 2)The p-value for dose related response is 4.397525e-14 and therefore we reject the null hypothesis in favor of the alternate hypothesis, that there is a difference in tooth between doses 0.5 & 2 3)Further analysis was done since the bonferroni corrections would need to be included and the sample size was deemed too small for that.