Final Project – ASDS 5301

Study on the growth of the odontoblast of the incisor teeth as a criterion of vitamin C intake in guinea pigs using Two Way ANOVA

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INTRODUCTION

A concern during the Second World War was the provision of vitamin C to soldiers, and in this broad context the effects of ascorbic acid and orange juice were studied in animals. One such study was the Crampton's study, 60 guinea pigs were given a dietary supplement of vitamin C in one of three doses (0.5, 1 or 2 mg/day) delivered in one of two ways (as ascorbic acid or orange juice).

Study Details

- The experiment was conducted when the Guinea pig was 28 days old. There were 10 guinea pigs in the study, five males and five females, in each combination of dose and supplement type.
- Study on length of the odontoblasts — cells that are important to tooth development was conducted after 42 days of dietary supplement.
- The Vitamin C supplements provided during the experiment were Ascorbic Acid(VC) and Orange Juice(OJ).

Data Overview

	len <dbl>	supp <fctr>	dose <dbl>
28	21.5	VC	2.0
29	23.3	VC	2.0
30	29.5	VC	2.0
31	15.2	OJ	0.5
32	21.5	OJ	0.5
33	17.6	OJ	0.5

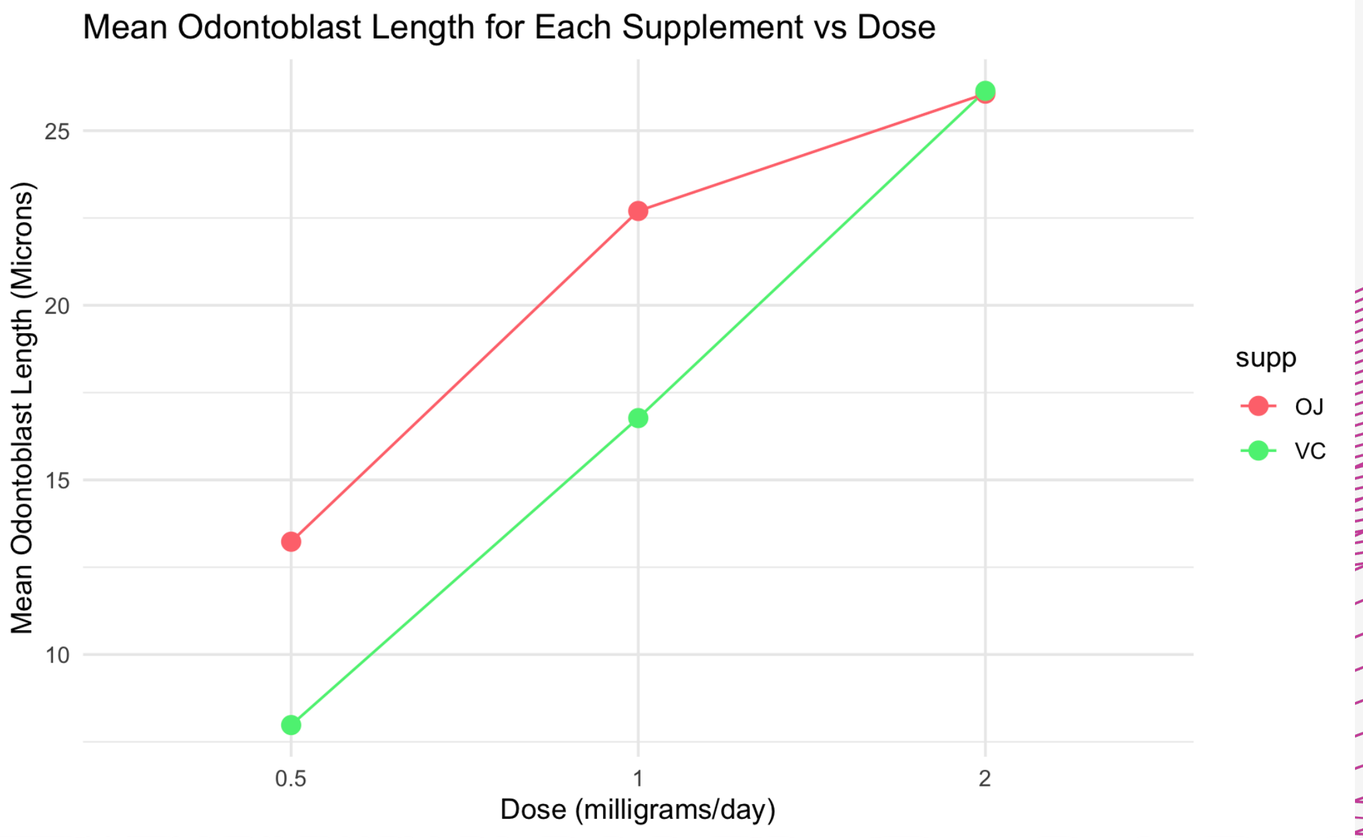
6 rows

```
'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 ...
```

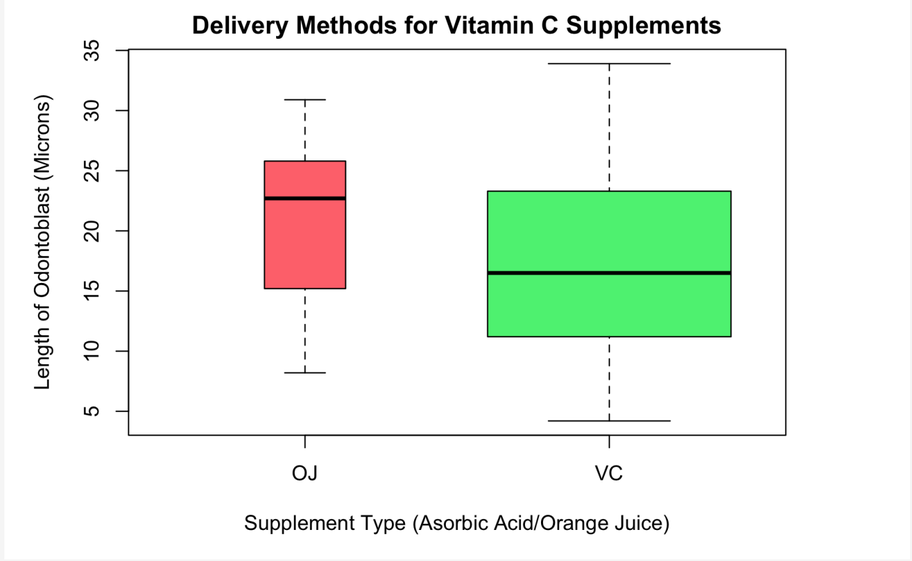
Descriptive Analysis

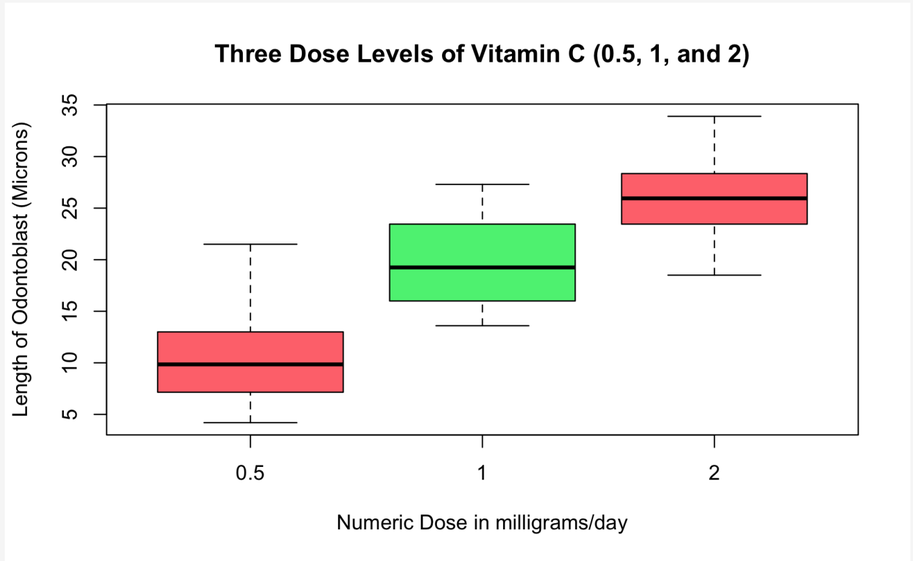
```
      len        supp     dose
 Min.   : 4.20   OJ:30   0.5:20
 1st Qu.:13.07   VC:30   1  :20
 Median :19.25           2  :20
 Mean   :18.81
 3rd Qu.:25.27
 Max.   :33.90
```

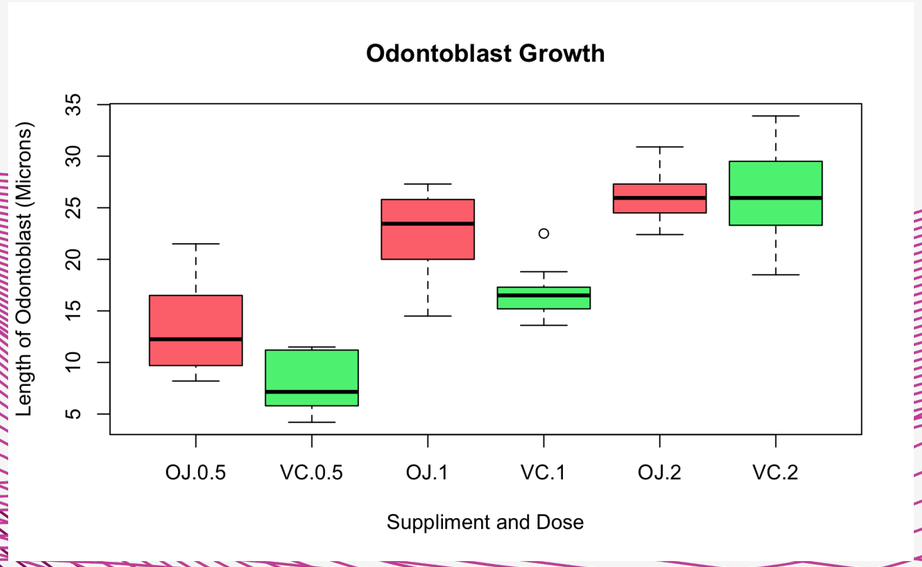
supp <fctr>	dose <fctr>	count <int>	mean <dbl>	sd <dbl>
OJ	0.5	10	13.23	4.459709
OJ	1	10	22.70	3.910953
OJ	2	10	26.06	2.655058
VC	0.5	10	7.98	2.746634
VC	1	10	16.77	2.515309
VC	2	10	26.14	4.797731



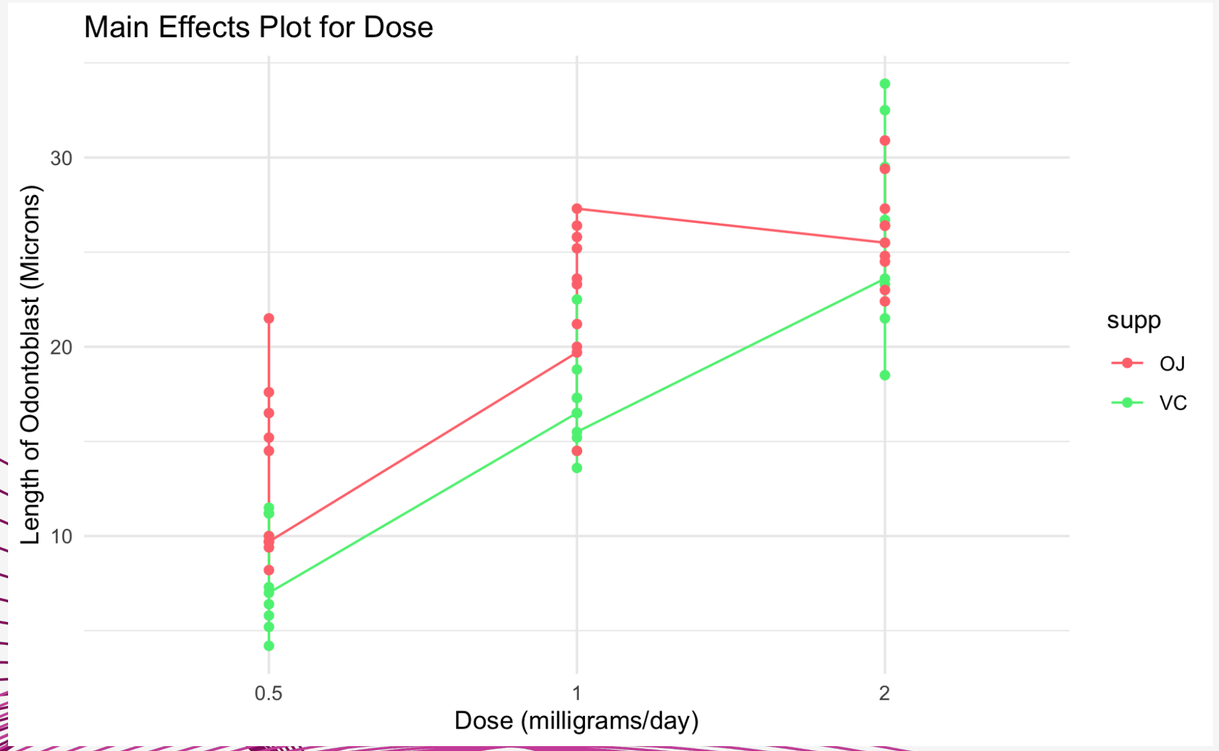
Boxplots

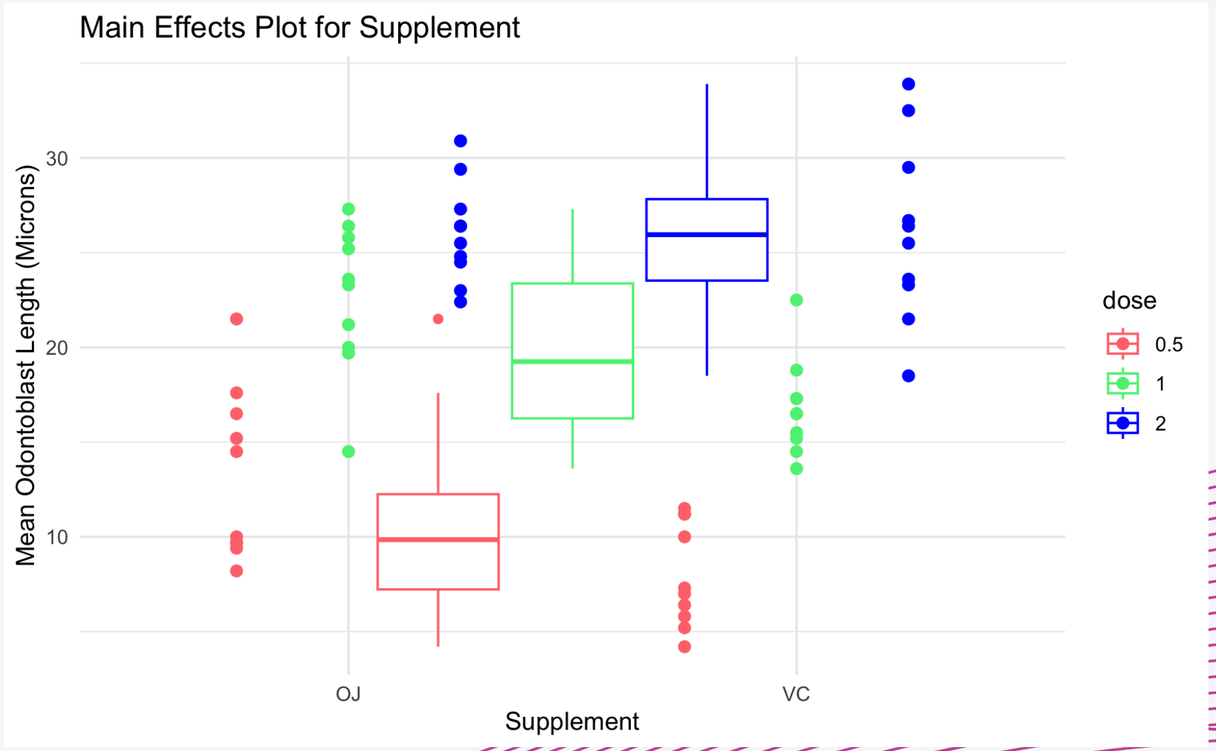

Delivery Methods for Vitamin C Supplements
Length of Odontoblast (Microns)
5
10
15
20
25
30
35
OJ
VC
Supplement Type (Asorbic Acid/Orange Juice)


Three Dose Levels of Vitamin C (0.5, 1, and 2)
Length of Odontoblast (Microns)
5
10
15
20
25
30
35
0.5
1
2
Numeric Dose in milligrams/day

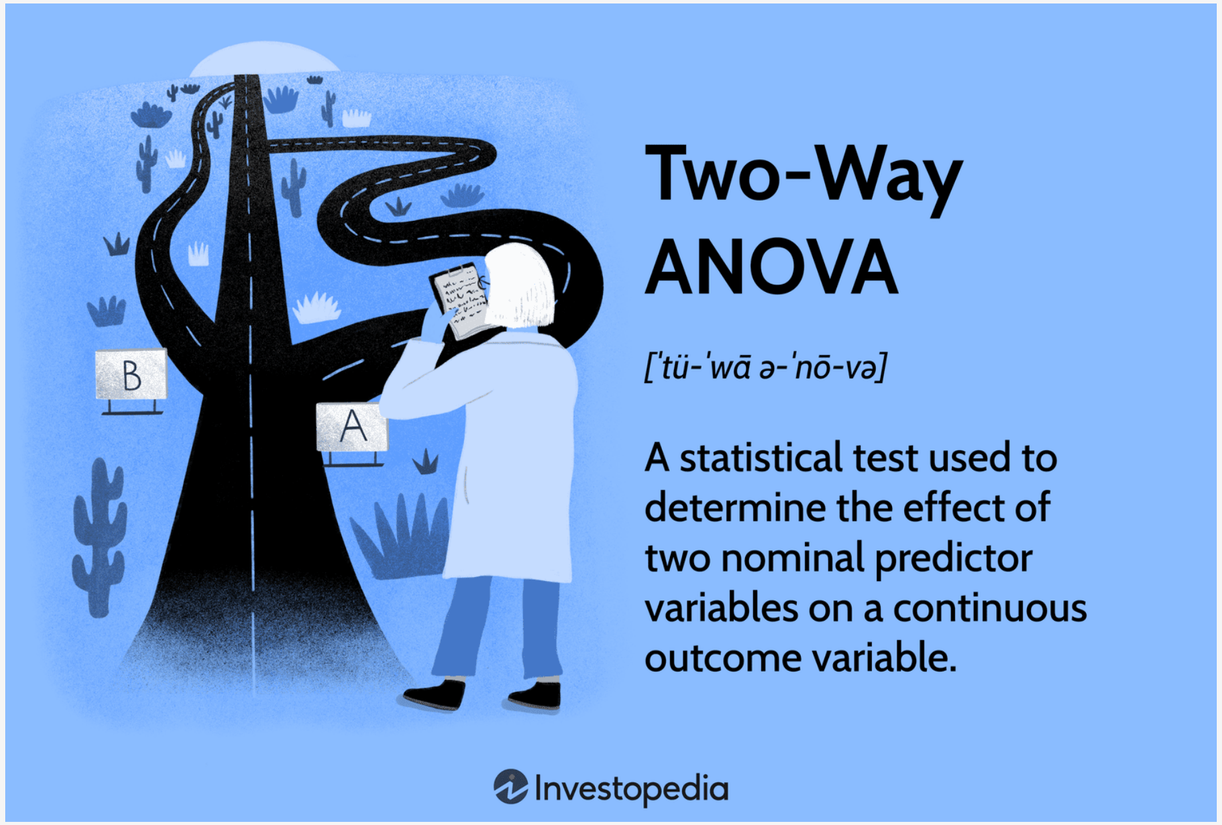

Odontoblast Growth
Length of Odontoblast (Microns)
5
10
15
20
25
30
35
OJ.0.5
VC.0.5
OJ.1
VC.1
OJ.2
VC.2
Suppliment and Dose

Main Effects Plot





Two Way ANOVA



Assumptions of Two Way ANOVA

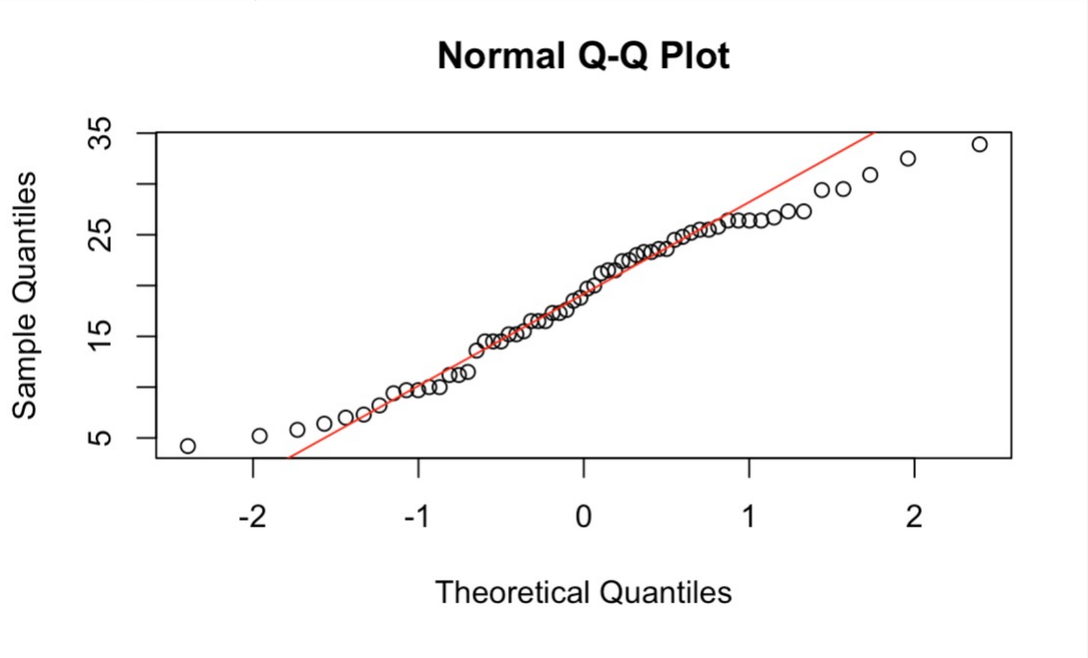
Independence

Homogeneity of Variance

Normality

Normality Test

- We used Shapiro-Wilk normality Test and observed the p-value of 0.1091.



Homogeneity Of Variance

- We used Levene's Test check for Homogeneity of Variance

```
Levene's Test for Homogeneity of Variance (center = median)
      Df F value Pr(>F)
group  5  1.7086 0.1484
      54
Levene's Test for Homogeneity of Variance (center = median)
      Df F value Pr(>F)
group  1  1.2136 0.2752
      58
Levene's Test for Homogeneity of Variance (center = median)
      Df F value Pr(>F)
group  2  0.6457 0.5281
      57
```

Test for Independence

- We used Chi-Square Test to check for Independence.

```
        Pearson's Chi-squared test

data:  contingency_table
X-squared = 0, df = 2, p-value = 1
```

Two-Way Anova

```
                    Df Sum Sq Mean Sq F value   Pr(>F)
supp                 1  205.4   205.4  15.572 0.000231 ***
factor(dose)         2 2426.4  1213.2  92.000  < 2e-16 ***
supp:factor(dose)    2  108.3    54.2   4.107 0.021860 *
Residuals           54  712.1    13.2
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

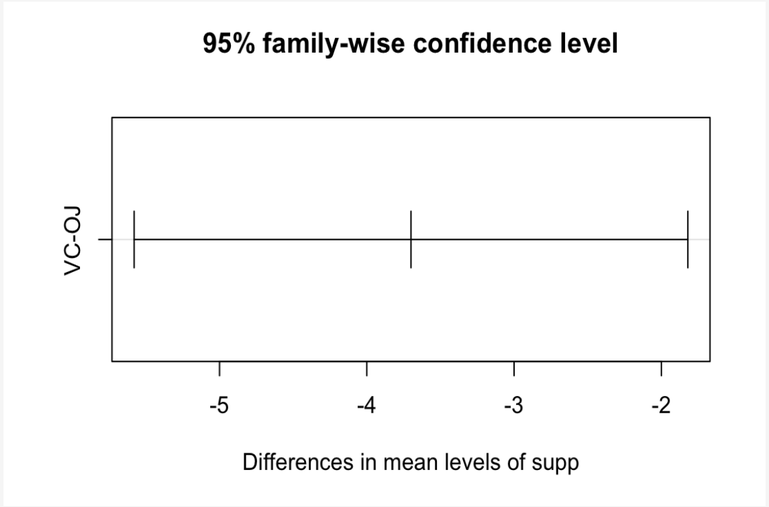
TukeyHSD Test

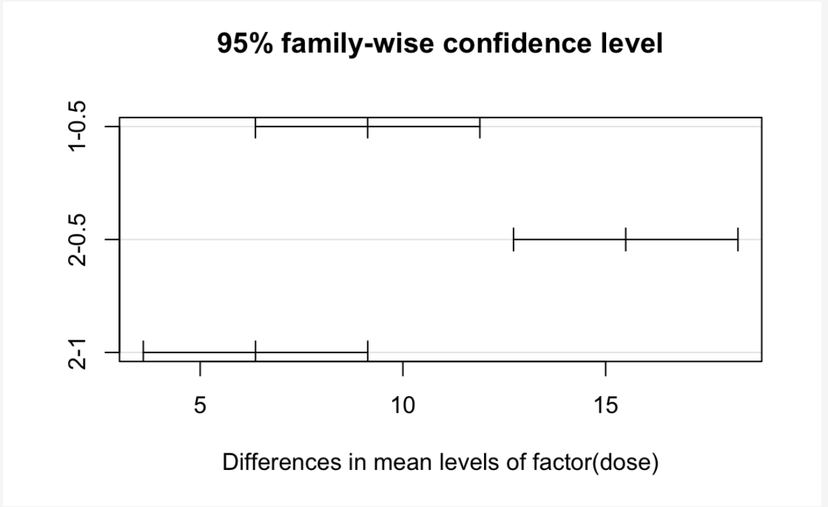
```
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = len ~ supp * factor(dose), data = df_tooth_growth)

$supp
      diff       lwr       upr     p adj
VC-OJ -3.7 -5.579828 -1.820172 0.0002312

$`factor(dose)`
        diff       lwr       upr   p adj
1-0.5  9.130  6.362488 11.897512 0.0e+00
2-0.5 15.495 12.727488 18.262512 0.0e+00
2-1    6.365  3.597488  9.132512 2.7e-06
```

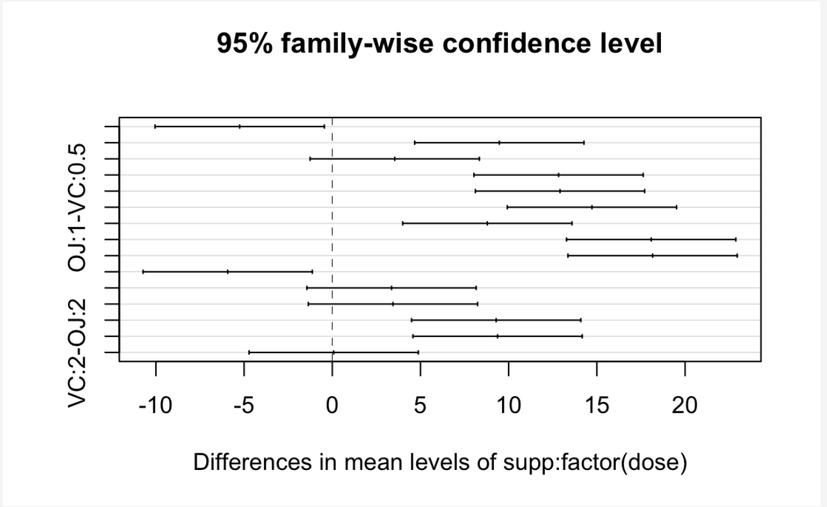
- We used TUkeyHSD Test for Post Hoc Analysis.

```
$`supp:factor(dose)`
                  diff        lwr         upr      p adj
VC:0.5-OJ:0.5 -5.25 -10.048124 -0.4518762 0.0242521
OJ:1-OJ:0.5    9.47   4.671876 14.2681238 0.0000046
VC:1-OJ:0.5    3.54  -1.258124  8.3381238 0.2640208
OJ:2-OJ:0.5   12.83   8.031876 17.6281238 0.0000000
VC:2-OJ:0.5   12.91   8.111876 17.7081238 0.0000000
OJ:1-VC:0.5   14.72   9.921876 19.5181238 0.0000000
VC:1-VC:0.5    8.79   3.991876 13.5881238 0.0000210
OJ:2-VC:0.5   18.08  13.281876 22.8781238 0.0000000
VC:2-VC:0.5   18.16  13.361876 22.9581238 0.0000000
VC:1-OJ:1     -5.93 -10.728124 -1.1318762 0.0073930
OJ:2-OJ:1      3.36  -1.438124  8.1581238 0.3187361
VC:2-OJ:1      3.44  -1.358124  8.2381238 0.2936430
OJ:2-VC:1      9.29   4.491876 14.0881238 0.0000069
VC:2-VC:1      9.37   4.571876 14.1681238 0.0000058
VC:2-OJ:2      0.08  -4.718124  4.8781238 1.0000000
```

TukeyHSD Plots







Conclusions

- There is significant difference in means between the groups of factor A(Supplements).
- There is significant difference in means between the groups of factor B(Dose).
- We can observe that there is interaction between the two factors (Supplement and Dose).


THANK
YOU!