Peer-graded Assignment: Statistical Inference Course Project Part 2

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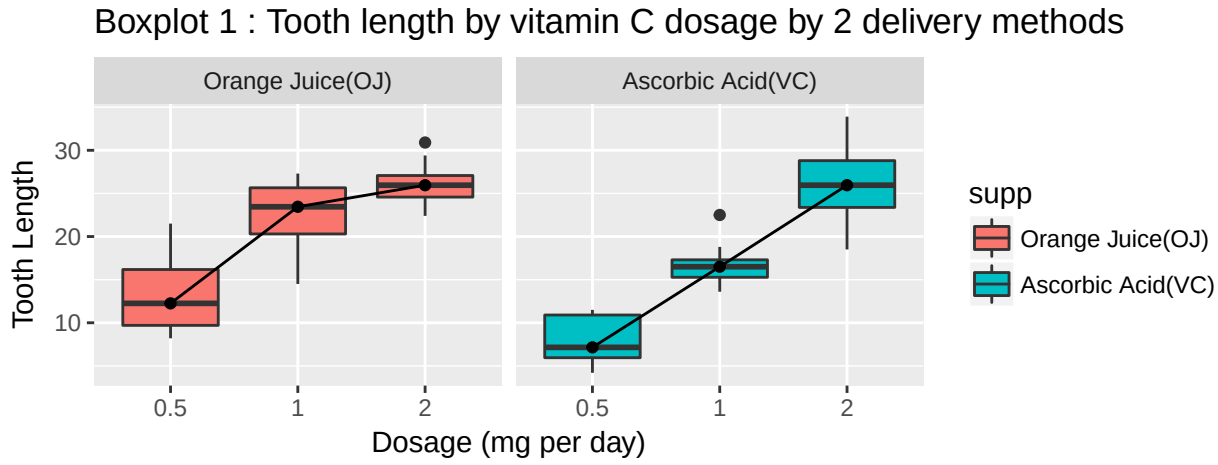
Overview

This is an analysis on the dataset ToothGrowth to investigate the relationship of the tooth length of Guinea Pigs under the impact of vitamin C at different dosage level using 2 different delivery supplements, orange juice and ascorbic acid. Let's look at the data summary :

```
##       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
```

Exploratory Data Analysis

```
TG <- ToothGrowth
levels(TG$supp) <- c("Orange Juice(OJ)", "Ascorbic Acid(VC)")
ggplot(data=TG, aes(x=factor(dose),y=len)) + geom_boxplot(aes(fill=supp)) +
  stat_summary(fun.y=median, geom="line", aes(group=1)) +
  facet_grid(.~supp) + stat_summary(fun.y=median, geom="point") +
  labs(title="Boxplot 1 : Tooth length by vitamin C dosage by 2 delivery methods",
     x="Dosage (mg per day)", y="Tooth Length")
```



Observations :

- From Boxplot 1, we can see a general increase in tooth length with increase in dosage.
- OJ is a better method at low-mid level dosage, 0.5mg/day & 1.0mg/day.
- At high level dosage, both supplements demonstrate similar tooth length.

Hypothesis Testings

```
levels(TG$supp) <- c("OJ", "VC")
ci95 <- list()
ci95$OJ05 <- round(t.test(TG$len[TG$supp=="OJ" & TG$dose==0.5])$conf.int,2)
ci95$OJ10 <- round(t.test(TG$len[TG$supp=="OJ" & TG$dose==1.0])$conf.int,2)
ci95$OJ20 <- round(t.test(TG$len[TG$supp=="OJ" & TG$dose==2.0])$conf.int,2)
ci95$VC05 <- round(t.test(TG$len[TG$supp=="VC" & TG$dose==0.5])$conf.int,2)
ci95$VC10 <- round(t.test(TG$len[TG$supp=="VC" & TG$dose==1.0])$conf.int,2)
ci95$VC20 <- round(t.test(TG$len[TG$supp=="VC" & TG$dose==2.0])$conf.int,2)

ci95 <- t(as.data.frame(ci95))
colnames(ci95) <- c("2.5%", "97.5%")
rownames(ci95) <- c("Orange Juice(OJ) & 0.5mg/day",
                    "Orange Juice(OJ) & 1.0mg/day",
                    "Orange Juice(OJ) & 2.0mg/day",
                    "Ascorbic Acid(VC) & 0.5mg/day",
                    "Ascorbic Acid(VC) & 1.0mg/day",
                    "Ascorbic Acid(VC) & 2.0mg/day")
message("Table 95% Confidence Intervals for the\n
        tooth length at different supplement and dosage level")
```

```
## Table 95% Confidence Intervals for the
##
##         tooth length at different supplement and dosage level
```

```
ci95
```

```
##                               2.5% 97.5%
## Orange Juice(OJ) & 0.5mg/day  10.04 16.42
## Orange Juice(OJ) & 1.0mg/day  19.90 25.50
## Orange Juice(OJ) & 2.0mg/day  24.16 27.96
## Ascorbic Acid(VC) & 0.5mg/day  6.02  9.94
## Ascorbic Acid(VC) & 1.0mg/day 14.97 18.57
## Ascorbic Acid(VC) & 2.0mg/day 22.71 29.57
```

Observations :

- No overlapping of confidence levels at low level dosage in both OJ & VC supplements.
- No overlapping at all levels in VC supplements.
- There is overlapping at 1.0mg/day & 2.0mg/day in OJ supplements.

P-Values

```
pvalue <- list()
pvalue$OJ05v10 <- t.test(TG$len[TG$supp=="OJ" & TG$dose==0.5],
                         TG$len[TG$supp=="OJ" & TG$dose==1.0])$p.value
pvalue$OJ10v20 <- t.test(TG$len[TG$supp=="OJ" & TG$dose==1.0],
                         TG$len[TG$supp=="OJ" & TG$dose==2.0])$p.value
pvalue$VC05v10 <- t.test(TG$len[TG$supp=="VC" & TG$dose==0.5],
                         TG$len[TG$supp=="VC" & TG$dose==1.0])$p.value
pvalue$VC10v20 <- t.test(TG$len[TG$supp=="VC" & TG$dose==1.0],
                         TG$len[TG$supp=="VC" & TG$dose==2.0])$p.value
```

```
pvalue$OJ05VC05 <- t.test(TG$len[TG$supp=="OJ" & TG$dose==0.5],
                          TG$len[TG$supp=="VC" & TG$dose==0.5])$p.value
pvalue$OJ10VC10 <- t.test(TG$len[TG$supp=="OJ" & TG$dose==1.0],
                          TG$len[TG$supp=="VC" & TG$dose==1.0])$p.value
pvalue$OJ20VC20 <- t.test(TG$len[TG$supp=="OJ" & TG$dose==2.0],
                          TG$len[TG$supp=="VC" & TG$dose==2.0])$p.value


pvalue <- t(as.data.frame(pvalue))
colnames(pvalue) <- c("P-Value")
rownames(pvalue) <- c("Orange Juice(OJ) & Dosage 0.5mg/day Vs 1.0mg/day",
                      "Orange Juice(OJ) & Dosage 1.0mg/day Vs 2.0mg/day",
                      "Ascorbic Acid(VC) & Dosage 0.5mg/day Vs 1.0mg/day",
                      "Ascorbic Acid(VC) & Dosage 1.0mg/day Vs 2.0mg/day",
                      "Orange Juice(OJ) Vs Ascorbic Acid(VC), Dosage 0.5mg/day",
                      "Orange Juice(OJ) Vs Ascorbic Acid(VC), Dosage 1.0mg/day",
                      "Orange Juice(OJ) Vs Ascorbic Acid(VC), Dosage 2.0mg/day")
message(" P-Values for 2 samples T-test\n Tooth length for each dosage and supplment combination")
```

```
##  P-Values for 2 samples T-test
##  Tooth length for each dosage and supplment combination
```

```
pvalue
```

```
##                                                           P-Value
## Orange Juice(OJ) & Dosage 0.5mg/day Vs 1.0mg/day        8.784919e-05
## Orange Juice(OJ) & Dosage 1.0mg/day Vs 2.0mg/day        3.919514e-02
## Ascorbic Acid(VC) & Dosage 0.5mg/day Vs 1.0mg/day       6.811018e-07
## Ascorbic Acid(VC) & Dosage 1.0mg/day Vs 2.0mg/day       9.155603e-05
## Orange Juice(OJ) Vs Ascorbic Acid(VC), Dosage 0.5mg/day 6.358607e-03
## Orange Juice(OJ) Vs Ascorbic Acid(VC), Dosage 1.0mg/day 1.038376e-03
## Orange Juice(OJ) Vs Ascorbic Acid(VC), Dosage 2.0mg/day 9.638516e-01
```

Observations :

- The p-values align with our observations above that it fails to reject the null hypothesis that the mean difference of the tooth length Orange Juice(OJ) at 1.0mg/day and 2.0mg/day is the same.
- The p-values align with our observations above that it fails to reject the null hypothesis that the mean difference of the tooth length Orange Juice(OJ) and Ascorbic Acid(VC) at 2.0mg/day is the same.
- All other pvalues are below 0.05 threshold and hence corresponding null hypothesis of having the same means can be rejected.

Conclusion & Assumptions :

- Tooth lengths are t distributed with not equal variance among different combinations.
- The the tooth length generally increases as the increase in dosage level of Vitamin C per day.
- For Orange Juice(OJ), the impact is higher at low-mid level dosage, 0.5 & 1.0 mg/day, than Ascorbic Acid(VC).
- Both supplements demonstrate similar impact at high level, 2.0mg/day. Means of difference is not significant.
- The impact of dosage at 1.0 & 2.0 mg/day of Orange Juice(OJ) are similar. Means of difference is not significant.