ToothGrow Inferential Analysis

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4/18/2021

ToothGrow Dataset Inferential Analysis

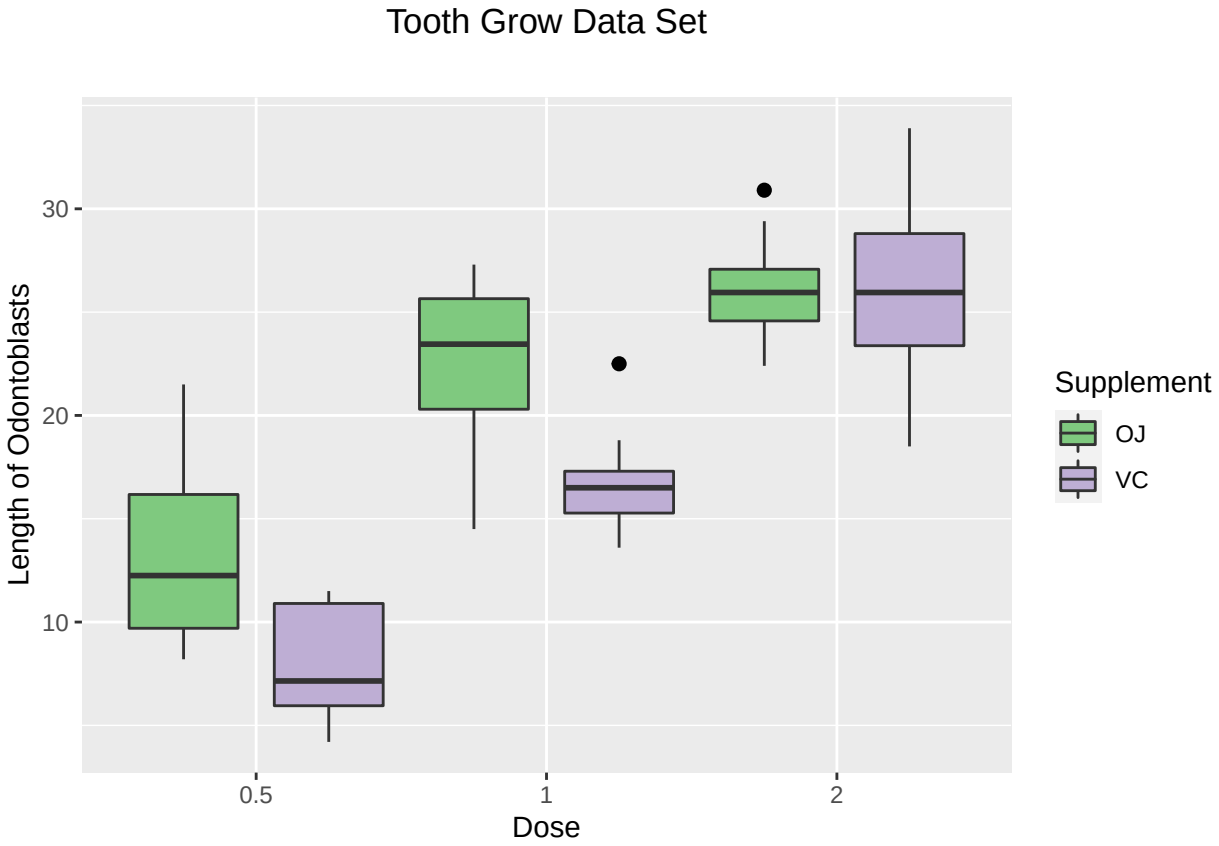
This is an analysis on the ToothGrow dataset in library datasets. In short this dataset is a study on length of Odontoblasts in 60 guinea pigs where each animal received a certain dose (0.5,1 or 2 mg/day) of Vitamin C Supplement through one of the two delivery methods viz. Orange Juice (OJ) or Ascorbic Acid Vitamin C (VC)

Assumptions:

1. We will assume variances are not equal across different experiments since we do not have any basis for such presumption.
2. Values are not paired since we do not have any basis for that either and the very nature of experiment suggests that way.
3. Confidence Level = Two Sided at 95%

Let us first load the dataset and perform some basic EDA.

```
tg <- ToothGrowth
tg$dose <- as.factor(tg$dose)
ggplot(data=tg, aes(x=dose,y=len,fill=supp)) +
  geom_boxplot(outlier.colour="black",
               outlier.size=2,position=position_dodge(1)) +
  labs(title = "Tooth Grow Data Set",
       subtitle = "",
       y = "Length of Odontoblasts", x = "Dose") +
    scale_fill_brewer(name = "Supplement",palette="Accent")  +
  theme(plot.title = element_text(hjust = 0.5))
```



So we can see that visually the Length increases with increase in dosage and generally the length is higher for OJ (Orange Juice) for Dosage = 0.5 and 1 as compared to VC (Ascorbic Acid Vitamin C). For Dosage = 2, we can see that the median length for both OJ and VC seem to be the same but there is a high amount of variance with VC as compared to OJ.

Let us confirm this with Hypothesis Testing. We have two things to confirm.

1. Increase in Dose causes an Increase in Length of Odontoblasts across both Delivery Methods (OJ and VC)
2. Across each Dose, OJ provides higher increase in length.

```
tg$supp.dose <- paste0(tg$supp,".",tg$dose)
tg$supp.dose <- as.factor(tg$supp.dose)
supp.doses <- levels(tg$supp.dose)
n.supp.dose <- length(supp.doses)

mat.comparison <- matrix(rep(0,n.supp.dose**2),n.supp.dose,n.supp.dose)
rownames(mat.comparison) <- supp.doses
colnames(mat.comparison) <- supp.doses
for (i in 1:n.supp.dose) mat.comparison[i,i] <- "X"

comb.supp.doses <- combn(levels(tg$supp.dose),2)
comb.supp.pvalues <- rbind(comb.supp.doses,
apply(comb.supp.doses,2,function(x)
{
  t.test(len~supp.dose,data=tg[tg$supp.dose %in% x,],alternative="two.sided",conf.level=0.95,var.equal=
}
```

```
  ))
comb.supp.pvalues <- as.data.frame(t(comb.supp.pvalues))
colnames(comb.supp.pvalues) <- c("Method.1","Method.2","P.Value")
comb.supp.pvalues$P.Value <- as.numeric(levels(comb.supp.pvalues$P.Value)[comb.supp.pvalues$P.Value])
comb.supp.pvalues$VERDICT <- with(comb.supp.pvalues,ifelse(P.Value < 0.05,"SIGNIFICANT",
    ifelse((P.Value >= 0.05) & (P.Value < 0.1), "BORDERLINE","INSIGNIFICANT")))
color.significant <- which(comb.supp.pvalues$VERDICT=="SIGNIFICANT")
color.borderline <- which(comb.supp.pvalues$VERDICT=="BORDERLINE")
color.insignificant <- which(comb.supp.pvalues$VERDICT=="INSIGNIFICANT")
comb.supp.pvalues$VERDICT <- as.factor(comb.supp.pvalues$VERDICT)
```

Let us study the Pair-wise T Test Statistics

Table 1: Pair wise Testing

Method.1	Method.2	P.Value	VERDICT
OJ.0.5	**OJ.1**	**0.0000878**	**SIGNIFICANT**
OJ.0.5	**OJ.2**	**0.0000013**	**SIGNIFICANT**
OJ.0.5	**VC.0.5**	**0.0063586**	**SIGNIFICANT**
OJ.0.5	**VC.1**	**0.0460103**	**SIGNIFICANT**
OJ.0.5	**VC.2**	**0.0000072**	**SIGNIFICANT**
OJ.1	**OJ.2**	**0.0391951**	**SIGNIFICANT**
OJ.1	**VC.0.5**	**0.0000000**	**SIGNIFICANT**
OJ.1	**VC.1**	**0.0010384**	**SIGNIFICANT**
OJ.1	**VC.2**	**0.0965261**	**BORDERLINE**
OJ.2	**VC.0.5**	**0.0000000**	**SIGNIFICANT**
OJ.2	**VC.1**	**0.0000002**	**SIGNIFICANT**
OJ.2	**VC.2**	**0.9638516**	**INSIGNIFICANT**
VC.0.5	**VC.1**	**0.0000007**	**SIGNIFICANT**
VC.0.5	**VC.2**	**0.0000000**	**SIGNIFICANT**
VC.1	**VC.2**	**0.0000916**	**SIGNIFICANT**

Conclusion

1. The finding matches with the Box Plot.
2. There is no statistical significance to suggest that for a fixed Dose = 2, the delivery method viz. OJ/VC has any specific impact
3. While the Dose increases from 1 to 2, the Delivery method if changed from OJ to VC, there is no statistical significance to suggest that there is any change in length of Odontoblasts.
4. Apart from the above exceptions, a general trend is that with increase in dosage, length of Odontoblasts increases and Orange Juice (OJ) has greater impact on length as compared with Ascorbic Acid Vitamin C (VC)