ToothGrowth Statistical Inference

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Introduction

The report attempts to analyze the ToothGrowth data in the R datasets package.

The data contains responses of (the length of odontoblasts) teeth in each of 10 guinea pigs at each of three dose levels of Vitamin C (0.5, 1, and 2 mg) with each of two delivery methods (orange juice or ascorbic acid).

Exploratory Data Analysis

```
#load the data
data(ToothGrowth)

# let's do a quick summary check
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
```

We see that there are 2 supplement types available in the data; VC and OJ.

There are 3 amounts of dosage; 0.5mg, 1mg and 2mg based on the data description that we derive by using the *'?ToothGrowth'* command.

```
# understand relation between length of tooth and amount of dose
require(graphics)
coplot(len ~ dose | supp, data = ToothGrowth, panel = panel.smooth,
       xlab = "ToothGrowth data: length vs dose, given type of supplement")
```

Given : supp
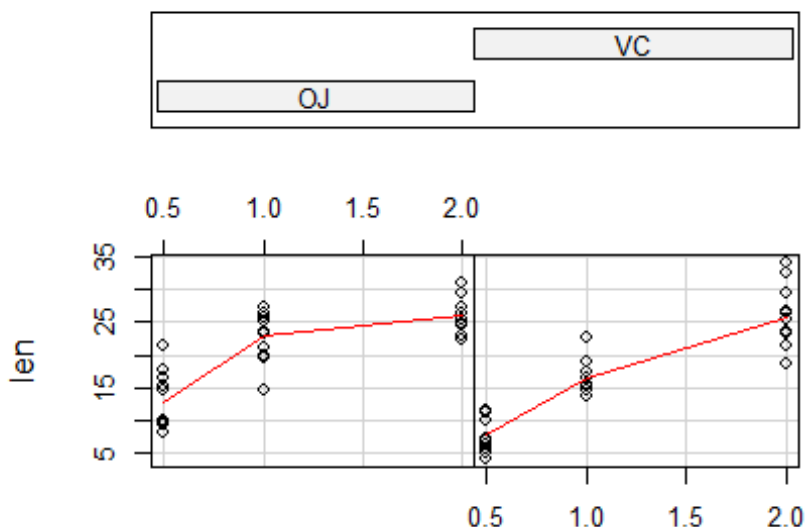
ToothGrowth data: length vs dose, given type of supplement

From the co-plot graph we see that the group supplemented using OJ have a higher overall mean for length of tooth.

Confidence Interval Test (Tooth Growth by Supplement)

In this section, we compare the supplement VC against OJ with regards to tooth growth. We assume that the variance across both data set as equal.

```
#VC
VC <- ToothGrowth$len[ToothGrowth$supp == 'VC']
#OJ
OJ <- ToothGrowth$len[ToothGrowth$supp == 'OJ']

con_int <- as.vector(t.test(VC,OJ, var.equal = TRUE)$conf.int)
con_int

## [1] -7.5670064  0.1670064

pval <- as.vector(t.test(VC,OJ, var.equal = TRUE)$p.value)
pval

## [1] 0.06039337
```

As the p-value is above 0.05, we conclude that there is no relationship between VC and OJ. However, based on the first graph (the co-plot) we generated we know that this result

might be misleading - since we have yet to factor in another dimension to the analysis; the amount of dose.

Confidence Interval Test (Tooth Growth by Dose)

In this section we compare the 3 dosage (0.5mg ,1mg and 2mg) against each other with regards to tooth growth.

```r
#0.5
halfmg <- ToothGrowth$len[ToothGrowth$dose == 0.5]
#1.0
onemg <- ToothGrowth$len[ToothGrowth$dose == 1.0]
#2.0
twomg <- ToothGrowth$len[ToothGrowth$dose == 2.0]

#test 1.0 against 0.5
onemg_con_int <- as.vector(t.test(onemg,halfmg, var.equal = TRUE)$conf.int)
onemg_con_int

## [1]  6.276252 11.983748
```

As the interval is above zero, we conclude that using 1 mg dose is better than 0.5 mg dose.

```r
#test 2.0 against 0.5
twomg_con_int_1 <- as.vector(t.test(twomg,halfmg, var.equal = TRUE)$conf.int)
twomg_con_int_1

## [1] 12.83648 18.15352
```

As the interval is above zero, we conclude that using 2 mg dose is better than 0.5 mg dose.

```r
#test 2.0 against 1.0
twomg_con_int_2 <- as.vector(t.test(twomg,onemg, var.equal = TRUE)$conf.int)
twomg_pval_2 <- as.vector(t.test(twomg,onemg, var.equal = TRUE)$p.value)
twomg_con_int_2

## [1] 3.735613 8.994387

twomg_pval_2

## [1] 1.810829e-05
```

As the interval is above zero, we can say that using 2 mg dose is better than 1.0 mg dose, with regards to tooth growth.

Assumption and Conclusion

It is important to highlight that in our analysis, we assume that the interval has a constant variance across the two groups. Should this be violated, then the interval would give us a proper coverage.

In both of our analysis, we simply seek to compare the confidence intervals of tooth growth across 2 dimensions, separately.

While a more correct analysis would seek to join the 3 dimensions together in a single analysis, this has not been covered within the report and is not the main objective to begin with.

We conclude this analysis by reporting our finding:

- On the surface, there is no significant relationship between OJ and VC with regards to tooth growth. However further analysis might reveal other insights.
- On the surface, it appears that the more dosage is supplemented, the tooth growth seems to be positively impacted - regardless of whatever the supplement type is.