

Analysis on ToothGrowth Data

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Overview

This is the second portion of the statistical inference class' course project of Coursera, we're going to do basic inferential data analysis on the ToothGrowth data in the R datasets package.

Data Background

The ToothGrowth data is 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).

Load the ToothGrowth data and exploratory data

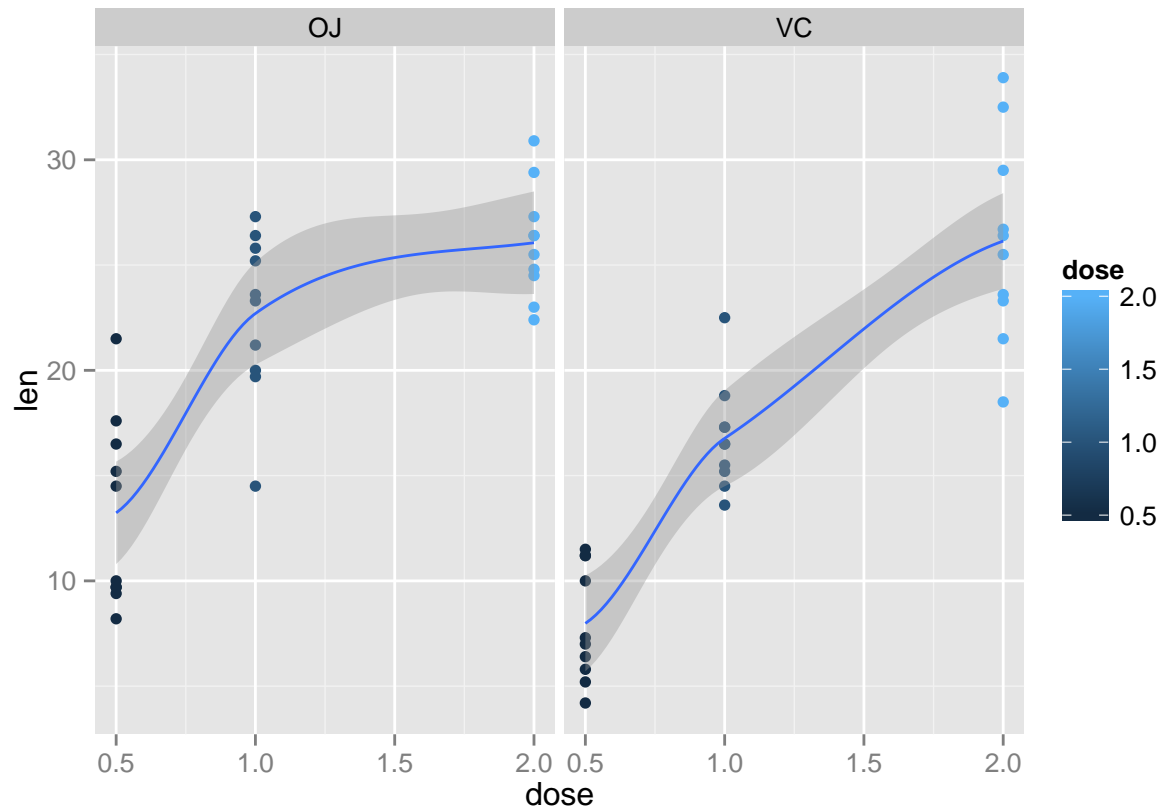
Load the ToothGrowth data and show basic summary

```
library(datasets)
data("ToothGrowth")
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
```

Plot a figure to show the feature of the data

```
library(ggplot2)
g <- ggplot(data=ToothGrowth, aes(dose, len, group = supp))
g <- g + facet_grid(facets = .~supp)
g <- g + geom_point(aes(colour = dose))
g <- g + geom_smooth(stat = "smooth", method = "loess")
suppressWarnings(print(g))
```



analyze intervals

Below, use one side confidence intervals and/or hypothesis tests to compare tooth growth by supp and dose.

T test on different supp, Supplement type (VC or OJ)

null hypothesis: mean of supplement with “VC” \geq mean of supplement with “OJ”

alternative hypothesis: mean of supplement with “VC” $<$ mean of supplement with “OJ”

```
t.test(ToothGrowth$len[ToothGrowth$supp == 'VC'], ToothGrowth$len[ToothGrowth$supp == 'OJ'],
       var.equal = FALSE, paired = FALSE, alternative="less")
```

```
##
##  Welch Two Sample t-test
##
## data:  ToothGrowth$len[ToothGrowth$supp == "VC"] and ToothGrowth$len[ToothGrowth$supp == "OJ"]
## t = -1.9153, df = 55.309, p-value = 0.03032
## alternative hypothesis: true difference in means is less than 0
## 95 percent confidence interval:
##      -Inf -0.4682687
## sample estimates:
## mean of x mean of y
##  16.96333  20.66333
```

Result: $p\text{-value} < 0.05$

T test on different Dose(milligrams)

1. 0.5 vs. 1.0

null hypothesis: mean of dose with 0.5 milligrams \geq mean of dose with 1.0 milligrams
alternative hypothesis: mean of dose with 0.5 milligrams $<$ mean of dose with 1.0 milligrams

```
t.test(ToothGrowth$len[ToothGrowth$dose == 0.5], ToothGrowth$len[ToothGrowth$dose == 1.0],
       var.equal = FALSE, paired = FALSE, alternative="less")
```

```
##
## Welch Two Sample t-test
##
## data: ToothGrowth$len[ToothGrowth$dose == 0.5] and ToothGrowth$len[ToothGrowth$dose == 1]
## t = -6.4766, df = 37.986, p-value = 6.342e-08
## alternative hypothesis: true difference in means is less than 0
## 95 percent confidence interval:
##      -Inf -6.753323
## sample estimates:
## mean of x mean of y
##    10.605    19.735
```

Result: p-value < 0.05

2. 1.0 vs. 2.0

null hypothesis: mean of dose with 1.0 milligrams \geq mean of dose with 2.0 milligrams
alternative hypothesis: mean of dose with 1.0 milligrams $<$ mean of dose with 2.0 milligrams

```
t.test(ToothGrowth$len[ToothGrowth$dose == 1.0], ToothGrowth$len[ToothGrowth$dose == 2.0],
       var.equal = FALSE, paired = FALSE, alternative="less")
```

```
##
## Welch Two Sample t-test
##
## data: ToothGrowth$len[ToothGrowth$dose == 1] and ToothGrowth$len[ToothGrowth$dose == 2]
## t = -4.9005, df = 37.101, p-value = 9.532e-06
## alternative hypothesis: true difference in means is less than 0
## 95 percent confidence interval:
##      -Inf -4.17387
## sample estimates:
## mean of x mean of y
##    19.735    26.100
```

Result: p-value < 0.05

Conclusion

- Assumptions
 1. Suppose the guinea pigs are chosen randomly.
 2. The each group of 10 guinea pigs is independent.
 3. Assume a different variance per group.
- Conclusion According to the T test result of null hypothesis and alternative hypothesis, we know:
 1. Supplement with VC is not better to length of teeth than OJ. So, orange juice(OJ) is more effective.
 2. Vitamin is effective to teeth, as dose increase, length of teeth will be longer.