Statistical Inference Week4 Programming Assignment (2)

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Overview

This report addresses the questions from Week 4 Assignment of **Statistical Inference**, the Course #6 of the Data Science Specialization series, offered by Coursera.org. The report is mainly consist of 2 parts, aiming to discuss the results of the two topics:

- Testing CLT with simulation from exponential distribution;
- **Performing inferential analysis on the ToothGrowth dataset**.

Case Study 2:

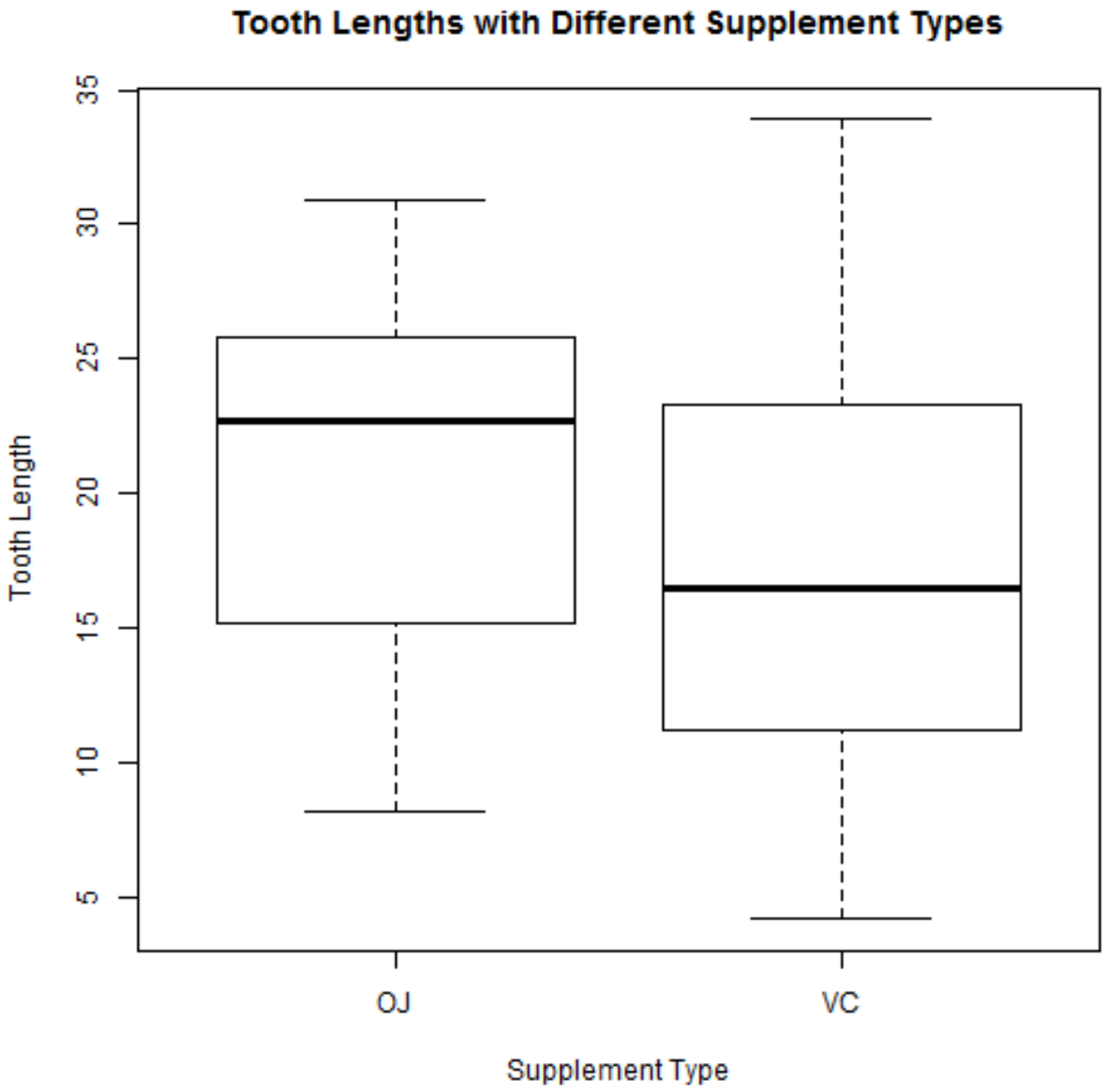
In this case we will take a look at the `ToothGrowth` dataset from `datasets` package.

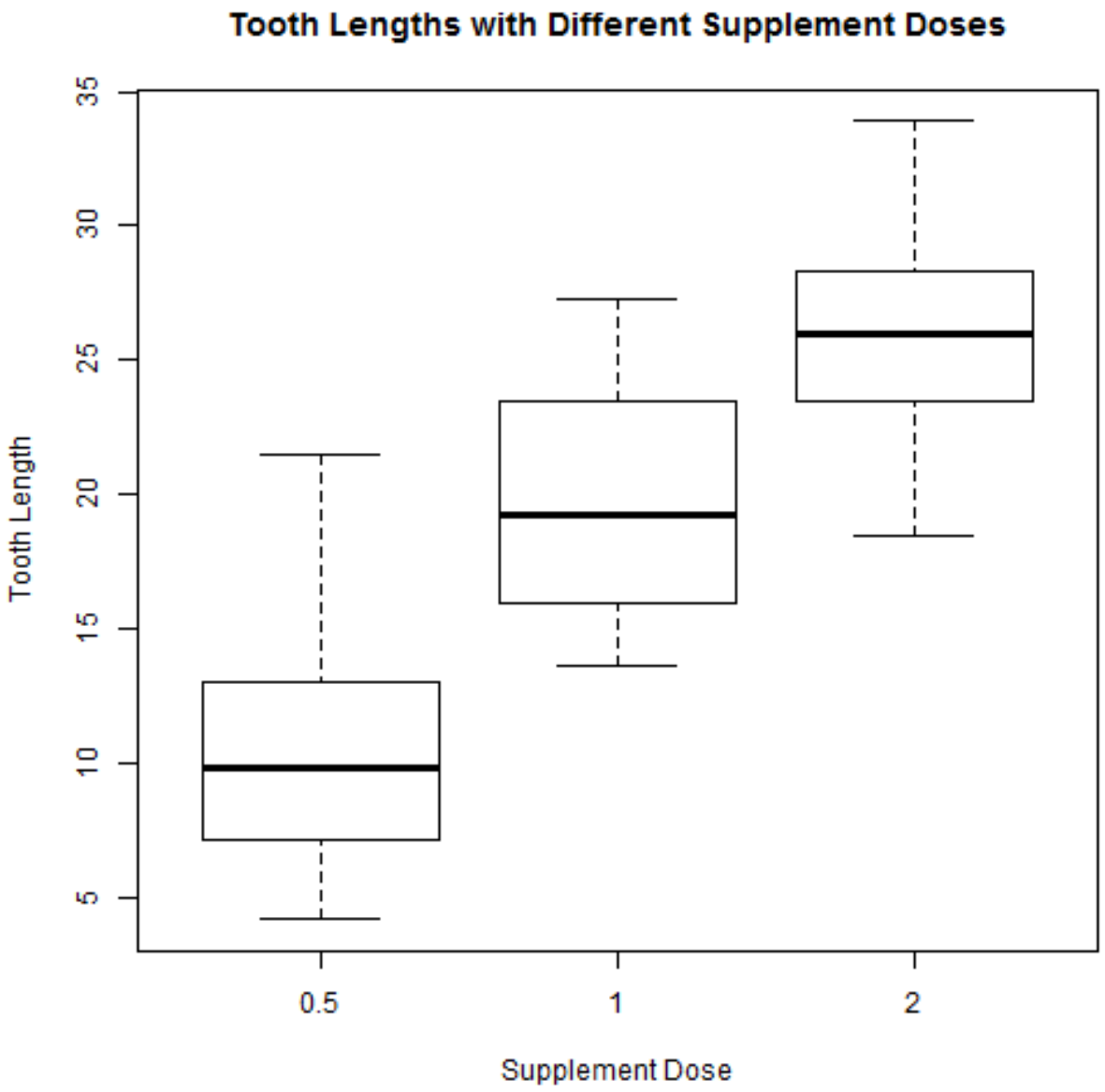
First let's load and take a quick look at the dataset.

```
## [1] 60  3
```

```
##       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
```

```
## '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: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```


Tooth Lengths with Different Supplement Types
Tooth Length
5
10
15
20
25
30
35
OJ
VC
Supplement Type



So from the summary we know that the dataset has 3 variables:

- len - tooth length: numeric value indicating tooth growth;
- supp - supplement type: 2-component factor (`VC`, `OJ`), 30 entries each;
- dose - dose in mg/day: 3-component numeric factor (`0.5`, `1`, `2`), 20 entries each.

Now we need to perform inferential analysis over the topics:

1. Is vitamin supplement type related to tooth growth?
2. Is vitamin supplement dose related to tooth growth?

For question 1, we'll establish H0: there's no difference between the 2 groups of supplements. Then we'll use t-test to find out p-value, and compare to the cutoff alpha = 0.05 (two sides).

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 1.9153, df = 55.309, p-value = 0.06063
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1710156  7.5710156
## sample estimates:
## mean in group OJ mean in group VC
##         20.66333         16.96333
```

As the p-value (0.0606345) is greater, and confidence interval (-0.17 ~ 7.57) passes 0, we therefore have to retain the H0: **difference in supplement types isn't relevant to tooth growth**.

And for question 2, we need to do the same thing, but one pair each time; hence there are 3 null hypotheses to be checked. We'll show the summary of only 1 here.

```
##
##  Welch Two Sample t-test
##
## data:  dose1 and dose2
## t = -6.4766, df = 37.986, p-value = 1.268e-07
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.983781  -6.276219
## sample estimates:
## mean of x mean of y
##    10.605    19.735
```

As we see, the p-value between dose of 0.5 mg/d and 1 mg/d is 1.2683007×10^{-7}, way smaller than 0.05; so do the comparisons between 0.5 mg/d and 2 mg/d (4.397525×10^{-14}), and 1 mg/d and 2 mg/d (1.9064295×10^{-5}). Hence we can safely reject the H0, and confirm that **the dose does have a relationship with tooth growth**.

Appendix: Codes

Codes for Data Loading, Summary and Plotting

```
# Load dataset
library(datasets)
data(ToothGrowth)

# Look at the dataset
dim(ToothGrowth)
summary(ToothGrowth)
str(ToothGrowth)
boxplot(ToothGrowth$len ~ ToothGrowth$supp, xlab = 'Supplement Type',
        ylab = 'Tooth Length',
        main = 'Tooth Lengths with Different Supplement Types')
```

```
boxplot(ToothGrowth$len ~ ToothGrowth$dose, xlab = 'Supplement Dose',
        ylab = 'Tooth Length',
        main = 'Tooth Lengths with Different Supplement Doses')
```

Codes for T-Test of Supplement Types

```
# Is vitamin supplement type related to tooth growth?
ttest <- t.test(len ~ supp, data = ToothGrowth)
ttest
```

Codes for T-Tests of Supplement Doses

```
# Is vitamin supplement dose related to tooth growth?
# Here we show comparison between 0.5 and 1.
dose1 <- ToothGrowth[ToothGrowth$dose == 0.5, 1]
dose2 <- ToothGrowth[ToothGrowth$dose == 1, 1]
ttest1 <- t.test(dose1, dose2)
ttest1

# p-values for the other pairs
dose3 <- ToothGrowth[ToothGrowth$dose == 2, 1]
ttest2 <- t.test(dose1, dose3)
ttest3 <- t.test(dose2, dose3)
```