Statistical Inference Course Project

1. Simulation Exercise

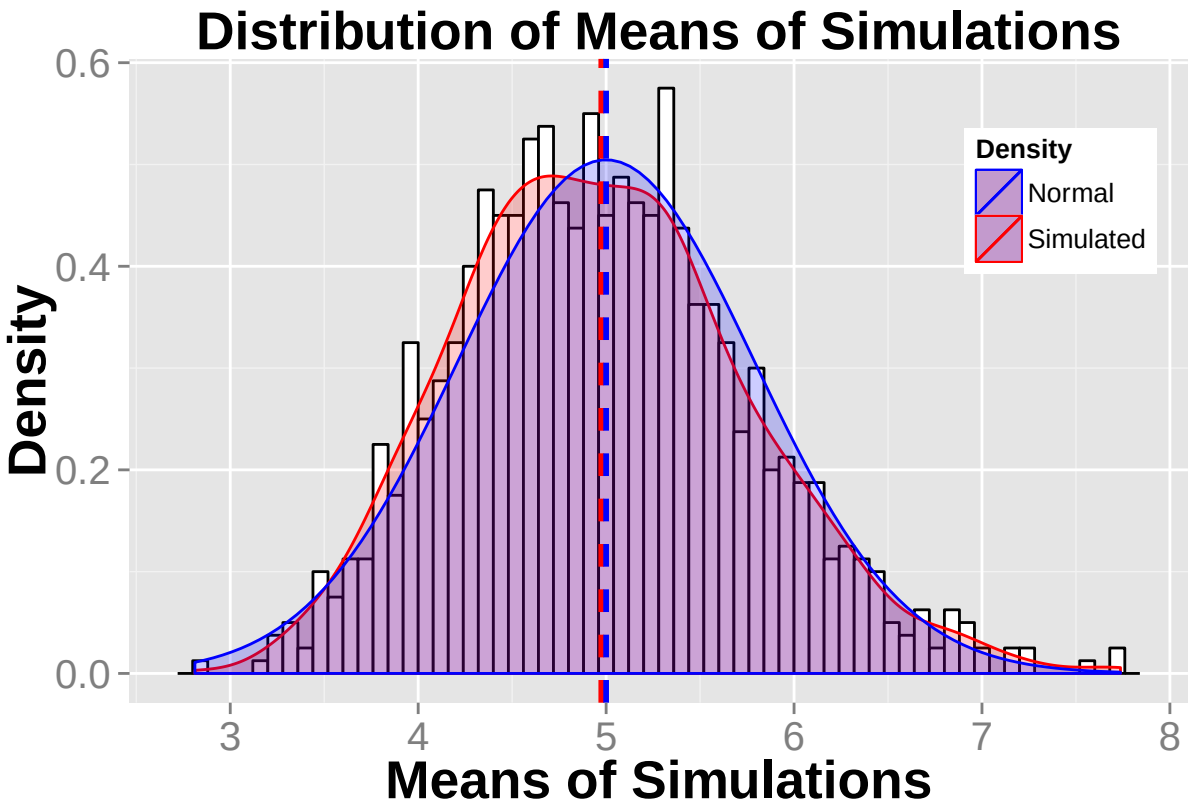
1. Show where the distribution is centered at and compare it to the theoretical center of the distribution

```
##      [,1] [,2]                                  [,3]
## [1,] "1"  "Theoretical Centre of distribution" "5"
## [2,] "1"  "Centre of Simulation Distribution"  "4.97423877125153"
```

2. Show how variable it is and compare it to the theoretical variance of the distribution.

```
##      [,1] [,2]                                   [,3]
## [1,] "2"  "Theoretical Variance of Distribution" "25"
## [2,] "2"  "Vairance of Simulation Distribution"  "23.3726136368744"
```

3. Show that the distribution is approximately normal. See image below: This shows the distribution of means of the 1000 sample Simulations is approximately normally distributed



4. Evaluate the coverage of the confidence interval

Confidence Interval

```
## [1] 4.675 5.274
```

Confidence Interval Coverage

```
## [1] 0.04947
```

2. Basic Inferential Data Analysis

1. Load the Tooth Growth Dataset & Basic Exploratory Analysis

Type of Supp	Number Trials
VC	30
OJ	30

Dose (milligrams)	Number Trials
0.5	20
1.0	20
2.0	20

2. Basic Summary of Data

Supplements and Doses Summary Table

```
##    supp dose meanLength sdLength
## 1:   VC  0.5       7.98    2.747
## 2:   VC  1.0      16.77    2.515
## 3:   VC  2.0      26.14    4.798
## 4:   OJ  0.5      13.23    4.460
## 5:   OJ  1.0      22.70    3.911
## 6:   OJ  2.0      26.06    2.655
```

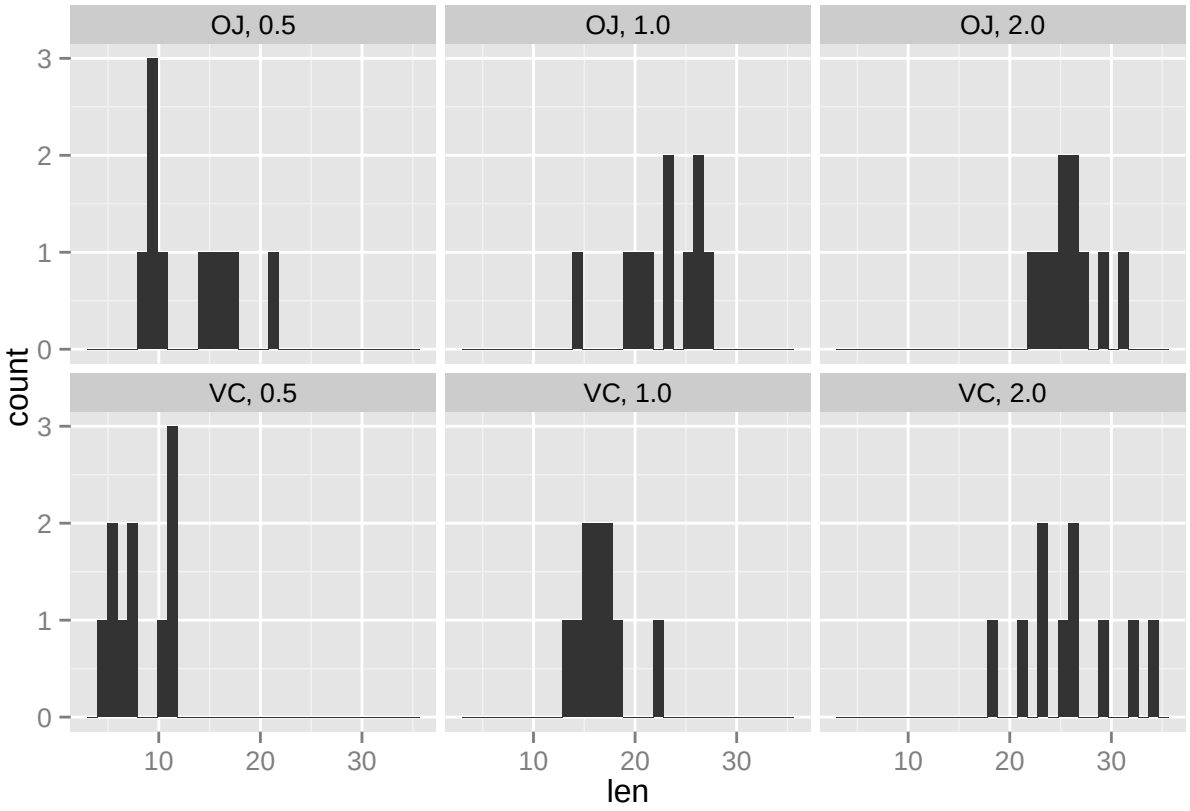
Supplements Summary Table

```
##    supp meanLength sdLength
## 1:   VC      16.96    8.266
## 2:   OJ      20.66    6.606
```

Doses Summary Table

```
##    dose meanLength sdLength
## 1:  0.5      10.61    4.500
## 2:  1.0      19.73    4.415
## 3:  2.0      26.10    3.774
```

Graphical Summary of Supplements and Doses



3. Use Confidence Intervals and Hypothesis Tests to compare tooth growth by supplement and dose

a) Confidence Intervals

Comparing by Supp
Independent t confidence interval for OJ - VC

```
## [1] -0.17  7.57
```

Most of the time the OJ out performs the VC with 95% confidence

Comparing by Dose

Independent t confidence interval comparing doses 0.5 vs 1.0 milligrams

```
## [1]  6.28 11.98
```

Dose of 1.0 always out performs does of 0.5 in stimulating tooth growth with 95% confidence

Independent t confidence interval comparing doses 0.5 vs 2.0 milligrams

```
## [1] 12.84 18.15
```

Dose of 2.0 always out performs does of 0.5 in stimulating tooth growth with 95% confidence

Independent t confidence interval comparing doses 2.0 vs 1.0 milligrams

```
## [1] 3.74 8.99
```

Dose of 2.0 always out performs does of 1.0 in stimulating tooth growth with 95% confidence

b) Hypothesis Test

Comparing by Supp

```
##
##  Welch Two Sample t-test
##
## data:  dt[supp == "OJ"]$len and dt[supp == "VC"]$len
## t = 1.915, df = 55.31, p-value = 0.06063
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.171  7.571
## sample estimates:
## mean of x mean of y
##     20.66     16.96
```

```
##     mean    sd
## 1: 18.81 7.649
```

```
## [1] "Reject H0"
```

Comparing by Dose

```
##
##  Welch Two Sample t-test
##
## data:  dt[dose == 0.5]$len and dt[dose == 1]$len
## t = -6.477, df = 37.99, p-value = 1.268e-07
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.984  -6.276
## sample estimates:
## mean of x mean of y
##     10.61     19.73
```

```
##
##  Welch Two Sample t-test
##
## data:  dt[dose == 0.5]$len and dt[dose == 2]$len
## t = -11.8, df = 36.88, p-value = 4.398e-14
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -18.16 -12.83
## sample estimates:
## mean of x mean of y
##     10.61     26.10
```

```
##
##  Welch Two Sample t-test
##
## data:  dt[dose == 1]$len and dt[dose == 2]$len
## t = -4.901, df = 37.1, p-value = 1.906e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -8.996 -3.734
## sample estimates:
## mean of x mean of y
##     19.73     26.10
```

4. Conclusions and Assumptions

Conclusions

1. Most of the time the OJ out performs the VC with 95% confidence
2. Dose of 1.0 always out performs does of 0.5 in stimulating tooth growth with 95% confidence
3. Dose of 2.0 always out performs does of 0.5 in stimulating tooth growth with 95% confidence
4. Dose of 2.0 always out performs does of 1.0 in stimulating tooth growth with 95% confidence

Assumptions

1. Use t interval as not sure if data is normally distributed
2. Assume unequal variances for t distribution confidence interval
3. Central limit theorm for Z test
4. n must be large enough to be statistically signifcant
5. If n is small then Gossett's T test is used, n is small for each set of tests so use t test
6. Assuming a constant variance between groups of Guinea Pigs receiving difference amounts of treatment and different supplements