IST-772 Quantitative Reasoning in Data science

Week4/HW-4: Statistical Inference Part-1

Logic of inference using Confidence Intervals (Page-66: Problems:7-10)

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1. Using the built-in dataset PlantGrowth, run the summary and hist commands and interpret the results

The summary output is as below:

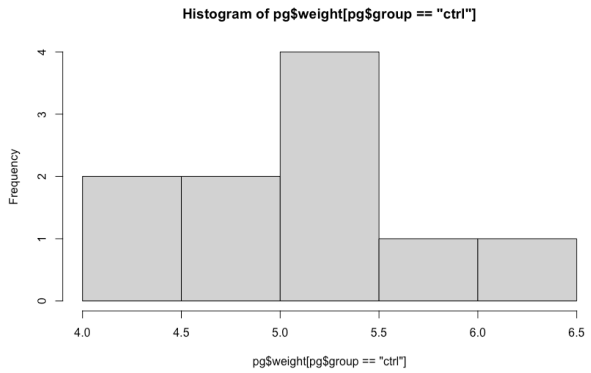
```
> summary(pg)
     weight       group
 Min.   :3.590   ctrl:10
 1st Qu.:4.550   trt1:10
 Median :5.155   trt2:10
 Mean   :5.073
 3rd Qu.:5.530
 Max.   :6.310

> str(pg)
'data.frame':  30 obs. of  2 variables:
 $ weight: num  4.17 5.58 5.18 6.11 4.5 4.61 5.17 4.53 5.33 5.14 ...
 $ group : Factor w/ 3 levels "ctrl","trt1",..: 1 1 1 1 1 1 1 1 1 1 ...
```

Command interpretation: The summary output shows two columns, weight and group – let us use str() to better understand the data in the two columns:

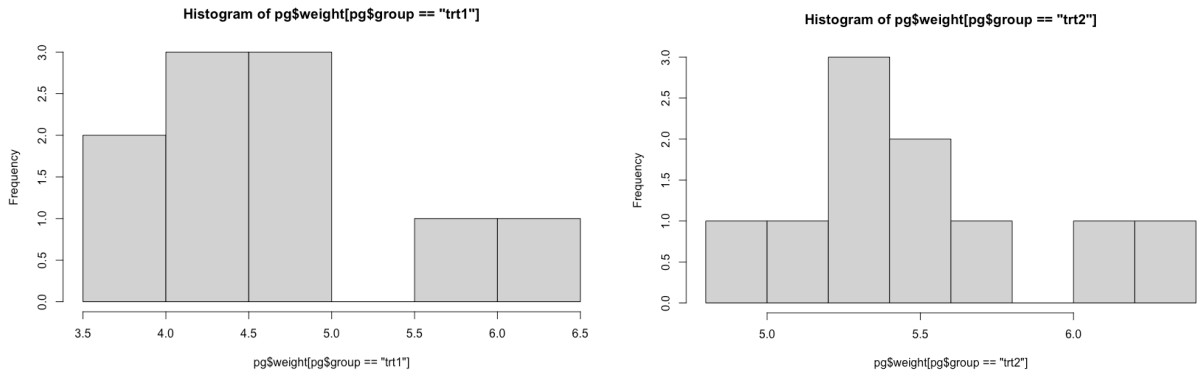
- Weight is type numeric and so the summary for this column shows:
  - range – min/max values
  - central tendencies – mean/median
  - quartiles – 1st/3rd
- Group is type factor and summarizes the 3 known groups – crtl, trt1 and trt2, with counts

Using the following R code, we can obtain the histogram of the weight for group ctrl:

```
> pg$weight[pg$group == 'ctrl']
 [1] 4.17 5.58 5.18 6.11 4.50 4.61 5.17 4.53 5.33 5.14
> hist(pg$weight[pg$group == 'ctrl'])
```



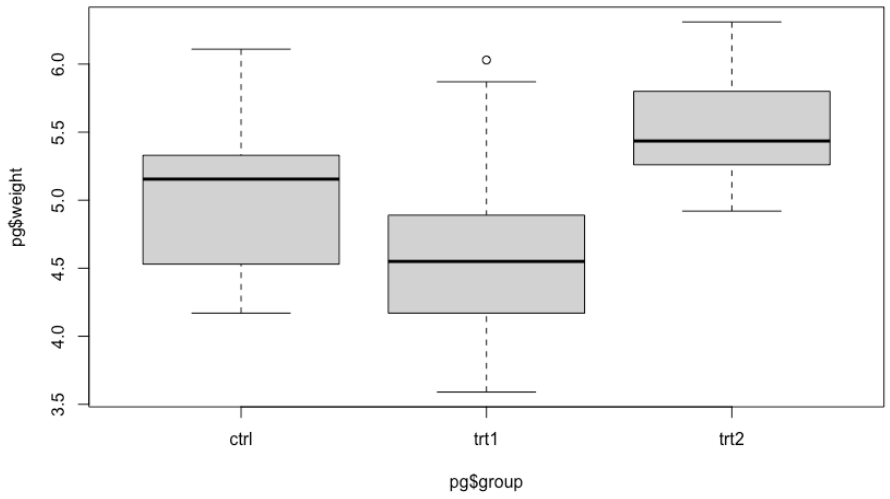
Correspondingly, below are histograms for trt1 and trt2 groups:



2. Create a boxplot of the plant growth data

Using the following R-code, we can create a boxplot:

```
> boxplot(pg$weight ~ pg$group)
```



Interpreting the box plot:

- group *trt2* has higher min, max, 1st and 3rd quartile and median values compared to groups ctrl and trt1
- group *trt1* has the lowest min values but a comparable max value with groups ctrl and trt2 and so has a larger range
- medians for all three groups are in the range 4.5 – 5.5 - trt1 is on the lower end and trt2 is on the higher end of that range

3. Run a t-test between ctrl and trt1

Use the following R-code to run a t-test between ctrl and trt1:

```
> t.test(pg$weight[pg$group == 'ctrl'], pg$weight[pg$group == 'trt1'])

        Welch Two Sample t-test

data:  pg$weight[pg$group == "ctrl"] and pg$weight[pg$group == "trt1"]
t = 1.1913, df = 16.524, p-value = 0.2504
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2875162  1.0295162
sample estimates:
mean of x mean of y
    5.032     4.661
```

The Welch two sample t-test results are seen in the output above. The 95% confidence interval is shown as a range -0.287, +1.029

Interpreting the confidence interval:

- Span -0.287, +1.029 is the interval estimate of the population mean difference
- We can say that 95% of the intervals contain the true population mean difference, somewhere between -0.287, +1.029 (likely 0.371 +/- 0.658)

4. Run a t-test between ctrl and trt2

Use the following R-code to run a t-test between ctrl and trt2:

```
> t.test(pg$weight[pg$group == 'ctrl'], pg$weight[pg$group == 'trt2'])

        Welch Two Sample t-test

data:  pg$weight[pg$group == "ctrl"] and pg$weight[pg$group == "trt2"]
t = -2.134, df = 16.786, p-value = 0.0479
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.98287213 -0.00512787
sample estimates:
mean of x mean of y
   5.032     5.526
```

95% confidence interval is between -0.982, -0.005. Some take aways:

- The fact that the mean difference between ctrl and trt2 is negative tends to show that means and hence the values of ctrl are lower than trt2
- Like earlier, the confidence interval is saying that 95% of the intervals will comprise the true population mean difference