STA 104 Non-parametric Statistics

Project I

Instructor: Maxime Pouokam

Man Chuen Chau (919819081)

Lucas Choi (917246805)

Jean Marco Oviedo (919345322)

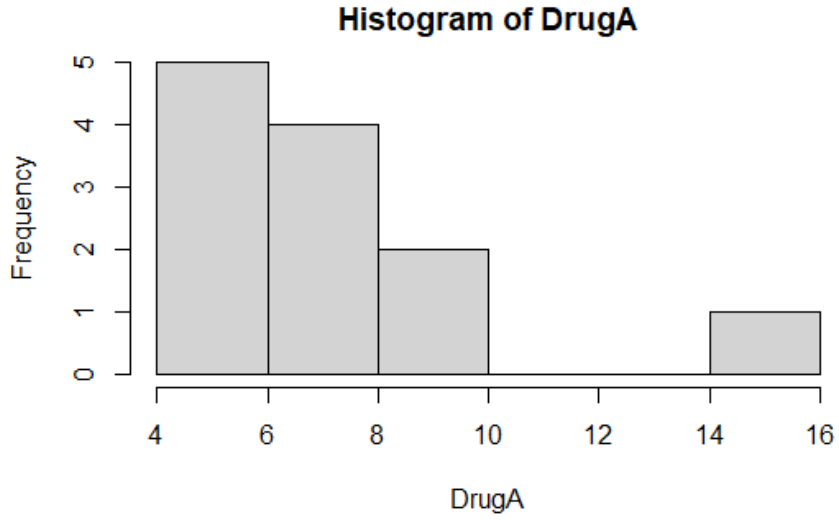
Comparison of Pain Relief with Two Different Drugs

I. Introduction

The study was comparing the hours of pain relief for two common over the counter pain medications. Our goal is comparing effectiveness across two drug groups and analyzing our data. There are two columns; Column 1 indicates relief which is the number of hours of relief provided and Column 2 indicates either drug A or drug B. In this part, we are going to analyze our data by using the Mann-Whitney / Wilcoxon Rank-Sum testing method. Once we get the p- value from those we are going to compare with the confidence level and decide the conclusion if we can conclude the null hypothesis that both drugs times of the relief pain are the same or not.

II. Summary of the data

We can summarize this data as we make two types of the graphs below;



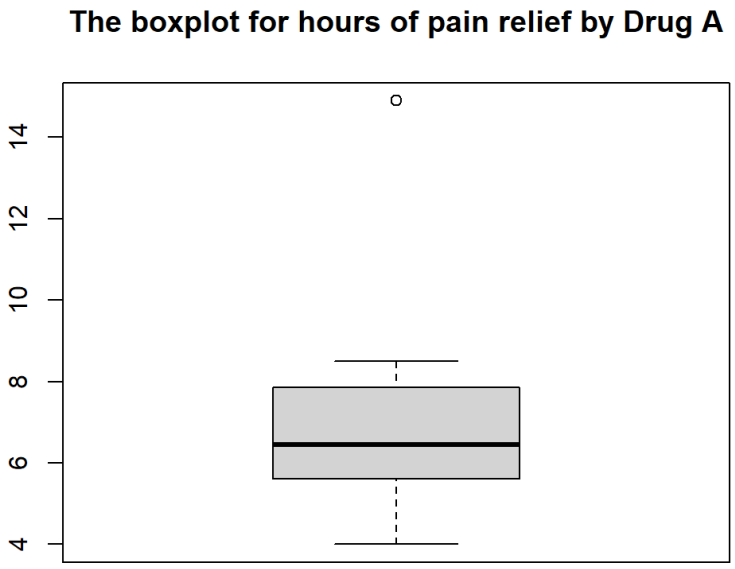
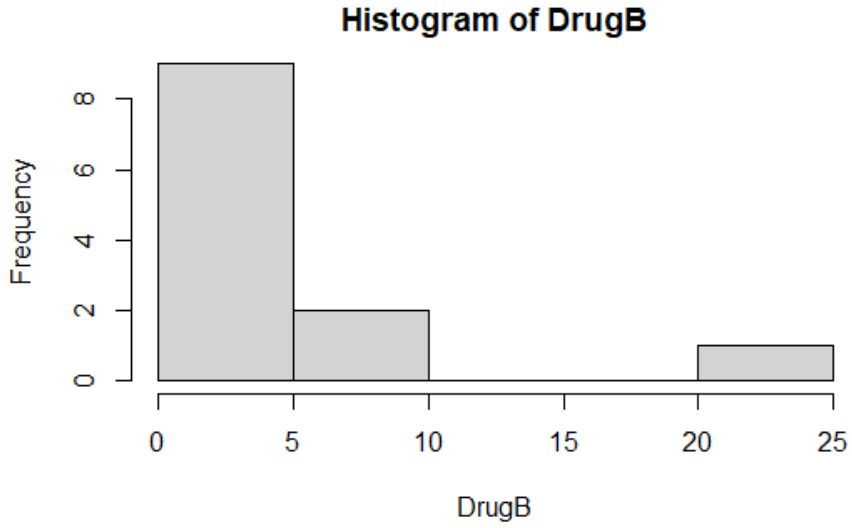


Figure 3.1

In the Drug A histogram graph, it seems skewed to the right. This is not a normal distribution since it does not have a bell shape. There is one outlier in Drug A data on the box plot graph.



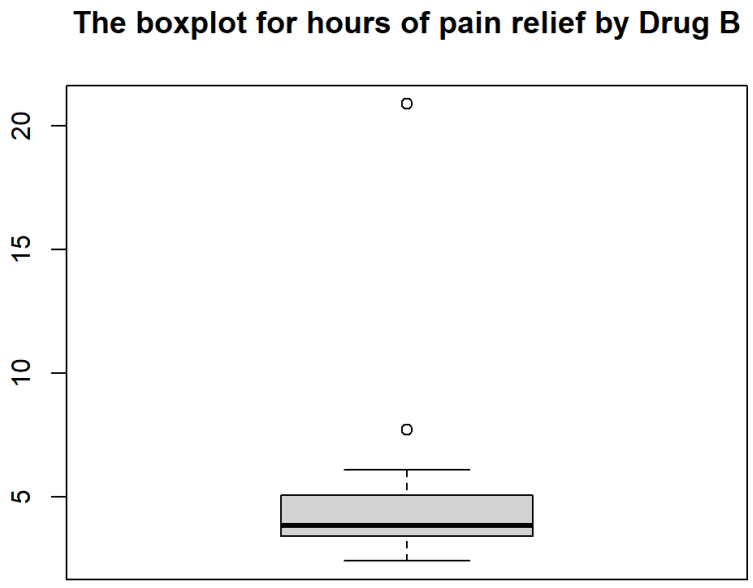


Figure 3.2

In the Drug B histogram graph, it also seems skewed to the right. This is not a normal distribution since it does not have a bell shape. There are two outliers in Drug B data on the box plot graph.

Since the data for Drugs A and B are skewed and have outliers present we will use the Mann-Whitney / Wilcoxon Rank-Sum testing method in the analysis. When we compare both graphs, the outlier in Drug A data is smaller than Drug B data on box plot graphs.

Summary Drugs Data			
Group Size		**Relief**	
Drug A	12	Minimum	2.400
Drug B	12	1st quarter	3.875
		Median	5.600
Drug A Mean	6.96667	Overall Mean	6.242
Drug B Mean	5.516667	3rd quarter	6.925
Standard Deviation		Maximum	20.900
Drug A	2.880446		
Drug B	5.052062		

Table 3.1

Based on our data Table 3.1, the overall mean value is 6.242, minimum is 2.400 and maximum is 20.900. It seems like the drugs data is skewed to the right. The standard deviation of Drug A data is smaller than Drug B data.

Although we are using the Wilcoxon Rank-Sum/Mann-Whittney test we also calculated the total amount of possible permutations for the data with the equation below:

$$\frac{(m+n)!}{n!m!} \quad \text{m = 12, n = 12} \qquad (3.1)$$

Where m is equal to the sample size of Drug A and n is equal to the sample size of Drug B. After our calculations are done we know that there are 2,704,156 total possible permutations for this data set.

III. Analysis

To determine if Drug A provides longer pain relief as compared to Drug B we conducted a Mann-Whittney test because there are outliers present in our data and distribution is skewed. The results were calculated using Rstudio with the following null and alternative hypothesis:

$$H_0: F_1(x) = F_2(x) \qquad (\mu_1 \leq \mu_2)$$
$$H_1: F_1(x) \leq F_2(x) \qquad (\mu_1 > \mu_2)$$

$$With\ F_1(x),\ \mu_1\ representing\ the\ cumulative\ density\ function\ and\ mean\ of\ Drug\ A$$
$$and$$
$$F_2(x),\ \mu_2\ representing\ the\ the\ cumulative\ density\ function\ and\ mean\ of\ Drug\ B$$

After calculating our Mann-Whittney test statistic, we got the U_{Mw} = 2.548 and p-value = 0.0046. Since our p-value is less than the level of significance of $\alpha = 0.05$, we can reject the null hypothesis and conclude $F_1(x) \leq F_2(x)$.

Next, we can calculate the shift parameter confidence interval for the two groups. Our 95% confidence interval is (0.5, 3.6). We are 95% confident that the true shift parameter for pain relief between Drug A and Drug B is (0.5, 3.6).

IV. Interpretation

After performing our Mann-Whittney test we were able to reject the null hypothesis and conclude that the pain relief provide by Drug A is longer than the pain relief provided by Drug B. If the distribution of pain relief was the same between Drug A and B we would observe our data or more extreme 0.46% of the time. Also, since both bounds of Confidence Interval are greater than zero it suggests that there is a positive difference between the two Drugs. Meaning that Drug A tends to have a higher average time of pain relief than Drug B.

V. Conclusion

In conclusion when comparing the time of pain relief by Drugs A and B, Drug A provides a longer average duration of pain relief. If someone was looking to take a drug that provided the longest pain relief they should choose Drug A.

```
## Summary of Data
summary(dat)
DrugA=c(4,5.6,5.6,5.6,7.3,8.4,14.9,6.6,6.3,4,6.8,8.5)
DrugB=c(3.5,3.7,2.9,2.4,3.9,3.3,7.7,4,3.8,4,6.1,20.9)
sd(DrugA)
sd(DrugB)
mean(DrugA)
mean(DrugB)

## draw boxplot
dat <- data.frame(
Group = as.factor(c(rep("drugA", 12), rep("drug B", 12))),
Relief = c(
4,5.6,5.6,5.6,7.3,8.4,14.9,6.6,6.3,4,6.8,8.5,
3.5,3.7,2.9,2.4,3.9,3.3,7.7,4,3.8,4,6.1,20.9
)
)
boxplot(DrugA, main = "The boxplot for hours of pain relief by Drug A", xlab = "Figure 3.1")
boxplot(DrugB, main = "The boxplot for hours of pain relief by Drug B", xlab = "Figure 3.2")

## draw histogram
hist(DrugA)
hist(DrugB)

## Mann-Whitney test statistics
some.numbers = `Drug`[,1]
some.groups = `Drug`[,2]
some.data = data.frame(numbers = some.numbers,groups = some.groups)
some.groups <- as.factor(some.groups)
```

```
 wilcox_test(numbers ~ as.factor(groups),some.data, distribution = "exact",alternative =
"greater")


## Shift Parameter Confidence Interval

alpha =0.05

save.me = wilcox_test(numbers ~ as.factor(groups),some.data, distribution = "exact",alternative
= "two.sided",conf.int = TRUE, conf.level = 1-alpha)

confint(save.me)
```