Two Sample Mean T-Test: Alpha Wave Frequency levels and Sensory Deprivation

Introduction:

Sensory deprivation and it's effects on the human psyche and health has long been debated. The effects of sensory deprivation can be detected by electroencephalography (EEG). EEG is a test in which electrodes are applied to the skull. It can detect and measure different types of brain waves and their frequencies. A technician or physician can analyze these brain waves. Alpha waves are prominent during wakeful relaxation with closed eyes, meditation, and mindfulness. There frequency range for the alpha wave is between 7.5-12.5 Hz. It was of interest to test a difference in means in a randomized study between two groups, a treatment group who experienced 10 days of sensory deprivation and the control group who did not experience sensory deprivation.

Methods:

Subjects were randomly allocated into the two treatments. The alpha wave frequency measurements were summarized for each group with means, standard deviations and 95 % confidence intervals, while the observed difference between the two sample means, its standard error and 95 % confidence interval are also reported. Data were checked for normality with QQ plots, and the equality of variances between the two groups was assessed using the F-test. We will test the null hypothesis that Treatment group and the Control group means are equal. (H_0: $\mu_T-\mu_C=0$) against a two-sided alternative hypothesis that the means are not equal (H_A: $\mu_T-\mu_C \neq 0$) with either the equal-variance or unequal-variance independent two-sample t-test. We will reject the null hypothesis in favor of the alternative if the observed p-value is less than the significance level of ($\alpha = 0.05$), otherwise we will fail to reject the null hypothesis. All calculations and analyses were conducted using the R (version 2.11.1) statistical software.

Results:

We assume that the data are representative and subjects are independently measured. The data are summarized in Table 1.0 below, where we see that Treatment group mean is 10.28 alpha frequency wave is lower than that of Control group. Note that while the sample sizes are relatively small (Treatment group *n*=10, Control group *n*=10), the data values in both groups are reasonably normally distributed based on inspection of the QQ plots. Further, the p-value for the F-test is 0.4433, so we can assume that the variances in both groups are equal. The results from the equal-variance t-test (t = -3.3567, p-value = 0.003512) indicate that there is a significant difference between the Treatment group and Control group means.Since p value < alpha, we reject the null hypothesis in favor of the alternative that there are differences in the means of Treatment group and Control group

Table 1.0 Summary Data for Alpha Wave Frequency Measurements Based on Group Status

Group	*n*	Mean	SD	95% CI
Treatment	10	10.28	0.60	9.9, 10.7
Control	10	11.08	0.46	10.8,11.4
		Mean	SE	95%CI
Difference(T-C)		-0.8	0.24	-1.30-0.30

Discussion:

Based on our observed data, the mean alpha wave frequency for the Treatment group was significantly lower than the mean alpha wave frequency for the control group. The results suggest there is a difference in means between the treatment and the control. This research will lead to more discoveries in the effects of alpha wave frequencies to sensory deprivation.

Question 2

Two Sample Median Mann-Whitney U Test: Blood Glucose and Stress in Two Strains of Mice

Introduction:

Stress hyperglycemia is a phenomenon that occurs during stressful or traumatic events in one's life that results in transient elevation of blood glucose. Stressful/traumatic experiences cause cortisol levels to raise, which results in lower insulin sensitivity be the liver causing increased levels of blood glucose. We were interested to test the effects of stress and blood glucose on two strains of mice, strain A and strain B.

Methods:

Blood Glucose levels of Strain A and Strain B of mice were obtained. These blood glucose levels were checked for normality using QQ plots, and then were summarized with the median, IQR, and sample size. We will test the null hypothesis that Strain A and Strain B medians are equal (H_0: Median A = Median B) against a two-sided alternative hypothesis that Strain A and Strain B medians are not equal (H_0: Median A ≠ Median B) with a Mann-Whitney U Test. We will reject the null hypothesis in favor of the alternative if the observed p-value is less than the significance level of ($\alpha = 0.05$), otherwise we will fail to reject the null hypothesis. All calculations and analyses were conducted using the R (version 2.11.1) statistical software.

Results:

We assume that the data are representative and subjects are independently measured. We summarized the data below in table 2.0. Note that while the sample sizes are relatively small (group A n=10, group B n=12), the data values in both groups are not normally distributed based on inspection of the QQ plots. We see that Strain A median is 78.50 (first quartile: 55.75, third quartile: 97.00). The Strain B median is 93.50 (first quartile: 90.25, third quartile: 98.75) Strain A's median is lower Strain B. The results from the Mann-Whitney U Test (p-value = 0.1133). Since p value > alpha, we fail to reject the null hypothesis that there is no significance difference between Strain A and Strain B medians.

Table 2.0:

Summary Data for Blood Glucose Levels Of Mice Strain A and Strain B After A Traumatic Event

Strains	Sample Size	Median	1st Quartile	3rd Quartile
Strain A	10	78.50	55.75	97.00
Strain B	12	93.50	90.25	98.75

Discussion:

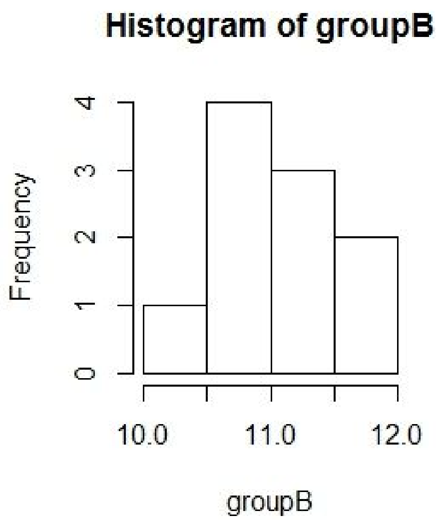
Based on our observed data, the mean alpha wave frequency for Group A was significantly lower than the mean alpha wave frequency for Group B, therefore the medians are not equal between the two different strains of mice. Going forward, health care professionals can properly teach their patients about the importance of stress management and in order to decrease the episodes of blood glucose spikes.

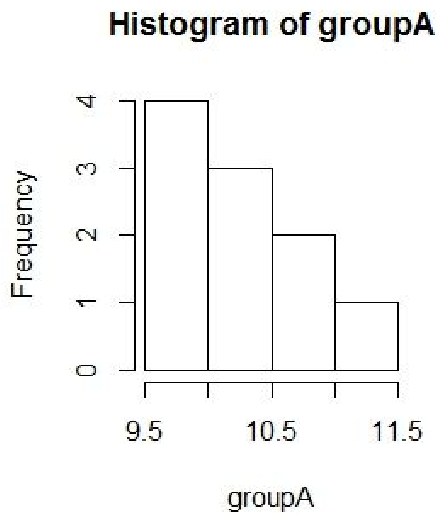
Appendix

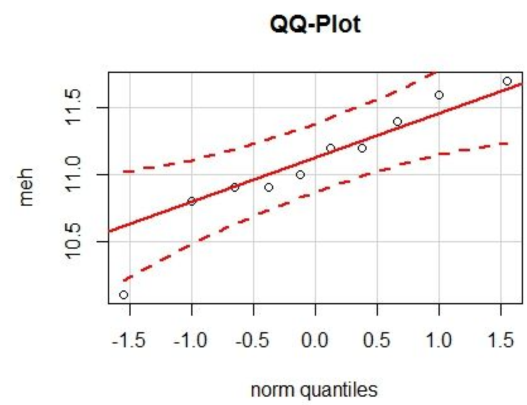
```
#homework 6-question 1
# group A
groupA<-c(10.2,9.5,10.1,10.0,9.8,10.9,11.4,10.8,9.7,10.4)
hist(groupA)
qqPlot(groupA,ylab="meh", main = "QQ-Plot")
var.test(groupA)
#group B
```

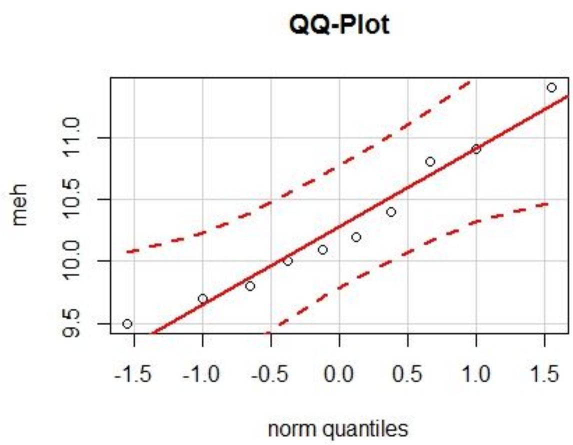
```
groupB<-c(11.0,11.2,10.1,11.4,11.7,11.2,10.8,11.6,10.9,10.9)
hist(groupB)
qqPlot(groupB,ylab="meh", main = "QQ-Plot")
#var test
var.test(groupA, groupB, ratio = 1,
        alternative = c("two.sided"),
        conf.level = 0.95)
#F test to compare two variances
#
#data:  groupA and groupB
#F = 1.6962, num df = 9, denom df = 9, p-value = 0.4433
#alternative hypothesis: true ratio of variances is not equal to 1
#95 percent confidence interval:
#  0.4213127 6.8289015
#sample estimates:
#  ratio of variances
#1.696203
summary(groupA)
#Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
#9.50    9.85   10.15   10.28   10.70   11.40
summary(groupB)
#Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
#10.10   10.90   11.10   11.08   11.35   11.70

#standard devian
sdA<-sd(groupA)
sdA
#0.5977736
sdB<-sd(groupB)
sdB
#0.4589844

#difference in means
diff<-mean(groupA)-mean(groupB)
diff
# -0.8

#sample size
nA<-10
nB<-10

#group A CI
mean <-  10.28
n <- 10
error <- qnorm(0.95)*sdA/sqrt(n)
left <- mean-error
right <- mean+error
left
right
#[1] 9.969069
#> right
#[1] 10.59093

#group B CI
mean <-  11.08
n <- 10
error <- qnorm(0.95)*sdB/sqrt(n)
left <- mean-error
right <- mean+error
left
right
#> left
#[1] 10.84126
#> right
#[1] 11.31874
```

```
sp<-((nA-1)*sdA*sdA+(nB-1)*sdB*sdB)/(nA+nB-2)
sp
# 0.284

#pooled standard error
#pooled-use this due to near equal variances
sep<-sqrt(sp*(1/nA+1/nB))
sep
# 0.2383275

#unpooled
seu<-sqrt(sdA*sdA/nA+sdB*sdB/nB)
seu
# 0.2383275

t.test(x, y = NULL, alternative = c("two.sided", "less", "greater"), mu = 0, paired =
        FALSE, var.equal = FALSE, conf.level = 0.95)


t.test(groupA, groupB, mu=0, alternative="two.sided", var.equal=TRUE, conf.level = 0.95)
#data:  groupA and groupB
#t = -3.3567, df = 18, p-value = 0.003512
#alternative hypothesis: true difference in means is not equal to 0
#95 percent confidence interval:
#  -1.3007075 -0.2992925
#sample estimates:
#  mean of x mean of y
#10.28     11.08
```





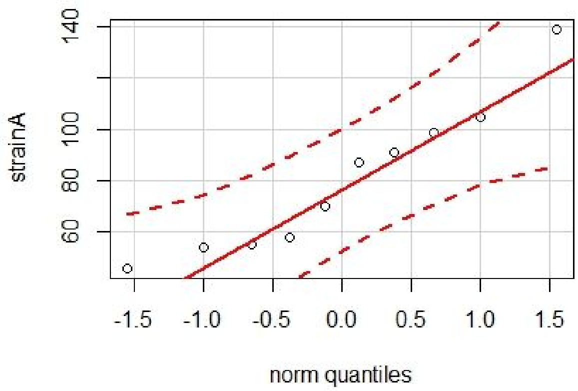


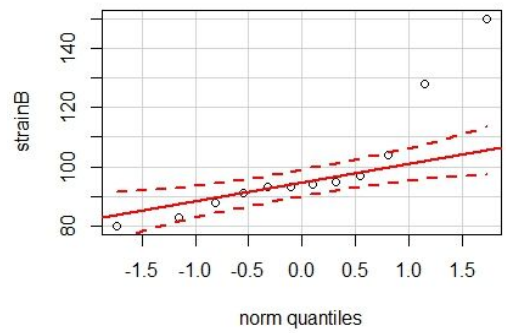


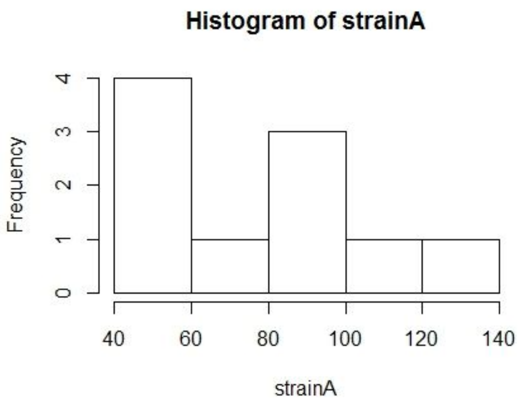
Group B **Group A**

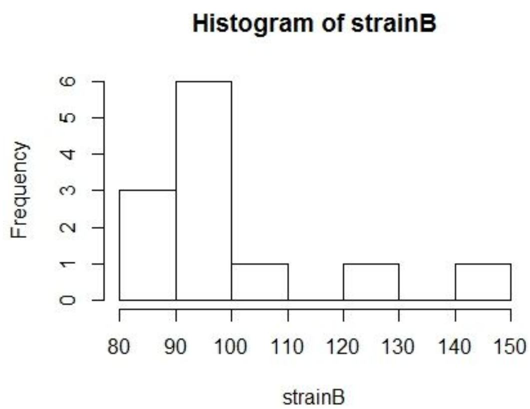
```
##########################################################################################
#question 2
strainA<-c(54,99,105,46,70,87,55,58,139,91)
qqPlot(strainA)
hist(strainA)
strainB<-c(93,91,93,150,80,104,128,83,88,95,94,97)
qqPlot(strainB)
hist(strainB)
#var test
var.test(strainA, strainB, ratio = 1,
        alternative = c("two.sided"),
        conf.level = 0.95)

#difference in means
diff<-mean(strainA)-mean(strainB)
diff
#[1] -19.26667

summary(strainA)
#Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
#46.00   55.75   78.50   80.40   97.00  139.00
```

```
summary(strainB)
#Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
#80.00   90.25   93.50   99.67   98.75  150.00

#standard devian
sdA_2<-sd(strainA)
sdA_2
# 29.20502
sdB_2<-sd(strainB)
sdB_2
#19.95601

#sample size
nA<-10
nB<-12

#group A CI
mean <-  80.40
n <- 10
error <- qnorm(0.95)*sdA_2/sqrt(n)
left <- mean-error
right <- mean+error
left
right
#[1]  65.20905
#> right
#[1] 95.59095

#group B CI
mean <-  99.67
n <- 12
error <- qnorm(0.95)*sdB_2/sqrt(n)
left <- mean-error
right <- mean+error
left
right
#> left
#[1] 90.19432
#> right
#[1]  109.1457

sp<-((nA-1)*sdA_2*sdA_2+(nB-1)*sdB*sdB)/(nA+nB-2)
sp
# 602.8533

#pooled-use this due to near equal variances
sep<-sqrt(sp*(1/nA+1/nB))
sep
#  10.513

#unpooled
seu<-sqrt(sdA_2*sdA_2/nA+sdB_2*sdB_2/nB)
seu
#10.88486
wilcox.test(strainA, strainB, mu = 0, alternative = "two.sided")
#Wilcoxon rank sum test with continuity correction
#data:  strainA and strainB
#W = 35.5, p-value = 0.1133
#alternative hypothesis: true location shift is not equal to 0
```


strainA
norm quantiles


strainB
norm quantiles


Histogram of strainA
Frequency
strainA


Histogram of strainB
Frequency
strainB