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Math 6357

Homework 3

1. > t.test(prob22, mu=225, alternative = "greater")

   One Sample t-test

```
data:  prob22
t = 0.66852, df = 15, p-value = 0.257
alternative hypothesis: true mean is greater than 225
95 percent confidence interval:
 198.2321      Inf
sample estimates:
mean of x
   241.5
```

2. A) > var.test(Type.1, Type.2, data = prob26, alternative = "two.sided")

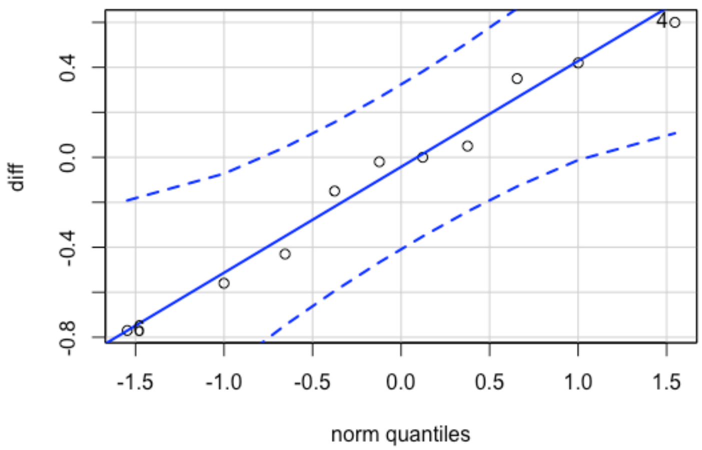
```
        F test to compare two variances

data:  Type.1 and Type.2
F = 0.97822, num df = 9, denom df = 9, p-value = 0.9744
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.2429752 3.9382952
sample estimates:
ratio of variances
        0.9782168
```

   B) > t.test(Type.1, Type.2, data = prob26, var.equal = FALSE)

```
        Welch Two Sample t-test

data:  Type.1 and Type.2
t = 0.048008, df = 17.998, p-value = 0.9622
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -8.552517  8.952517
sample estimates:
mean of x mean of y
     70.4      70.2
```

3. A) > diff <- Birth.Order..1 - Birth.Order..2

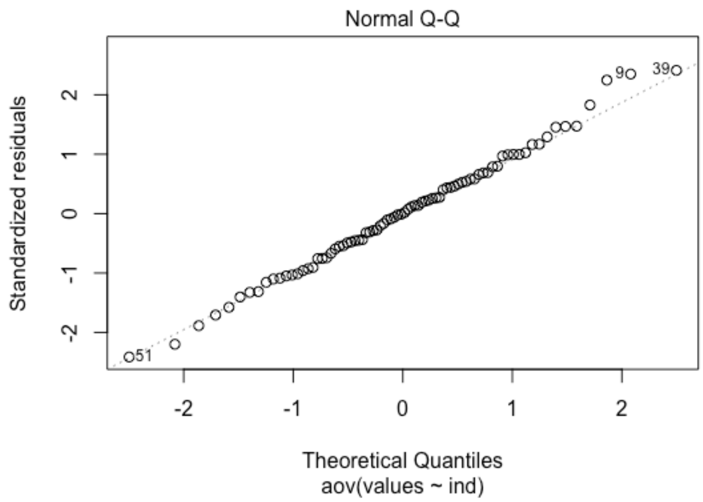
```
> shapiro.test(diff)

        Shapiro-Wilk normality test

data:  diff
W = 0.96727, p-value = 0.8645
> qqPlot(diff)
```



B)
```
> t.test(Birth.Order..1, Birth.Order..2, data = prob33, paired = TRUE)

        Paired t-test

data:  Birth.Order..1 and Birth.Order..2
t = -0.36577, df = 9, p-value = 0.723
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.3664148  0.2644148
sample estimates:
mean of the differences
               -0.051
> qt(.975, 9)
[1] 2.262157
```

4.
```
> prob4 <- read_excel("Downloads/Data_Sets.xlsx",
+     sheet = "Chapter 03", range = "A3:D23")
> prob4.stacked <- stack(prob4)
> prob4.stacked
> attach(prob4.stacked)
> prob4.aov <- aov(values ~ ind, data = prob4.stacked)
```

```
> summary(prob4.aov)
            Df Sum Sq Mean Sq F value Pr(>F)
ind          3  10.04   3.348   1.298  0.281
Residuals   76 196.03   2.579

> plot(prob4.aov, which = 2)
```



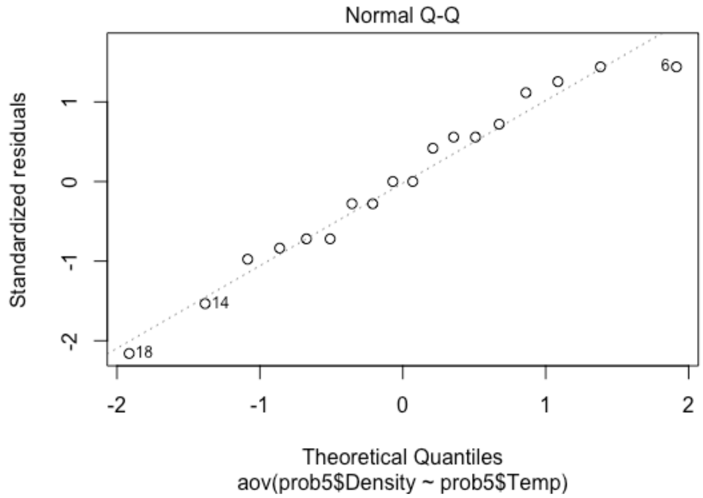
5. Null hypothesis: firing temperature doesn't affect density of bricks
   Alternative hypothesis: firing temperature does affect density of bricks

```
attach(prob5)
plot(Density ~ Temp, data = prob5)
prob5$Temp <- as.factor(Temp)
> prob5.aov <- aov(prob5$Density ~ prob5$Temp)
> summary(prob5.aov)
            Df Sum Sq Mean Sq F value Pr(>F)
prob5$Temp   3 0.1561 0.05204   2.024  0.157
Residuals   14 0.3600 0.02571
```

Since the p-value is greater than the 0.05 level of significance, we fail to reject the null hypothesis and conclude that there is enough evidence to support the claim that firing temperature does not affect density of bricks.

b) Since there is no difference in the treatments, there is no need to conduct Fisher's LSD to decide which mean is different.

c) > plot(prob5.aov, which = 2)



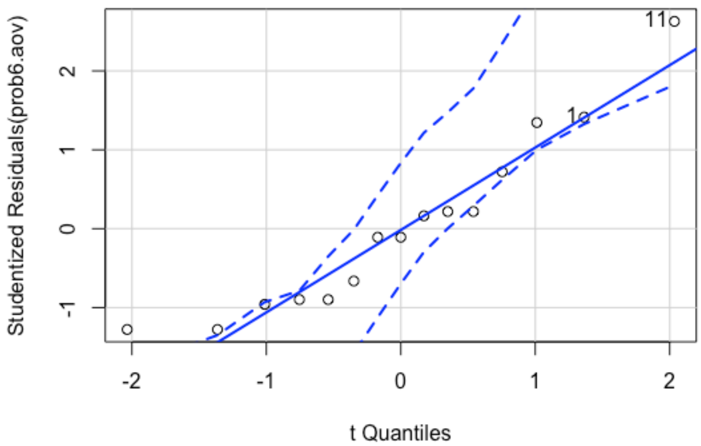
Based off of the plot, the ANOVA assumptions are satisfied. The plot shows a normal distribution.

6. A) Null hypothesis: There is not a difference in the lives of batteries
   Alternative hypothesis: there is a difference in the lives of batteries.

```
> library(readxl)
> prob6 <- read_excel("Desktop/prob6.xlsx")
> View(prob6)
> prob6 <- data.frame(prob6)
> prob6.stacked <- stack(prob6)
> attach(prob6.stacked)
> prob6.aov <- aov(values ~ ind, data = prob6.stacked)
> summary(prob6.aov)
            Df Sum Sq Mean Sq F value   Pr(>F)
ind          2 1196.1   598.1   38.34 6.14e-06 ***
Residuals   12  187.2    15.6
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Based off of the p-value for the F statistic, there is a significant difference between the lives of batteries (since p-value is less than 0.05). Hence, we reject the null hypothesis.

b) > qqPlot(prob6.aov)



The residuals are scattered from the straight line, therefore the normal distribution assumption cannot be accepted on the residual.

c) > mean(prob6$Brand.2)
[1] 79.4
> sd(prob6$Brand.2)
[1] 3.847077

99% CI for brand 2 and brand 3:

> t.test(prob6$Brand.2, prob6$Brand.3, data = prob6, mu=0, alternative = "two.sided", paired = TRUE, conf.level = 0.99)

Paired t-test

data: prob6$Brand.2 and prob6$Brand.3
t = -7, df = 4, p-value = 0.002192
alternative hypothesis: true difference in means is not equal to 0
99 percent confidence interval:
-34.812285 -7.187715
sample estimates:
mean of the differences
-21

d) > TukeyHSD(prob6.aov)
Tukey multiple comparisons of means
95% family-wise confidence level

Fit: aov(formula = values ~ ind, data = prob6.stacked)

```
$ind
              diff       lwr       upr     p adj
Brand.2-Brand.1 -15.8 -22.464321 -9.135679 0.0001044
Brand.3-Brand.1   5.2  -1.464321 11.864321 0.1355226
```
Brand.3-Brand.2 21.0 14.335679 27.664321 0.0000063

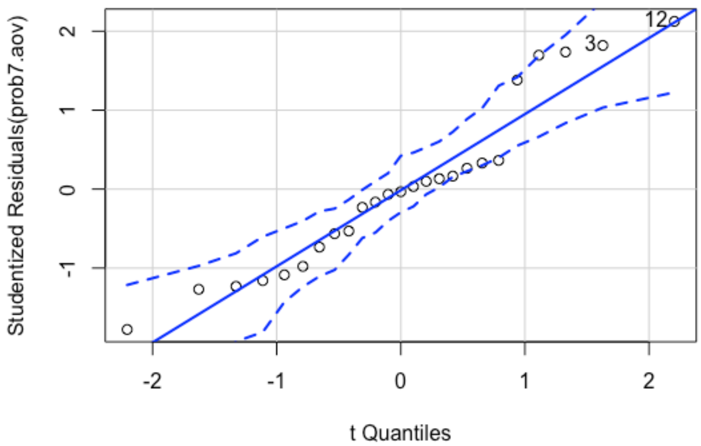
```
t.test(prob6, mu=85, alternative = "two.sided", paired = FALSE, var.equal = FALSE) #right sided t test

        One Sample t-test

data:  prob6
t = 2.5975, df = 14, p-value = 0.02108
alternative hypothesis: true mean is not equal to 85
95 percent confidence interval:
 86.16191 97.17142
sample estimates:
mean of x
 91.66667
```

7. A) prob7.stacked <- stack(prob7)

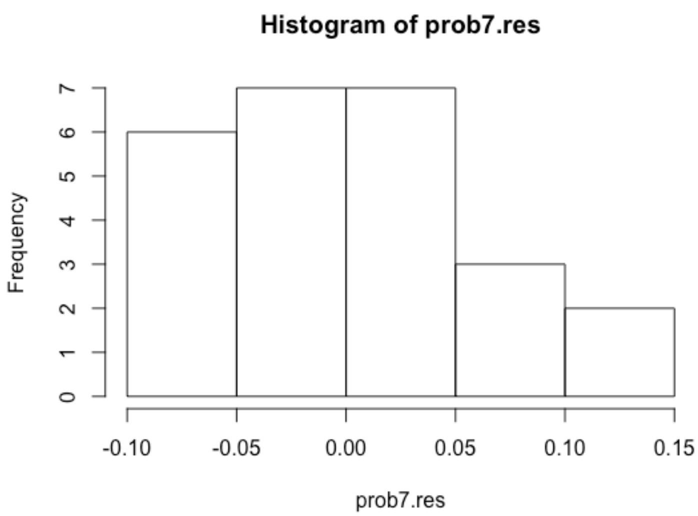
```
attach(prob7.stacked)
prob7.aov <- aov(values ~ ind, data = prob7.stacked)
summary(prob7.aov)
> summary(prob7.aov)
            Df  Sum Sq Mean Sq F value  Pr(>F)
ind          4 0.09698 0.02424   5.535 0.00363 **
Residuals   20 0.08760 0.00438
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Fail to reject null hypothesis since p value is < 0.05.

d) > qqPlot(prob7.aov)




```
> prob7.res <- resid(prob7.aov)
> hist(prob7.res)
```



The points slightly deviate from the line in the QQ-plot. Therefore, the assumptions are not satisfied since the plot rejects the assumption of normality.