Experiment no: 04

Experiment Name:

Draw a random number of size 200 from
(a) normal distribution with mean 50 and variance 26.

(i) Find the estimate of the parameter by maximum likelihood method.

(ii) Construct a 90% / 95% / 80% confidence interval for the parameter(s).

(iii) Estimate the variance using exponential distribution.

solution:

Code:

```
norm = rnorm(200, 50, 26); norm
exp = rexp(60); exp
```

(i)

```
n = length(norm); n
muhat = sum(norm)/n; muhat
sigmahat = sqrt((sum(norm^2)-n*muhat^2)/n); sigmahat
thetahat = 1/mean(exp); thetahat
```

Output:

```
> norm=rnorm(200,50,26); norm
[1] 35.14 , 69.33 , 53.00 , 45.12 , 101.803
[6] 76.59, 39.74, 75.41 , 50.85, 85.07
:
[196] 71.96 , 21.48 , 33.99 , 18.58 , 34.67

> exp=rexp(60); exp
[1] 0.51 , 0.11 , 0.80 , 2.84 , 0.88
:
[56] 0.01 , 1.60 , 0.13 , 2.39 , 0.84
```

(i)

```
> n=length(norm); n
[1] 200
> muhat =sum(norm)/n ; muhat
[1] 49.73421
>sigmahat =sqrt((sum(norm^2)-n*muhat^2)/n); sigmahat
[1] 25.70963
> thetahat = 1/mean(exp); thetahat
[1] 1.1148
```

Problem no: 06

Problem name:

According to a survey in 2008, the mean of MBA graduates in accounting was 37000 TK per month. In a follow up study in June 2009, a sample of 48 MBA students graduating in accounting found a sample mean of 38,100 TK. and a sample standard deviation of 5,200 TK.

(i) Formulate the null and alternative hypothesis that can be used to determine wheather the sample data support the conclusion that MBA graduates in accounting have a mean salary greater than 37,000 Tk.

(ii) At 5% level of significance what is conclusion?

(iii) Find the p. value and state your conclusion.

(iv) Find 95% confidence interval for mean salary of MBA graduates.

code:

```
xbar = 38100; xbar
n = 48; n
sd = 5200; sd
mu = 37,000; mu
alpha = 0.05; alpha
zstat = (xbar - mu)/(sd/sqrt(n)); zstat
ztab = qnorm(alpha, mean=0, sd = 1, lower.
                              tail=False); #ztab
if(zstat > ztab){
  print("NULL hypothesis is rejected")
}else{
  print("NULL hypothesis is accepted")
}
pval= pnorm(zstat, lower.tail=False);
                                    pval
if (pval < alpha)
{
 print("NULL hypothesis is rejected").
}else{
 print("NULL hypothesis is accepted").
}
```

CI = xbarr - z-tab * sd/sqrd(n); CI

output:

(i)

```
>xbarr = 38000; xbarr
[1] 38000
>n=48; n
[1] 48
>sd = 5200; sd
[1] 5200
>mu = 37000; mu
[1] 37000
```

comment:

Null hypothesis

$H_0 : \mu <= 37000$

Alternative $H_1 : \mu > 37000$

(ii)

```
>alpha = 0.05; alpha
[1] 0.05
>zstat = (xbarr - mu)/(sd/sqrt(n)); zstat
[1] 1.465581
```

```
> z tab = qnorm (alpha, mean = 0, sd = 1
                lower.tail = False); z tab
[1] 1.644854
```

```
[1] "Null hypothesis is accepted"
```

Comment:

The ~~null hypothe~~ calculated value is less than critical value than the null hypothesis is accepted. The ~~the~~ graduate student salary is greater than 37000.

(iii)

```
> Pval = pnorm (z tab, lower.tail = False);
                                      ~~z tab~~
                                      Pval
[1] 0.07138
```

Comment:

Since the p-value 0.07138 is greater than the significance level ($\alpha = 0.05$), null hypothesis is accepted. Therefore, we can conclude that the sample data support

(iv)

```
> CI = xbar - ztab * sd/sqrt(n); CI
[1] 36865.45
```

Comment: Therefore, the 95% confidence interval for the mean salary of MBA graduates in accounting is approximately 36865.45 TK.

Problem no: 07

Problem name:

The daily temperature (in degree celsius) of two months during summer season are shown below:

Months	Daily temperature (in degree celsius)
1	32, 34, 31, 33, 35, 36 .... 32, 32, 34 32, 31, ... 33, 34, 34
2	34, 34, 35, 35, 35, 35 ...... 36, 35, 35, 34, ~~35~~

(i) Input the two set of data using R software and save this file in csv format in desktop

(ii) Formulate the null hypothesis and alternative hypothesis that can be used to determine that the temperature of both months is not similar.

(iii) Calculate the value of test statistic and state your conclusion.

(iv) what is p-value of the test? ~~statistic~~ Given ~~and state your~~ conclusion based on p-value.

(v) Construct box plots for these two sets of data. Do the box plots support you conclusion obtained in question (iv).

Code :

(i)

```
temp1 = c(32,34,31,35 ....... 33,34,34); temp1
temp2 = c(34,34,35,35, ....... 36,35,35,34); temp2
data = cbind(temp1, temp2); data
write.csv(data,"c:\Users\Hp\Downloads\
                                    data1.csv")
```

(ii) Comment:

Here the null hypothesis

$$H_0 : \mu_1 = \mu_2$$

alternative hypothesis

$$H_1 : \mu_1 \neq \mu_2$$

μ_1 = mean temperature month 1

μ_2 = mean tempeature month 2.

(iii)

```
alpha = 0.05; alpha
n1 = length(temp1); n1
n2 = length(temp2); n2
xbar1 = mean(temp1); xbar1
xbar2 = mean(temp2); xbar2
sd1 = sd(temp1); sd1
sd2 = sd(temp2); sd2
zstat = (xbar1 - xbar2)/sqrt(sd1^2/n1 + sd2^2/
                                            n2); zstat
ztab = qnorm(alph/2, mean=0; sd=1); ztab
```

```
if (abs(zstat)>abs(ztab){
  print("NULL hypothesis is rejected")}
  else{
  print("Null hypothesis is accepted")}
```

(iii) Pal=2*pnorm(zstat); pval

(iv)
```
boxplot(temp1, temp2, main="Box plot",
 x.lab="Month", y.lab="Temperature")
LCL=(xbar1-xbar2)-abs(ztab)*sqrt
        (sd1^2/n1+sd2^2/n2); LCL
UCL=(xbar1-xbar2)+abs(ztab)*sqrt
        (sd1^2/n1+sd2^2/n2); UCL
```

output:

```
(i)>temp1;
[1]  32,34,31,35........33,34,34
>temp2;
[1]  34,34,35,35........36,35,35,34;

>data=cbind(temp1,temp2); data
       temp1  temp2
[1,]    32     34
[2,]    34     34
 : :    :      :
[31,]   34     35
```

In

```
>write.csv(data, file='C:/users/Hp/data1.csv',
                                   row.names=False),
```

(ii) The objective is to test hypothesis

$H_0: \mu_1 = \mu_2$

$H_1: \mu_1 \neq \mu_2$

(iii)

```
>alpha=0.05;alpha
[1] 0.05
>n1=length(temp1);n1
[1] 31
>n2 = length(temp2); n2
[1] 31
>xbar1=mean(temp1); xbar1
[1] 33.29032
>xbar2=mean(temp2); xbar2
[1] 34.51613
>sd1=sd(temp1);sd1
[1] 1.188656
>sd2 = sd(temp2);sd2
[1] 1.0286
> zstat
[1] -4.3417
> ztab
[1] -1.9599
```

[1] Null hypothesis is rejected

Comment: Since $|z| > 1.96$ therefore we can say that H_0 is rejected at 5% level of significance i.e the temperatures in two months are not similar.

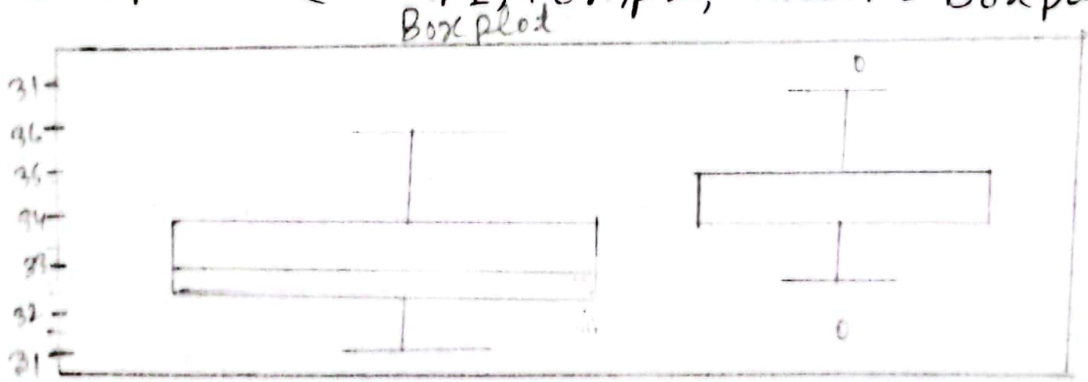
(iv)

> Pval = 2 * pnorm(zstat); pval

[1] 1.4132×10^{-5}

Comment: The p-value is less than the chosen ~~d~~ level of significance we ~~rejected~~ reject the null hypothesis. The temperature are not same.

(v) boxplot (temp1, temp2, main = 'Boxplot')



Comment: In box plot the means in two point lower limit, median, uper limit. extrem value two are in moth 2 plot. man are eqal so suppot my conclusion.

Problem no: 08

Problem Name: In a sample of 80 Americans, 44 wished that they were rich. In a sample of 90 European, 41 wished that they were rich. Answer the following questions using R. software.

(i) At $\alpha = 0.01$, is there a difference in the properations?

(ii) what is the p-value of the test? what is your conclusion compared with Palue? compare the conclusion with the conclusion obtained in (i).

(iii) Find the 99% confidence interval for the difference of the two properteis

Code:

(i)
```
alpha = 0.01; alpha
a1 = 44; a1
n1 = 80;
a2 = 41; a2
n2 = 90; n2
P1 = a1/n1; P1
```

```
p2 = a2/n2 ; p2
p = (a1+a2)/(n1+n2); p
Q = 1- p; Q
z stat = (p1-p2)/sqrt(p*Q*(1/n1+1/n2));
                                        zstat
z tabu = qnorm(alpha/2, mean=0;sd=1,
                  lower.tail=False); ztab
if (zstat>ztab){
    print('Null hypothesis is rejected')}
else
  {print('Null hypothesis is accepted')}
```

(ii)

```
pval = 2*pnorm(zstat, lower.tail=False);
                                         pval
if (pval<alpha){
print("Null hypothesis is rejected")}
else{
print ("Null hypothesis is accepted")}
```

(iii)

```
LCL = (p1-p2)-abs(ztab)*sqrt(p*q*(1/n1+1/n2);
                                          LCL
UCL = (p1-p2)+abs(ztab)*sqrt(p*q*(1/n1+1/n2);
                                          UCL
```

>Z tab

[1] 2.5758

[1] "Null hypothesis is accepted"

~~Comment~~

Comment: The null hypothesis is accepted

Proportion of American wishing to be rich equals proportion of european ~~who~~ wishing to be rich.

(ii)

> ~~P~~val

[1] 0.2189696

"Null hypothesis is accepted.

Comment: The pvalue is less than the value of α. so the null hypothesis is rejected. The conclusion is the (i) and (ii) are same answer.

(iii) >LCL

[1] -0.1034

> UCL

[1] 0.2923442

Problem no: 09

Problem Name: The number of students admitted in two department in a university in different years are as follows:

Year	Statistics	Mathematics
2001	40	60
2002	42	64
⋮		
2019	42	64
2020	38	58

The researcher claims that the variation in addimission of students in different years are not same. Answer the following question in R software.

(i) Input the data in MS Excel and save this file in csv format. Export this csv file in R

(ii) Formulate the null and alternative hypothesis

(iii) Calculate the value of appropriate test statistic and comment on your result.

(iv) Find the p-value of this test and state your conclusion.

Problem no: 10

Problem name: The following are the heights(x) and weights (in kg) of 15 persons.

X	160	165	159	164	168	155	158	152	159	158	154	153	152	152	154
Y	70	72	64	63	72	65	62	56	56	60	58	58	55	56	60

(i) Input the dataset using R software and save this file in csv format.

(ii) Test the hypothesis that the weight of animals significantly increased due to the increase in height? Conclusion your result using p-value method.

(iii) Test the significance of correlation between weight and height. Conclusion your result using p value method.

Code:

(i)

```
X = c(160,165,159...... 153,152,154); x
Y = c(70,72,64 ..... 55,56,60); Y
n = length(x); n
data = cbind(x,Y); data
m = data.frame(x,Y); m
write.csv(data,file='c:/users/data2.csv').
```

(ii)

```
alpha=0.05;alpha
reg=lm(m$Y~m$X,m);reg
summary(reg)
r=corr(X,Y);r
tcal=r*sqrt(n-2)/(1-r^2);tcal
ttab=qt(alpha/2,n-2);ttab
if(abs(tcal)>abs(ttab){
 print("Null hypothesis is rejected")}
else{
 print("Null hypothesis is accepted")
}
```

(iii)

```
Pval=2*pt(tcal,n-2,lower.tail=false);
                                 pval
if(pval<alpha){
 print("Null hypothesis rejected")}
else{
 print("Null hypothesis accepted")
}
```

output:

(i) >x=c(160,165,159 . . . . . 153,152,154);x

[1] 160 165 159 . . . . . 153,152 154

>Y=c(70,72,64 . . . . . .55, 56, 60);Y

[1] 70 72 64 . . . . . 55 56 60

>length(x);n

[1] 15

>data=cbind(x,Y);data

	x	Y
[1,]	160	70
[2,]	165	72
[3,]	159	64
⋮	⋮	⋮
[14,]	152	56
[15,]	154	60

(ii)

>alpha=0.05;alpha

[1] 0.05

>reg=lm(m$Y~m$x,m);reg

[1] coefficients:

intercepts: m$x

-93.949 0.983

>summary(reg)

r=cor(x,Y);r

Residuals:

Min	1Q	Median	3Q	Max
-4.96	-2.596	-0.13	1.4123	5.9719

```
> r=cor(x,y):r
[1] 0.8284
> tcal =r*sqrt(n-2)/(1-r^2); tcal
[1] 9.52
> ttab=qt(alpha/2, n-2);ttab
[1] -2.16

[1] 'NULL hypothesis is rejected'.
```

Comment: Here the pvalue is less than alpha. null hypothsis is rejected. So the weight of the animals are not significantly increased.

(iii)

```
> Pval=2*pt(tcal, n-3 lower.tail=False);
                                   P.val
[1] 3.1726x10^-7
[1] Null hypothesis is rejected.
```

Comment: