VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

ASSESSMENT – 9

Name: Preyash Reg. No.: 20BPS1022

SMALL SAMPLE TEST

Aim: Exploring and visualizing the small sample tests (t-test, chi square test, F test) using R code

Syntax:

- **t.test() :** To Do the t- test for a small sample data
- **var.test() :** To Do the f- test for a small sample data
- **chi.test() :** To Do the chi squared- test for a small sample data

Questions:

1. Based on field experiments, a new variety of green gram is expected to be given an the yield of 12.0 quintals per hectare. The variety was tested on 10 randomly selected farmers fields. The yield (quintals/hectare) was recorded as 14.3,12.6,13.7,10.9,13.7,12.0,11.4,12.0,12.6,13.1. Do the results confirm the expectation? Comment your result using the R code.

2. A group of 5 patients was treated with medicine. A is of weight 42,39,38,60 &41 kgs. Second group of 7 patients from the same hospital treated with medicine B is of weight 38, 42, 56, 64, 68, 69, & 62 kgs. Find whether there is any difference between medicines? Comment your result using the R code.

(Hint: F test)

3. The following data related to the rubber percentage of two types of rubber plants, where the sample have been drawn independently. Test for their mean difference. Comment your result using the R code.

Type I	6.21	5.70	6.04	4.47	5.22	4.45	4.84	5.84	5.88	5.82	6.09	5.59
	6.06	5.59	6.74	5.55								

Type II	4.28	7.71	6.48	7.71	7.37	7.20	7.06	6.40	8.93	5.91	5.51	6.36

4. In certain food experiments to compare two types of baby foods A and B, the following results of an increase in weight (lbs) we observed in 8 children are as follows.

Food A(x)	49	53	51	52	47	50	52	53
Food B(y)	52	55	52	53	50	54	54	53

Examine the significance of the increase in weight of children due to food B. Comment your result using the R code.

5. A poker-dealing machine is supposed to deal cards at random, as if from an infinite deck. In a test, you counted 1600 cards, and observed the following:
Spades 404
Hearts 420
Diamonds 400
Clubs 376
Could it be that the suits are equally likely? Or are these discrepancies too much to be random? Comment your result using the R code.

Q1.)

Code:

```
x=c(14.3,12.6,13.7,10.9,13.7,12.0,11.4,12.0,12.6,13.1)
xbar=mean(x)
xbar
s=sqrt(var(x))
s
n=10
mue=12
den=s/sqrt(n)
den
alpha=0.05
t=abs((xbar-mue)/den)
t
tv=qt(1-alpha/2,df=n-1)
tv
if(t<tv)
{
  print("null hypothesis is accepted")
}else
{
  print("null hypothesis is rejected")
}
```

Output:

```
> x=c(14.3,12.6,13.7,10.9,13.7,12.0,11.4,12.0,12.6,13.1)
> xbar=mean(x)
> xbar
[1] 12.63
> s=sqrt(var(x))
> s
[1] 1.085306
> n=10
> mue=12
> den=s/sqrt(n)
> den
[1] 0.3432039
> alpha=0.05
> t=abs((xbar-mue)/den)
> t
[1] 1.835644
> tv=qt(1-alpha/2,df=n-1)
> tv
[1] 2.262157
> if(t<tv)
+ {
+   print("null hypothesis is accepted")
+ }else
+ {
+   print("null hypothesis is rejected")
+ }
[1] "null hypothesis is accepted"
```

Inference:

We estimate that the new green gramme variety will yield 12 quintals per acre on average.

Q2)

Code:

```
A=c(42,39,38,60,41)
B=c(38, 42, 56, 64, 68, 69, 62)
n1=5
n2=7
varA=var(A)
varA
varB=var(B)
varB
FV=qf(1-alpha/2,n1-1,n2-1)
FV
if(varA>varB)
{
  f=varA/varB
  f
}else
{
  f=varB/varA
  f
}
if(f<FV)
{
  print("null hypothesis is accepted")
}else
{
  print("null hypothesis is rejected")
}
```

Output:

```
> A=c(42,39,38,60,41)
> B=c(38, 42, 56, 64, 68, 69, 62)
> n1=5
> n2=7
> varA=var(A)
> varA
[1] 82.5
> varB=var(B)
> varB
[1] 154.3333
> FV=qf(1-alpha/2,n1-1,n2-1)
> FV
[1] 6.227161
> if(varA>varB)
+ {
+   f=varA/varB
+   f
+ }else
+ {
+   f=varB/varA
+   f
+ }
[1] 1.870707
> if(f<FV)
+ {
+   print("null hypothesis is accepted")
+ }else
+ {
+   print("null hypothesis is rejected")
+ }
[1] "null hypothesis is accepted"
```

Inference:

The medicines A and B do not vary appreciably, we conclude.

Q3)

Code:

```
n1=16
n2=12
x=c(6.21 ,5.70 ,6.04 ,4.47 ,5.22 ,4.45 ,4.84 ,5.84 ,5.88,6.06, 5.59 ,6.74 ,5.55 ,5.82 ,6.09, 5.59)
y=c(4.28,7.71,6.48,7.71,7.37,7.20,7.06,6.40,8.93,5.91,5.51,6.36)
xbar1=mean(x)
xbar2=mean(y)
xbar1
xbar2
s1barsquare=var(x)
s2barsquare=var(y)
s1barsquare
s2barsquare
t=abs((xbar1-xbar2)/(sqrt((s1barsquare/n1)+(s2barsquare/n2))))
t
alpha=0.05
tv=qt(1-alpha/2,df=n-1)
tv
if(t<tv)
{
  print("null hypothesis is accepted")
}else
{
  print("null hypothesis is rejected")
}
```

Output:

```
> n1=16
> n2=12
> x=c(6.21 ,5.70 ,6.04 ,4.47 ,5.22 ,4.45 ,4.84 ,5.84 ,5.88,6.06, 5.59 ,6.74 ,5.55 ,5.82 ,6.09, 5.59)
> y=c(4.28,7.71,6.48,7.71,7.37,7.20,7.06,6.40,8.93,5.91,5.51,6.36)
> xbar1=mean(x)
> xbar2=mean(y)
> xbar1
[1] 5.630625
> xbar2
[1] 6.743333
> s1barsquare=var(x)
> s2barsquare=var(y)
> s1barsquare
[1] 0.3880329
> s2barsquare
[1] 1.451788
> t=abs((xbar1-xbar2)/(sqrt((s1barsquare/n1)+(s2barsquare/n2))))
> t
[1] 2.919756
> alpha=0.05
> tv=qt(1-alpha/2,df=n-1)
> tv
[1] 2.262157
> if(t<tv)
+ {
+   print("null hypothesis is accepted")
+ }else
+ {
+   print("null hypothesis is rejected")
+ }
[1] "null hypothesis is rejected"
>
```

Inference

We reject the null hypothesis H0 (i.e., that the two rubber plants are significantly different).

Q4)

Code:

```
x=c(49 ,53, 51 ,52 ,47 ,50 ,52 ,53)
y=c(52 ,55 ,52 ,53 ,50 ,54 ,54 ,53 )
d=x-y
dbar=mean(d)
sumd=sum(d)
sumd
dsquare=d^2
dsquare
sigmadsquare=sum(dsquare)
s=sqrt((sigmadsquare-sumd/n)/n-1)
s
dbar
n=8
t1=abs(dbar/s)
t1
t=t1/sqrt(n)
t
alpha=0.05
tv=qt(1-alpha/2,df=n-1)
tv
if(t<tv)
{
  print("null hypothesis is accepted")
}else
{
  print("null hypothesis is rejected")
}
```

Output:

```
> x=c(49 ,53, 51 ,52 ,47 ,50 ,52 ,53)
> y=c(52 ,55 ,52 ,53 ,50 ,54 ,54 ,53 )
> d=x-y
> dbar=mean(d)
> sumd=sum(d)
> sumd
[1] -16
> dsquare=d^2
> dsquare
[1]  9  4  1  1  9 16  4  0
> sigmadsquare=sum(dsquare)
> s=sqrt((sigmadsquare-sumd/n)/n-1)
> s
[1] 1.886796
> dbar
[1] -2
> n=8
> t1=abs(dbar/s)
> t1
[1] 1.059998
> t=t1/sqrt(n)
> t
[1] 0.3747658
> alpha=0.05
> tv=qt(1-alpha/2,df=n-1)
> tv
[1] 2.364624
> if(t<tv)
+ {
+   print("null hypothesis is accepted")
+ }else
+ {
+   print("null hypothesis is rejected")
+ }
[1] "null hypothesis is accepted"
```

Inference:

The null hypothesis H0 (i.e., there is no substantial difference between the two meals A and B) is accepted.

Q5)

Code:

```
expected=c(400,400,400,400)
observed=c(404,420,400,376)
a=observed-expected
n=4
chisquare=sum((a)^2/expected)
chisquare
alpha=0.05
chiv=qchisq(1-alpha,df=n-1)
chiv
if(chisquare<chiv)
{
  print("null hypothesis is accepted")
}else
{
  print("null hypothesis is rejected")
}

```

Output:

```
> expected=c(400,400,400,400)
> observed=c(404,420,400,376)
> a=observed-expected
> n=4
> chisquare=sum((a)^2/expected)
> chisquare
[1] 2.48
> alpha=0.05
> chiv=qchisq(1-alpha,df=n-1)
> chiv
[1] 7.814728
> if(chisquare<chiv)
+ {
+   print("null hypothesis is accepted")
+ }else
+ {
+   print("null hypothesis is rejected")
+ }
[1] "null hypothesis is accepted"
```

Inference:

As a result, both suits are equally likely.