PRACTICAL NO: 1.

Topic: Random Variable.

Q1 Find the mean and Variable for the following:

(a)

x	-1	0	1	2
P(x)	0.1	0.2	0.3	0.4

Soln

X	P(x)	x·P(x)	$E(x)^2$	$[E(x)]^2$
-1	0.1	-0.1	0.1	0.01
0	0.2	0	0	0
1	0.3	0.3	0.3	0.09
2	0.4	0.8	1.6	0.64
TOTAL	$\Sigma = 1$	$\Sigma = 1$	$\Sigma E(x)^2 = 2$	$\Sigma [E(x)]^2 = 0.74$

$\therefore$ Mean $= E(x) = \Sigma x_i \cdot p(x) = 1$

$\therefore$ Variance $= V(x) = \Sigma E(x)^2 - \Sigma [E(x)]^2$

$= 2 - 0.74$

$= 1.24.$

$\therefore$ Mean $E(x) = 1$ & Variance $V(x) = 1.24$

(b)

x	-1	0	1	2
P(x)	1/8	1/8	1/4	1/2

Soln

Soln:

x	p(x)	x·p(x)	$E(x)^2$	$[E(x)]^2$
-1	1/8	-1/8	1/8	1/64
0	1/8	0	0	0
1	1/4	1/4	1/4	1/16
2	1/2	1	2	1
3				
Total	$\Sigma=1$	$\Sigma=9/8$	$\Sigma=19/8$	$\Sigma=69/64$

$\therefore$ Mean $= E(x) = \Sigma x \cdot p(x) = 9/8$.

$\therefore$ Variance $= V(x) = \Sigma E(x)^2 - \Sigma [E(x)]^2$

$$= \frac{19}{8} - \frac{69}{64}$$

$$= \frac{152-69}{64}$$

$$= \frac{83}{64}$$

$\therefore$ Mean $E(x) = 9/8$ and Variance $V(x) = 83/64$.

(c)

x	-3	10	15
p(x)	0.4	0.35	0.25

Soln:

x	p(x)	x·p(x)	$E(x)^2$	$[E(x)]^2$
-3	0.4	-1.2	3.6	1.44
10	0.35	3.5	35	12.25
15	0.25	3.75	56.25	14.0625
Total	$\Sigma=1$	Σ6.05	$\Sigma=94.85$	$\Sigma=27.7525$

$\therefore$ Mean $= E(x) = \sum x \cdot P(x) = 6.05$

Variance $= V(x) = \sum E(x)^2 - \sum [E(x)]^2$

$= 94.85 - 27.7525$

$= 67.0975$

$\therefore$ Mean $E(x) = 6.05$ & Variance $V(x) = 67.097$.

Q2. If $p(x)$ is pmf of a random variable x. If $p(x)$ represents pmf for random variable x. Find value of k. Then evaluate mean and variance

Soln: As $P(x_i)$ is a pmf it should satisfy the properties of pmf which are.

a] $P(x_i) > 0$ for all sample space

b] $\sum p(x_i) = 1$

X	-1	0	1	2
P(x)	$k+1/13$	$k/13$	$1/13$	$k-4/13$

$\therefore \sum p(x_i) = 1 = \frac{k+1}{13} + \frac{k}{13} + \frac{1}{13} + \frac{k-4}{13}$

$1 = \frac{k+1+k+1+k-4}{13}$

$13 = 3k - 2$

$15 = 3k$

$\boxed{k = 5}$

x	P(x)	x·P(x)	$E(x)^2$	$[E(x)]^2$
-1	6/13	-6/13	6/13	36/169
0	5/13	0	0	0
1	1/13	1/13	1/13	1/169
2	1/13	2/13	4/13	4/169
TOTAL	$\Sigma = 1$	$\Sigma = -3/13$	$\Sigma = 11/13$	$\Sigma = 41/169$

$\therefore$ Mean $= E(x) = \Sigma x \cdot p(x) = \frac{-3}{13}$

$\therefore$ Variance $= V(x) = \Sigma E(x)^2 - \Sigma [E(x)]^2$

$$= \frac{11}{13} - \frac{41}{169}$$

$$= \frac{143-41}{169}$$

$$= \frac{102}{169}$$

$\therefore$ Mean $= -3/13$ & Variance $= 102/169$

Q3 The pmf of random Variable x is given by

x	-3	-1	0	1	2	3	5	8
P(x)	0.1	0.2	0.15	0.2	0.1	0.15	0.05	0.05

Obtain cdf find (i) $P(-1 \leq x \leq 2)$ (ii) $P(1 \leq x \leq 5)$

(iii) $P(x \leq 2)$ (iv) $P(x \geq 0)$

Soln:

X	−3	−1	0	1	2	3	5	8
P(X)	0.1	0.2	0.15	0.2	0.1	0.15	0.05	0.05
F(X)	0.1	0.3	0.45	0.65	0.75	0.90	0.95	1.0

① $P(-1 \leq x \leq 2) = p(x \leq 2) - P(x \leq -1) + P(x = -1)$
$= F(xb) - F(xa) + p(a)$
$= F(2) - F(-1) + P(-1)$
$= 0.75 - 0.3 + 0.2$
$= 0.25$

② $P(1 \leq x \leq 5) = F(xb) - F(xa) + p(a)$
$= F(5) - F(1) + P(1)$
$= 0.95 - 0.65 + 0.2$
$= 0.15$

③ $P(x \leq 2) = p(x = -3) + p(x = -1) + p(x = 0) + P(x = 1) +$
$p(x = 2)$
$= 0.1 + 0.2 + 0.15 + 0.2 + 0.1$
$= 0.75$

④ $p(x \geq 0) = 1 - F(0) + P(0)$
$= 1 - 0.45 + 0.15$
$= 0.40$

Q4. Let f be continuous random variable with pdf
$\because f(x) = \frac{x+1}{2}, \quad -1 < x < 1$

$= 0 \quad , \text{otherwise}$

Obtain cdf of x. ~~Find mean and variance.~~

Sol^n: By definition of cdf we have

$$F(x) = \int_{0-1}^{1} t \, dt$$

$$= \int_{-1}^{1} \frac{x+1}{2} \, dx$$

$$= \frac{1}{2}\left(\frac{1}{2}x^2 + x\right) \text{ for } -1 \leq x \leq 1$$

Hence the cdf is

$$F(x) = 0 \text{ for } x \leq 0-1$$

$$= \frac{1}{4}x^2 + \frac{1}{2}x \text{ for } -1 \leq x \leq 1$$

$$= 0 \text{ for } x \geq 1.$$

Q5. Let f be continuous random variable with pdf: $f(x) = \dfrac{x+2}{18}$ $\quad -2 < x < 4$

$= 0$ otherwise

calculate cdf

Sol^n: By definition of cdf we have

$$F(x) = \int_{-2}^{4} t \, dt$$

$$= \int_{2}^{4} \frac{x+2}{18} \, dx$$

$$= \frac{1}{18}\left(\frac{1}{2}x^2 + 2x\right)$$

for $-2 < x < 4$

Hence cdf is

$$F(x) = 0 \text{ for } x < -2$$

$$= \frac{1}{18}\left(\frac{1}{2}x^2 + 2x\right)$$

for $-2 < x < 4$

$= 0$ for $x \geq 4$

Kew

PRACTICAL No: 2

Topic: Binomial Distribution.

Q1. An unbiased coin is tossed 4 times. calculate the probability of obtaining no head, atleast one head and more than one tail.

• No head:

```
> dbinom(0,4,0.5)
 [1] 0.0625
```

• Atleast one head.

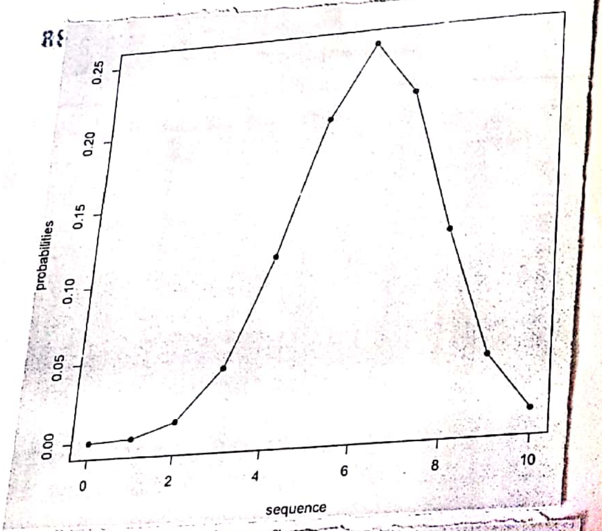
```
> 1-dbinom(0,4,0.5)
 [1] 0.9375
```

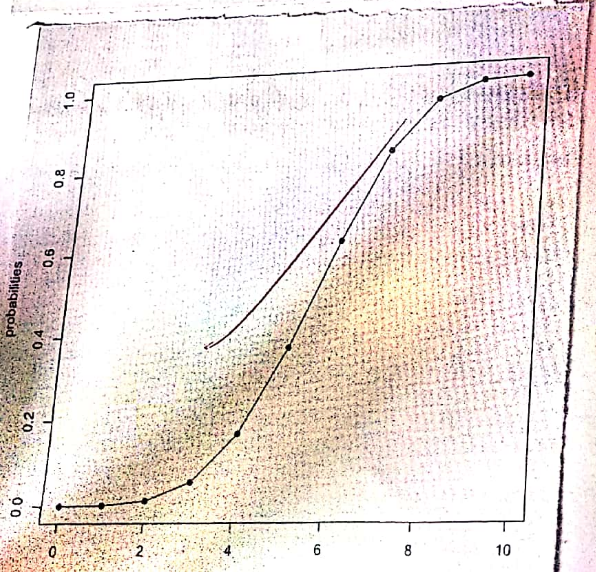
• More than one Tail:

```
> pbinom(1,4,0.5,lower.tail=F)
 [1] 0.9375
```

Q2. The probability that student is accepted to a prestigious college is 0.3. If 5 students supply, what's the probability of atmost 2 are accepted.

```
> pbinom(2,5,0.3)
 [1] 0.83692
```





Q3 An unbiased coin is tossed 6 times, the probability of head at any toss = 0·3. Let x be no of heads that comes up. calculate p(x=2), p(x=2), p(1<x<5)

```
>dbinom (2,6,0.3)
 [1] 0.324135
>dbinom (3,6,0.3)
 [1] 0.18522
>dbinom (2,6,0.3) + dbinom(3,6,0.3) + dbinom(4,
                                         6,0.3)
[1] 0.74373
```

Q4 For n=10, p=0.6, evaluate binomial probabilities and plot the graphs of pmf and cdf.

```
>x = seq (0,10)
>y = dbinom (x,10,0.6)
>y
[1] 0.0001048576  0.0015728640  0.0106168320
    0.0424673280  0.1114767360  0.2006581248
    0.2508226560  0.2149908480  0.1209323520
    0.0403107840  0.0060466176
>plot (x,y, xlab = "sequence", ylab = "probabilities",
      "l", pch = 16)
>x = seq (0,10)
>y = pbinom (x, 10, 0.6)
>plot (x,y, xlab = "sequence", ylab = "probabilities", "o",
                                           pch = 16)
```

P.E

Q5 Generate a random sample of size 10 for a B.D → B(8, 0.3). Find the mean and the variance of the sample

```
> x = rbinom (8,10,0.3)
[1] 2 2 3 4 3 4 2 3
> rbinom(8,10) summary (x)
[1] 2.375
> var (x)
[1] 3.125
```

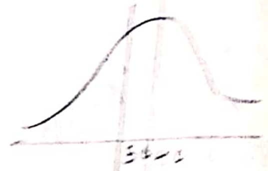
Q6. The probability of men hitting the target is 1/4 if he shoots 10 times what is the probability that he hits the target exactly 3 times, probability that he hits target atleast one time.

```
> dbinom (3,10,0.25)
[1] 0.2502823.
> 1-dbinom (1,10,0.25)
[1] 0.8122883.
```

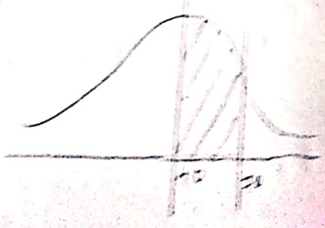
Q7 Bits are sent for communication channel in packet of 12. If the probability of bit being Corrupted is 0.1. what is the probability of no more than 2 bits are Corrupted in a packet?

```
> pbinom (2,12,0.1, lower.tail = F ) + dbinom (2, 12, 0.1)
[1] 0.3409977.
```

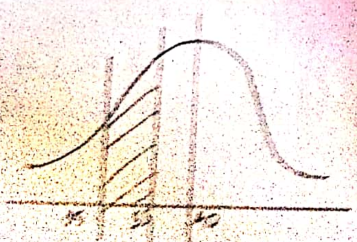
Q1
a]



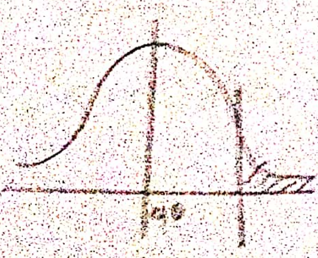
b]



c]



d]



PRACTICAL NO: 3.

Topic: Normel distribution

A normal distribution of 100 students with mean = 40, SD = 15

Find no of student whose marks are ① p(x<30) ② p(40<x<70) ③ p(25<x<35) ④ p(x>60)

```
>pnorm (30,40,15)
 [1] 0.2524925

> pnorm (70,40,15) - pnorm (40,40,15)
 [1] 0.4772499.

>pnorm (35,40,15) - pnorm (25,40,15)
 [1] 0.2107861

> 1 - pnorm (60,40,15)
 [1] 0.09121122.
```

Q2 If the eandom variable x follows the normal distribution with mean = 50, v = 100.
Find ① p(x ≤ 70) ② p(x>65) ③ p(x ≤ 30) ④ p(35 < x < 60) ⑤ p(20 < x < 30)

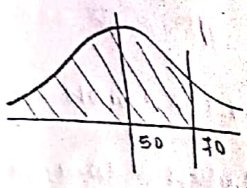
```
> pnorm (70,50,10)
 [1] 0.9772499
```

```
> 1-pnorm(65,50,10)
[1] 0.0668072

> pnorm(32,50,10)
[1] 0.03593032

> pnorm(60,50 10)-pnorm(35,50,10)
[1] 0.7745375

> pnorm(30,50,10) - pnorm(20,50,10)
[1] 0.02140023
```

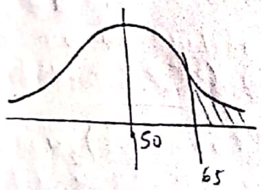
Q3 Let $X \sim N(160, 400)$ find k_1 & k_2 such that $P(X<k_1) = 0.6$ & $P(X>k_2) = 0.8$

```
> qnorm(0.6,160,20)
[1] 165.0669

> qnorm(0.8,160,20)
[1] 176.8324
```

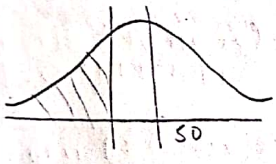
a]



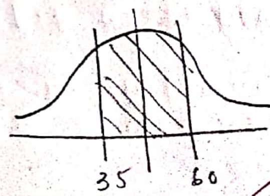
b]



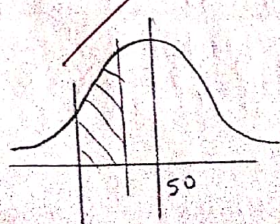
c]



d]



e]



A random variable x follow normal distribution with $\mu = 10$, $\sigma = 2$. Generate 100 observations and evaluate its mean, median and variance

> x = rnorm (100, 10, 2)
> summary (x)

[1] Min	1st Q	Median	Mean	3rd Q	Max
5.713	8.444	9.723	9.914	11.325	14.238

> var (x)
[1] 3.648924

Q5 write a command to generate 10 random numbers for normally distribution with $\mu = 50$, $\sigma = 4$. Find the sample mean and median

> x = rnorm (10, 50, 4)
> summary (x)

Min	1st Q	Median	Mean	3rd Q	Max
44.73	50.48	52.01	52.35	54.37	58.85

S.B

PRACTICAL NO: 4

Topic: Testing of hypothesis

CASE 1: Sample mean and Standard derivative given
Single population

Q1. Suppose the food label on cookies bag states that it has atmost 2g of saturated fats in a single cookies. In sample of 35 cookies it was found that mean amount of saturated fat per cooky is 2.1 g assume that the sample S.D is 0.3 at 0.5 level of significance (5%) can we reject the claim on food label

$H_0 = \mu < 2$

$H_1 = \mu > 2$

```
> z = (2.1 - 2) / (0.3 / sqrt (35))
[1] 1.972027
> 1 - pnorm (z)
[1] 0.0243
```

∴ Reject the null Hypothesis

∴ Accept H_1

(2) A sample of 1000 customers was randomly selected and its was found that average spending was 275/- The S.D = 30 Using 0.05 level of significance would you conclude that amount spend by customer is more than 250/-

$H_0 = \mu < 250$

$H_1 = \mu > 250$

```
>z= (275-250)/(30/sqrt(100))
>z
[1] 8.333
> 1-pnorm(z,99)
[1] 2.3057
```

∴ Reject the null hypothesis

∴ Accept H_1

(3) A quality control of engimees finds that sample of 100 light have aveeage life of ~~480~~ hours. Assuming population SD = 25 test whether the population mean is 480 hours

Lose → 0.05

$H_0 = \mu < 480$

$H_1 = \mu > 480$

```
> z = (470-480)/(25/ sqrt(100))
>z
[1] -4
> pt(z, 99, lowertail = T)
[1] 6.11257
```

∴ Reject the null hypothesis

∴ Accept H_1

Q4. A principle at school claims that the IQ is 100 of the students. A random sample of 30 students whose IQ was found to 118. The S.D of population =15 - test the claim of principle

$H_0 = \mu = 100$
$H_1 = \mu > 100$

```
>z =(112-100)/(15/sqrt(30))
>z
[1] 4.38178
>pt(z,99, lower-tail =F)
[1] 5.8856e-06.
```

∴ Reject null Hypothesis.

* SINGLE POPULATION PROPORTION.

Q1. It is believed that coin is fair. The coin is tossed 40 times; 25 times - head occurs. Indicate whether the coin is fair or not at 95% LOC $p_0 = 0.5$ $q_0 = 1 - p_0 = 0.5$ $p = 28/40 = 0.7$ $n = 40$ $H_0 = \mu = 0.5$
$H_1 = \mu \neq 0.5$

```
>z =(0.7-0.5)/ sqrt((0.5*0.5)/40 )
>z
>2*(1-pnorm(abs(z)))
 [1] 0.01141204
```

~~Reject null hypothesis~~
Accept the H_1

Q: In a hospital 400 females and 520 males are born in a week. Do this confirm male and female are born equal in number

$H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

```
> z=(0.52-0.5)/(sqrt((0.5*0.5)/1000))
> z
[1] 1.2645
> 2*(1-pnorm(abs(z)))
[1] 0.2060506
```

Reject Ho

Accept H1

Q: In a big city, 325 men out of 600 men were found to be self employed. Conclusion is that maximum men in city are self employed

$H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

```
> z=(0.5-0.325)/sqrt((0.5*0.5)/600)
> 2*1-pnorm(abs(z))
[1] 0.04155234
```

Reject Ho

Accept H1.

Q4 Experience shows that 20% of manufacturer products are of top quality. In 1 day production of 400 articles only 50 are top quality. Test hypothesis that experience of 20% of manufacture is wrong.

$H_0 = \mu - 0.2$

$H_1 = \mu + 0.2$

```
> z=(0.125-0.20)/sqrt((0.2*0.8)/400)
> 2*1-pnorm(abs(z))
[1] 0.0001768346
```

Reject H_0, Accept $= H_1$

Q. Equality of 2 population proportion

1) In an early election campaign a telephone phone of 800 registered voters shows favor 460. In second pole opinion 520 of 1000 registered voters favoured the candidate at 5% level of confidence is there sufficient evidence that popularity has decreased.

$H_0 = p_1 \neq p_2$

$H_1 = p_1 \neq p_2.$

```
> p=(460*800+520*1000)/(520+1000)
> p
> [1] 0.544
> 1-0.544
> 0.455
> z=sqrt(0.544*0.456*(1/520+1)/1000))
```

```
>2 * (1-pnorm(abs(z))
[1]  0.5444
```

Accept Ho.

(i) From a consinment 200 articles are drawn and 44 was found defective from consinment B1 200 sample are drawn out of which 30 was found defective test whether the proportion of defective items in 2 consinment are significantly differement

$H_0 = P_1 = P_2$

$H_1 = P_1 \neq P_2$

```
> (0.22*200 + 0.15*200/((1/200 + 1/200))
> 0.185
> 1-0.185
> 0.815 sort
> z = (0.185 * 0.815 * (1/200 + 1/200))
> 2 * (1-pnorm(abs(z))
[1] 0.4469018
```

Accept Ho.

P.A

PRACTICAL NO: 8

AIM: Chi - Square Test

Q1. Use the following data to test whether the attribute Conditions of home and Child are independent

		Condition of Homes	
		Clean	dirty
Condition of Child	Clean	70	50
	f.clean	80	20
	dirty	35	45

H_0 = Both are independent, H_1 = Both are dependent

```
> x = c(70, 50, 35)
> y = c(50, 20, 45)
> z = data.frame(x, y)
> z
[1]     x    y
   1   70   50
   2   80   20
   3   35   45
> chisq test(z)
        Pearson's Chi squared test
data: z
X - squared = 25.646, df = 2, p-value = 2.698e-06
```

∴ Reject the null hypothesis

∴ Both are dependent

A dice is tossed 120 times and following results are obtained:

No. of teems	frequency.
1	30
2	25
3	18
4	10
5	22
6	15

Test the hypothesis that dice is unbaised.

∴ Ho = dice is unbaised

∴ H1 = dice is baised

```
>obs = c(30,25,18,10,22,15)
>exp= sum(obs)/length(obs)
>exp
[1]  20
> z= sum((obs-exp)^2/exp)
>pchisq(z, df = length(obs)-1)
[1]  0.956659
```

∴ Accept the null hypothesis

∴ dice is unbaised.

Q3 An IQ test was conducted and the students were observed before and after training the result are following

before	after
110	120
120	118
123	125
132	136
125	121

Test whether there is change in the IQ after the training

∴ H_1 = no change in IQ.

∴ H_0 = IQ increased after training

```
> a=c(120,118,125,136,121)
> b=c(110,120,123,132,125)
> z=sum((b-a)^2)/a)
> pchisq(z, df=length(b)-1)
[1] 0.1135959
```

Accept the null hypothesis.

∴ There is change in IQ after training

Q4

	Graduate	Undergraduate
online	20	25
face to face	40	5

Is there any association between student's preference for type of education and method.

∴ Ho : independent

H1 : Dependent

```
> x = c(20,40,25,5)
> z = matrix(x, nrow = 2)
> chisq.test(z)
        pearson's chi squared test with Yates'
        continuity correction
  data : z
  x-squared = 18.05, df = 1 , p-value = 2.157 e-05
```

∴ Reject null hypothesis

∴ Both are dependent

55 A dice is tossed 180 times

No. of items	frequency
1	20
2	30
3	35
4	40
5	12
6	43

Test the hypothesis that dice is unbaised

Ho = dice is baised

H1 = dice is unbaised

```
> x = c(20,30,35,40,12,43)
> chisq.test(x)
```

Chi squared test for given probabilities

data: z

x - squared = 23.933, df = 5, p-value = 0.0002236

∴ Reject null hypothesis.

∴ dice is unbaised

Pratical No:6

Topic: t test

Q) let x = 3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 33515, 3408, 3401, 3398, 3424, 3388, 3374, 3384, 3374

write the R command for following to test hypothesis

(1) Ho: μ = 3400, H1: $\mu \neq$ 3400

(2) Ho: μ = 3400, H1: μ > 3400

(3) Ho: μ = 3400, H1: μ < 3400

at 95% level of confidence. Also check at 97% level of confidence

→ (1) Ho: μ = 3400

H1: $\mu \neq$ 3400

\> x = c(3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3398, 3424, 3383, 3374, 3384, 3374)

\> t-test(x, mu = 3400, alter = "two.sided", conf.level = 0.95)

one sample t-test

data: x

t = -4.4865, df = 19, p value = 0.0002528

alternative hypothesis: True mean is not equal to 3400

95 percent confidence level:

3361.797 3386.103

Sample estimates:

mean of x:

3373.95

∴ Reject H_0

∴ Accept H_1

```
> t.test(x, mu=3400, alter="two.sided",
        conf.level=0.97)
  One Sample t-test
data: x
t = -4.4865, df = 19, p-value = 0.0002528
alternative hypothesis: true mean is not equal
to 3400
 3360.33   3387.57
Sample estimates:
mean of x :
3373.95
```

∴ Reject H_0

∴ Accept H_1

→ (2) $H_0 = \mu = 3400$

$H_1 = \mu > 3400$

```
> t.test(x, mu=3400, alter="greater", conf.level=0.95)
        One sample t-test
data: x
t = -4.4865, df = 19, p value = 0.9999
alternative hypothesis: true mean is greater than 3400
  3363.91  Inf
Sample estimates:
mean of x :
 3373.95
```

∴ Accept H_0

>t.test(x, mu = 3400, alter = "greater", conf.level = 0.97)

One sided t-test

data: x

t = -4.4865, df = 19, p value = 0.9999 alternative hypothesis: true mean is greater than 3400.

3367.37 Inf

Sample estimates:

mean of x:

3373.95

∴ Accept Ho.

(3) $H_0 = \mu = 3400$

$H_1 = \mu < 3400$

>t.test(x, mu = 3400, alter = "less", conf.level = 0.95)

one sided t-test

data: x

t = -4.4865, df = 19, p value = 0.0001264

alternative hypothesis: true mean is less than 3400

95 percent level of confidence

-Inf 3383.99

Sample estimates:

mean of x:

3373.95

∴ Reject Ho

∴ Accept H_1

>t.test(x, mu = 3400, alter = "less", conf.level = 0.99)

one sample t test

data: x

t = -4.4865, df = 19, p value = 0.0001264

alternative hypothesis: true mean is less than 3400.

97 percent level of confidence
- Int 3385.563
Sample estimates:
mean of x.
3373.95
∴ Reject Ho
∴ Accept H_1

Q2. Below are the data of gain in weights on 2 different diets A and B

Diet A: 25, 32, 30, 43, 24, 14, 32, 24, 31, 31, 35, 25

Diet B: 44, 34, 22, 10, 47, 31, 40, 30, 32, 35, 18, 21

→ ∴ $H_0 = a - b = 0$
∴ $H_1 = a - b \neq 0$
>a=c(25,32,30,43,24,14,32,24,31,31,18,21)
>b=c(44,34,22,10,47,31,40,30,32,35,18,21)
t.test(a,b,paired=T,alter="two.sided",
conf.level=0.95)

Paired t-test
data: a and b
t = -0.62787, df = 11, p-value = 0.5429
alternative hypothesis: true difference in means is not equal to 0.
95 percent confidence interval:
-14.267330 7.933997

sample estimates:
mean of the difference
-3.166667
∴ Accept Ho.
∴ There is no difference in weights.

Q: Eleven students gave the test after 1 month they again gave the test after the tutions, do the marks gives evidence that students have benifitted by coaching.

E1: 23, 20, 19, 21, 18, 20, 18, 17, 23, 16, ~~#~~19.
E2: 24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17
test at 99 level of confidence

→ E1: 23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19.
E2: 24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17.
∴ Ho: e1 = e2
∴ H1: e1 < e2
> t.test(e1, e2, paired = T, alter = "less", conf.level = 0.99)
paired t test:
data: e1 and e2
t = -1.4832, df = 10, p-value = 0.08441
alternative hypothesis: true difference in means is less than 0
99 percent confidence interval:
-Inf 0.863333
Sample estimates:
mean of the differences:
-1
∴ Accept Ho.

Q4. Two drugs for BP was given and date was collected
D1: 0.7, -1.6, -0.2, -1.2, -0.1, 3.4, 3.7, 0.8, 0.2
D2: 1.9, 0.8, 1.1, 0.1, 0.1, 4.4, 5.5, 1.6, 4.6, 3.4.

The two drugs have same effect, check whether two drugs have same effect on patient or not.

→ $H_0: d_1 = d_2$

$H_1: d_1 \neq d_2$

```
> d1=c(0.7, -1.6, -0.2, -1.2, -0.1, 3.4, 3.7, 0.8, 0.2
> d2=c(1.9, 0.8, 1.1, 0.1, -0.1, 4.4, 5.5, 1.6, 4.6, 3.4
> t.test(d1, d2, alter = "two.sided", paired = T,
        conf.level = 0.95)
```

Paired t test

data: d1 and d2

t = -4.0621, df = 9, p-value = 0.002833

alternative hypothesis: true difference in means is not equal to 0.

95 percent confidence interval:

mean of the differences:

-1.58

∴ Reject H_0

∴ Accept H_1

Q5. If there is difference in salaries for the same job in 2 different countries

CA: 53000, 49958, 41974, 44366, 40470, 36963.

CB: 62490, 58850, 49495, 52263, 47674, 43552.

∴ $H_0: S_1 = S_2$

∴ $H_1 = S_1 \neq S_2$

```
> CA = c(53000, 49958, 41974, 44366, 46470, 36963)
> CB = c(62,490, 58850, 49495, 52263, 47674, 43552)
> t.test(ca.cb, paired = T, alter = "two.sided",
conf.level = 0.95)
```

Paired t test

data: ca and cb

t = -4.4564, df = 5, p-value = 0.00666,

alternative hypothesis: true difference in means is not equal to 0.

95 percent confidence interval:

-10404.821 -2792.846.

Sample estimates:

mean of the differences:

~~∴ Reject Ho.~~ -6598.833

∴ Reject Ho

∴ Accept H_1

New

PRACTICAL NO: 7.

Q1. Li TITLE: F Test.

Q1. Life exceptancy in 10 region of india in 1990 and 2000 are given below test whether the Variance at the 2 times are same.

1990 37, 39, 36, 42, 45, 44, 46, 49, 50, 51
2000 44, 45, 47, 43, 42, 49, 50, 41, 48, 52, 42, 59

→ > x=c(37,39,36,42,45,44,46,49,50,51
> y=c(44,45,47,43,42,49,50,41,48,52,42,59
var.test(x,y)

F test to compare two variances.

data: x and y
F = 1.0548, num df = 9, denom df = 11, p-value = 0.9176
alternative hypothesis: true ratio of variance is not equal
to 95 percent confidence interval:
0.2939977 4.1265887
Sample estimates
ratio of variance
1.054834

∴ Accept Ho
∴ Variance at 2 times are same.

Q2. I 25 28 26 22 22 29 31 31 26 31

II 30 25 31 32 23 25 36 26 51 32 32 27 31 38, 24

at 95% of Confidence level check the ratio of two population variance

> var : Ho = $\sigma_1^2 = \sigma_2^2$
$H_1 = \sigma_1^2 \neq \sigma_2^2$

>x = c(25, 28, 26, 27, 27, 31, 31, 26, 31

>y = c(30, 25, 31, 32, 23, 25, 26, 25, 31, 32, 32, 27, 3,
38, 21)

>var.test(x, y)

F Test to compare two variance

p-value = 0.4535.

∴ Accept the Ho.

∴ Variance of I and II are same.

Q3

For the following data test the hypothesis for

(1) equality of 2 population mean → t test

(2) equality of proportion variance → f test

Sample 1: 175, 168, 145, 190, 181, 185, 175, 200.

Sample 2: 180, 170, 153, 180, 179, 183, 187, 205

→ (1) Ho = $\mu_1 = \mu_2$

$H_1 = \mu_1 \neq \mu_2$.

>x = c(175, 168, 145, 190, 181, 185, 175, 200)

>y = c(180, 170, 153, 180, 179, 183, 187, 205)

>t.test(x, y, alter="two.sided", conf.level = 0.95)

welch two sample t-test

p-value = 0.7771

∴ Accept Ho

∴ equality of 2 population mean are same.

→ (3) equality of proportion Variance
> var.test (x, y)
F test to compare two Variances
p-value = 0.7759
∴ Accept Ho.
∴ equality of proportion variance are same.

Q4. The following are the price of comodity in the sample of shops selected at random from different city.

City A: 74.10, 77.70, 75.35, 74, 73.80, 79.30, 75.80, 76.80, 77.10, 76.40,
City B: 70.80, 74.90, 76.20, 72.80, 78.10, 74.70, 69.80, 81.20.

∴ $H_0 : \sigma_1^2 = \sigma_2^2$
$H_1 : \sigma_1^2 \neq \sigma_2^2$
> x = c(74.80, 77.10, 75.35, 74, 73.80, 79.30, 75.80, 79.30, 76.80, 77.10, 76.40)
> y = c(70.80, 74.90, 76.20, 72.80, 78.10, 74.70, 69.80, 81.20)

> var-test (x, y)
F test to compare two variance
p-value = 0.02756.
∴ Reject Ho
equality of 2 population mean are not same

> t.test (x, y, var.equal = F, paired = F)

Welch Two Sample t-test

p-value = 0.3244

∴ Accept H_0

∴ mean of two population is same

Q5 Prepare a CSV file in excel import the file in R and apply the test to check the equality of Variance of 2 data.

Observed 1: 10 15 17 11 16 20

Observed 2: 15 14 16 11 12 19

∴ $H_0: \sigma_1^2 = \sigma_2^2$

$H_1: \sigma_1^2 \neq \sigma_2^2$

Save the above observation in excel file in CSV (ms-DOS) format.

> data = read.csv(file.choose(), header = T)

> data

	OB.1	OB.2
1	10	15
2	15	14
3	17	16
4	11	11
5	16	12
6	20	19

> attach(data)

> var.test (OB.1, OB.2)

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F Test to compare two variance

F-value = 0.5717

$\therefore$ Accept H_0

$\therefore$ the variance of 2 data are same.

PRACTICAL NO:8

TITLE : Non-parametric Test :

The times of failures in hours of 10 randomly selected 9 volt battery of a certain company is as follows :
28.9, 15.2, 28.7, 72.5, 48.6, 52.4, 37.6, 49.5, 62.1, 54.5
Test the hypothesis that the population median is 63 against the alternative that it is less than 63 at 5% level of significant.

H0 : median = 63
H1 : median ≠ 63
x = c(28.9, 15.2, 28.7, 72.5, 48.6, 52.4, 37.6, 49.5, 62.1, 54.5)
>Sp = which (x>63)
>a = length (Sp)
>a
>[1] 1

Sn = length (which (x<63)
>Sn
>[1] 9

>n = a+Sn
qbinom (0.05, n, 0.5)
[1] 2
qbinom < sn
∴ accept the null hypothesis

Q:- The following data gives the weight of 40 student in random sample.
46, 49, 57, 64, 46, 67, 54, 48, 69, 61, 57, 54, 50, 45, 65, 61, 66, 54, 50, 45, 49, 62, 47, 49, 47, 55, 59, 63, 53, 56, 67, 49, 60, 64, 53, 50, 45, 51, 52, 54.
Use the sign test to test whether the median weight of population is 50 kgs against the alternative that is greater than 50.

→ H_0 = median = 50
H_1 = media ≠ 50

```
> x = c( 46, 49, 57, 64, 46, 67, 54, 48, 69, 61, 57, 54, 50,
  45, 65, 61, 66, 54, 50, 48, 41, 62, 47, 49, 47,
  55, 59, 63, 53, 56, 67, 49, 60, 64, 53, 50, 45,
  51, 52, 54.

> sp = length (which (x < 50)
> sp
[1] 15
> sn = length (which (x > 50)
> sn
[1] 12
> n = sn + sp
> qbinom (0.05, n, 0.5)
14.
```

∴ qbinom >< sn
∴ Reject H_0.

Q: The median age of tourist visiting to certain place is claim to be 41 yrs. A random sample of 17 tourist have the age 25,

25, 29, 52, 48, 57, 39, 45, 36, 30, 49, 28, 39, 44, 63, 32, 65, 42.

Use the sign test to check the claim.

→ Ho = median = 41

H1 : median ≠ 41

```
x = c(25, 29, 52, 48, 57, 39, 45, 36, 30, 49, 28, 39, 44,
      63, 32, 65, 42)
> sp = length(which(x > 41))
> sp
[1] 9
> sn = length(which(x < 41))
> sn
[1] 8

n = sp + sn
qbinom(0.05, n, 0.5)
[1] 5
```

∴ qbinom < sn

∴ Accept the Ho.

Q4. The times in minutes that the patient has to wait for consultation.
15, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26.
use the wilcoxon sign test to check whether the median waiting time is more than 20 at 5% of level of significant.
H0: median > 20 H1: median < 20.

→ x = c(15, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26
>wilcox.test(x, alternative = "greater")
p-value = 0.001253.
∴ Reject H0.
∴ median < 20.

Q5 The weight in kgs of the person before and after they stop smoking are as follows

weight before	weight after.
65	72
75	82
75	72
62	66
72	73

use wil'coxon test to check whether the weight of person increase after stop the smoking use 5% of level of significant

→ * H0: weight increase after ~~sp~~ stopping
H1: weight not increases.

>x = c(65, 75, 75, 62, 72)

```
> y = c(72, 82, 72, 66, 73)
> z = x - y
> wilcox.test(z, mu=0)
  p-value = 0.1756.
```

∴ Accept H_0

PRACTICAL NO: 9.

TITLE: ANOVA.

Q1. The following data gives the effect of three treatments

T1: 2, 3, 7, ~~3~~, 2, 6
T2: 10, 8, 7, 5, 10
T3: 10, 13, 14, 13, 15
Test the hypothesis that all treatments are equally effective

→ Ho: t1 = t2 = t3
H1: t1 ≠ t2 ≠ t3

```
> t1 = c(2,3,7,2,6)
> t2 = c(10,8,7,5,10)
> t3 = c(10,13,14,13,15)
> data = data.frame(t1, t2, t3)
> e = stack(data)
> oneway.test(values ~ ind, data = e)
[1] p-value = 0.0006232
```

∴ Reject Ho
All treatments are not equally ~~equally~~

Q2. The following gives the life of tyres of 4 brands

A: 20, 23, 18, 17, 22, 24
B: 19, 15, 17, 20, 16, 17
C: 21, 19, 22, 17, 20
D: 15, 14, 16, 18, 14, 16.
Test the hypothesis that the average life of all the tyres are same

H1: A = B = C = D

Ho: A ≠ B ≠ C ≠ D

```
> A=c(20, 23, 18, 17, 22, 24)
> B=c(19, 15, 17, 20, 16, 17)
> C=c(21, 19, 22, 17, 20)
> d=c(15, 14, 16, 18, 14, 16)
> e=list(a1=a, b1=b, c1=c, d1=d)
> f=stack(e)
> oneway.test(values~ind, data=f)
[1] p-value = 0.006291
```

∴ Reject Ho

∴ All The average life of all brands are not same.

Q3 The types of waxs is applied for the protection of cars and number of days of protection were noted. Test whether these are equally effective.

A: 44, 45, 46, 47, 48, 49

B: 40, 42, 51, 52, 55

C: 50, 53, 58, 59

Ho: A = B = C

H1: A ≠ B ≠ C

```
> A=c(44, 45, 46, 47, 48, 49)
> B=c(40, 42, 51, 52, 55)
> C=c(50, 53, 58, 59)
> d=list(a1=a, b1=b, c1=c)
> e=stack(d)
> One way.test(values~ind, data=e)
```

[1] p-value = 0.03822

∴ Reject Ho.

∴ These are not equally effective.

Q4. An experiment was conducted on 8 persons and the observations were noted these were. Test the hypothesis that all groups have equal result on there health.

→ no exercise: 23, 26, 51, 48, 58, 37, 29, 44

20 min exercise: 22, 27, 29, 39, 46, 48, 49, 65

60 min exercise: 59, 66, 38, 49, 56, 60, 56, 62.

```
> a = c(23, 26, 51, 48, 58, 37, 29, 44)
> b = c(22, 27, 29, 39, 46, 48, 49, 65)
> c = c(59, 66, 38, 49, 56, 60, 56, 62)
> d = data.frame(a, b, c)
> e = stack(d)
> oneway.test(values ~ ind, data = e)
[1] p-value = 0.01935
```

∴ Reject Ho.

∴ All the groups not have equal result on there health.