Practical - 1

Aim: Basics of R software.

1) R is a software for statistical analysis and data computing.

2) It is an effective data handling software and outcome storage is possible.

3) It is capable of graphical display.

4) It is a free software.

Q1 Solve the following

1. $4+6+8 \div 2-5$

```
> 4+6+8/2 -5
[1] 9
```

2. $2^2+|-3|+\sqrt{45}$

```
> 2^2+abs(-3)+sqrt(45)
[1] 13.7082.
```

3. $5^3+7\times5\times8+46/5$

```
> 5^3 + 7*5*8 + 46/5
[1] 414.2.
```

4. $4^2+5\times3+7/6$

```
> sqrt (4^2+5*3+7/6)
[1] 5.671567.
```

5. round off

$46\div7+9\times8$

```
> round (46/7+9*8)
[1] 79.
```

<u>Q2</u>

```
>c (2,3,5,7)*2
[1] 4 6 10 14
>c (2,3,5,7)* c (2,3,6,2)
[1] 4 9 30 14
>c (2,3,5,7)^2
[1] 4 9 25 49
>c (6,2,7,5)/c (4,5)
[1] 1.50 0.40 1.75 1.00

>c (2,3,5,7)* c (2,3)
[1] 4 9 10 21

>c (1,6,2,3)* c (-2,-3,-4,-1)
[1] -2 -18 -8 -3

>c (4,6,8,9,4,5)^c (1,2,3)
[1] 4 36 512 9 16 125
```

Q3

```
>x = 20   >y = 30   >z = 2
>x^2 + y^3+z
[1] 27402
>sqrt (x^2+y)
[1] 20.73644
>x^z + y^z
[1] 1300
```

Q4

```
>x <- matrix [nrow = 4, ncol=2, data = c(1, 2, 3, 4, 5,6,7, 8)]
>x       [,1]    [,2]
[1][1,]   1       5
   [2,]   2       6
   [3,]   3       7
   [4,]   4       8
```

Q5 Find x+y and 2x+3y where $x = \begin{bmatrix} 4 & -2 & 6 \\ 7 & 0 & 7 \\ 9 & -5 & 3 \end{bmatrix}$

$y = \begin{bmatrix} 10 & -5 & 7 \\ 12 & -4 & 9 \\ 15 & -6 & 5 \end{bmatrix}$

```
>x <- matrix (nrow=3, ncol = 3, data = c(4, 7, 9, -2, 0, -5, 6, 7, 3))
>x
      [,1]   [,2]   [,3]
[1,]   4      -2     6
[2,]   7      0      7
[3,]   9      -5     3
```

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```
>y<-matrix (nrow=3, ncol=3, data=c(10,12,15,-5,-4,-6,
        7,9,5))
```

```
>y      [,1]   [,2]   [,3]
[1,]    10     -5     7
[2,]    12     -4     9
[3,]    15     6      5
```

```
>x+y    [,1]   [,2]   [,3]
[1,]    14     -7     13
[2,]    19     -4     16
[3,]    24     -11    8
```

```
>2*x+3*y
        [,1]   [,2]   [,3]
[1,]    38     -19    33
[2,]    50     -12    41
[3,]    63     28     21
```

Q6 Marks of statistics of CS Batch B

x=c(58, 20, 35, 24, 46, 56, 55, 45, 27, 22, 47, 58, 54, 40, 50, 32, 36, 29, 35, 39)

```
>x=c(data)
>break=seq(20,60,5)
>a=cut(x, break, right=FALSE)
>b=table(a)
>c=transform(b)
>c.
```

	a	freq
1	[20, 25]	3
2	[25, 30]	2
3	[30, 35]	1
4	[35, 40]	4
5	[40, 45]	1
6	[45, 50]	3
7	[50, 55]	2
8	[55, 60]	4

Practical - 2

TOPIC : Probability distribution.

Check whether the following are p.m.f or not

x	$P(x)$
0	0.1
1	0.2
2	0.5
3	0.4
4	0.3
5	0.5

If the given data is pmf then $\Sigma P(x) = 1$

$\therefore P(0) + P(1) + P(2) + P(3) + P(4) + P(5) = P(x)$

$= 0.1 + 0.2 - 0.5 + 0.4 + 0.3 + 0.5$

$= 1.0.$

$\because P(2) = -0.5$, it can be a probability mass function

$\because P(x) \geq 0 \quad \forall, x.$

2)

x	$P(x)$
1	0.2
2	0.2
3	0.3
4	0.2
5	0.2

The condition for p.m.f is $\sum P(x) = 1$

So,

$\sum P(x) = P(1) + P(2) + P(3) + P(4) + P(5)$

$= 0.2 + 0.2 + 0.3 + 0.2 + 0.2$

$= 1.1$

$\therefore$ The given data is not a pmf because the $P(x) \neq 1$.

3)

x	$P(x)$
10	0.2
20	0.2
30	0.35
40	0.15
50	0.1

The condition for pmf is

1) $P(x) \geq 0 \ \forall x$ satisfy

2) $\sum P(x) = 1$

$\sum P(x) = P(10) + P(20) + P(30) + P(40) + P(50)$.

$= 0.2 + 0.2 + 0.35 + 0.15 + 0.1$

$= 1$

$\therefore$ The given data is pmf

Code:

```
> prob = c (0.2, 0.2, 0.35, 0.15, 0.1)
> sum(prob)
[1] 1
```

Q2 Find the cdf for the following pmf and sketch the graph

x	10	20	30	40	50
$P(x)$	0.2	0.2	0.35	0.15	0.1

$F(x) = 0$ $x < 10$

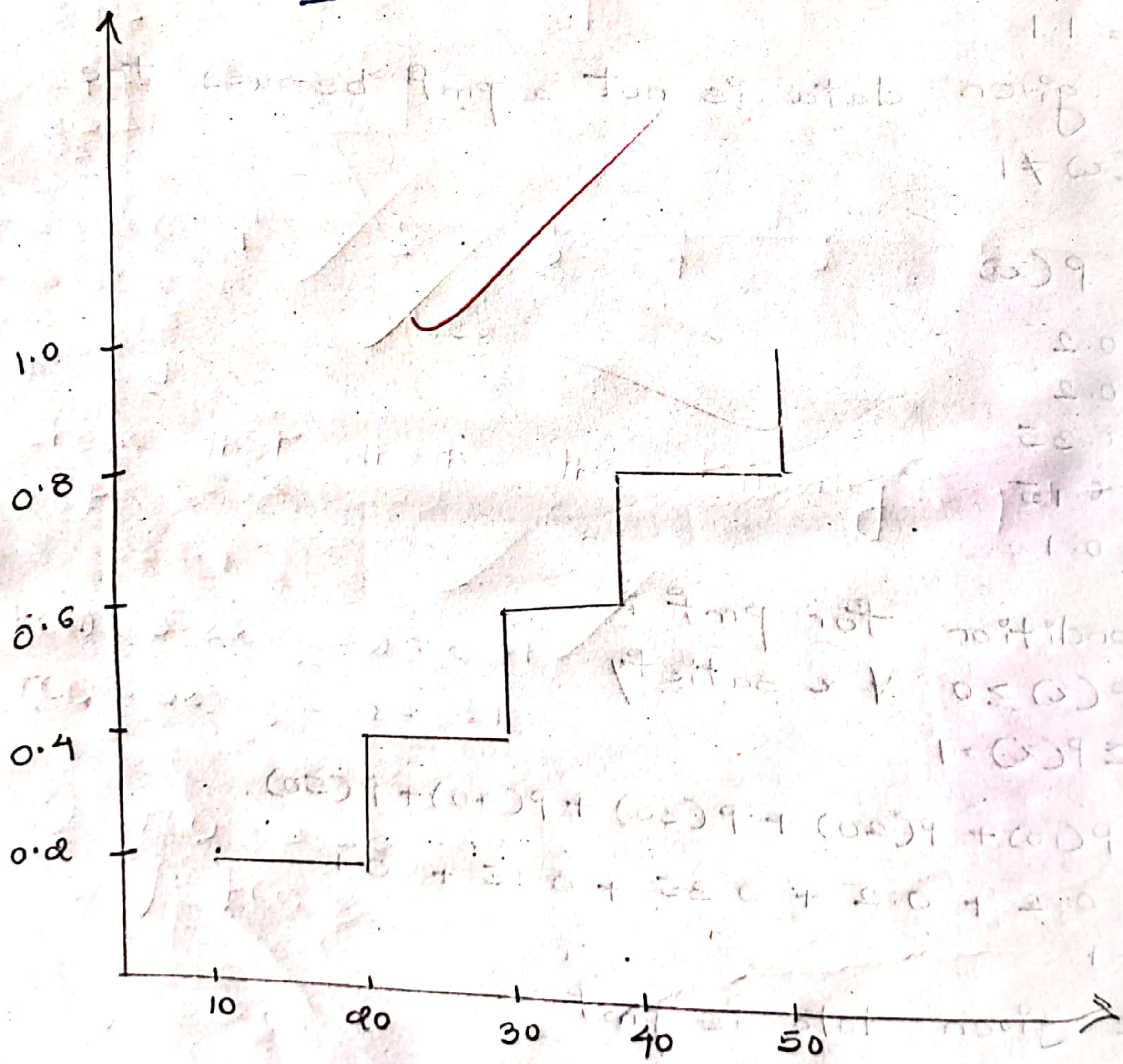
0.2 $10 \leq x < 20$

0.4 $20 \leq x < 30$

0.75 $30 \leq x < 40$

0.90 $40 \leq x < 50$

1.0 $x \geq 50$




```
> X = c (10, 20, 30, 40, 50)
> plot (X, cumsum (prob), "s")
```

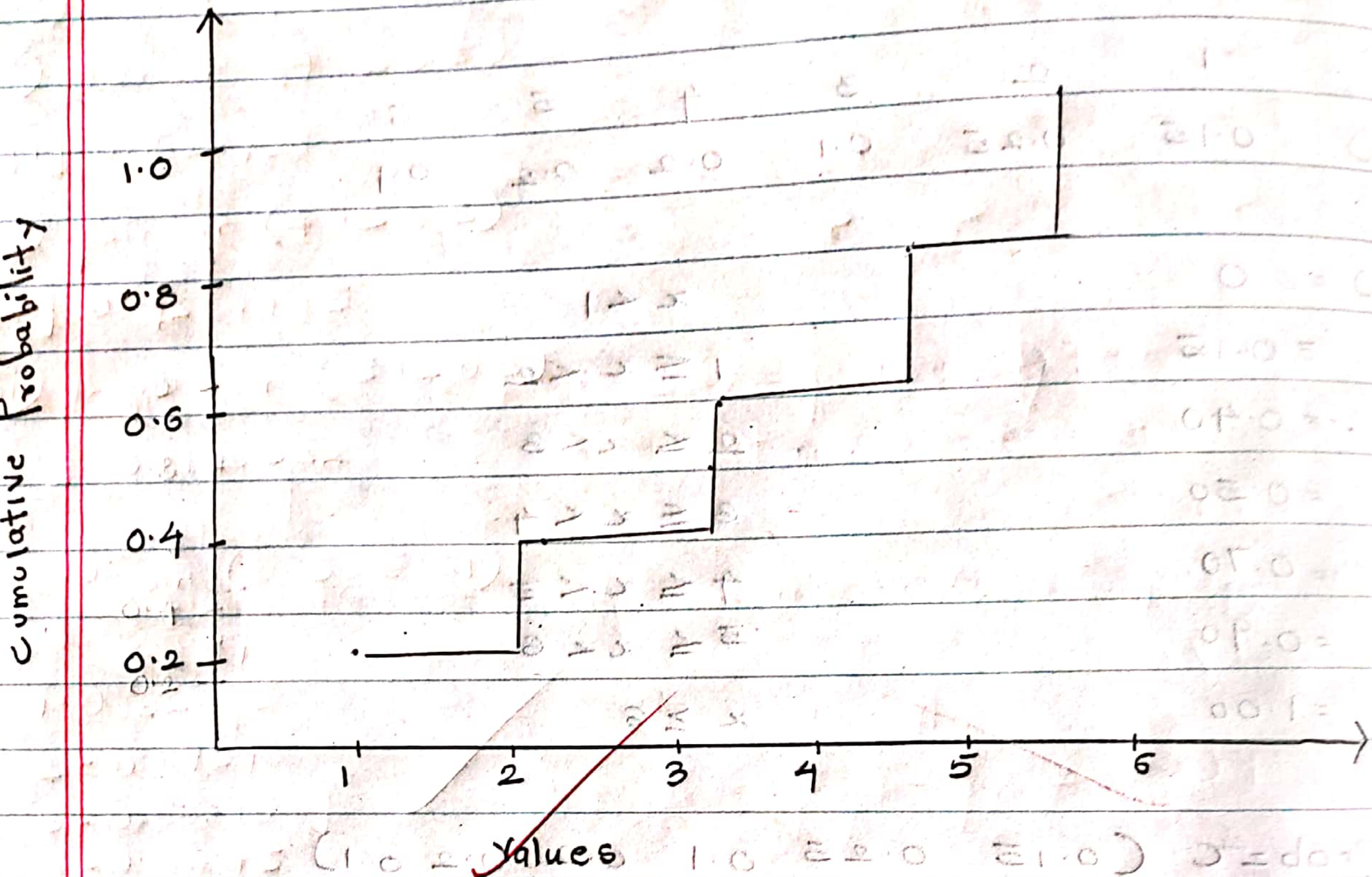
Q2 Find

x	1	2	3	4	5	6
$P(x)$	0.15	0.25	0.1	0.2	0.2	0.1

$F(x) = 0 \quad x < 1$
$= 0.15 \quad 1 \le x < 2$
$= 0.40 \quad 2 \le x < 3$
$= 0.50 \quad 3 \le x < 4$
$= 0.70 \quad 4 \le x < 5$
$= 0.90 \quad 5 \le x < 6$
$= 1.00 \quad x \ge 6$

```
> prob = c (0.15, 0.25, 0.1, 0.2, 0.2, 0.1)
> sum (prob)
[1] 1
> cumsum (prob)
[1] 0.15, 0.40, 0.50, 0.70, 0.90, 1.00
> x = c (1, 2, 3, 4, 5, 6)
> plot (x, cumsum (prob), "s", xlab = "Value",
    ylab = "cumulative probability",
    main = "CDF graph", "col= brown")
```

CDF Graph



3. Check that whether the following is p.d.f or not.

i) $f(x) = 3-2x \; ; \; 0 \leq x \leq 1$

ii) $f(x) = 3x^2 \; ; \; 0 < x < 1$

i) $f(x) = 3-2x$

$= \int_0^1 f(x)$

$= \int_0^1 (3-2x)dx$

$= \int_0^1 3dx - \int_0^1 2x dx$

$= [3x - x^2]_0^1 = 2.$

$\therefore$ The $\int_0^1 f(x) = 1$ $\therefore$ It is not a pdf

2) $f(x) = 3x^2$; $0 < x < 1$

$\int_0^1 f(x)$

$= \int_0^1 3x^2$

$= 3\int_0^1 x^2$

$= \left[3 \frac{x^3}{3}\right]_0^1$ $\because x^n = \frac{x^{n+1}}{n+1}$

The $\int_0^1 f(x) = 1$ $\therefore$ It is a pdf

Cod,

1 > x = dbinom (10, 100, 0.1)
> x
[1] 0.1318653

2 i) dbinom (4, 12, 0.2)
[1] 0.1328756
ii) pbinom (4, 12, 0.2)
[1] 0.4274445
iii) 1- pbinom (5, 12, 0.2)
[1] 0.01940528.

3 dbinom (0:5, 5, 0.1)
0 - 0.59049
1 - 0.32805
2 - 0.07290
3 - 0.00810
4 - 0.0045
5 - 0.00001

4 1) dbinom (5, 12, 0.25)
[1] 0.1032414
2) pbinom (5, 12, 0.25)
[1] 0.9455978
3) 1- pbinom (7, 12, 0.25)
[1] 0.00278151
4) dbinom (6, 12, 0.25)
[1] 0.04014945

Practical - 3

TOPIC : Binomial distribution.

\# $P(x = x) =$ dbinom (x, n, p)
\# $P(x \leq x) =$ pbinom (x, n, p)
\# $P(x > x) = 1 -$ pbinom (x, n, p)
\# if x is unknown
$p_1 = P(x \leq x) =$ qbinom (p_1, n, p)

1. Find the probability of exactly 10 success in hundred trials with $p = 0.1$

2. Suppose there are 12 mcq. Each question has 5 option out of which 1 is correct find the probability of having exactly 4 correct answers
   ii) atmost 4 correct answers
   iii) More than 5 correct answers.

3. Find the complete distribution when $n = 5$ and $p = 0.1$.

4. $n = 12$ $p = 0.25$ find the following probabilities.
   i) $P(x = 5)$
   ii) $P(x \leq 5)$
   iii) $P(x > 7)$
   iv) $P(5 < x < 7)$

5) The probability of a salesman making a sale to customer 0·15 Find the probability of

i) No. sales out of 10 customer

ii) More than 3 Sales out of 20 customer.

6. A salesman has 20% probability of making a sale to customer out of 30 customer what minimum number of sales he can make with 88% of probability

7. X follows binomial distribution with $n=10$, $p=0.3$ plot the graph pmf and c.d.f.

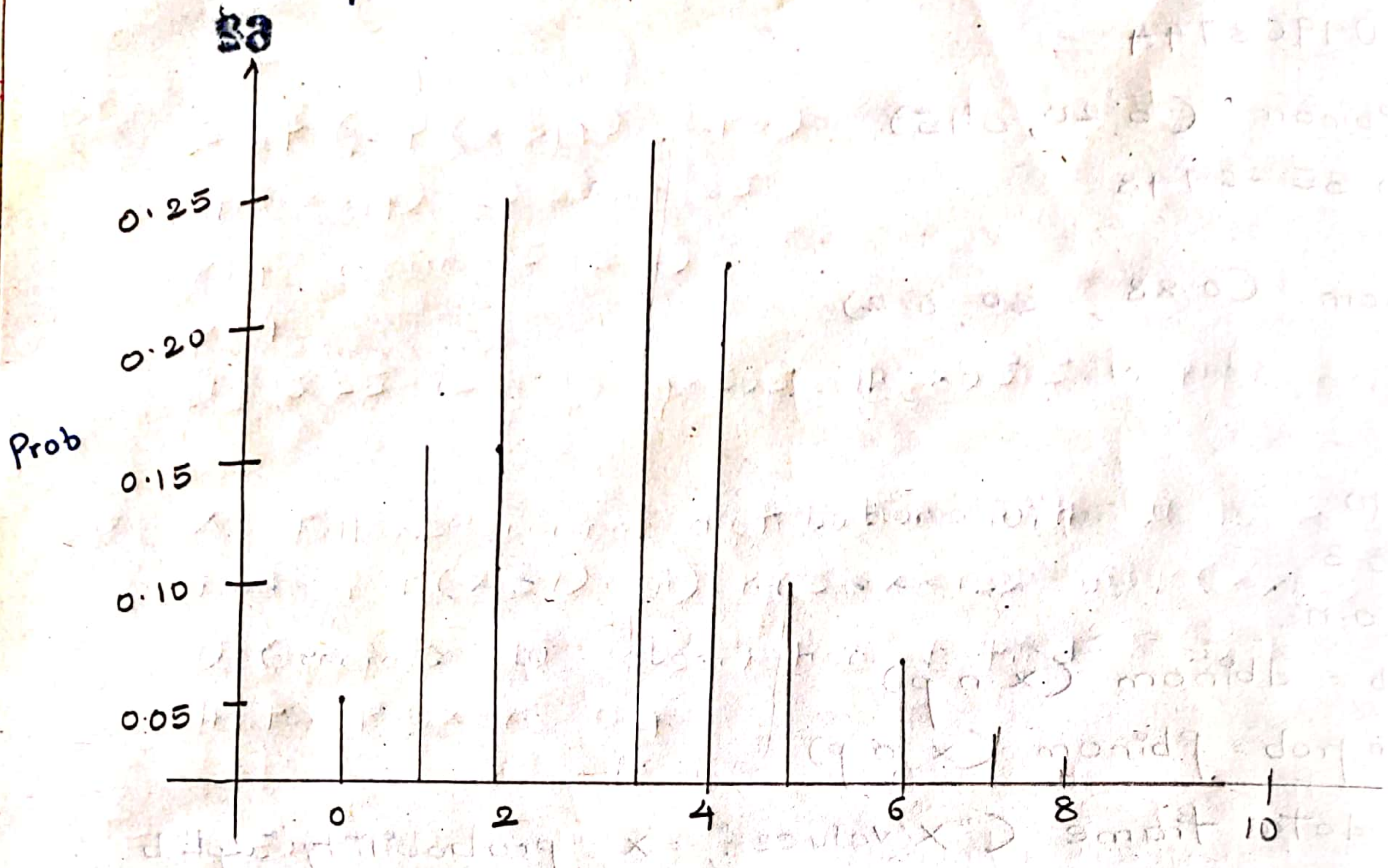
```
> dbinom (0, 10, 0.15)
[1] 0.1968744
> 1 - pbinom (3, 20, 0.15)
[1] 0.3522748
```

6.
```
qbinom (0.88, 30, 0.2)
[1] 9
```

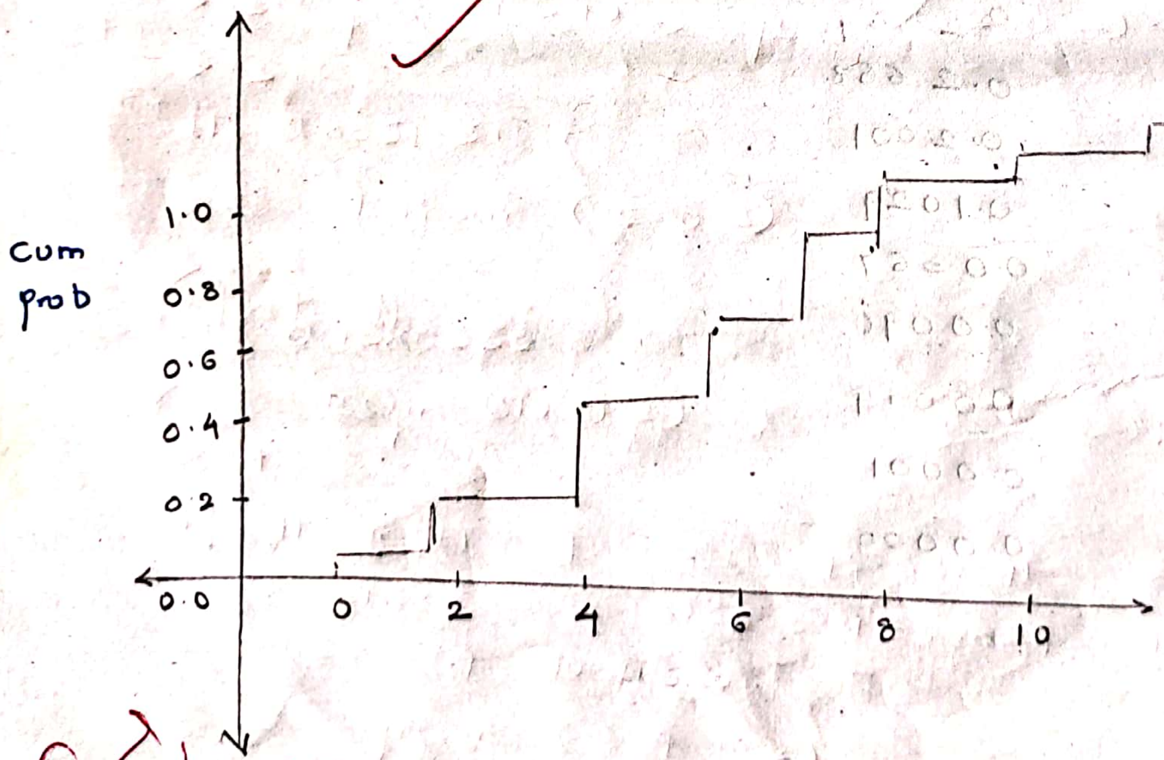
7.
```
> n = 10
> p = 0.3
> x = 0:n
> prob = dbinom (x, n, p)
> cum prob = pbinom (x, n, p)
> d = data. frame ("X values", = x, "probability" = prob
> print (d)
```

	x Values	probability
1	0	0.0282
2	1	0.1210
3	2	0.2334
4	3	0.2668
5	4	0.2001
6	5	0.1029
7	6	0.0367
8	7	0.0090
9	8	0.0014
10	9	0.0001
11	10	0.0000

> plot (x, prob, "h")



> prob (x, comprob, "s")



Practical 4

Aim : Normal Distribution

i) $P(x = X)$ = dnorm (x, μ, σ)

ii) $P(X \leq x)$ = pnorm (x, μ, σ)

iii) $P(x > x)$ = 1 - pnorm (x, μ, σ)

iv) To generate random numbers from a normal distribution (n random numbers) the R code is rnorm (n, μ, σ)

Q1 A random variable x follows normal distribution with Mean, $\mu = 12$ and S.D $= \sigma = 3$. Find
i. $P(x \leq 15)$ ii $P(10 \leq x \leq 13)$ iii. $P(x > 14)$
iv. Generate 5 observation (random numbers)

CODE :

```
> P1 = pnorm (15, 12, 3)
> P1
[1] 0.8413447
> cat ("P(x<=15) = ", P1)
P(x<=15) = 0.8413447
> P2 = pnorm (13, 12, 3) - pnorm (10, 12, 3)
> P2
[1] 0.3780661
> cat ("P(10<=x<=13)= ", P2)
P(10<=x<=13)= 0.3780661
> P3 = 1 - Pnorm (14, 12, 3)
> P3
[1] 0.2524925
```

```
>cat ("P (x >14) = " P3)
 P (X>14) = 0.2524925
>P4 = rnorm (5, 12, 3)
>P4
[1] 15.254723  16.548505  11.280515  6.419944  12.272460
```

2. X follows normal distribution with $\mu = 10$ $\sigma = 2$

Find i $P(X \leq 7)$ ii) $P(5 < x < 12)$ iii $P(x > 12)$

iv) Generate 10 observation & find k such that $P[X < k] = 0.4$

CODE:

```
>a1 = pnorm (7, 10, 2)
>a1
[1] 0.668072
>a2 = pnorm (5, 10, 2) - pnorm (12, 10, 2)
>a2
[1] 0.8351351
>a3 = 1- Pnorm (12, 10, 2)
> a3
[1] 0.1586553
>a4 = rnorm (10, 10, 2)
>a4
[1]  11.608931   9.120417   12.637741   8.073354
     8.721380    9.193726   9.366824    11.707106
     9.537584    10.715006
>a5 = qnorm (0.4, 10, 2)
>a5
[1] 9.493306
```

Q3. Generate 5 random numbers from a normal distribution $\mu = 15$, $\sigma = 4$ Find sample Mean, median, S.D and print it.

CODE:

```
>rnorm ( 5,15,4)
[1] 10.7649   7.793249   9.953444   13.345904
    17.509668
>am = mean (x)
>am
[1] 11.87345
>cat [" Sample mean is= ", am]
 sample mean is= 11.87345
>me = median (x).
>me
[1] 10.76499
>cat ("Median is = ", me)
 Median is= 10.76499
>n=5
>v= (n-1) * var (x)/n
>v
[1] 11.09965
>SD = sqrt (v)
>SD
[1] 3.33163
>cat ("SD is =", SD)
  SD is = 3.331613.
```

Q4 $X \sim N(30, 100)$, $\sigma = 10$

i $P(X \leq 40)$

ii $P(x > 35)$

iii $P(25 < x < 35)$

iv Find k such that $P(x < k) = 0.6$

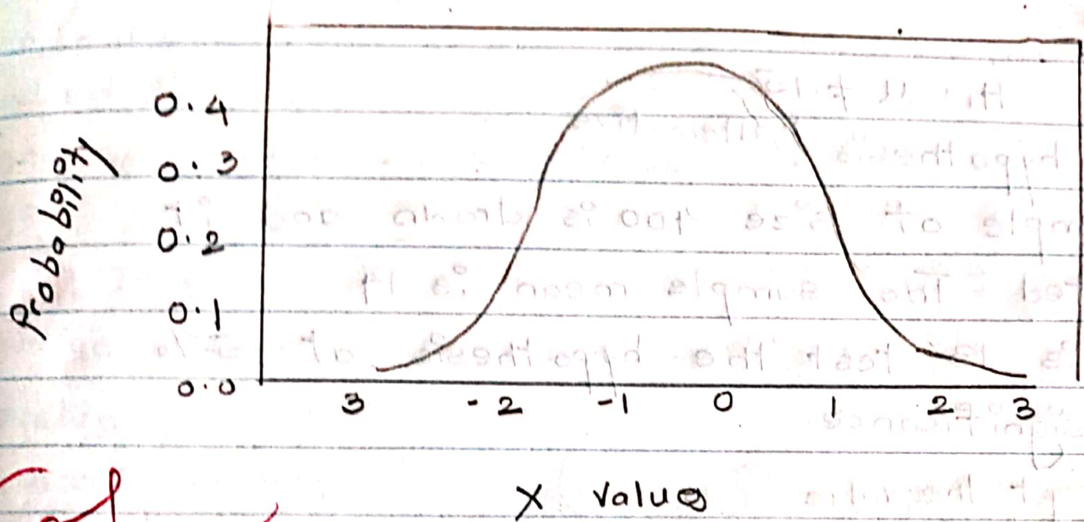
```
> f1 = pnorm (40, 30, 10)
> f1
[1] 0.8413447

> f2 = 1- pnorm (35, 30, 10)
> f2
[1]  0.3085375
> f3 = pnorm (25, 30, 10) - pnorm (35, 30, 10)
> f3
[1] 0.3085375

> f4 = qnorm (0.6, 30, 10)
> f4
[1] 32.53347
```

Q5 Plot the standard normal graph

```
> x = seq (-3, 3, by = 0.1)
> y = dnorm (x)
> plot (x, y, xlab = "xvalues", ylab = "probability",
main = "standard normal graph")
```

Scanned with CamScanner

Standard Normal Graph



Practical 5

TOPIC : Normal and t-test

Null

$H_0 : \mu = 15$ $H_1 : \mu \neq 15$ alternative

Test the hypothesis

Random sample of size 400 is drawn and it is calculated. The sample mean is 14 AND S.D is 13 test the hypothesis at 5% level of significance.

\# 0.05 > accept the value

\# 0.05 < less than Reject

```
> m0 = 15
> mx = 14
> n = 400
> sd = 3
> zcal = (mx-m0) / (sd / (sqrt(n)))
> zcal
[1] -6.666667
> cat ("Calculated value of z is = ", zcal)
Calculated value of z is = -6.666667
> pvalue = 2 * (1- pnorm (abs (zcal)))
> pvalue
[1] 2.616796e-11
```

∴ The value is less than 0.05 we will reject the value of $H_0 = \mu = 15$.

2) Test the hypothesis $H_0 = \mu = 10$ against $H_1 : \mu \neq 10$
A random sample size of 400 is drawn with sample mean = 10.2 and SD = 2.25
Test the hyptothesis at

```
> mo= 10
> n= 400
> mx= 10.2
> sd = 2.25
> zcal = (mx-mo)/ (sd/(sqrt (n)))
> zcal
[1] 1.77778
> pvalue = 2 * (1- pnorm (abs (zcal)))
> pvalue
[1] 0.07544036
```

∵ The Pvalue is greater than 0.05
∴ The value is accepted

3. Test the hypothesis H_0: proportional of smokers in college is 0.2 A sample is collected and calculated the sample proportion as 0.125 Test the hypothesis at 5% level of significance (sample size is 900)

```
> p = 0.2
> p= 0.125
> n= 400
> Q = 1-p
> zcal = (p-p) (sqrt (p * Q/n))
> cat (" Calculated value of z is = ", zcal)
[1] calculated value of z is = - 3.75
> pvalue = 2 * (1-pnorm (abs (zcal)))
> pvalue
[1]  0.0001768346 (Reject)
```

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4) Last year farmer's last 20% of their crops. A random sample of 60 fields are collected and it found that a field crops are insert polluted Test the hypothesis of 1% level of significance

```
> P=0.2
> p=9/60
> n=60
> zcal=(p-P)/(sqrt(P*Q/n))
>zcal
[1]-0.9682458
>pvalue = 2 * (1-pnorm(abs(zcal)))
>pvalue
[1] 0.3329216
```

∴ The value is 0.1 so value is accepted.

5) Test the hypothesis $H_0 : \mu = 12.5$ from the following at 5% level of significance.

```
>x=c(12.25, 11.97, 12.15, 12.08, 12.31, 12.28, 11.94, 11.89,
  12.16, 12.04)
>n=length(x)
>n
[1] 10
>mx =mean(x)
>mx
[1]12.107
```

```
> variance = (n-1) * var (x)/n
> variance
[1] 0.019521
> sd = sqrt (variance)
> sd.
[1] 0.1397176
> mo = 12.5
> t = (mx - mo) / (sd / sqrt (n))
> t
[1] - 8.894909
> pvalue = 2 * (1 - pnorm (abs (t)))
> pvalue
[1] 0
```

∴ The value is less than 0.05 the value is accepted.

Practical 6

Aim: Large sample test

1. Let the population mean (the amount spent per customer in a restaurant) is 250 A sample of 100 customers selected the sample mean is Calculated as 275 and SD 30 Test the hypothesis that the population mean is 250 or not on 5% level of significance.

2. In a random sample of 1000 students it is found that 750 use blue pen test the hypothesis that the population proportion is 0.8 at 1% Level of significance.

1. Solution:

```
>m0 = 250
>mx = 275
>sd = 30
>n = 100
>zcal = (mx-m0) / (sd/(sqrt(n)))
>cat ("Calculated value of z is = ", zcal)
[1] Calculated value of z is - 8.333333
>pvalue = 2* (1-pnorm(abs(zcal)))
>pvalue
[1] 0
```

∵ The value is less than 0.05 we will reject value of $H_0 = \mu = 250$.

Soln

2.

```
> p = 0.8
> Q = 750/1000
> n = 1000
> zcal (p-p) / (sqrt (p * Q/n))
> cat ("Calculated value of z is : ", zcal)
[1] Calculated value of z is : -3.952847
> pvalue = 2 * (1-pnorm (abs (zcal)))
> pvalue
[1] 7.72268e-05
```

∵ The value is less 0.01 we reject!

3. To random sample of size 1000 & 2000 are drawn from two population with same SD 2.5 the sample means are 67.5 and 68 Test the hypothesis $\mu_1 = \mu_2$ at 5% < of significance

4. A study of noise level in 2 hospital is given below test the claim that 2 hospital have same level of noise at 1% level of significance

Hos. A	Hos. B
84	34
61.2	59.4
7.9	7.5

5. In a sample of 600 students is clg 400 used Blue ink. In another clg from a sample of 900 student 450 use blue ink. Test the hypothesis that the proportion of student using blue ink in two colleges are equal or not at 1% level of significance.

3. Solution

```
> n1 = 1000
> n2 = 2000
> mx1 = 67.5
> mx2 = 68
> sd1 = 2.5
> sd2 = 2.5
> zcal = (mx1 - mx2)/sqrt ((sd1^2/n1) + (sd2^2/n2))
> zcal
[1] -5.163978
> pvalue = 2* (1-pnorm (abs (zcal)))
> pvalue
[1] 2.417564e-07    ∴ (Rejected)
```

4. Soln

```
> n1 = 84
> n2 = 34
> mx1 61.2
> mx2 = 59.4
> sd1 = 7.9
> sd2 = 7.5
> zcal = (mx1 - mx2) / sqrt ((sd1^2/n1) + (sd^2))
> zcal
[1] 1.162528
> pvalue = 2* (1-pnorm (abs (zcal)))
> pvalue.
```

[1] 0.2450211

∴ The value is greater than 0.01 we accept the value

5.

$H_0 : P_1 = P_2$ against $H_1 : P_1 \neq P_2$

```
> n1 = 600
> n2 = 900
> P1 = 400/600
> P2 = 450/900
> P = (n1*P1 + n2*P2) (n1+n2)
> P
[1] 0.566067
> q = 1-p
> q
[1] 0.4333333
> zcal = (p1-p2) / sqrt (P*q*(1/n1 + 1/n2))
> zcal
[1] 6.381534
> pvalue = 2*(1-pnorm (abs (zcal)))
> pvalue
[1] 1.75322 e-10
```

∴ Value is less than 0.01 the value is rejected

6. Ho : P1 = P2 as H1 : P1 ≠ P2

```
>n1=200
>n2= 200
>P1= 44/200
>P2= 30/200
>P=(n1*P1+n2*P2)/(n1+n2)
>P
[1] 0.185
>q=1-p
>q
[1] 0.815
>zcal = (P1-P2)/sqrt(p*q*(1/n1+1/n2))
>zcal
[1] 1.802741
>pvalue = 2*(1-pnorm(abs(zcal)))
>pvalue
[1] 0.07142888
```

∴ (Accept ∵ greater than 0.05)

Practical 7

TOPIC : Small sample test

The marks of 10 students are given by 63, 63, 66, 67, 68, 69, 70, 71, 72, test the hypothesis that the sample comes from the population with average 66.

$H_0 : \mu = 66$

```
>x = c(66, 63, 66, 67, 68, 69, 70, 70, 71)
>t.test(x)
One sample t-test
data : x
t= 68.319, df= 9, pvalue= 1.558e-13
alternative hypothesis.
True mean is not equal to 0
95 percent confidence interval
65.65171          70.14829
Sample estimates
mean of x.
67.9
```

∴ The pvalue is less than 0.05 we reject the hypothesis at 5% level of significance.

2. Two groups of student scored the following marks. Test the hypothesis that there is no significance difference between the 2 groups.

GR1 - 18, 22, 21, 17, 20, 17, 23, 20, 22, 21
GR2 - 16, 20, 14, 21, 20, 18, 13, 15, 17, 21

Ho : There is not difference b/w the 2 groups.

```
> x = c(18, 22, 21, 17, 20, 17, 23, 20, 22, 21)
> y = c(16, 20, 14, 21, 20, 18, 13, 15, 17, 21)
> t.test (x, y).
            Two sample t-test.

data : x and y
t= 2.2573  df= 16.376  p-value = 0.03798
alternative hypothesis:
    True difference in means is not equal
to 0. 95 percent confidence interval
   0.1628205       5.0371795
sample estimate :
  mean of x  mean of y
   20.1         17.5

> p.value = 0.03798
> if (pvalue > 0.05) {(cat ("accept ho")}
else  {cat ("reject ho")}
  reject Ho.
```

(PAIRED T-test)

3) The sales data of 6 shops before & after a special campaign are given below. 72

Before: 53, 28, 31, 48, 50, 42

After: 58, 29, 30, 55, 56, 45

Test the hypothesis that the campaign is affective or not.

Ho: There is no significance difference of sales before & after campaign.

```
>x = c(Before)
>y = c(After)
>t.test(x,y, paired = T, alternative = "greater")
     paired t-test
     data: x & y
t = -2.7815 , df = 5, pvalue = 0.9806
alternative hypothesis:
 ~~Three~~ True difference in means is greater
 than 0  95 percent confidence interval:
   -6.035547  inf
 sample estimates
 mean of the difference
            -3.5
```

∵ pvalue is greater than 0.05, we accept the hypothesis at 5% level of significance.

4. Following are the weight before & after the diet program. Is the diet program effective:

Before : 120, 125, 115, 130, 123, 119

After : 100, 114, 95, 90, 115, 99.

Soln : H_0 : There is bio significance difference.

> x = c (Before)

> y = c (after)

> t.test (x, y, paired = T, alternative = "less")

paired t-test

data : x & y

t = 4.3458, df = 5, pvalues = 0.9963

alternative hypothesis : true difference in means is less than 0.

95 percent confidence interval:

-inf 29.0295

sample estimate:

mean of the differences

19.83333

∵ pvalue is greater than 0.05 we accept the hypothesis at 5% level of significance.

Scanned with CamScanner

5. 2 medicines are applied to two groups of patients respectively.

GR1 : 10, 12, 13, 11, 14

GR2: 8, 9, 12, 14, 15, 10, 9

Is there any significance difference between 2 medicines

Ho : There is no significance difference

```
> x = c (GR1)
> y = c (GR2)
> t.test (x,y)
   data : x & y
   t= 0.80384 , df= 9.7594 , pvalue= 0.4406
   alternative hypothesis : true difference
   in means is not equal to 0
   95 percent confidence interval
   -0.9698553        4.2981886
   Sample estimates :
     mean of x        mean of y
     12.0000          10.33333
```

∴ pvalue is Greater than 0.05 we accept the hypothesis at 5% level of significance.

Practical 8

Topic : Large and Small Test.

1. $H_0: \mu = 55$, $H_1: \mu \neq 55$

```
> n = 100
> mx = 52
> mo = 55
> sd = 7
> zcal = (mx-mo) / (sd / (sqrt(n)))
> zcal
[1] -4.285714
> pvalue = 2* (1-pnorm (abs (zcal)))
> pvalue
[1] 1.82153e-05
```

As pvalue is less than 0.05 we reject H_0 at 5% level of significance.

2. $H_0: P = 0.5$ against $H_1: P \neq 0.5$.

```
> P = 0.5
> q = 1-p
> n = 700
> zcal = (p-P) / (sqrt (P*q/n))
> zcal
[1] 0
> pvalue = 2 * (1-pnorm (abs (zcal)))
> pvalue
[1] 1
```

As pvalue is greater than 0.05 we accept Ho at 1% level of significance.

3. Ho : $P_1 = P_2$ against $H_1 : P_1 \neq P_2$

```
> n1 = 1000
> n2 = 1500
> p1 = 2/1000
> p2 = 1/1500
> p = (n1 * p1+n2 * p2)/(n1 + n2)
> p
[1] 0.0012
> q = 1-p
[1] 0.9988
> zcal = (p1-p2)/sqrt (p*q* (1/n1 + 1/n2)
> zcal
[1] 0.9433752
> pvalue = 2 * (1-pnorm (abs (zcal))
> pvalue
[1] 0.345489
```

∵ pvalue is greater than 0.05 we accept Ho and 5% level of significance

4. $H_0 : \mu = 100$ against $H_1 : \mu \neq 100$

```
> var = 64
> n = 400
> mo = 100
> mx = 99
> sd = sqrt(var)
[1] 8
> zcal = (mx-mo) / (sd/ (sqrt (n)))
>zcal
> zcal = (mx - mo)/(sd / (sqrt (n)))
>zcal
[1]2.5
>pvalue = 2 * ( 1-pnorm (abs(zcal)))
> pvalue
[1] 0.01241933
```

∵ pvalue is less than 0.05 we reject Ho at 5% level of significance.

5 $H_0 : \mu = 66$ against $H_1 : \mu \neq 66$

```
> x = c (63, 63, 68, 69, 71, 71, 72)
> t. test (x)
          One Sample t-test

data: x
t = 47.94   df = 6   p.value = 5.522e-09
alternative hypothesis : true mean is not
equal to 0   95 percent confidence interval
   64.66479   71.62092
 sample estimates:
 mean of x.
 68.14286
```

∵ p value is less than 0.05 we reject H_0 at 1% level of significance.

6. $H_0 : \sigma_1 = \sigma_2$ against $H_1 : \sigma_1 \neq \sigma_2$

```
> x = c (66, 67, 75, 76, 82, 88, 90, 92)
> y = c (64, 66, 74, 78, 82, 85, 87, 92, 93, 95, 97)
> var. test (x, y)
       F test to compare two variance
data  x and y.
```

F : 0.788803 num df = 7 dnom. df = 10 pvalue : 0.773
alternative hypothesis : true ratio of variance
variance in not equal to 1
95 percent confidence interval:
0.199509 3.351881
sample estimates :
ratio of variance
0.7880255

∵ pvalue is greater than 0.05 we accept
Ho at 5% level of significance.

7. Ho : μ = 1150 against H1: μ ≠ 1150.

```
> n=100
> mx=1150
> mo= 1200
> sd= 125
> zcal = (mx-mo) / (sd /(sqrt(n))
> zcal
[1] -4
> pvalue . 2* (1-pnorm (abs (zcal))
> pvalue
[1] 6.334248 p-0.5
```

∵ pvalue is less than 0.5 we reject
Ho.

8. $H_0: P_1 = P_2$ against $H: P_1 \neq P_2$

```
>n1 = 200
>n2 = 300
>p1 = 44/200
>p2 = 56/300
>p = (n1*p1 + n2*p2)/(n1+n2)
>p
[1] 0.2
>q = 1-p
[1] 0.8
> zcal = (p1-p2) / sqrt (p*q* (1/n1 + 1/n2))
>zcal
[1] 0.9128709
>pvalue = 2* (1-pnorm (abs (zcal)))
>pvalue
[1] 0.3613104
```

∵ pvalue is greater than 0.05 we accept H_0 at 1% level of significance.

Soln: H_0 : H_1: $P_1 \neq P_2$

```
> n1 = 200
> n2 = 300
> P1 = 44/200
> P2 = 56/300
> P = (n1*P1+n2*P2)/(n1+n2)
[1] 0.2
> q = 1-p
> zcal = (P1-P2)/sqrt(p*q*(1/n1+1/n2))
> zcal
[1] 0.9128709
```

Practical 9

TOPIC: Non parametric Testing of hypothesis using R- Environment.

1. The following data represent earning (in dollars) for a random sample of five common stacks listed on the New york stock exchange. Test whether median earnings is 4 dollars.

Data : 1.68, 3.35, 2.50, 6.23, 3.24.

```
> x <- c (1.68, 3.35, 2.50, 6.23, 3.24);
> n <- length (x);
> n

> x > 4;
[1] FALSE FALSE FALSE TRUE FALSE.
> s <- sum (x >4); s;
[1]  1
> binom. test (s, n, p = 0.5, alternative = "greater");
              Exact binomial test

data : s and n.
number of success = 1 number of trials = 5, p.values : 0.9688
alternative hypothesis : true probability of success
 is greater than 0.5;
 95 percent confidence interval:
   0.01020622   1.00000000
   sample estimates :
    probability of success
                        0.2.
```

2. The scores of 8 student in reading before and after lesson are as follows :
Test whether there is effect of reading

Student No:	1	2	3	4	5	6	7	8
Score before:	10	15	16	12	09	07	11	12
Score After :	13	16	15	13	09	10	13	10

CODE :

```
> b <- c (10, 15, 16, 12, 09, 07, 11, 12);
> a <- c ( 13, 16, 15, 13, 08, 10, 13, 10);
> D<- b-a ;
> wilcox . test (D, alternative = "greater");
```

Wilcoxon signed rank test with continuity correction data : D.

v= 10.5 , p-value = 0.8722
alternative hypothesis : true location is greater than 0.

Warning message.
In wilcox.test . default (D alternative = "greater");
cannot compute exact p-values with ties.

∴ p-values is greater than 0.05 we accept it.

3. The diameter of a ball bearing was measured by 6 inspectors, each using two different kind of caliper. the result were, Test whether average ball bearing for.

Inspector:	1	2	3	4	5	6
Caliper 1:	0.265	0.268	0.266	0.267	0.269	0.264
Caliper 2:	0.263	0.262	0.270	0.261	0.271	0.260

Caliper 1 and caliper 2 are same.

CODE:

```
> x <- c (0.265, 0.268, 0.266, 0.267, 0.269, 0.264);
> y <- c (0.263, 0.262, 0.270, 0.261, 0.271, 0.260);
> wilcox . test (x, y , alternative = "greater")
```

wilcoxon rank sum test

data: X and Y.

W= 24, P= 0.197

alternative hypothesis: true location shift is greater than 0.

∴ p-value is greater than 0.05 we accept it.

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4. An officer has three effective type writers A, B & C In a study of machine usage, firm has kept records of machine usage rate of seven week. Machine out of for repair for two weeks. It is Interest to find out which machine has better usage rate. Analyze the following data on usage rates and determine if there is a significant different in average rate.

A	B	C
12.3	15.7	32.4
15.4	10.8	41.2
10.3	45.0	35.1
08.0	12.3	25.0
14.6	08.2	08.2
	20.1	18.4
	26.3	32.5

CODE:

```
> x <- c (12.3, 15.4, 10.3 8.0, 14.6);
> n1 <- length (x);
> n1
 [1] 5

> y <- c (15.7, 10.8, 45.0, 12.3, 8.2, 20.1, 26.3);
> n2 <- length (y)
> n2
[1] 7

> z <- c (32.4, 41.2, 35.1, 25.0, 8.2, 18.4, 32.5);
> n3 <- length (z);
> n3
[1] 7.
```

```
> x <- c (x, y, z);
> g <- c (rep (1, n1) rep (2, n2), rep (3, n3));
> krushkal.test (x, g)
```

krushkal - Wallis rank sum test.

data : x and g

kruskal - Wallis chi - squared = 5.217, df = 2

p-value = 0.07365

∴ p-value is greater than 0.05 we accept it.

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Practical 10.

Aim : chi square test & ANOVA (Analysis of variance)

Q1 Use the following data to test whether the condition of home & condition of child are independent or not.

cond child	cond Home	
	clean	Dirty
clean	70	50
Fairly clean	80	20
Dirty	35	45

Ho: condition of Home & child are independent

```
> x = c (70, 80, 35, 50, 20, 45)
> m = 3
> n = 2
> y = matrix (x, nrow = m, ncol = n)
> y
      [,1]  [,2]
[1,]   70    50
[2,]   80    20
[3,]   35    45
> pv = chisq.test (y)
> pv
```

Pearson's chi-squared test.

data : y
x-squared = 25.646.
df = 2
p-value = 2.698e-06
They are dependent
∵ pvalue is less than 0.05 we reject the hypothesis at 5% level of significance.

Q2 Test The hypothesis that vacation & disease are independent or Not.

Disease \ Vaccine	Affected	Not affected
Affect	70	46
No.affected	35	37.

Ho : Disease & vaccine are independent.

```
> x = c (70, 35, 46, 37)
> m = 2
> n = 2
> y = matrix (x, nrow = m, ncol = n)
> y
      [,1]  [,2]
[1,]   70    46
[2,]   35    37
```

```
> pv = chisq.test(y)
> pv
```

Pearson's chi squared test with yate's continuity correction

data : y

x- square = 2.0275

df = 1

p-value = 0.1545

∵ pvalue is more than 0.05 we accept the hypothesis at 5% Level of significance.

They are INDEPENDENT

Q3 Perform a ANOVA for the following data

TYPE	OBSERVATION
A	50, 52
B	53, 55, 53
C	60, 58, 57, 56
D	52, 54, 54, 55

Ho: The mean's are equal for A, B, C, D

```
> x1 = c (50, 52)
> x2 = c (53, 55, 53)
> x3 = c (60, 58, 57, 56)
> x4 = c (52, 54, 54, 55)
> d = stack (list (b1= x1, b2= x2, b3= x3, b4= x4))
> names (d)
[1] "values" "ind"
> oneway. test (values ~ ind, data = d, var. equal= T)
        One-way analysis of means
data: values and ind
  F= 11.735   df= 3 , denom df= 9,
  pvalue = 0.00183
```

> pvalue is less than 0.05 we reject the hypothesis.

```
> anova = aov (values ~ ind, data = d)
> Summary (anova)
```

	Df	sum	Mean sq	Fvalue	Pr (>F)
ind	3	71.06	23.688	11.73	0.00183 **
Residuals	9	18.17	2.019		

Signif. codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Q4 Following data gives a life of 4 ~~boards~~ brands.

TYPE	LIFE
A	20, 23, 18, 17, 18, 22, 24
B	19, 15, 17, 20, 16, 17
C	21, 19, 22, 17, 20
D	15, 14, 16, 18, 14, 16.

Ho: The mean's of A, B, C, D are equal

```
> x1 = c(20, 23, 18, 17, 18, 22, 24)
> x2 = c(B)
> x3 = c(C)
> x4 = c(D)
> d = stack(list(b1=x1, b2=x2, b3=x3, b4=x4))
> names(d).
[1] "Values" "ind"
> one way.test(Values ~ ind, data=d, var.equal=T)
        one-way analysis of means.
data: Values & ind.
F = 6.8445   num df = 3   denom df = 20
p-values = 0.002349
```

∴ pvalue is less than 0.05 we reject the hypothesis.

```
> anova = aov (values ~ind, data = d)
> summary (anova)
            Df   Sum Sq   mean sq   F value   Pr(<F)
ind          3   91.44    30.479    6.845     0.00235**
Residual    20   89.06    4.453

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05
                                           '.' 0.1 ' ' 1

> x = read.csv("C:/user/admin/Desktop/marks.cs
> x
     Stats     Maths
1     40        60
2     45        48
3     42        47
4     15        20
5     37        25
6     36        27
7     49        57
8     59        58
9     20        25
10    27        27
> am = mean (x $ stats)
> am
[1] 37
> am1 = mean (x $ Maths)
> am1
[1] 39.4
```

>m1 = median (x $ stats)
>m1
[1] 38.5
>m1 = median (x $ stat Maths)
[1] 37
>n = length (x $ stats)
>n
[1] 10.
>sd = sqrt ((n-1) * var (x $ stats)/n)
>sd
[1] 12.649
>n1= length (x $ maths)
>n1
[1] 10.
>sd1 = sqrt ((n-1) * var (x $ maths)/n)
>sd1
[1] 15.2
> (r (x $ stats, x $ Maths)
[1] 0.830618.