PRACTICAL No: 1

Basics of R software.

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

2) This software is used for effective data handling and output storage is possible.

3) It is capable of graphical display.

4) It is a free software.

1) $2^2 + \sqrt{25} + 35$
> (2**2) + sqrt (25) + 35
[1] 44

2) $2 \times 5 \times 3 + 62 \div 5 + \sqrt{49}$
> (2*5*3) + (62/5) + sqrt(49)
[1] 49.4.

3) $\sqrt{76 + 4 \times 2 + 9 \div 5}$
> sqrt (76+ (4*2) + (9/5))
[1] 9.262829.

4) $42 + |-10| + 7^2 + 3 \times 9$
> 42 + abs (-10) + (7**2) + (3*9)
[1] 128.

Q.2) x = 20

y = 30

find $x+y$, x^2+y^2 , $\sqrt{y^3-x^3}$; $|x-y|$

```
> x+y
[1] 50
> (x**2) + (y**2)
[1] 1300
> sqrt ((y**3) - (x**3))
[1] 137.8405
> abs (x-y)
[1] 10
```

Q.3)

```
c (2,3,4,5)^2
[1] 4 9 16 25

c(4,5,6,8)*3
[1] 12 15 18 24

c(2,3,5,7)* c(-2,-3,-4,-5)
[1] -4 -9 -25 -28

c(2,3,5,7) * c(8,9)
[1] 16 27 40 63

c(1,2,3,4,5)* c(2,3,4)
Error.
```

c(1,2,3,4,5,6) ^ c(2,3)

[1] 1 8 9 64 25 216

Q) Find the sum , product , maximum , minimum of the values

5, 8, 6, 7, 9, 10, 15, 5.

```
> x = c(5, 8, 6, 7, 9, 10, 15, 5)
> length (x)
[1] 8
> sum(x)
[1] 65
> prod(x)
[1] 11340000
> max (x)
[1] 15
> min(x)
[1] 5
```

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

1A

$$x = \begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix}$$

$$y = \begin{bmatrix} 2 & 4 & 10 \\ -2 & 8 & -11 \\ 10 & 6 & 12 \end{bmatrix}$$

```
> x <- matrix (nrow = 3, ncol = 3, data=c(1,2,3,4,5,6,7,
> y <- matrix (nrow = 3, ncol = 3, data=c(2,-2,10,4,8,6,b
                                              -11, 12)
> x + y
```

	[1]	[2]	[3]
[1]	3	8	17
[2]	0	13	-3
[3]	13	12	21

```
> x * y
```

	[1]	[2]	[3]
[1]	2	16	70
[2]	-4	40	-88
[3]	30	36	108

```
> x^2 + y^3
```

	[1]	[2]	[3]
[1]	8	20	44
[2]	-2	34	-17
[3]	36	30	84

```
> x = c(2,4,6,1,3,5,7,18,16,14,17,19,3,3,2,
       5,0,15,99,14,18,10,12);
> length (x)
[1]  23
> a = table (x)
> a
x
0 1  2  3  4  5  6  7  9  10  12  14  15  16  17 18 1
1 1  2  3  1  2  1  1  1  1   1   2   1   1   1  2 1
> transform (a)
    x        freq
    0        1
    1        1
    2        2
    3        3
    4        1
    5        2
    6        1
    7        1
    9        1
    10       1
    12       1
    14       2
    15       1
    16       1
    17       1
    18       2
    19       1
```

```
> breaks = seq(0, 20, 5).
>s = cut(x, breaks, right = FALSE)
>c = table(s)
> transform (c)
```

	s	Freq.
1	[0,5)	8
2	[5,10)	5
3	[10,15)	4
4	[15,20)	6

Can the following be p.d.f ?

i) $f(x) = \begin{cases} 2-x ; & 1 \le x \le 2 \\ 0 & \text{otherwise} \end{cases}$

$\Rightarrow \int_1^2 (2-x)\,dx$

$= \int_1^2 2dx - \int_1^2 x\,dx.$

$= 2x \Big]_1^2 - \frac{x^2}{2} \Big]_1^2$

$= (4-2) - (2-0.5)$

$\neq 1$

$\Rightarrow$ Not a p.d.f.

ii) $f(x) = \begin{cases} 3x^2 ; & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$

$\Rightarrow \int_0^1 (3x^2)\,dx.$

$\int_0^1 \frac{\cancel{3}x^3}{\cancel{3}}$

$= x^3 \Big|_0^1$

$= 1$

$\Rightarrow$ It is a p.d.f.

P.T.

iii) $f(x) = \begin{cases} \frac{3x}{2}\left(1 - \frac{x}{2}\right) ; & 0 \leq x \leq 2 \\ 0 , & \text{otherwise} \end{cases}$

$\Rightarrow \int_0^2 \left(\frac{3x}{2} - \frac{3x^2}{4}\right) dx$

$= \frac{3}{2}\int_0^2 x \, dx - \frac{3}{4}\int_0^2 x^2 \, dx.$

$= \frac{3}{2}\left[\frac{x^2}{2}\right]_0^2 - \frac{3}{4}\left[\frac{x^3}{3}\right]_0^2$

$= \frac{3}{4}\left[x^2\right]_0^2 - \frac{1}{4}\left[x^3\right]_0^2$

$= \frac{3}{\cancel{4}}\left[\cancel{4}\right] - \frac{1}{\cancel{4}}\left[\cancel{8}^{2}\right]$

$= 1$

It is a p.d.f.

Can the following be p.m.f

x	1	2	3	4	5
$p(x)$	0.2	0.3	-0.1	0.5	0.1

Since, 1 of the probability is negative, it is not a p.m.f.

x	0	1	2	3	4	5
$p(x)$	0.1	0.3	0.2	0.2	0.1	0.1

Since $p(x) \geq 0 \ \forall x$

and $\sum p(x) = 1$

$\therefore$ It is a p.m.f

x	10	20	30	40	50
$p(x)$	0.2	0.3	0.3	0.6	0.2

Since $p(x) \geq 0 \ \forall x$

and $\sum p(x) \neq 1$

$\therefore$ It is not a p.m.f.

~~Since $p(x) \geq 0 \ \forall x$~~

Find $P(x \leq 2)$, $P(2 \leq x < 4)$, P(atleast 4) $P(3 < x < 6)$

x	0	1	2	3	4	5	6
$p(x)$	0.1	0.1	0.2	0.2	0.1	0.2	0.1

$\rightarrow p(x \leq 2)$

$= p(0) + p(1) + p(2)$

$= 0.1 + 0.1 + 0.2$

$= 0.4$

$p(2 \leq x < 4)$

$= p(2) + p(3)$

$= 0.2 + 0.2$

$= 0.4$

p(atleast 4)

$= p(4) + p(5) + p(6)$

$= 0.1 + 0.2 + 0.1$

$= 0.4$

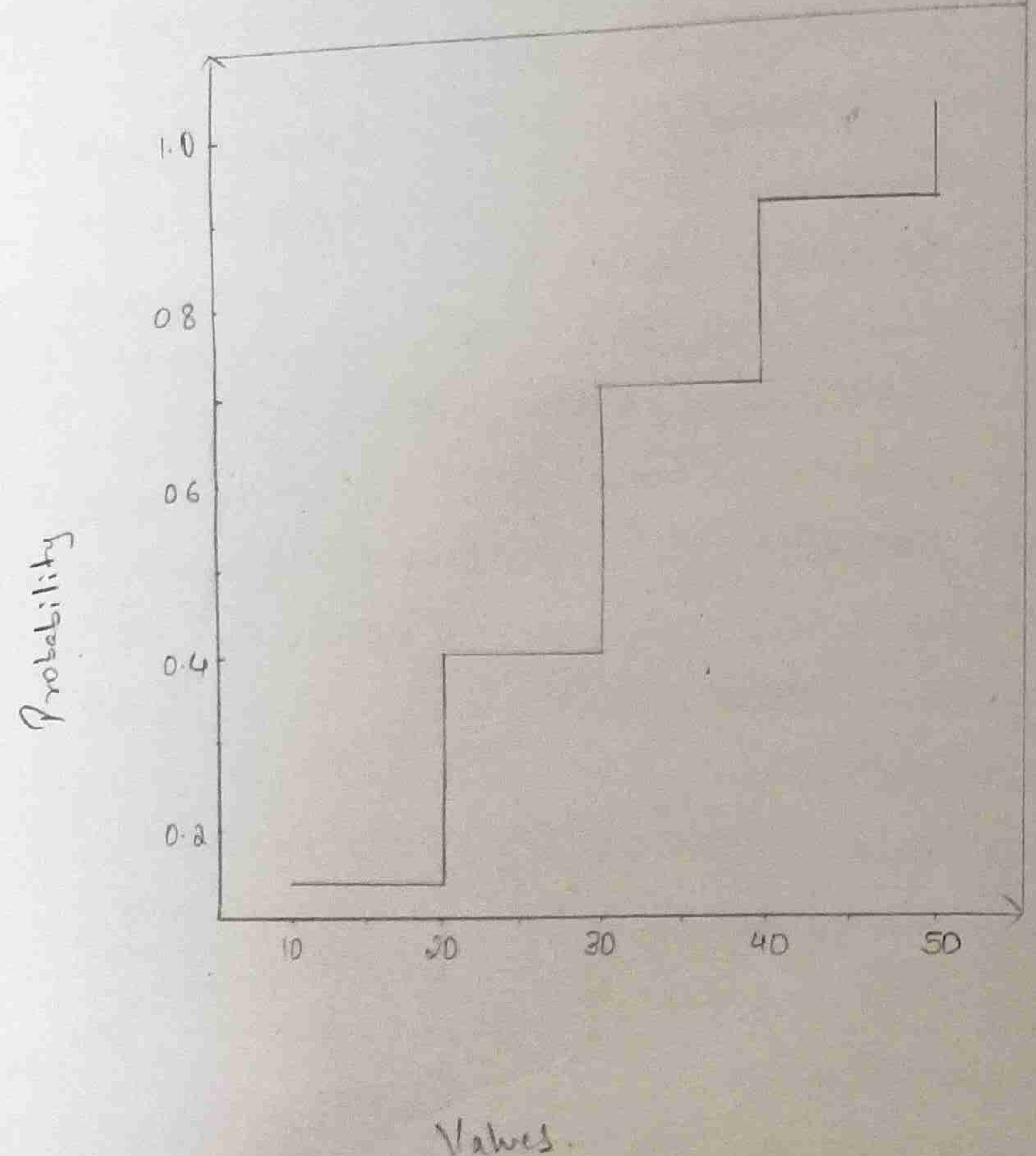
$p(3 < x < 6)$

$= p(4) + p(5)$

$= 0.1 + 0.2$

$= 0.3$

Graph of c.d.f



PRACTICAL NO : 3

Probability Distribution

Find c.d.s of the following p.m.f draw the graph

x	10	20	30	40	50
$p(x)$	0.15	0.25	0.3	0.2	0.1

$f(x) = 0$ if $x < 10$

$= 0.15$ $10 \leq x \leq 20$

$= 0.40$ $20 \leq x < 30$

$= 0.70$ $30 \leq x \leq 40$

$= 0.90$ $40 \leq x < 50$

$= 1.0$ $x \geq 50$

```
> x = c(10, 20, 30, 40, 50)
> prob = c(0.15, 0.25, 0.3, 0.2, 0.1)
> cumsum (prob)
[1]  0.15  0.40  0.70 0.90 1.00
> plot (x, cumsum(prob) , xlab = "Values" , ylab = " probability"
  main = " graph of c.d.f ", "s")
```

Binomial Distribution

Suppose there are 12 mcq's in a test each question has 5 options and only one of them is correct. Find probability of having (i) 5 correct answers (ii) Atmost 4 correct answers.

→ Given that

$n = 12 \quad p = 1/5 \quad q = 4/5$

x = Total no. of correct answer

$x \sim B(n, p)$

$n = 12, p = 1/5, q = 4/5, x = 5$

```
> n= 12 ; p = 1/5 ; q = 4/5 ; x = 5
> sum (n,p,q,x)
[1] 18
> dbinom (5,12,1/5)
[1] 0.05315022
> pbinom (4,12,1/5)
[1] 0.9274445.
```

There are 10 members in a commitee, the probability of any member attending a meeting is 0.9 . Find the probabity

1) 7 members attended.
2) Atleast 5 members attended.
3) Atmost 6 members attended.

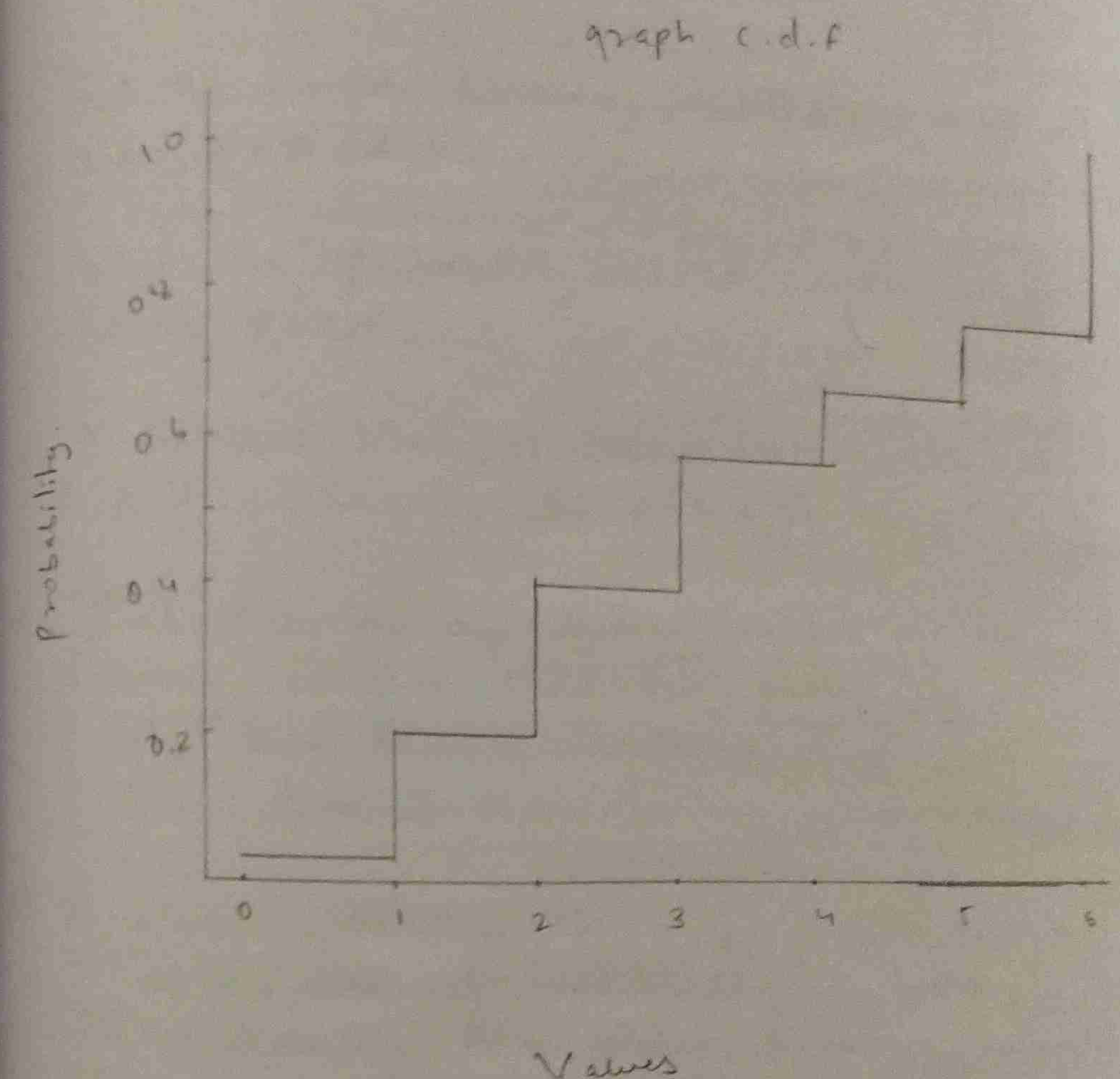
> Given that
$n = 10$, $p = 0.9$ & $q = 0.1$
x = Total no. of member attended
$x \sim B(n, p)$
$n = 10$, $p = 0.9$, $q = 0.1$

```
> n=10, p=0.9, q=0.1
> dbinom (7,10, 0.9)
[1] 0.05739563
>1- pbinom (5,10, 0.9)
[1] 0.9983651
> pbinom (6,10, 0.9)
[1] 0.0127952.
```

4 Find the c.d.f and draw the graph.

x	0	1	2	3	4	5	6
p(x)	0.1	0.1	0.2	0.2	0.1	0.2	0.1

```
> x = c(0,1,2,3,4,5,6)
> prob = c( 0.1, 0.1, 0.2, 0.2, 0.1, 0.2, 0.1)
cumsum(prob)
[1] 0.1 0.2 0.4 0.6 0.7 0.8 1.0
plot(x, cumsum(prob), xlab = " values", ylab = " probability
   main = "graph of c.d.f ", "s")
```

An
1.12.19

Practical no: 4

Binomial Distribution

1) Find the complete binomial distribution when $n = 5$ and $p = 0.1$.

2. Find the probability of 10 success in 100 times where $p = 0.1$

3. x follows binomial distribution with $n = 12$, $p = 0.25$ find (1) $p(x = 5)$ (2) $p(x \leq 5)$, (3) $p(x > 7)$ (4) $p(5 < x < 7)$

4) Probability of a salesman makes a sell to a customer is 0.15 Find the probability.
1) No sale for ~~10~~ customer.
2) More than 3 sales in 20 customer.

5) A student writes 5 mcq's each question has 4 option out of which one is correct. Calculate the probability for atleast 3 correct answer.

6. x follows binomial distribution with $n =$, $p =$
Plot the graph of p.m.f and c.d.f

Note

$p(X=x)$ = dibinom (x, n, p)

$p(x \leq x)$ = pbinom(x, n, p)

$p(x > x)$ = 1 - binom(x, n, p)

To find the value of x for which the probability is given as P_i, command is qbinom.

⇒ qbinom(p_i, n, p)

∝ Answers :-

1. n = 5, p = 0.1

dbinom (0.5, 5, 0.1)

[1] 0.59049 0.32805 0.07290 ~~0.00810~~ 0.00045 0.00

2. x = 10 n = 100 p = 0.1

dbinom (10, 100, 0.1)

[1] 0.1318653

3. n = 12 p = 0.25

1) $p(x=5)$ = ~~dif~~ dbinom (x, n, p)

> dbinom (5, 12, 0.25)

[1]

2) $p = (x \leq 5)$ = pbinom(x, n, p)

> pbinom (5, 12, 0.25)

[1] 0.9455978

p(5 < x < 7) = dbinom(x, n, p)

> dbinom (6, 12, 0.25)

[1] 0.04014945

3) p(x > 7) = 1 - pbinom (x, n, p)

1 - pbinom (7, 12, 0.25)

[1] 0.00278151

4) p = 0.15

1) n = 10, p = 0.15, x = 0

> dbinom (0, 10, 0.15)

[1] 0.1968744

4) p = 0.15, n = 20

p(x > 3) = 1 - p (x < 3)

> 1 - pbinom (3, 20, 0.15)

[1] 0.3522748.

7) n = 5, p = 1/4

p(x ≥ 3)

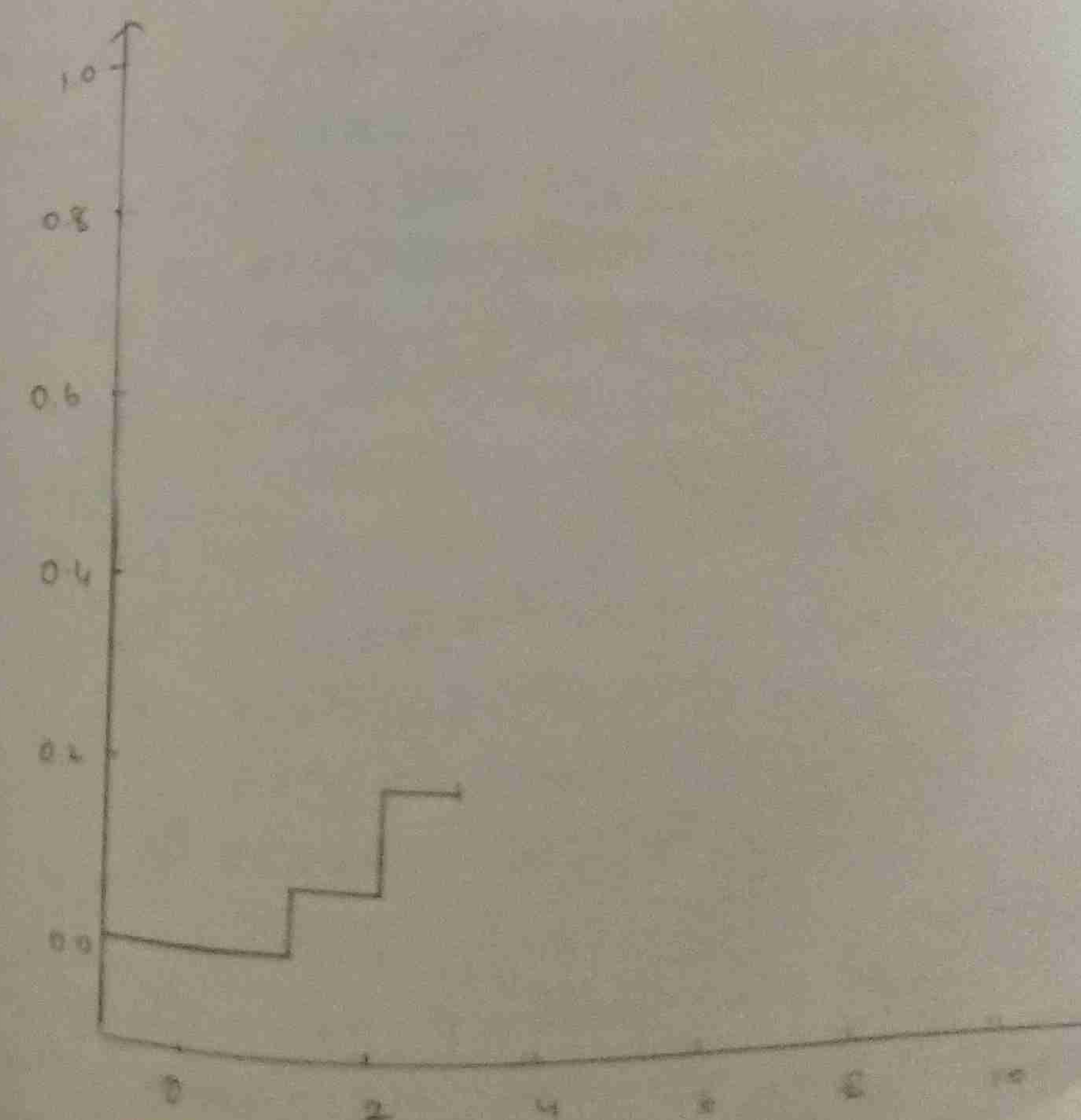
= 1 - p (x ≤ 2)

> 1 - pbinom (3, 5, 1/4)

[1] 0.015625

6. n = 10 , p = 0.4

```
x = 0:n
>prob = dbinom (x,n,p)
>cumprob = pbinom (0:10, 10, 0.4)
>d = data.frame ("x values" = 0:10, "probability" = 0.4)
>print (d)
>plot (0:10, prob, "n")
```



PRACTICAL - 5

Note :-

1. $P[X = x] =$ dnorm (x, μ, σ)
2. $P[X \leq x] =$ pnorm (x, μ, σ)
3. $P[X > x] = 1 -$ pnorm (x, μ, σ)
4. $P[x_1 < X < x_2] =$ pnorm $(x_2, \mu, \sigma) -$ pnorm(x_1, μ, σ)
5. To find the value of K so that
   $P[X \leq k] = p_1$; qnorm (p, μ, σ)
6. Two generation random no. the command is
   rnorm(n, μ, σ)

$X \sim N(\mu = 50, \sigma^2 = 100)$

find (1) $P(X \leq 40)$

(2) $P(X > 55)$

(3) $P(42 \leq X \leq 60)$

(4) $P(X \leq K) = 0.7$, $K = ?$

$X \sim N$

find (1) $P(X \leq 110)$

(2) $P(X \leq 95)$

(3) $P(X > 115)$

(4) $P(95 \leq X \leq 105)$

(5) $P(X \leq K) = 0.4$; $K = ?$

Generate 10 random no.s from a normal distribution with mean $(\mu = 60)$ and S.D (a=5)
Also calculate the sample mean, median, variance and standard deviation

Solution:

1. > a = pnorm (40, 50, 10)

> cat ("P (X <= 40) is = ", a)

[1] 0.1586553

2. > b = 1 - pnorm (35, 50, 10)

[1] 0.3085375

3. > c = pnorm (60, 50, 10) - pnorm (42, 5

[1] 0.6294893

4. > d = qnorm (0.7, 50, 10)

[1] 55.24401

2) 1. > a = pnorm (110, 100, 6)

> a

[1] 0.9522096

> b = pnorm (95, 100, 6)

> b

[1] 0.2023284

```
>c = 1- pnorm(115,100,6)
>c
[1] 0.006209665
>d = pnorm(105,100,6) - pnorm(95,100,6)
>d
[1] 0.5953432
>e = qnorm(0.4,100,6)
>e
[1] 98.47992
>x= rnorm(10,60,5)
>x
[1] 64.30801  56.28556  57.12444  62.66236  57.07212
52.90656  63.04319  59.37558  59.78091  56.48671

>am = mean(x)
>am
[1] 58.30124

>me = median(x)
>me
[1] 58.22385
>n=10
>variance = (n-1)* var(x)/n
[1] 17.05339
>sq = sqrt(variance)
[1] 4.129575
```

4. >x = seq (-3, 3 , by = 0.1)

 >x

 [1] -3.0 -2.9 -2.8 -2.7 -2.6 -2.5 -24 -2.3 -2.2 -2.1

 -2.0 -1.9 -1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1

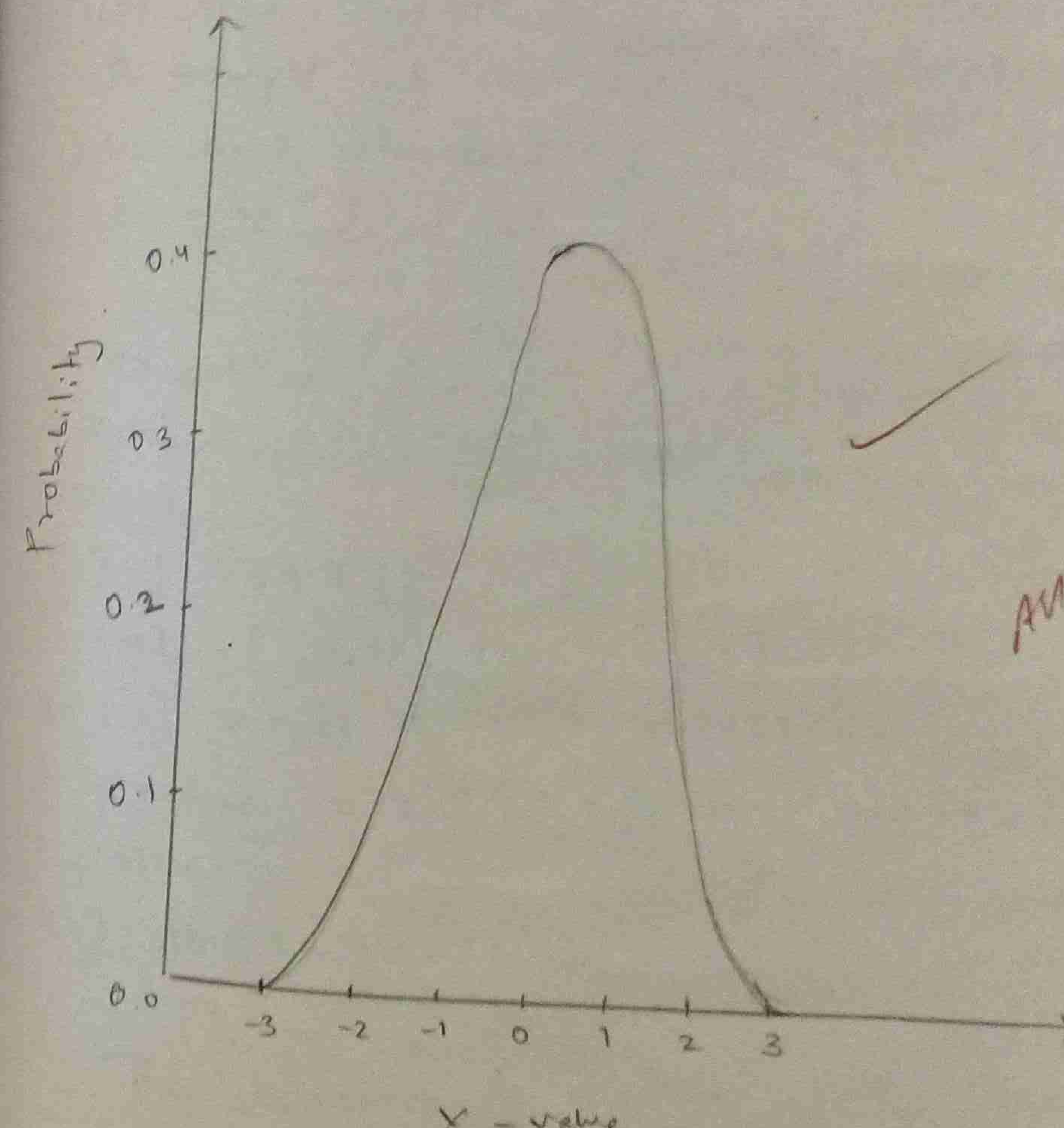
 -1.0 -0.2 -0.3 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9 -1.0

 >y = dnorm (x)

 >y

 >plot (x, y , xlab = "x values", ylab = "probability", main = "standard normal graph")

Standard value graph



AM

Topic - z distribution.

Test the hypothesis (H₀) $H_0: \mu = 10$ against $H_1: \mu \neq 10$. A sample of size 400 is selected which gives the mean 10.2 and standard deviation 2.25. Test the hypothesis at 5% level of significance.

```
> mo = 10 ; mx = 10.2; sd = 2.25 ; n = 400
>zcal = (mx - mo) / (sd / (sqrt (n)))
>zcal
[1] 1.777778
> cat ("zcal is = ", zcal)
> [1] zcal is = 1.777778
> pvalue = 2*(1 - pnorm (abs (zcal)))
> pvalue
[1] 0.07544036
```

∴ The answer is more than 0.05, the value of the H₀ is correct.

Test the hypothesis $H_0: \mu = 75$ against $H_1: \mu \neq 75$. A sample of size 100 is selected ad sample mean is 80 with standard deviation of 3. Test the hypothesis at 5% level of significance.

```
> mo = 75 ; mx = 80 ; sd = 3 ; n = 100
> zcal = (mx - mo) / (sd/ sqrt(n))
> zcal
```

```
[1] 16.66667
> cat ("zcal is =",zcal)
z cal is = 16.66667
> pvalue = 2* (1- pnorm (abs(zcal)))
> pvalue
[1] 0.
```

Since, the value of is less than 0.05, the value of Ho is incorrect.

3) Test the hypothesis Ho: $\mu = 25$ against $H_1 : \mu \neq 25$ at 5% level of significance. Following sample of 30 is selected.

S= 20, 24, 27, 35, 30, 46, 26, 27, 10, 20, 30, 37, 35, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 39, 27, 15, 19, 22, 20, 18.

```
> mx = mean(x)
> mx
[1] 26.06667
> n = length(x)
> n
[1] 30
> variance = (n-1) * var(x) / n
> variance
[1] 52.99556
> sd = sqrt (variance)
> sd
[1] 7.279805
> mo = 25 ; mx = 26.07 ; sd = 7.28 ; n = 30
> zcal = (mx - mo) / (sd / (sqrt (n)))
```

```
> zcal
[1] 0.8050318
> cat ("Zcal is=", zcal)
zcal is = 0.8050318
> pvalue = 2*(1-pnorm(abs(zcal)))
> pvalue
[1] 0.4208013.
```

∴ The value is more than 0.05, the value of Ho is correct.

Experience has shown that 20% students of a college smoke. A sample of 400 students reveal that out of 400 only 50 smoke. Test the hypothesis that the experience gives the correct proportion or not.

```
> P = 0.2
> Q = 1-P
> Q
[1] 0.8
> p = 50/400
> p
[1] 0.125
> n = 400
> zcal = (p-P) / (sqrt(P*Q/n))
> zcal
[1] -3.75
```

∴ The value is less than 0.05, the value of Ho is not accepted.

5] Test the hypothesis $H_0 : P = 0.5$ against $H_1 : P \neq 0.5$
A sample of 200 is selected and the sample proportion is calculated $p = 0.36$. Test the hypothesis at 2% level of significance

```
> P = 0.5
> Q = 1-P
> Q = 0.5
> p = 0.56
> n = 200
> zcal = (p-P) / (sqrt (P*Q /n))
[1] 1.697056
> pvalue = 2 * (1-pnorm (abs (zcal)))
[1] 0.89688
```

∴ The value is more than 0.05, the value of Ho is accepted.

PRACTICAL - 7

Large Sample Test

A study of noise level into hospital is calculated below. Test the hypothesis that the noise level into hospital. Test the hypothesis that the noise level in 2 hospital are same or not.

	Hos A	Hos B
No. of sample obj.s	84	34
Mean	61	59
S.D	7	8

Ho: The noise level are same

$n_1 = 84$

$n_2 = 34$

mx = 61

my = 59

sdx = 7

sdy = 8.

```
> z = (mx - my) / sqrt((sdx^2/n1) + (sdy^2/n2)).
> z
[1] 1.273682
> cat("z calculated is =", z)
z calculated is = z      > pvalue = z*(1 - pnorm (abs(z)))
> pvalue
[1] 0.1291361
```

Since the pvalue is 0.1291361, we reject H0 at 5% level of significance.

2. Two random sample of size 1000 and 2000 are drawn from 2 population with the means 67.5 and 68 resp. and with same S.D of 2.5. Test the hypothesis the mean of 2 population are equal.

Ho : 2 population are equal

n_1 = 1000

n_2 = 2000

mx = 67.5

my = 68

sdx = 2.5

sdy = 2.5

```
> z = (mx-my)/sqrt((sdx^2/n1)+ (sdy^2/n2))
> z
[1] -5.1
> cat ("z calculated is=", z)
z calculated is = z > pvalue = 2 * (1- pnorm (abs(z)))
> pvalue
[1] 2.417
```

Since the pvalue is 2.4, we reject at 5%. level of significance.

In FYBSc 20% of a ~~random~~ ~~sp~~ sample of 400 students had detective eye sight in sy class 15.5% of 500 sample had the same detect is the difference of propostion is same?

Ho = The proportion of population is equal.

```
>n1 = 400
>n2 = 500
>p1 = 0.2
>p2 = 0.155
>p = (n1 * p1 + n2 * p2)/(n1+n2)
>p
[1] 0.175
>q = 1-p
>q
[1] 0.825
>z = (p1-p2)/sqrt(p*q(1/n1+1/n2))
z
[1] 1.76547
>cat ("z calculated is=",z)
z calculated is = 1.76547>pvalue = 2*(1-pnorm(abs(z)))
>pvalue
[1] 0.7748487
```

Since pvalue of 0.7748487, we ~~reject~~ accept Ho at 5% level of significance.

4] From each of the box of the apple an sample size of 200 is collected. It is found that there are 44 bad apple in the 1st sample and 30 bad apple in 2 sample test the hypothesis that the 2 boxes are equivalent in terms of number of bad apple.

Ho = The proportion of boxes is same.

```
> n1 = 200
> n2 = 200
> p1 = 44/200
> p2 = 30/200
> p1 = 0.22
> p2 = 0.15
>p = (n1* p1 + n2 * p2)/(n1+n2)
[1] 0.185
> q = 1-p
> q
[1] 0.815
>z = (p1 - p2)/sqrt (p*q*(1/n1+1/n2))
> z
[1] 1.802741
> cat ("z calculated is =", z)
z calculated is = 1.802741 > pvalue = 2*(1-pnorm(abs(z
> pvalue
[1] 0.714 288...
```

since pvalue is 0.714, we ~~reject~~ accept at 5% of level of significance.

In a MA class out of the sample of 60 mean height is 63.5 inch with a SD 2.5. In an M.com class out of 50 student mean height 69.5 inch with SD of 2.5. Test the hypothesis that the mean of MA & M.com class are same.

H0 = Mean height of MA and Mean students are equal

```
> n1 = 60
> n2 = 50
> mx = 63.5
> my = 69.5
> sdx = 2.5
> sdy = 2.5
> z = (mx - my) / sqrt((sdx^2/n1) + (sdy^2/n2))
> z
[1] -12.5335
cat ("z calculed is =", z)
> pvalue = 2* (1-pnorm(abs(z)))
> pvalue
> [1] 0.0956 0026
```

Since, pvalue is 0.09, we reject 1.5 level of significance.

AM
5.2.20

PRACTICAL - 8.

Small Sample Test

Q.I. The tons are selected & height are found to be 63, 63, 68, 69, 71, 71, 72 cms. Test hypothesis that mean height x are 66 cm or not at 1.

h0 = Mean = 66 cms.

```
> mean = 66
> x = c(63, 63, 68, 69, 71, 71, 72)
> t.test (x)
    One Sample t-test
data : x
t = 47.94, df = 6, Pvalue = 5.22e-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
```

∴ pvalue < 0.01 is rejected on h0 in 1% level of significance.

Q.2] Two random sample was drawn from two different population.

Sample 1 : 8, 10, 12, 11, 16, 15, 18, 7.

Sample 2 = 20, 15, 16, 9, 8, 10, 11, 12.

Test the hypothesis that there is no difference between the population mean at 5% los.

H0 there is no difference in the population mean

```
> y = c( ... , 10, 11, 14)
> t.test (x, y)
  welch Two-Sample Test
data : x & y
t = -0.36247 , df = 13.837 , P value = 0.7225.
alternative hypothesis : true difference in mean is not equal
-5.192719      3.692719.
 Sample estimates
 mean of x    mean of y
   12.125       12.875
```


p.value < 0.01 is accepted in H0 on 1% level of signi

Q.3] following are the weights of 10 people

Before = (100, 125, 95, 96, 98, 102, 115, 104, 109, 110)

After = (95, 80, 95, 98, 90, 100, 110, 85, 100, 101)

H0. The Diet Program is not effective

```
> x = c(100, 125, 95, 96, 98, 102, 115, 104, 109, 110)
> y = c(95, 80, 95, 98, 90, 100, 110, 85, 100, 101)
> t.test (x, y, Paired = T, alternative = "less")
  Paired t test
data : x and y
t = 2.3215 , df = 9 , P value = 0.9773
Alternative hypothesis : True difference in means is less than
0 , 95% confidence ~~tooth~~ interval.
```

-Inf 17.89635

Sample estimates -

Mean of the differences 10

4) Marks before and after a training program is given below:-

Before = 20, 25, 32, 28, 27, 36, 35, 25

After = 30, 35, 32, 37, 37, 40, 40, 23

Test the hypothesis that training program is effective or not.

Ho: The training program is not effective.

```
> x = c(20,25,32,28,27,36,35,25)
> y = c(30,35,32,37,37,40,40,23)
> t.test(x,y, paired = T, alternative = "greater")
```

Paired t-test

Data : x and y

t = -3.3859, df = 7, p-value = 0.9942.

Alternative hypothesis : True difference in means is greater than 95 percent confidence interval.

-8.967399 Inf

Sample estimates

Mean of the difference -5.75

5) Two random sample were drawn from ~~two~~ normal population the values are:

A = 66, 67, 75, 76, 82, 84, 88, 90, 92

B = 64, 66, 74, 78, 82, 85, 87, 92, 93, 95, 97

Test whether the population have same variance at 5% level of significance.

Ho = variance of the population are equal.

```
> x = c(66, 67, 75, 76, 82, 84, 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 variances.

Data : x and y

F = 0.70686, num df = 8, denom df = 10, p-value = 0.6359

Alternative hypothesis : True ratio of variances is not equal to 1 95 percent confidence interval.

6.1833662 3.0360393

Sample estimates :

Ratio of variance 0.7068567

6) The A.P of sample 100 observations is 52 if S.D is 7 test the hypothesis that the population mean 55 or not at 5% of level of significance.

Ho = Population mean = 55

```
> n = 100
> mx = 52
> mo = 55
> sd = 7
> zcal = (mx - mo) / (sd / sqrt(n))
> pvalue = 2*(1 - pnorm(abs(zcal)))
> pvalue
[1] 1.82153e-0.5
```

17

PRACTICAL - 9

Chi ~~Sq~~ Square & ANOVA

Use the following data to test whether the of the name depend upon the child condition or not.

Condition of home

		clean	dirty
lead of child	clean	70	50
	fairly dirty	80	20
	dirty	35	45

> Ho condition of the name and child are independent

> x = c(70, 80, 35, 50, 20, 45

> m = 3

> n = 2

> y = matrix (x, nrow = n, ncol = n)

	[, 1]	[, 2]
[1,]	70	50
[2,]	80	20
[3,]	35	45

> pvalue = chisq.test (y)

> p value.

Pearson's chi - squared test

data = y

x = squared - 25.646, df : 2, pvalue = 2.698 e - 0.6

Pvalue is less than 0.05 we reject Ho at 5% LOS.

Table below shows the relation between the performances of mathematics and computer of CS students.

Maths

comp	Hy	My	Ly
Hy	56	71	12
My	47	163	38
Ly	14	46	85

H0: performance between maths and computer are independent

```
x = c(56, 47, 14, 71, 163, 42, 12, 38, 85)
m = 3
n = 3
y = matrix(x, nrow = m, ncol = n).
```

	[,1]	[,2]	[,3]
[1,]	56	71	12
[2,]	47	163	38
[3,]	14	42	85

```
> Pvalue = chisq.test(y)
> Pvalue
data y
X-squared = 145.75, df = 4, p.value < 2.2e-16.
```

Varieties Observations

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

Mean 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))
> oneway, test (values ~ ind, data = d, var equal = T)
anova = aov (values ~ ind, data = d)
F = 11.735, num df = 3, denom df = 9, p-value = 0.00115
summary (anova).
```

Accepted.

PRACTICAL - 10

Non- Parametric Test

Following are the amount of sulphur oxide.

Data :-

17, 15, 20, 29, 19, 18, 22, 25, 27, 9, 24, 20, 17, 6, 24, 14, 15, 23, 24, 26.

Apply sign test to test the hypothesis that population median is 21.5 against the alternative it is less than 21.5.

H_0 : population median = 21.5

H_1 : It is less than 21.5.

```
> x = c(17, 15, 20, 29, 19, 18, 22, 25, 27, 9, 24, 20, 17, 6, 24, 14
15, 23, 24, 26)
>x
> m = 21.5
> sp = length(x[x>m])
>sn = length(x[x<m])
>n = sp + sn
>n
[1] 20
>pv = pbinom(sp, n, 0.5)
>pv
[1] 0.411
```

NOTE : If the alternative is greater than median,

pv = pbinom(sn, n, 0.5).

25

2] For the observations
12, 19, 31, 28, 45, 40, 55, 49, 70, 63
Apply sign test to test population median is 25 against the alternative is more than 25.

```
> x = c(12, 19, 31, 28, 43, 40, 55, 49, 70, 63)
> m = 25
> sp = length (x[x>m])
> sn = length (x[x<m])
> n = sp + sn
> pv = pbinom (sn, n, 0.5)
> pv
[1] 0.054
```

3] 60, 65, 63, 89, 61, 71, 56, 51, 48, 66
Test the hypothesis using wilcoson sign test.
For testing the hypothesis that the median is 60 against the alternative it is greater than 60.

H_0 : Median is 60.
H_1 : Median is greater than 60.

```
> x = c(60, 65, 63, 89, 61, 71, 58, 51, 48, 66)
> m = 60
> sp = length (x [x>m])
> sn = length (x [x<m])
> n = sp + sn
> pv = pbinom (sn, n, 0.5)
[1]
```

> wilcox. test (x, alter = "greater", mv = 60)
V = 29 , p-value = 0.2386.
alternative hypothesis : true location is greater than 60.

If the alternative is less,
wilcox. test (x, alter = "less", mu = - -)

If the alternative is not equal to
wilcox - test (x, alter = "2.sided", mu =)

Using wilcoxon test, test the hypothesis where the median is 12 against the alternative is less than 12.

Data :
12, 13, 10, 20, 15, 5, 1, 7, 6, 11, 9, 20)

> x = c(12, 13, 10, 20, 15, 5, 1, 7, 6, 11, 9, 20)
> m = 12
> sp = length (x[x > m])
> sn = length (x[x < m])
> n = sn + sp
> pv = pbinom(sn, n, 0.5)
> pv
[1]
> wilcox. test (x, alter = "less", mu = 12)
V = 25, p-value = 0.775
Alternative hypothesis : true location is greater than 12.

AA
1.3