cat ("P(x>14) = ", P1)
P(x>14) is 0.2524925
> P1 = rnorm (5, 10, 2)
> P1
[1] 10.264723 [illegible] [illegible] [illegible] 12.2[illegible]

a) X follows normal distribution with $\mu = 10$, $\sigma = 2$
find i) $P(X \le 7)$ ii) $P(8 < X < 12)$ iii) $P(X > 12)$
iv) Generate 10 observation v) Find k such that $P(X < k) = 0.4$

Code

```
> a1 = pnorm (7, 10, 2)
> a1
[1] 0.66807[illegible]
> a2 = pnorm (8, 10, 2) - pnorm (12, 10, 2)
> a2
[1] 0.626135
> a4 = rnorm(10, 10, 2)
> a4
[1]  9.608931   9.120417   12.63774
     8.72138    9.173726   9.366824
     9.53758    10.71960
> a5 = qnorm (0.4, 10, 2)
> a5
[1] 9.4932106
```

Q) Generate 5 random numbers from a normal distribution $\mu = 10$, $\sigma = 4$. Find sample Mean, Median, S.D. and Print it.

Code

```
> x = rnorm (5, 10, 4)
[1] 10.7649   7.7922   9.9834
    17.5096   13.340
> am = mean (x)
> am
[1] 11.8724
> cat (" Sample mean is ", am)
Sample mean is 11.8724
> me = median(x)
> me
[1] 10.7649
> 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] 3.3316
> cat ("SD is ", SD)
SD is 3.23417
```

Practical 9

Topic: Non Parametric Testing of Hypothesis using R-Environment

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

Data: 1.68, 3.35, 2.50, 6.23, 3.24

```
> x <- c(1.68,3.35,1.5,6.23,3.24)
> 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-value [illegible]

alternative hypothesis: true possibility of success is greater than 0.5;

95 percent confidence interval:

0.01020622 1.000

Sample estimates:

Probability of success

0.2

1) The scores of 8 student in reading before and after teaching are as follows. Test whether there is effect of reading.

Student No:	1	2	3	4	5	6	7	8
Score before:	10	15	12	13	[illegible]	[illegible]	[illegible]	13
Score after:	12	14	15	13	[illegible]	[illegible]	[illegible]	10

Code:

```
> b <- c(10,15,12,13,[illegible]);
> a <- c(12,14,15,13,[illegible]);
> D = b - a
> wilcox.test(D,alternative="greater")
```

Wilcoxon signed rank test with continuity correct data: D

V = 10.5, p-value = 0.8[illegible]

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.

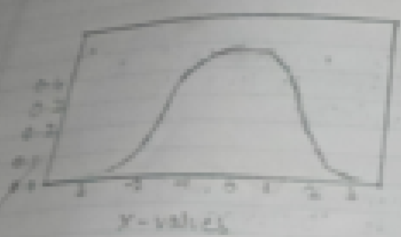
2)

Inspection:	1	2	3	4	5
Caliper 1	0.265	0.268	0.266	0.260	0.269
Caliper 2	0.263	0.262	0.270	0.261	0.261

Q.4) Plot the standard normal graph.

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

Standard Normal Graph



Practical-5

Topic: Normal and t-test

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

Test the hypothesis.

Random sample of size 400 is drawn and it is calculated. The sample mean is 14 and S.D. is 3 test the hypothesis at 5% level of significance.

0.05 > accept the values.
0.05 less than reject.

```
> m0 = 15
> mx = 14
> n = 400
> sd = 3
> zcal = (mx - m0) / (sd / (sqrt(n)))
> zcal
> cat("Calculated value of z is -", zcal)
Calculated value of z is = -6.666
> pvalue = 2 * (1 - pnorm(abs(zcal)))
> pvalue
[1] 2.616796e-11
```

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

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

A	B	
		32.4
13.3	18.7	41.2
15.4	10.8	35.1
10.2	15	25.0
8.0	12.3	8.2
14.6	8.2	18.4
	9.4	32.5
	24.3	

Code:

```
> x <- c(13.3, 15.4, 10.2, 8.0, 14.6);
```



```
> n1 <- length(y)
> n1
[1] 5
> y <- c(18.7, 10.8, 15.0, 12.3, 8.2, 9.4, 24.3)
> 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)
> y <- c(rep(1, n1), rep(2, n2), rep(3, n3))
> kruskal.test(x, y)
        Kruskal-Wallis rank sum test
data: x and y
        Kruskal-Wallis chi-squared = 5.217, df = 2,
        p-value = 0.07366
```

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

❀ Practical 1 ❀

* Basic of R software

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

2) It is an effective for statistical data handling and outcome; storage is possible.

3) It is a free software.

Q.1) Solve

1) 4+6+8÷2-5
> 4+6+8/2-5
[1] 9

2) $2^2 + |-3| + \sqrt{66}$
> 2^2 + abs(-3) + sqrt(66)
[1] 15.1240

3) $5^3 + 7 \times 5 \times 8 + 46/6$
> 5^3 + 7*5*8 + 46/6
[1] 414.7

4) $\sqrt{4^2 + 5 \times 3 + 7/6}$
> sqrt(4^2 + 5*3 + 7/6)
[1] 5.671567

5) round off
46÷7+9×8
> round(46/7+9*8)
[1] 79

Q.2) > c(2,3,5,7)*2
[1] 4 6 10 14

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

> c(2,3,5,7)*c(2,3,6,2)
[1] 4 9 30 14

> c(6,2,7,5)/c(4,5)
[1] 1.5 0.4 1.75 1.00

> c(2,3,5,7)*c(2,3,6,2)
[1] 4 9 30 14

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

> c(2,4,8,3)^c(2,3,2,3)
[1] 4 64 64 27

Q.3) > x=20 > y=30 > z=2
> x^2 + y^3 + z
[1] 27402
> sqrt(x^2 + y)
[1] 20.7364
> x^2 + y^2
[1] 1300

Q.4) > x <- Matrix(nrow=4, ncol=2, data=c(1,2,3,4,5,6,7,8))

5) Last year farmer's lost 20% of their crops. A random sample of 60 fields are collected and it found that 9 field crops are insect polluted. Test the hypothesis at 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.

6) Test the hypothesis H0: μ=12.5 from the following sample at 5% level of significance.

```
>x=c(12.25,11.97,12.15,12.08,12.31,12.28,11.94,11.79,
     12.26,12.04)
>n=length(x)
>n
[1]10
```

15

```
>mx=mean(x)
>mx
[1] 12.107
>variance=(n-1)*var(x)/n
>variance
[1] 0.014521
>sd=sqrt(variance)
>sd
[1] 0.1249776
>mo=12.5
>t=(mx-mo)/(sd/sqrt(n))
>t
[1] -8.894908
>pvalue=2*(1-pnorm(abs(t)))
>pvalue
[1] 0
```

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

Practical- 10

Aim: Chi square tests & ANOVA (Analysis of variance)

Q.1] 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	80
Fairly clean	80	20
Dirty	35	45

H0: Condition of Home & Child are independent

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



```
> pearson.chisq.test(y)
> N
```

Pearson's Chi-squared test

data: Y
x-squared = 20.646
df = 2
p-value = 2.0986e-06
They are dependent

Q.2] Perform a ANOVA for the following data

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

H0: 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)
```

```
> x         [,1]    [,2]
[1,]         1       5
[2,]         2       6
[3,]         3       7
[4,]         4       8
```

(3) Q x+y and 2x+3y where x = [4 -2 6 ; 7 8 7 ; 9 6 3]
y = [10 -5 7 ; 12 -4 9 ; 15 6 5]

```
> x <- Matrix(nrow=3, ncol=3, data=c(4,7,9,-2,8,-6,6,7,3))
> x     [,1]    [,2]    [,3]
[1,]     4       -2      6
[2,]     7       8       7
[3,]     9       6       3

> 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      -12     8
```

(4) Marks of statistics of CS Batch B

```
x = c(49, 20, 36, 34, 46, 56, 55, 45, 32, 23, 41, 58,
      54, 45, 50, 32, 36, 39, 35, 34)

> x = c(data)
> breaks = seq(20,60,5)
> a = cut(x, breaks, right=FALSE)
> b = table(a)
> c = transform(b)
> c
        a          Freq
1    [20,25)        1
2    [25,30)        2
3    [30,35)        4
4    [35,40)        4
5    [40,45)        1
6    [45,50)        3
7    [50,55)        2
8    [55,60)        4
```

Practical 6

* Aim: Large sample test

1. Let the populatn 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.

Ans →
```
> mo = 250
> mx = 275
> sd = 30
> n = 100
> zcal = (mx - mo)/(sd/(sqrt(n)))
> cat ("calculated value of z is =", zcal)
[1] Calculated value of z is = 8.333
> Pvalue = 2 * (1 - pnorm(abs[zcal]))
> Pvalue
[1] 0
```
∴ The values is less than 0.05 we will get the value of $H_0 = \mu = 250$.

2] In a random sample of 1000 students it is found that 950 use blue pens then test the hypothesis that the populatn proportion is 0.8 at 1% level of significance.

```
> mo = 250
> mx = 275
> sd = 30
> n = 100
> zcal = (mx - mo)/(sd/sqrt(n))
> cat ("calculated value of z is", zcal)
> pvalue = 2 * (1 - pnorm(abs(zcal)))
[1] 0
```
∴ The value is less than 0.05 we will reject the value of $H_0 = \mu = 250$

3) Two random value of size 1000 & 2000 are drawn from two populatn with same SD 2.5 the sample means are 67.5.

4) A study of noise level in 2 hospital is given by below test then 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

```
3] > 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))
```

* F = 11.730 , df = 3 , denom df = 9 ,
p-value = 0.00188

* p-value is less than 0.05 we reject the hypothesis

> anova (lm(values ~ ind, data = d))
summary (anova)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ind	3	77.08	25.68	11.73	0.00188
Residuals	9	19.17	2.19		

signif codes 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Q.3)

Type	LFC
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

H0: 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"
> oneway.test(values ~ ind, data = d, var.equal = T)
```

F = 6.545, num df = [illegible], denom df = 20
p-value = 0.00[illegible]

```
> anova (lm(values ~ ind, data = d))
> summary (anova)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ind	3	91.449	30.483	6.545	0.00284
Residual	20	93.06	4.653		

Practical - 2

TOPIC: Probability distribution.

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

x	p(x)
0	0.1
1	0.2
2	-0.6
3	0.4
4	0.2
5	0.6

If the given data is p.m.f then $\sum P(x) = 1$

$\therefore P(0) + P(1) + P(2) + P(3) + P(4) + P(5) = P(x)$
$= 0.1 + 0.2 - 0.6 + 0.4 + 0.2 + 0.6$
$= 1.0$

$\because P(2) = -0.6$, it can't be a probability mass function
$\because P(x) \geq 0 \;\forall x$

2)

x	P(x)
1	0.2
2	0.1
3	0.2
4	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 $\sum p(x) \neq 1$.

3)

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

The condition for p.m.f is
i) $p(x) \geq 0 \;\forall x$ satisfy
ii) $\sum P(x) = 1$

$\sum P(x) = P(10) + P(20) + P(30) + P(40) + P(50)$
$= 0.2 + 0.2 + 0.35 + 0.15 + 0.1$
$= 1$

$\therefore$ P.M.F.

* Code:

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

```
>zcal
[1] -5.163579
>pvalue = 2*(1-pnorm(abs(zcal)))
>pvalue
[1] 2.417954e-07 .. (Rejected)
```

3.

```
>n1 = 64
>n2 = 36
>mx1 = 61.2
>mx2 = 59.4
>sd1 = 7.9
>sd2 = 7.6
>zcal = (mx1-mx2)/sqrt((sd1^2/n1)+(sd2^2/n2))
>zcal
[1] 1.1625
>pvalue
>pvalue
[1] 0.2450211
```

∴ The value is greater than 0.01 we accept the value.

4) $H_0: P_1 = P_2$ 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] 0.2450211
```

∴ The value is greater than 0.01 we accept the value.

5) $H_0: P_1 = P_2$ as $H_1: P_1 \neq P_2$

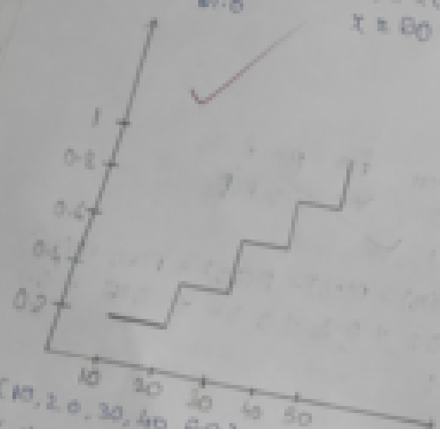
```
>n1 = 200
>n2 = 200
>P1 = 44/200
>P2 = 30/200
>P = (n1*P1 + n2*P2)/(n1+n2)
>P
[1] 0.185
>q = 1-P
>q
[1] 0.815
>zcal = (P1-P2)/sqrt(P*q*(1/n1 + 1/n2))
>zcal
[1] 1.8072
>pvalue = 2*(1-pnorm(abs(zcal)))
>pvalue
[1] 0.0714288
```

∴ (Accept ∵ greater than 0.05)

Q) Find the c.d.f for the following 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 ≤ x < 20
0.4   20 ≤ x < 30
0.75   30 ≤ x < 40
0.9   40 ≤ x < 50
1.0   x ≥ 50




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


Q) 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   x < 1
0.15   1 ≤ x < 2
0.4   2 ≤ x < 3
0.5   3 ≤ x < 4
0.7   4 ≤ x < 5
0.9   5 ≤ x < 6
1.0   x ≥ 6

```
> prob = c(0.15, 0.25, 0.1, 0.2, 0.2, 0.1)
> sum(prob)
[1] 2
> cumsum(prob)
[1] 0.15, 0.4, 0.5, 0.7, 0.9, 1.0
> x = c(1, 2, 3, 4, 5, 6)
> plot (x, cumsum(prob), "s", xlab = "value",
      ylab = "cumulative probability")
```

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Practical 7

Topic: Small sample Test

1. 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.

→ H0: μ = 66

x = c(63, 63, 66, 67, 68, 69, 70, 71, 72)
t-test (x)

t = 68.319 , df = 9, pvalue = 1.958e-13
True mean ≠ 0
95 % confidence interval
65.7711 70.1429
sample estimate
mean of x
67.9

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

2]

→ Ho

> x = c(18, 22, 21, 17, 20, 217, 23, 20, 22, 21)
y = c(16, 20, 14, 21, 20, 15, 13, 15, 17, 21)

11

t-test (x, y)
t = 2.2672, df = 16.376, pvalue = 0.0279
True difference in means ≠ 0 95%
confidence interval:
0.1628206 8.0371794
sample estimate:
Mean of x mean of y
20.1 17.5

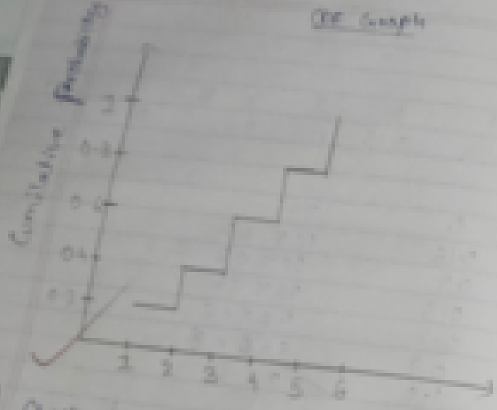
∴ p-value = 0.2798
∴ if (pvalue > 0.05) { cat ("accept") }
else { cat ("reject") }
reject

(Paired T-test)

3) x / c(Before)
y
x = c(83, 28, 31, 48, 50, 42)
y = c(58, 27, 20, 55, 56, 40)
t.test(x, y, paired = T, alternative = "greater")
t = -2.7815 , df = 5 , pvalue = 0.9806
True difference > 0
95% confidence interval :
-6.036047 inf
sample estimate
mean of the difference
-3.5

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

CDF Graph



Q.2) Check that whether the following is p.d.f or not.

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

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

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

$= \int_0^1 f(x)$

$= \int_0^1 3x^2$

$= 3\int_0^1 x^2$

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

$= x^3$

$= 1$

The $\int_0^1 f(x) = 1$ $\therefore$ It is a p.d.f.

1) > x = dbinom (10, 100, 0.1)

> x

[1] 0.1318653

2 > dbinom (4, 12, 0.2)

[1] 0.1328756

ii) pbinom (4, 12, 0.2)

[1] 0.927445

Q x=c(100,105, 98, 130, 122, 117)
> y=c(108, 95, 98, 90, 116, 99)
> t.test(x,y, paired=T, alternative="less")
Paired t-test
t=1.1455, df=5, pvalue=0.7468
95% confidence interval:
-inf 29.02795
Mean of differences
14.5233

∴ p-value is greater than 0.05 we accept the hypothesis at 5% level of significance.

Q 2 medicines are applied to two group of patient respectively.
gr1: 10, 12, 13, 11, 14
gr2: 8, 9, 12, 14, 15, 10, 9
Is there any significance difference b/w 2 medicines
H_0: There is no significance difference

> x=c(gr1)
> y=c(gr2)
> t.test(x,y)
data x & y
t=0.80284 & df 7.7594, pvalue=0.4406
The difference in means ≠ 0

95% confidence interval:
-0.9683563 4.2281886
Sample estimates:
mean of x mean of y
12.000 10.833

∴ p-value is greater than 0.05 we accept the hypothesis at 5% level of significance.

d) 1 - pbinom (3, 9, 0.5)
[1] [illegible]
e) dbinom (0:5, 5, 0.3)
[illegible]

a) dbinom(2,12,0.25)
[1] [illegible]
b) pbinom(3,12,0.25)
[1] 0.9455
c) 1- pbinom(7,12,0.25)
[1] 0.0027
d) dbinom(5,12,0.24)
[1] 0.0401948

PRACTICAL-3

TOPIC :- Binomial Distribution.

- $P(X = x) =$ dbinom (x, n, p)
- $P(X \le x) =$ pbinom (x, n, p)
- $P(X \ge x) =$ 1- pbinom (x, n, p)
- If x is unknown
  $P_1 = P(X \le x) =$ qbinom (P_1, n, p)

a)
```
>dbinom(0,10,0.15)
[1] 0.19[illegible]
```

```
> 1- pbinom (3,20,0.15)
[1] 0.35227648
```

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

e)
```
>n = 10
>p = 0.3
>x = 0:n
>prob = dbinom (x,n,p)
>cumprob = pbinom(x,n,p)
>d = data.frame ("x values ", =x, "Probability" =prob)
>print (d)
```

Practical 8

Topic: Large and small test.

① H_0: μ=[illegible] , H_1: $\mu \neq$ [illegible]

```
> n=100
> mx=62
> m0=50
> sd=7
> zcal= (mx-m0)/(sd/(sqrt(n)))
> zcal
[1] -1.02574
> pvalue = 2*(1-pnorm(abs(zcal)))
> pvalue
[1] 1.83 e-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≠0.5

```
> P=0.5
> q=1-P
> n=100
> 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 H_0 at 5% level of significance.

① H_0: $P_1 = P_2$ against H_1: $P_1 \neq P_2$

```
> n1=1000
> n2=1000
> p1= [illegible]/1000
> p2= [illegible]
> p= (n1*p1+n2*p2)/(n1+n2)
> p
[1] 0.0[illegible]
> zcal= (p1-p2)/sqrt(p*q*(1/n1 + 1/n2))
> zcal
[1] 0.9[illegible]
> pvalue= 2*
> pvalue
[1] 0.34[illegible]
```

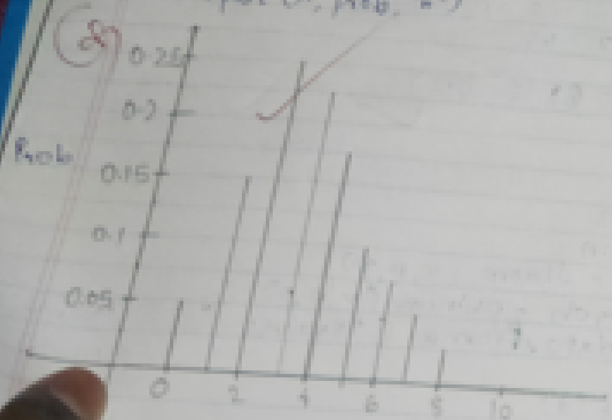
∵ p-value is greater than 0.05 we accept H_0 at 5% level of significance

③ H_0 : μ=100 against H_1 : $\mu \neq$ 100

```
> var = 64
> n=400
> m0=100
> mx=99
> sd =sqrt(var)
> sd
[1] 8
> zcal = (mx -m0)/(sd /(sqrt(n)))
> zcal
[1] 2.5
```

x values	Probability
0	0.028
1	0.121
2	0.233
3	0.266
4	0.200
5	0.103
6	0.107
7	0.084
8	0.01
9	0.0001
10	0.0000

```
>plot (x, prob, "h")
```



Practical 4

Aim: Normal Distribution

i] P(X = x) = dnorm (x, μ, σ)
ii] P (X ≤ x) = pnorm (x, μ, σ)
iii] P(X > x) = 1 - pnorm (x, μ, σ)
iv] To generate random numbers from a normal distribution (x = rnorm, n

Q.1] A random variable X follows normal distribution with mean = μ = 12 and S.D = σ = 3
Find 1. P(X ≤ 15) ii] P(10 < X ≤ 13) iii] P(X > 14)
iv] Generate 5 observations (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
```

```
> pvalue = 2* (1-pnorm(abs(z cal)))
> p value
[1] 0.002 4923
```

∵ p-value is less than 0.05 we reject H_0 at 5% level of significance.

③ $H_0: \mu = 66$ 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 = 43.94, df = 6, p-value = 5.522e-09
alternative hypothesis: true mean is not equal to 0
   95% 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.

④ $H_0: \mu = 1150$ against $H_1: \mu \neq 1150$


```
> n = 100
> mu = 1150
> m = 1200
> sd = 125
> z cal = (m - mu) / (sd / sqrt (n))
> z cal
[1] 4
> pvalue = 2* (1-pnorm (abs(z cal)))
[1] 6.334248e-05
```

∵ p-value is less than 0.05 we reject H_0.

⑤ $H_0: P_1 = P_2$ against $H_1: P_1 \neq P_2$

```
> 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(z cal)))
> pvalue
[1] 0.3613504
```