Practical 01

* Basics of R-software

R is a software for data analysis of statistical computing. Thus software is used for effective data handling & output storage is possible.
It is capable of graphical display.
It is a free software

1) $2^2 + \sqrt{25} + 35$

→ 2^2 + sqrt(25) + 35

= 44

2) $2 \times 5 \times 3 + 62 \div 5 + \sqrt{49}$

→ 2*5*3 + 62/5 + sqrt(49)

= 49.4.

3) $\sqrt{76 + 4 \times 2 + 9 \div 5}$

→ sqrt(76 + 4*2 + 9/5)

= 9.262829.

4) $42 + |-10| + 7^2 + 3 \times 9$

→ 42 + abs(-10) + 7^2 + 3*9

= 128.

Q. $x = 20$; $y = 30$

find, $x+y$; x^2+y^2 ; $\sqrt{y^3-x^3}$; abs(x−y)

i) $x+y$

= 50.

ii) x^2+y^2

→ x^2 + y^2

= 1300.

iii) $\sqrt{y^3-x^3}$

→ y^3 − x^3

= 137.8405

iv) abs(x − y)

= 10.

Q. calculate the following.

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

→ 4 9 16 25.

2) c(4,5,6,8) * 3

→ 12 15 18 24.

3) c(2,3,5,7) * c(-2,-3,-5,-4)

→ -4 -9 -25 -28.

4) c(2,3,5,7) * c(8,9)

→ 16 27 40 63

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

→ 1 8 9 64 25 216.

2) Find the sum, prod, min, max of the given value
5, 8, 6, 7, 9, 10, 15, 5.

→ x = c(5, 8, 6, 7, 9, 10, 15, 5)

length(x)
= 8

sum(x)
= 65

max(x)
= 15

min(x)
= 5.

prod(x)
= 11340000.

Matrix calculation.

1) $\begin{bmatrix} 1 & 5 \\ 2 & 6 \\ 3 & 7 \\ 4 & 8 \end{bmatrix}$.

→ X ← matrix (nrow = 4, ncol = 2, data = c(1,2,3,4,5,6,7,8))

2) $X' = \begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix}$ $Y = \begin{bmatrix} 2 & 4 & 10 \\ -2 & 8 & -11 \\ 10 & 6 & 12 \end{bmatrix}$

Find $x + y$; $x * y$, $2x + 3y$

X ← matrix (nrow = 3, ncol = 3, data = c(1, 2, 3, 4, 5, 6, 7, 8, 9))

Y ← matrix (nrow = 3, ncol = 3, data = c(2, -2, 10, 4, 8, 6, 10, -11, 12))

6.2

i) $X + Y$

$$\begin{bmatrix} 3 & 8 & 17 \\ 0 & 15 & 3 \\ 18 & 12 & 21 \end{bmatrix}$$

ii) $X * Y$

$$\begin{bmatrix} 0 & 92 & 70 \\ 4 & 40 & 33 \\ 80 & 86 & 108 \end{bmatrix}$$

iii) $2 * X + 3 * Y$

$$\begin{bmatrix} 9 & 30 & 44 \\ -3 & 84 & 17 \\ 86 & 50 & 64 \end{bmatrix}$$

6 Perform the following.

```
y = c(2,4,6,1,3,5,7,18,15,14,17,10,3,3,2,5,10,15,9,
      14,18,10,12)
→ length(y)
  23
a = table(y)
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)
b = cut(x, breaks, light = FALSE)
c = tabl(b)
transform(c)
```

b	Freq
[0,5)	8
[5,10)	5
[10,15)	4
[15,20)	6

Practical - 02.

Title : problems on P.D.F and C.D.F

can the following be P.D.F?

i) $F(x) = \begin{cases} 2-x & ; 1 \le x \le 2 \\ 0 & \text{O.W} \end{cases}$

To prove :- $\int F(x)\,dx = 1$.

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

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

$= \left[2x\right]_1^2 \left[-\frac{x^2}{2}\right]_1^2$

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

$\neq 1$.

ii) $F(x) = \begin{cases} 3x^2 & ; 0 < x < 1 \\ 0 & \text{O.W.} \end{cases}$

To prove :- $\int F(x)\,dx = 1$.

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

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

$a^n = \frac{a^{n+1}}{n+1}$

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

$= \left[\frac{3}{3}\right] - 0$

$= 1$

Hence, it is P.D.F

iii) $f(x) = \begin{cases} \frac{3x}{2}\left(1-\frac{x}{2}\right) & ; 0 \le x \le 2 \\ 0 & \text{O.W} \end{cases}$

To prove :- $\int f(x)\,dx = 1$.

$= \int^2 \frac{3x}{2}\left(1-\frac{x}{2}\right) dx$

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

$= \left[\frac{3x^2}{4}\right]_0^2 - \left[\frac{3x^3}{12}\right]_0^2$

$= 3/11\ HIN3$

$= 3 - 2$

$= 1$

Hence, it is P.D.F

Can the following be P.M.F ?

(i)

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

$P(3) = -0.1$

Since, one probability is negative

Hence, it is not P.M.F

(ii)

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 $\Sigma P(x) = 1$.

Hence, it is a P.M.F.

(iii)

x	10	20	30	40	50
$P(x)$	0.2	0.3	0.3	0.2	0.2

$$\Sigma P(x) = 0.2 + 0.3 + 0.3 + 0.2 + 0.2$$
$$= 1.2$$

Since $\Sigma P(x) \neq 1$

$P(x)$ is not a P.m.f.

Q.4 Find c.d.f

(i)

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

→ $F(x) = 0$, $x < 0$

$= 0.1$, $0 \le x < 1$

$= 0.2$, $1 \le x < 2$

$= 0.4$, $2 \le x < 3$

$= 0.6$, $3 \le x < 4$

$= 0.7$, $4 \le x < 5$

$= 0.9$, $5 \le x < 6$

$= 1.0$, $x \ge 6$.

(ii)

x	1.0	1.2	1.4	1.6	1.8
$P(x)$	0.2	0.35	0.15	0.25	0.1

$F(x) = 0.2$, $x < 10$

$= 0.55$, $10 \le x < 12$

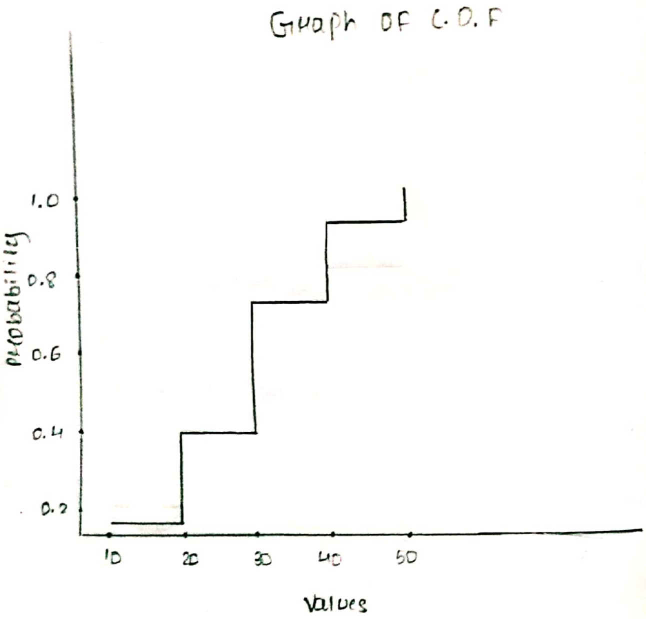
$= 0.70$, $12 \le x < 14$

$= 0.90$, $14 \le x < 16$

$= 1.0$, $x \ge 18$

M

Practical.



Practical No. 3

Title: Binomial Distributions and probability.

Q. Find the C.D.F. of the following P.D.F and 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 $x < 10$
$= 0.15$	$10 \leq x < 20$
$= 0.40$	$20 \leq x < 30$
$= 0.70$	$30 \leq x < 40$
$= 0.90$	$40 \leq x < 50$
$= 1.00$	$x \geq 50$

```
→ X = c(10,20 ,30 ,40,50)
  x
[1]  10  20  30  40  50
  PX = c(0.15, 0.25, 0.3 ,0.2,0.1)
  cumsum(PX)
[1]  0.15 0.40 0.70 0.90 1.00
  plot (x, cumsum(PX), xlab="Values", ylab="probability",
      Main = "Graph of C.D.F.", "s")
```

Q. Suppose there are 12 MCQ's in a test each question has 5 options & only one is correct. Find the probability of having:

1) five correct answers.
2) Atmost four correct answers.

→ It is given that
$n = 12$, $P = \frac{1}{5}$, $Q = \frac{4}{5}$.

x = Total no. of correct answers
$x \sim B(n, p)$

1) $n = 12$; $P = 1/5$; $q = 4/5$; $x = 5$
dbinom (5, 12, 1/5)
[1] 0.05315

2) $n = 12$; $P = 1/5$; $q = 4/5$; $x = 4$
pbinom (4, 12, 1/5)
[1] 0.9274

Q. There are 10 members in a committee. The probability of any member attending a meeting is 0.9, find the probability:

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

→ It is given that
$n = 10$, $P = 0.9$, $Q = 0.1$.

1) $n = 10$; $P = 0.9$; $Q = 0.1$; $X = 7$.
dbinom (7, 10, 0.9).
[1] 0.05739

2) $n = 10$; $P = 0.9$; $q = 0.1$; $X = 5$
1 - pbinom (5, 10, 0.9).
[1] 0.99836

3) $n = 10$; $P = 0.9$; $q = 0.1$; $X = 6$
pbinom (6, 10, 0.9)
[1] 0.01279

Q. Find the C.D.F & 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

$F(x) = 0$ if $x < 0$
$= 0.1$ $0 \le x < 1$
$= 0.2$ $1 \le x < 2$
$= 0.4$ $2 \le x < 3$
$= 0.6$ $3 \le x < 4$
$= 0.7$ $4 \le x < 5$
$= 0.9$ $5 \le x < 6$
$= 1.0$ $x \ge 6$

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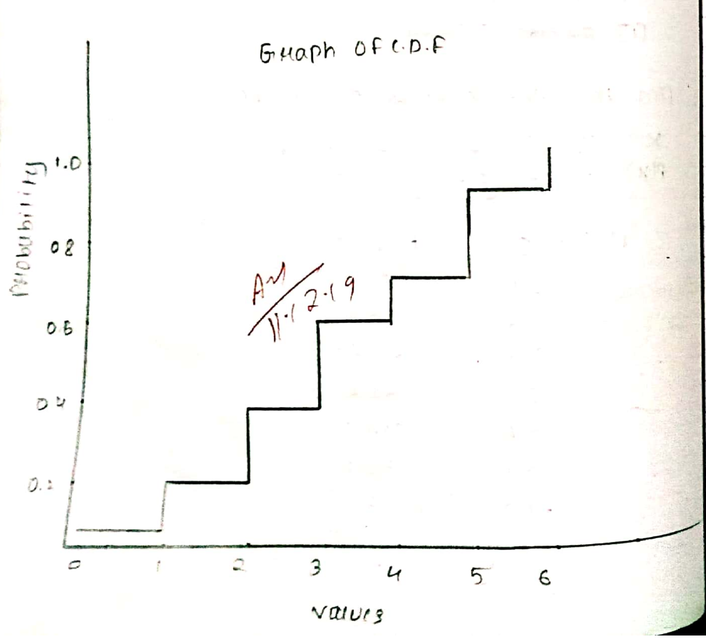
```
→ x = c(0,1,2,3,4,5,6)
x
[1] 0 1 2 3 4 5 6
Px = c(0.1,0.1,0.2,0.2,0.1,0.2,0.1).
cumsum(Px).
[1] 0.1 0.2 0.4 0.6 0.7 0.9 1.0
Plot(x,cumsum(px), xlab="values", ylab=" Probability",
   main="Graph of C.D.F.", "s").
```



AM 11-12-19

Practical No. 4.

1. Find the complete binomial distribution
$n = 5$ & $P = 0.1$

2. Find the probability of exactly 10 success in 100 trial with $p = 0.1$.

3. X follows binomial distribution with $n = 10$, $P = 0.25$.
Find i) $P(X = 5)$.
ii) $P(X \leq 5)$
iii) $P(X > 7)$
iv) $P(5 < X < 7)$.

4. Probability of salesman makes a sales to the customer is 0.15. Find the probability
i) No sale for 10 customers
ii) More than 3 sale in 20 customer.

5. A student writes 5 Mcq. Each question has 4 options out of which 1 is correct. Calculate the probability for atleast 3 correct answers

6. X follows binomial distribution $n = 10$, $P = 0.4$ plot the graph PMF & CDF

1. $n = 5, p = 0.1$

→ dbinom (0:5, 5, 0.1)

[1] 0.59049 0.32805 0.07290 0.00810 0.00045 0.00001

2. $n = 100, x = 10, p = 0.1$

→ dbinom (10, 100, 0.1)

[1] 0.1318653

3. $n = 12, p = 0.25$

→ (i) $P(X = 5)$

dbinom (5, 12, 0.25)

[1] 0.1032414

(ii) $P(X \leq 5)$

pbinom (5, 12, 0.25)

[1] 0.9455978

(iii) $P(X > 7)$

$P(X > 7) = 1 - P(X \leq 7)$ = 1 - pbinom (7, 12, 0.5)

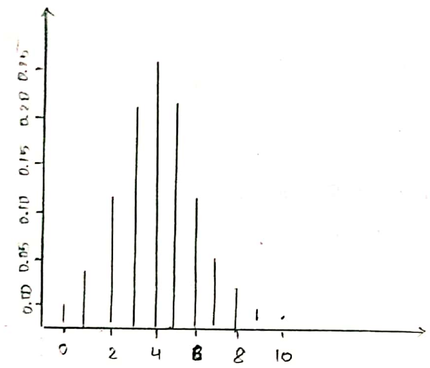
[1] 0.00278151

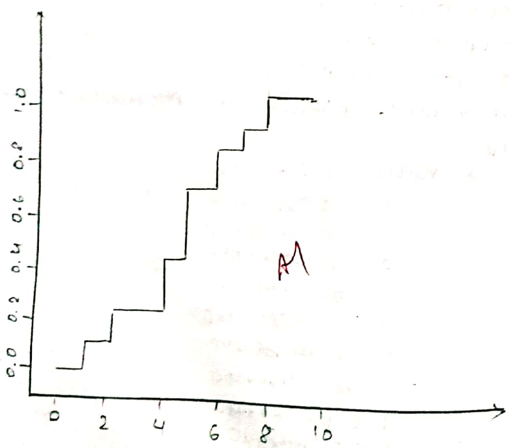
(iv) $P(5 < x < 7)$

dbinom (6, 12, 0.25)

[1] 0.00278151

plot(x, prob, "h")
plot(x, comprob, "s").





Practical No. 5.

Normal distribution.

1. $P[X = x] = \text{dnorm}(x, \mu, \sigma)$

2. $P(X \leq x) = \text{pnorm}(x, \mu, \sigma)$

3. $P(X > x) = 1 - \text{pnorm}(x, \mu, \sigma)$.

4. $P[x_1 < X < x_2] = \text{pnorm}(x_2, \mu, \sigma)$

5. To find the value of k so that :
$P(X \leq k) = P_1$; $\text{qnorm}(P_1, \mu, \sigma)$.

6. To generate 'n' random numbers :
$\text{rnorm}(n, \mu, \sigma)$.

Q.1 $X \sim N(\mu = 50, \sigma^2 = 100)$
Find i) $P(X \leq 40)$
ii) $P(X > 55)$
iii) $P(42 \leq X \leq 60)$
iv) $P(X \leq k) = 0.7$; $k = ?$

Q.2 $X \sim N(\mu = 100, \sigma^2 = \cancel{25})$.
i) $P(X \leq 110)$
ii) $P(X \leq 95)$
iii) $P(X > 115)$.
iv) $P(95 \leq x \leq 105)$
v) $P(X \leq k) = 0.4$; $k = ?$

Q.3. Generate 10 ~~more~~ random numbers from normal distribution with mean (μ) = 60, S.D = 5 also calculate the sample mean, median, variance & S.D.

Q.4. Draw the graph of standard normal distribution.

Q.1

→ (i) a = pnorm (40, 50, 10)

cat ("P(x<=40) is = ", a).

P(x<=40) is = 0.1586553 >

(ii) b = 1 - pnorm (55, 50, 10).

cat ("P(x>55) is = ", b).

P(x>55) is = 0.8085375 >.

(iii) c = pnorm (60, 50, 10) - pnorm (42, 50, 10)

cat ("P(42<=x<=60) is = ", c).

P(42<=x<=60) is = 0.6294893 >.

(iv) d = qnorm (0.7, 50, 10)

cat ("P(x<=k) = 0.7, k is = ", d).

P(x<=k) = 0.7, k is = 55.244017 >.

Q.2.

→ (i) a = pnorm (110, 100, 6)

cat ("P(x<=110) is = ", a).

P(x<=110) is = 0.9522096 >.

(ii) b = pnorm (95, 100, 6).

cat ("P(x<=95) is = ", b).

P(x<=95) is = 0.2023284 >.

(iii) c = 1 - pnorm (115, 100, 6).

cat ("P(x>115) is = ", c).

P(x>115) is = 0.006209665 >

(iv) d = pnorm (95, 100, 6) - pnorm (105, 100, 6).

cat ("P(95<=x<=105) is = ", d).

P(95<=x<=105) is = -0.5953482 >.

(v) e = qnorm (0.4, 100, 6).

cat ("P(x<=k) = 0.4, k is = ", e).

P(x<=k) = 0.4, k is = 98.47992 >.

PP.

Q.3.

→ n = 10, μ = 10, σ = 5

x = rnorm (10,60,5).

[1] 66.05727 51.97402 59.97334 60.87027 58.27801
56.90084 63.89487 56.54952

[9] 58.59008 65.11264.

am = mean (x).

>am

[1] 59.81959.

me = median(x).

> me

[1] 59.81959.

variance = (10-1) * var(x)/10.

> variance

[1] 16.93294.

sd = sqrt (variance).

>sd

[1] 4.114966.

Practical No. 6.

TOPIC :- Z distribution.

* Mean Test :

Q.1 Test the Hypothesis (H_0):

(i) $H_0 : \mu = 10$ against $H_1 : \mu \neq 10$.

A sample of size 400 is selected which gives a mean 10.2 & standard deviation 2.25. Test the hypothesis at 5% level of significance.

→

mo (mean of population) = 10

mx (mean of sample) = 10.2

sd = 2.25

n (sample size) = 400.

zcal = (mx − mo) / (sd / (sqrt(n)))

cat = ("zcal is :", zcal)

>> zcal is 1.77778.

pvalue = 2 * (1 - pnorm (abs (zcal)))

pvalue

>> 0.07544 , Thus hypothesis accepted.

(NOTE : If result of tested hypothesis is > 0.05, then assumed hypothesis of $H_0 : \mu = 10$ is accepted as verified / correct).

Q.2 Test the hypothesis (H_0):

$H_0 : \mu = 75$ against $H_0 : \mu \neq 75$

A sample of size 100 is selected & the sample mean is 80, with SD of 3. Test the hypothesis at 5% level of significance.

→ mo = 75

mx = 80

sd = 3

n = 100

zcal = (mx − mo) / (sd / (sqrt(n)))

cat = ("zcal : ", zcal)

pvalue = 2 * (1 - pnorm(abs (zcal)))

cat (pvalue is :", pvalue)

OUTPUT :

>> zcal : 16.667

>> pvalue is : 0

Thus, hypothesis rejected.

Q3) Test the Hypothesis (H_0) :-

$H_0 : \mu = 25$ against H_0 $\mu \neq 25$

A sample of 30 is selected. Test the hypothesis at 5% level of significance.

sample (x) = 20, 24, 27, 35, 30, 46, 26, 27, 10, 20, 30, 37, 35, 21, 22, 23, 24, 25, 26, 27, 28, 24, 30, 39, 27, 15, 19, 22, 20, 18.

→ mx = mean(x)

mx = 26.66

n = length (n)

variance = (n-1) * var (x) / n

sd1 = sqrt (variance)

>> sd = 2.2798

mo = 25

zcal = (mx - mo) / (sd / sqrt(n))
>> zcal = 0.8025
pvalue = 2 * (1 - pnorm (abs (zcal)))
>> pvalue = 0.4223.
Thus, hypothesis accepted.

* Proportion Test:

Q.1) 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 kept the correct proportion or not.
→ H0 pp = 0.2 (20%)
q = 1 - pp
sp = 50 / 400
n = 400

zcal = (sp - pp) / (sqrt (pp * q / n))
>>> zcal = -3.75
Pvalue = 2 * (1 - pnorm (abs (zcal)))
>>> Pvalue = 0.00017.
Thus, hypothesis is rejected.

Q.2 Test the hypothesis: H0: μ = 0.5 against p ≠ 0.5. A sample of 200 in selected where sp = 0.56 & pp = 0.5, level of significance is 1%.
→ H0 pp = 0.5
q = 1 - pp
sp = 0.56
n = 200
zcal = (sp - pp) / (sqrt (pp * q / n))
>>> zcal = 1.6970
pvalue = 2 * (1 - pnorm (abs (zcal)))
>> pvalue = 0.08968.

Thus, hypothesis is accepted.

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Practical No. 7

Topic :- Large sample Tests.

Q.1 H_0: A study of noise level in two hospitals is calculated below, Test the hypothesis that the noise level in two hospitals are same or not.

	HOS. A	HOS. B
No. of sample obs	84	34
Mean	61	59
S.D	7	8

→ H_0: The noise levels are same.

n1 = 84

n2 = 34.

mx = 61

my = 59

sdx = 7

sdy = 8.

z = (mx - my)/sqrt((sdx^2/n1) + (sdy^2/n2))

[1] 1.273682.

cat ("z calculated is =", z)

{ z calculated is = ~~1.~~ 1.273682 >

pvalue = 2 * (1 - pnorm (abs(z)))

[1] 0.2027761.

Since pvalue > 0.05, we accept ~~reject~~ H_0 at 5% level of significance.

Q.2 H_0: Two random samples of size 1000 & 2000 are drawn from population with the means 67.5 & 68 respectively & with the same standard deviation of 2.5. Test the hypothesis that the mean of two population are equal.

→ H_0: Two populations are equal.

n1 = 1000

n2 = 2000

mx = 67.5

my = 68

sdx = 2.5

sdy = 2.5

z = (mx - my)/sqrt((sdx^2/n1) + (sdy^2/n2))

z

[1] -5.163978

cat ("z calculated is =", z)

z calculated is = -5.163978 >

pvalue = 2 * (1 - pnorm (abs(z)))

pvalue

[1] 2.417564e-07

Since, pvalue < 0.05, we reject the H_0 at 5% level of significance.

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Q.3 H_0: In FYBSC, 20% of a random sample of 400 students had defective eye sight. In SYBSC, 15.5% of 500 students had the same defect. Is the difference of proportion same?

→ H_0: The proportion of the population are equal.

n1 = 400
n2 = 500
p1 = 0.2
p2 = 0.155
p = (n1 * p1 + n2 * p2) / (n1 + n2)
[1] 0.175
q = 1 - p
[1] 0.825
z = (p1 - p2)/sqrt (p * q * (1/n1 + 1/n2))
[1] 1.76547
cat ("z calculated is = ", z)
z calculated is = 1.76547 >
pvalue = 2 * (1 - pnorm (abs (z)))
pvalue
[1] 0.07748427

Since, pvalue > 0.05, we accept the H_0, at 5% level of significance.

Q.4 H_0: From each of the box of the apples, a sample size of 200 is collected. It is found that there are 44 bad apples in the 1st sample & 30 bad apples in the 2nd sample, Test the hypothesis, that the two boxes are equivalent in terms of no. of bad apples.

→ H_0: The two boxes are equivalent.

n1 = 200
n2 = 200
p1 = 44/200
p2 = 30/200
p = (n1 * p1 + n2 * p2)/(n1 + n2)
[1] 0.185
q = 1 - p
[1] 0.815
z = (p1 - p2) / sqrt (p * q * (1/n1 + 1/n2))
[1] 1.802741
pvalue = 2 * (1 - pnorm (abs (z)))
pvalue
[1]. 0.07142888

Since, pvalue > 0.05, we accept the H_0, at 5% level of significance.

Q.5 H_0: In MA class, out of a sample of 60, mean height is 63.5 inch with the SD 2.5. In a M.COM class out of 50 students, mean height is 69.5 inch with the SD as 2.5. Test the hypothesis that the mean of MA and Mcom class are same.

→ H_0: Heights of two classes is same.

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))

[1] 145.1808

pvalue = 2*(1-pnorm(abs(z)))

[1] 0

Since, pvalue < 0.05 we reject the H_0, at 5% level of significance

A-1

Practical No. 8.

Topic :- Small sample Test.

Q1 The flower's stems are selected & the heights are found to be 63, 63, 68, 69, 71, 71, 72 cm. Test the hypothesis that the mean height is 66 cm or not at 1% level of significance.

→ H_0: Mean = 66 cms.

x = c(63, 63, 68, 69, 71, 71, 72)

x

[1] 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% confidence interval:

64.66479 71.62092

sample estimates:

mean of x

68.14286

Since, p-value < 0.01, we reject the H_0 at 1% level of significance.

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Q.2 Two random samples were drawn from two different population.

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

Sample 2 : 20, 15, 18, 9, 8, 10, 11, 12.

Test the hypothesis that there is no difference between the two population mean at 5% level of significance.

→ H_0 : There is no difference in the population means.

```
X = c(8, 10, 12, 11, 16, 15, 18, 7)
Y = c(20, 15, 18, 9, 8, 10, 11, 12)
t.test(X, Y)
```

Welch two sample t-test

data : x and y

t = -0.36247 , df = 13.837, p-value = 0.7225

alternative hypothesis : True difference in mean is not equal to 0.

95 percent confidence interval :

-6.192719   3.692719

sample estimates :

mean of x   mean of y

12.125   12.875

Since, p-value > 0.05, we accept the H_0 at 5% level of significance

51

Q.4 The marks before & after a training program are given below:

before : 20, 25, 32, 28, 27, 36, 35, 25

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

Test the hypothesis, the training program is effective or not.

→ H_0 : 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 mean is greater than 0.

95 percent confidence interval :

-8.467399 Inf

sample estimated :

mean of the differences

-5.75

Since, p-value > 0.05, we accept the H_0 at 5% level of significance

52

Q.5 Two random samples 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.

→ H_0 : The variances of the two 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 variables

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:

0.1833662 3.0360393

sample estimates :

ratio of variances

0.7068567

Since, p-value > 0.05, we accept the H_0 at 5% level of significance.

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Q6 The arithmatic mean of sample of 100 observations is 52. If the S.D is 7, test the hypothesis that the population mean is 55 or not at 5% level of significance.

→ H_0: population mean = 55

n = 100

m_x = 52

m_0 = 55

sd = 7

zcal = (mx - m0) / (sd / sqrt (n))

zcal

[1] -4.285714

pvalue = 2 * (1 - pnorm (abs (zcal)))

pvalue

[1] 1.82153e-05

Since, p-value < 0.05, we reject the H_0 at 5% level of significance.

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Since, P-value < 0.05, we reject the H_0 at 5% level of significance.

Q2 Table below shows the relation between the performance of Mathematics & computer of cs students.

		Maths		
		HG	MG	LG
computer	HG	56	71	12
	MG	47	163	38
	LG	14	42	85

→ H_0: Performance between maths & computer is independent.

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

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

pv = chisq.test(y)
pv

Pearson's chi-squared test

data: y

X-squared ... 145.78, df = 4, p-value ... 2.2e-16

Since, P-value < 0.05, we reject the H_0 at 5% level of significance.

Q3 perform ANOVA for the following data

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

→ H_0: The means of variety of A, B, C, D are equal

x_1 = c(50, 52)
x_2 = c(53, 55, 53)
x_3 = c(60, 58, 57, 56)
x_4 = 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, num df = 3, denom df = 9, P-value = 0.00183

anova = aov (values ~ ind, data = d)
summary (anova)

	DF	Sum Sq	Mean Sq	F values	Pr(>F)
ind	3	71.06	23.688	11.73	0.00183 **
Residuals	9	18.17	2.019		

--

Since, p-value < 0.05, we reject the H_0 at 5% level of significance.

Q4 Perform Anova for the following data:

Types	Observations
A	6, 7, 8
B	4, 6, 5
C	8, 6, 10
D	6, 9, 9

→ H_0: The means of types of A, B, C, D are equal.

x1 = c(6, 7, 8).
x2 = c(4, 6, 5).
x3 = c(8, 6, 10).
x4 = c(6, 9, 9).
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)

Practical No. 10

Topic :- Non. parametric test

Q. Following are the amount of sulphur oxide emitted by a factory.
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 the population median is 21.5
against the alternative that it is less than 21.5

→ H_0 : population median is 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)
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] 0.4119015
```

Since, p-value > 0.05, we accept the H_0 at 5% level of significance

Q.3 For the following data : 60, 65, 63, 89, 61, 71, 58, 51, 48, 66.
Test the hypothesis using wilcoxon's ~~test~~ signed ~~rank test~~ rank 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: It is greater than 60.

```
x = c(60,65,63,89,61,71,58,51,48,66)
mu = 60
wilcox.test (x, alter = "greater", mu = 60)
```

wilcoxon signed rank test with continuity correction

data: x
V = 29, P-value = 0.2386
alternative hypothesis : true location is greater than 60.

Since, P-value > 0.05 , we accept the H_0 at 5% level of significance.

[NOTE: If the alternative is less, we have to write ~~[illegible]~~ wilcox.test (x, alter = "less", mu = 60)
If the alternative is not equal to, we have to write wilcox.test (x, alter = "two.sided", mu = 60)]

Q.4 Test the hypothesis ; median is 12, against the alternative that it is less than 12. using wilcoxon's values : 12, 13, 10, 20, 15, 5, 1, 7, 6, 11, 9, 20.

→ H_0: Median is 12.
H_1: It is less than 12.

```
x = c(12,13,10,20,15,5,1,7,6,11,9,20)
mu = 12
wilcox.test (x, alter = "less", mu = 12)
```

wilcoxon signed rank test with continuity correction

data: x
V = 25, P-value = 0.2521
alternative hypothesis : true location is less than 12.

Since, P-value > 0.05 , we accept the H_0 at 5% level of significance.

An
4.3.20