PRACTICAL - 1

Basic of R Software

i. R Software for data analysis & statistical Computing

ii. It is a Software by which effective data handling & outcome Storage is possible.

iii. It is Capable of graphical display

iv. It is a free Software

Q.1.

$2^2 + |-5| + 4 \times 5 + 6/5$

```
> 2^2 + abs(-5) + 4* 5+ 6/5
[1]  30.2
```

Q.2.

$x = 20$
$y = 2x$
$z = x + y$
$\sqrt{z}$

```
x = 20
y = 2* x
z = x + y
z ** 0.5
[1]  7.745
```

```
round (2.56)
[1] 3
```

```
round (2.4)
[1]  2
```

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Q.3

x = 10
y = 15
z = 5

a) x+y+z
b) xyz
c $\sqrt{xyz}$
d round of $\sqrt{xyz}$

a x+y+z
[1] 30

b ~~xyz~~ x*y*z
[1] 750

c sqrt(x*y*z)
[1] 27.38613

d round ((x* y* z)** 0.5)
[1] 27

Q.4.

A Vector in R Software is denoted by 'c'

c(2, 3, 5, 7)^2
> c (2, 3, 5, 7) ^2
> 4 9 25 49

Q.5.
c(2,3,5,7) ^ c(2,3)
> c (2,3,5,7) ^c (2,3)
[1] 4 27 25 343

Q.6. c (2,3,5, 7,9,11) ^ c(2,3)
> c(2,3,5,7,9, 11)^ c(2,3)
[1] 4 27 25 343 81 1331

Q.7.
c (1, 2,3,4,5,6)
c (2, 3, 4)

> c (1,2,3, 4,5,6)^c(2,3,4)
> 1 8 81 16 125 1296

Q.8.
c(2, 4, 6, 8)
> x = c (2,4, 6, 8)
x* 3
[1] 6 12 18 24

Q.9.
x = c (2, 4, 6, 8)
y = c (-2, -3, -5, -7)
x* y
[1] -4 -12 -30 -56

Q.10
x=c(2, 4, 6, 8)
x +10
[1] 12 14 16 18

Q. 11
c(2, 4, 6, 8) + c(-2, -3, -1, 0)
[1] 0 1 5 8

→ Sum, Product

Q. Find the Sum, product, Sqrt of the Sum & the product for the following values
= (4, 9, 2, 5, 7, 8, 3, 6, 15, 12, 10, 9, 8, 13, 14)

x = c(4, 9 . . . . . .)
y = sum(x)
z = prod(z)
y^0.5

y
[1] 125

z
[1] 5

> y^0.5
[1] 11.18034
> z^0.5
[1] 2925632

Q.13 Find the sum, product, max, min, values of
c(2, 8, 9, 11, 10, 7, 6)^2

x = c(2, 8 - - - -)^2
[1] 4 64 81 121 100 49 36
> sum(x)
[1] 455
> prod(x)
[1] 4425 9747 8400

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> max (x)
[1] 121
> min (x)
[1] 4

Q. Matrix

x <- matrix(nrow = 3, ncol = 4, c(2, 6, 7, 8, 9, 4, 5, 0, 2, 1, 4, 5))
x

	[, 1]	[, 2]	[, 3]	[, 4]
[1,]	2	8	5	1
[2,]	6	9	0	4
[3,]	7	4	2	5

~~[4,]~~

Q. Addition of Matrix

x = matrix (nrow = 3, ncol = 3, c(4, 5, 6, 7, 8, 9, 4, 0, 2)).
y = matrix (nrow = 3, ncol = 3, c(8, 4, 5, 11, 12, 8, 9, 7, 4))
x

	[, 1]	[, 2]	[, 3]
[1,]	4	7	4
[2,]	5	8	0
[3,]	6	9	2

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y

	[,1]	[,2]	[,3]
[1,]	6	11	9
[2,]	4	12	7
[3,]	5	8	4

x * 2

	[,1]	[,2]	[,3]
[1,]	8	14	8
[2,]	10	16	0
[3,]	12	18	4

y * 2

	[,1]	[,2]	[,3]
[1,]	12	22	18
[2,]	8	24	14
[3,]	10	16	8

x + y

	[,1]	[,2]	[,3]
[1,]	10	18	13
[2,]	9	20	7
[3,]	11	17	6

x * y

	[,1]	[,2]	[,3]
[2,]	24	77	36
[2,]	20	96	0
[3,]	30	72	8

Ak 25/1

Binomial Distribution

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Practical - 2

n = Total no. of trails
p = P(Success)
q = P(failure)
X = No. of Successes outcome of n

eq:-
$P(x) = {}^nC_x \, p^x \, q^{n-x}$
$E(x) = np$
$V(x) = npq$

$n=10, p=0.6, q=0.4$
$P(x \le x) = P(x \le 3)$

```
> dbinom(x,n,p)   | P(x)
> n * p           | E(x)
> n * p * q       | V(x)
> pbinom(x,n,p)   | P(X≤x)
```

Q1. Toss a coin 10 times with probability (Head) = 0.6. Let X be the no. of heads
i) Find the Probability of
i) Seven heads
ii) Four heads
iii) atmost 4 heads
iv) Atleast 6 heads
v) No heads
vi) All heads.
also find Expectation & Variance

Sol^n

```
> n=10, p=0.6, q=0.4, x=7
> dbinom(7,10,0.6)
[1] 0.2149908
> dbinom(4,10,0.6)
[1] 0.1114767
> pbinom(4,10,0.6)
[1] 0.6177194
```

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```
> 1 - pbinom(6, 10, 0.6)
[1] 0.3822806
> dbinom(0, 10, 0.6)
[1] 0.0001048576
> dbinom(10, 10, 0.6)
[1] 0.006046618
> n * p
[1] 6
> n * p * q
[1] 2.4
```

Q.2 Suppose there are 12 MCQ in an english question paper.
→ Each Question has 5 answers & only 1 of them is correct find the probability of having.
i) 4 Correct answers
ii) Atmost 4 Correct answers
iii) Atleast 3 Correct answer.

Q.3 Find the Complete binomial distribution when n=5, p=0.1, ~~x~~.

Q.4. Find the probability of exactly 10 success out of hundred trails with p=0.1

Q.5. X follows binomial distribution with n=12 & p=0.25. Find
i) $P(X \leq 5)$ ii $P(x > 7)$ iii $P(5 < x < 7)$

Q.6. There are 10 numbers in a Committee probability of any number attending a meeting is 0.9. What is the probability, there 7 or more members will be present in a meeting.

Q.7 A Salesman has a 20% probability of making a ~~sale~~ sell to a customer. On a typical day he will meet 30 customers. What minimum no. of Sells he will make with 88% probability

Q.8. For n=10 & p=0.6 find the binomial probabilities & plot the graphs of pmf & c.d.f.

Note:
i) $P(X=x)$ = dbinom(x, n, p)
ii) $P(X \leq x)$ = probability of atmost x values
= pbinom(x, n, p)
iii) $P(X > x)$ = 1 - pbinom(x, n, p)
iv) If x is known & the probability is given as P_1, to find x = qbinom(P_1, n, p)

A.2 n = 12, p = 1/5, x = 4
i dbinom(x, n, p)
[1] 0.1328756
ii pbinom(x, n, p)
[1] 0.4274445
iii x = 2
1 - pbinom(x, n, p)
[1] 0.4416543

A.3 n=5, p=0.1, x=1
dbinom(x, n, p) i.e dbinom(1, n, p)
[1] 0.32805
dbinom(2, n, p) i.e
[1] 0.0729

```
dbinom( 3,n,p)
[1] 0.0081
dbinom(4,n,p)
[1]0.00045
dbinom(5,n,p)
[1] 1e-05
dbinom(0,n,p)
[1] 0.59049
```

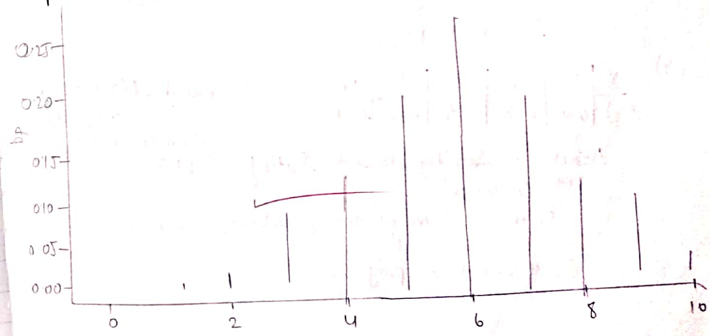
A.4.
```
n = 100, p = 0.1, x = 10
dbinom (x,n,p)
[1] 0.1318653
```

A.5
```
n=12, p= 0.25 , x=5
pbinom(x,n,p)
[1] 0.9455978
x = 7
p1- pbinom(x,n,p)
[1] 0.0027815l
x= 6
dbinom (x,n,p)
[1] 0.04014945
```

A.6
```
n=10, p=0.9, x=6
1- pbinom(x,n,p)
[1] 0.9872045
```

A.7
```
n= 30 , p= 0.2, p1= 0.88
qbinom(p1,n,p)
[1] 9
```


A.8.
```
n=10
p=0.6
x=0:n
bp=dbinom(x,n,p)
[1]0.0001048576 0.0015728640 0.0106168320 0.0424673280
0.1114767360 0.2006581284 0.2508226560 0.2149988480
0.1209323520 [10] 0.0403107840 0.0060466174
d=data.frame("x-values"=x, "probability" = bp)
  x-values  probability
1     0     0.0001048576
2     1     0.0015728640
3     2     0.0106188320
4     3     0.0424673280
5     4     0.1114767360
6     5     0.2006571248
7     6     0.2508220560
8     7     0.2149908480
9     8     0.1209323520
10    9     0.0403107840
11   10     0.0060466176
> plot (x, bp, 'h')
```




```
cp = pbino(x,n,p)    plot (x, p, 's')
```

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Practical- 3 (Probability distribution)

Q1. Check the following are P.M.F or Not

(1)

x	1	2	3	4	5
$p(x)$	0.2	0.5	-0.5	0.4	0.4

~~Condit~~ ~~Since~~ Conditions: 2

i $0 \le p(x) \le 1$

ii $\sum_{x} p(x_i) = 1$

Since, it doesn't satisfy the first condition

∴ it is not P.M.F

(2)

x	10	20	30	40	50
$P(x)$	0.3	0.2	0.3	0.1	0.1

```
prob = c(0.3,0.2,0.3,
0.1,0.1)
sum(prob)
[1] 1
```

Hence, it satisfy both the condition

∴ it is pmf.

(3)

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

```
probab = c(0.4, 0.2, 0.3,
0.2, 0.1)
sum(Probab)
[1] 1.2
```

Hence, it ~~Satisfy~~ doesn't satisfy 2nd condition

i.e ~~the~~ sum of the probability is more than 1

∴ it is not a pmf

Q.2

Following is a pmf of (X)

X_i	1	2	3	4	5
$P(x)$	0.1	0.15	0.2	0.3	0.25

Find mean & Variance

X_i	$P(x)$	$x_i P(x)$	$x_i^2 (P(x))$
1	0.1	0.1	0.1
2	0.15	0.3	0.6
3	0.2	0.6	1.8
4	0.3	1.2	4.8
5	0.25	1.25	6.25
		3.45	13.55

Mean $= E(x) = \sum x P(x) = 3.45$

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

$= 13.55 - (3.45)^2$

$= 1.6475$

in R software

```
x = c(1, 2, 3, 4, 5)
prob = c(0.1, 0.15, 0.2, 0.3, 0.25)
a = x * prob
a
[1] 0.10   0.30   0.60   1.20   1.25
Mean = sum(a)
mean
[1] 3.45
```

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i2
b = (x^2)* prob
var = sum (b) - mean^2
var
[1] 1.6475

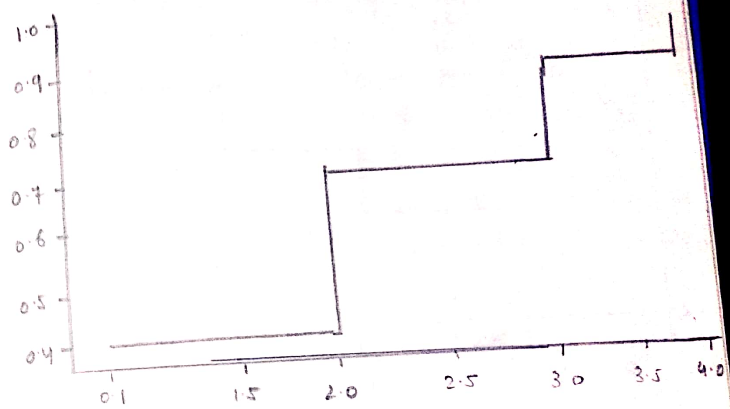
0.3. Find mean & Variance
X = c (5, 10, 15, 20, 25)
probab = c (0.1, 0.3, 0.2, 0.25, 0.15)
a = x * probab
a
[1] 0.50 3.00 3.00 5.00 3.75

b = (x^2)* probab
var = sum (b) - mean^2
var
[1] 38.6875

Mean = sum (a)
Mean
[1] 38.6875

0.4. Find C.D.F of the following p.m.f & Draw the graph of C.D.F

(i) x = seq(1, 4, 1)
prob = c(0.4, 0.3, 0.2, 0.1)
a = cumsum (prob)
a
[1] 0.4, 0.7, 0.9, 1.0
> plot (x, a, "s")



0.4.
ii x = c (0, 2, 4, 6, 8)
prob = c (0.2, 0.3, 0.2, 0.2, 0.1)
a = cumsum (prob)
a
[1] 0.2 0.5 0.7 0.9 1.0
> plot (x, a, "s")

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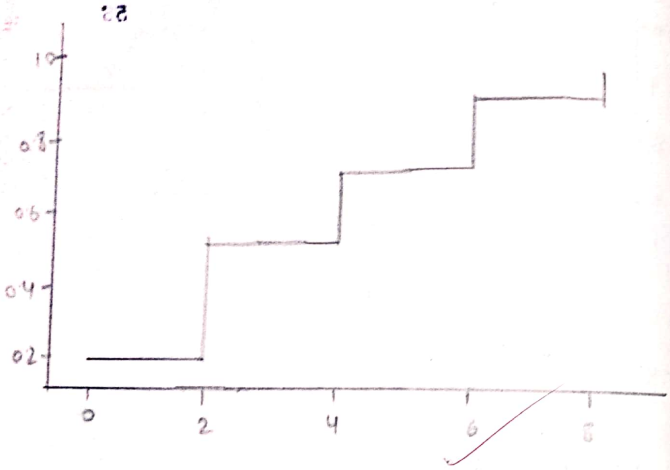
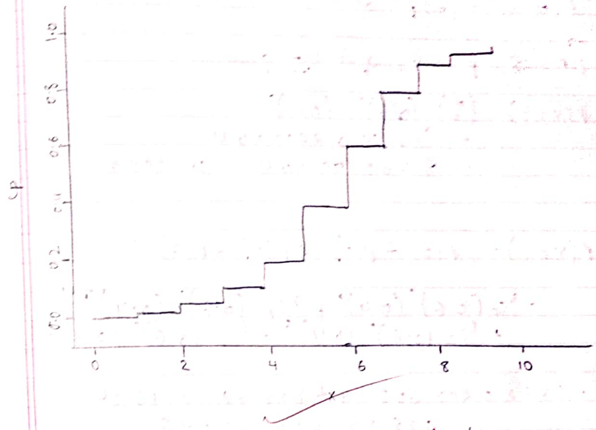


9.12.19



16.12.19

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No.	
1.	
2.	
3.	6
4.	P
5.	N
6	2
7	L
8.	S
9.	(a
	+
10	A

Practical - 4 ~~Normal distribution~~

$P(X=x) = \binom{n}{x} p^x q^{n-x}$

$[n = 8,\ p = 0.6,\ q = 0.4]$ given

① $P(x=7) = \binom{8}{7} (0.6)^7 (0.4)^{8-7}$

$= {}^8C_7 \times 0.2799 \times 0.4$

$= 8 \times 0.2799 \times 0.4 = 0.08957$

② $P(x \le 3) = P(0) + P(1) + P(2) + P(3)$

$= {}^8C_0 (0.6)^0 (0.4)^8 + {}^8C_1 (0.6)^1 (0.4)^{8-1} + {}^8C_2 (0.6)^2 (0.4)^6 + {}^8C_3 (0.6)^2 (0.4)^5$

$= 1 \times 1 \times 0.00065536 + 8 \times 0.6 \times 0.0016384 + 28 \times 0.36 \times 0.004096 + 56 \times 0.25 \times 0.01024$

$= 0.1736704.$

③ $P(x = 2 \text{ or } 3) = P(2) + P(3)$

$= {}^8C_2 (0.6)^2 (0.4)^6 + {}^8C_3 (0.6)^3 (0.4)^5$

$= 28 \times 0.36 \times 0.004096 + 56 \times 0.216 \times 0.01024$

$= 0.04128768 + 0.12386304$

$= 0.16515012$

PM

Practical - 5

(Normal distribution)

→ It is an example of Continuous probability distribution

$X \sim (\mu, \sigma^2)$

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

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

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

④ To find the Value of K

$P(X \le K) = P$

The Command is qnorm(p, μ, σ)

⑤ To generate a random sample of size n

rnorm(n, μ, σ)

Q.1.) A random Variable X follows normal distribution with $\mu = 10$, $\sigma = 2$. To find → $P(x \le 7)$

$P(x > 12)$

$P(5 \le x \le 12)$

$P(X < K) = 0.4$

Q.2. $X \sim N(100, 36)$

$\sigma = \text{sqrt}(36)$

~~Q.3.~~ $P(x \le 110)$

$P(x > 105)$

$P(x \le 92)$

$P(95 \le x \le 110)$

$P(X < N) = 0.9$

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Q.3 Generate 10 random Sample find the Sample mean, median & Variance & S.D.

$\mu = 10$, $\sigma = 3$, $n = 10$

A.1
```
p= pnorm ( 7,10, 2)
p
[1] 0.0668072
> Cat(" p (x<=7) is = ", p)

q= 1-pnorm (12, 10, 2)
q
[1] 0.1586553
Cat(" p(x>12) is = ", q)

p= pnorm ( 12,10, 2)-pnorm (5,10,2)
p
[1] 0.8351351
Cat(" p (5≤x≤12) is = ", p)

k = qnorm (0.4,10, 2)
k
[1] 9.493306
Cat ("p (x<k) is = ", k)
```

A.2
```
d= sqrt (36)
d
[1] 6
```
$\therefore \mu = 100, \sigma = 6$
```
p = pnorm(110, 100, 6)
p
[1] 0.9522096
```

q = 1- pnorm(105,100, 6)
q
[1] 0.2023284

p = pnorm(92,100,6)
p
[1] 0.9121122

p = pnorm(110, 100, 6) - pnorm(95,100, 6)
p
[1] 0.7498813

k = qnorm(0.9, 100, 6)
k
[1] 107.6893

A3 $\mu = 10$, $\sigma = 3$ $n = 10$

x = rnorm(10, 10, 3)
x
[1] 9.975788 9.101868 10.794680 12.497118
4.763568 7.281763 14.266924 12.234024
11.959975 14.250874

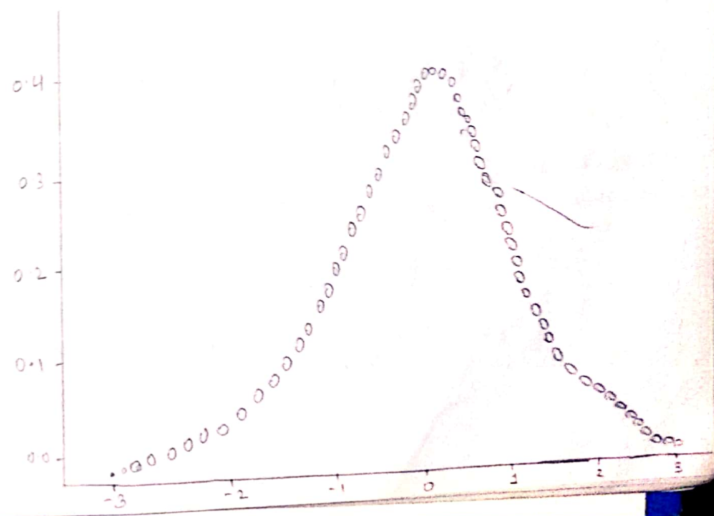
gm = mean(x)
gm
[1] 10.71266

md = median(x)
md
[1] 11.37733

n = 10
variance = ((n-1) * var(x))/n
variance
[1] 8.251349

sd = sqrt(variance)
sd
[1] 2.872516

Q.4].
A. x = seq(-3, 3, by = 0.1)
y = dnorm(x)
plot(x, y, xlab = "x values", ylab = "probability", main = "Standard normal curve")



Q.5 (i) X ~ N(50, 100) σ = 10
Find i) P(X ≤ 60)
ii) P(X > 65)
iii) P(45 ≤ x ≤ 60)

p = pnorm (60, 50, 10)
[1] 0.843447

p = pnorm (60, 50, 10) - pnorm (45, 50, 10)
p
[1] 0.5328072

p = 1 - pnorm(65, 50, 10)
p
[1] 0.0668072

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Practical-6
(z & t distribution Sums)

Q.1. Test the hypothesis H0: μ = 20 against H1: μ ≠ 20
a sample of size 400 will selected & the sample mean is 20.2 & the standard deviation 2.25.
Test at 5% level of significance

```
> mo = 20; mx = 20.2 ; sd = 2.25; n = 400
> zcal = ( mx - mo) / (sd/ sqrt (n))
> zcal
[1] 1.777778
> cat ("z calculated is zcal : ", zcal)
z calculated is zcal : 1.777778
> pvalue = 2 * (1 - pnorm (abs (zcal)))
> pvalue
[1] 0.07544036
```

Since, the pvalue is more than 0.05, we accept H0: μ = 20

Q.2. We want to test the hypothesis H0: μ = 250 against H1: μ ≠ 250. a sample of size 100 has a mean of 275. & s.d = 30. Test the hypothesis at 5% level of significance

```
> mo = 250; mx = 275; sd = 30; n = 100 ;
> zcal = (mx - mo) / (sd/sqrt(n))
> zcal
[1] 8.333333
```

·13

```
> cat (" z calculated is zcal : ", zcal)
  z calculated is zcal:  8.33333
> pvalue = 2*(1 -pnorm (abs (zcal)))
> p value
[1] 0
```

Since, the pvalue is less than 0.05, we reject the ~~Sample~~ mean $H_0: \mu = \cancel{20}\ 250$

Q.3. We want to test the hypothesis $H_0: P = 0.2$ against $H_1: P \neq 0.2$ (P = population proportion) a sample of 400 ~~be~~ is selected & the sample proportion is calculated 0.125. Test the hypothesis at 1% level of significance.

```
> P=0.2 ; Q = 1-P ; p= 0.125 ; n=400
> zcal = (p-P) /( Sqrt (P* Q)/n))
> zcal
[1]  -3.75
> pvalue = 2*(1- pnorm (abs (zcal)))
> pvalue
[1]  0.0001768346
```

Since, the pvalue is less than 0.01. we reject $H_0: P = 0.2$.

Q.4. In a big city 325 men out of 600 men, where found to be self employed. Does this information support the conclusion that exactly half of the men in the city are self employed?

```
> P=0.5 ; p=325/600; n=600; Q=1-P
> zcal =(p-P)/(Sqrt (P*Q/n))
> zcal
[1] 2.041241
> pvalue = 2*(1-pnorm (abs(zcal)))
> pvalue
[1] 0.04122
```

Since, the pvalue is less than 0.05, we reject $H_0: P = 0.5$

Q.5 Test the hypothesis $H_0: \mu = 50$ against $H_1: \mu \neq 50$ a sample of 30 is collected

50, 49, 52, 44, 45, 48, 46, 45, 49, 45, 40, 47, 55, 54, 46, 58, 47, 44, 59, 60, 61, 41, 52, 44, 55, 56, 46, 45, 48, 49

```
> x = c(Data)
> n = length(x)
> am = mean(x)
> v = var(x)
> Variance =((n-1)* v)/n
> Variance
[1] 30.95556
> sd = Sqrt(Variance)
> sd
[1] 5.563772
> mo= 50; mx = am; sd = 5.563772 ; n=30
> zcal =(mx - mo) / ( sd /sqrt (n))
> zcal
[1] -0.6562964
> pvalue = 2*(1-pnorm (abs (zcal)))
> pvalue        [1] 0.5116334
```

Since, the pvalue is more than 0.05 we accept $H_0: \mu = 50$

Dr 20.01.20

PRACTICAL- 7

Large Sample Test

Q.1.) Two random sample of size 1000 & 2000 are drawn from two population with the S.D (σ) = 2 & 3 respectively. Test the hypothesis that the two population means are equal or not at 5% level of significance. Sample means are = 67 & 68 respectively

Sol^n

$H_0 = \mu_1 = \mu_2$

against $H_1 = \mu_1 \neq \mu_2$

```
> n1 = 1000
> n2 = 2000
> mx1 = 67
> mx2 = 68
> sd1 = 2
> sd2 = 3
> zcal = (mx1 - mx2)/Sqrt((sd^1 /n1) + (sd^2/n2))
> zcal
[1] -10.84652
> pvalue = 2* (1-pnorm(abs(zcal)))
> pvalue
[1] 0
```

Since, the Pvalue is less than ~~0.005~~ 0.05, we reject $H_0 . \mu_1 = \mu_2$

Q.2. A study of noise level ~~into~~ two hospital is ~~given~~ done following data is Calculated. Sample size 84, Sample mean = 61.2, S.D1 = 7.9, 2nd Sample size = 34, Sample mean = 59.4. S.D2 = 7.8. Test $H_0: \mu_1 \neq = \mu_1$ at 1% level of significance.

```
> n1 = 84
> n2 - 34
> mx1 = 61.2
> mx2 = 594
> sd1 = 7.9
> sd2 = 7.8
> zcal = (mx1 - mx2)/ sqrt ((sd1^2/n1) + (sd2^2 /n2))
> zcal
[1] 1.131117
> pvalue = 2* (1- pnorm (abs (zcal)))
> pvalue
[1] 0.258006
```

Since, pvalue is greater than 0.01, we accept $H_0 : \mu_1 = \mu_2$

3. From each of two population of oranges the following samples are collected test, whether the proportion of bad oranges are equal or not, 1st Sample Size = 250, 2nd Sample Size = 200. No. of bad oranges in the 1st Sample = 44 & 2nd Sample 30

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

```
> n1 = 250
> n2 = 200
> p1 = 44/250
> p2 = 30/200
> p = (n1 * p1 + n2* p2) / (n1 + n2)
> p
[1] 0.1644444
> q = 1-p
> q
[1] 0.8355556
> zcal = (p1-p2)/sqrt(p*q* (1/n1 + 1/n2))
> zcal
[1] 0.7393 581.
```

```
>pvalue = 2* (1-pnorm (abs(zcal)))
>pvalue
[1] 0.4596896
```

Since, pvalue is greater than 0.05, we accept the Ho. $P_1 = P_2$

4. Random Sample of 400 males & 600 females, when asked whether they want a ATM near by. 200 males & 390 females ~~set~~ were in favour of proposals. Test the hypothesis that the proportion of males & females favouring the proposals are equal or not at 5% LOS

Solⁿ

```
>n1 = 400
>n2 = 600
>p1 = 200/400
>p2 = 390/600
>p = (n1*p1 + n2*p2)/(n1+n2)
>p
[1] 0.59
>q = 1-p
>zcal = (p1-p2) / sqrt(p*q*(1/n1+1/n2))
>zcal
[1] -4.724791
>pvalue = 2* (1-pnorm(abs(zcal)))
>pvalue
[1] 2.303972e-06
```


Q.5. Following are the two independent sample from the ~~the~~ two population test equality of two population mean at 5% level of significance

x1 = 74, 77, 74, 73, 79, 76, 82, 72, 75, 78, 77, 78, 76, 76

x2 = 72, 76, 74, 70, 70, 78, 70, 72, 75, 79, 79, 74, 75, 78, 72, 74, 80

Solⁿ

```
>x1 = c(Data)
>x2 = c(Data)
>n1 = length(x1)
>n2 = length(x2)
>mx1 = mean(x1)
>variance = (n1-1) * var(x1/n1)
[1] 0.4508014
>sd1 = sqrt(variance)
[1] 0.6714177
>variance = (n2-1) * var(x2/n2)
[1] 0.6116324
>sd2 = sqrt(variance)
[1] 0.7850631
>tcal = (mx1 - mx2)/sqrt((sd1^2/n1) + (sd2^2/n2))
>tcal
[1] 1.95227
>t.test(x1,x2)
pvalue : 0.1387
```

A.K.
27.4.20

PRACTICAL-8
(Small Sample test) t-test

Q.1. The Random Sample of 15 observation are given by 80, 100, 110, 105, 122, 70, 120, 110, 101, 88, 83, 95, 89, 107, 125.00 this data Support the assumption that the population mean is 100.

Soln
>x=c(Data)
>t.test(x)
t = 24.029   df = 14   p-value = 8.819e-13
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval;
91.37775   109.28892
Sample estimates:
mean of x
100.3333

Hence, p-value is less than 0.005 ∴ We reject the p-value Ho: μ=100.

Q.2. write two groups of 10 students Scored the following marks
grp 1= 18, 22, 21, 17, 20, 17, 23, 20, 22, 21
2= 16, 20, 14, 21, 20, 18, 13, 15, 17, 21
test the hypothesis that there is no significance difference betn the marks are 1% level of Significance. Ho: μo=100

Soln >x=c(Data)
>y=c(Data)
>t.test(x,y)
welch Two Sample t-test
data = x & 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 estimates:
mean of x   mean of y
20.1   17.5

Since, p-value is greater that 0.01, ∴ We accept Ho: μ=100.

Q.3. Two types of medicine are used to 5 & 7 patients, for, reducing weight. The decrease in the weight after medicine are given below.
Medicine A : 10, 12, 13, 11, 14
B : 8, 9, 12, 14, 15, 10, 9
If there a Significance different efficiency of the medicine.
Ho: μ1= μ2.

Soln >x=c(Data)
>y=c(Data)
>t.test(x,y)
welch Two Sample t-test
data : x & y
t = 0.80384   df = 9.7594   p-value = 0.4406
alternative hypothesis true difference in means is not equal to 0.
95 percent Confidence interval:
-1.781171   3.781171
Sample estimates:
mean of x   mean of y
12   11

∴ Since, p-value is greater that 0.01, we accept Ho: μo=μ1=0.01

(Paired t-test)

Q.4. The weight reducing diet program is Conducted & the observations are noted for participants. Test whether the program is effective or not.

Before = 120, 125, 115, 130, 133, 119, 122, 127, 128, 118

After- 111, 114, 107, 120, 115, 117, 112, 120, 119, 112

Ho: There is no Significant different in weight against H1: The diet program reduce weight.

Sol'

\> x=c (Data)

\> y=c (Data)

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

Paired t-test

data: x and y

t = 8.9019   df = 9   p-value = 1

alternative hypothesis: true difference in means is less than 0

95 percent Confidence interval:

-Inf   11.45627

Sample estimates:

mean of the difference

9.5

Since, p-value is more than 0.05, we accept Ho at the level of Significance.

Q.5. Sample A: 66, 67, 75, 76, 82, 84, 88, 90, 92

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

Test the population mean are equal or not.

Soln

\> x = c (Data)

\> y= c (Data)

\> t. test (x, y)

Welch Two Sample t-test

data: x and y

t = -0.63968   df = 17.974   p-value = 0.5304

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

95 percent Confidence interval:

-12.853992   6.853992

Sample estimates

mean of x   mean of y

80   83

Since, p-value is greater than 0.05, we accept level of Significance.

Q.6. The follow are the marks before & after of training program

Test the program is effective or not

Before : 71, 72, 74, 69, 70, 74, 76, 70, 73, 75

After : 74, 77, 74, 73, 79, 76, 82, 72, 75, 78

Soln

\>x = c(Data)

\>y = c(Data)

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

Paired t-test

data : x and y

t= -4.4691   df = 9   p-value = 0.9992

66

alternative hypothesis: true difference in means is greater than 0.
95 percent confidence Interval:
-5.076639 Inf
Sample estimates:
mean of the difference
-3.6

∴ Here p-value is more than 0.05
∴ we accept Ho: No: Ig is effective.

RM 10.2.20

PRACTICAL-9, Large & Small Sample test

Q.1 The arithmatic mean of a sample of 100 items from a large population is 52. If the Standard is 7 test the hypothesis that the population mean is 55 against the alternative it is more than 55 at 5% LOS.

Q.2 In a big City 350 out of 700 males are found to be Smokers does the information supports that exactly half of the males in the City are smokers? Test b at 1% LOS.

Q.3 Thousand article from a factory: A are found to have 2% defectives, 1500 articles from a 2nd factory: B are ~~are~~ found to have 1% defective test at 5% LOS that the two factory are similiar or not

Q.4 A Sample of Size 400 was drawn at a Sample mean is 99 test at 5% LOS that the Sample Comes from a population with mean 100 & Variance is 64.

Q.5 The flower stems are selected & the heights are found to be (cm) 63, 63, 68, 69, 71, 71, 72 test the hypothesis that the mean height is 66 or not at 1% LOS.

Q8 Two random samples were drawn from 2 normal populations & their 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 the same variance at 5% LOS.

A1
Sol^n

Ho: Uo=0.5
>n=100
>mx = 52
>sd = 30
> mo = 55
> zcal=(mx-mo)/(sd/sqrt(n))
>zcal
[1] -4.285714
>pvalue=2*(1-pnorm(abs(zcal))
>pvalue
[1] 0.00001

∴ p-value is less ~~that~~ than 0.05, we will reject Ho: Uo=0.05

A.2
Sol^n
Ho: P=0.5
>n=700
>P=0.5
>Q=1-P
>p = 350÷700
>zcal=(p-P)/(sqrt(P*Q/n))
>zcal
[1] 0
>pvalue =2*(1-pnorm(abs(zcal))
>pvalue
[1]
∴ p-value is greater than 0.01, we accept Ho: Po=0.05

A.3
Sol^n
Ho: P1=P2 against H1=P1≠P2
>n1= 1000
>n2= 1500
>p1=0.02
>p2=0.01
>P=(n1*p1+n2*p2)%(n1+n2)
>P
[1] 0.014
>Q=1-P
>zcal=(p-P)/(sqrt(P*Q*(1/n+1/n2))
>zcal
[1] 2.0848
>pvalue=2*(1-pnorm(abs(zcal))
>pvalue
[1] 0.0370

∴ P-value is less than 0.05, we reject Ho: P1=P2

A.4 [illegible]

Sol^n $H_0: \mu_0 = 0.5$

```
>n = 400
>v = 64
>mx = 49
>m0 = 100
>sd = sqrt(v0)
>sd
[1] 8
>zcal = (mx-m0)/(sd/sqrt(n))
>zcal
[1] -2.5
>pvalue = 2*(1-pnorm(abs(zcal)))
>pvalue
[1] 0.0124
```

∴ p-value is less than 0.05 we reject $H_0: \mu = 0.5$

A.5

Sol^n $H_0: \mu_1 = \mu_2$

```
>x = c(Data)
>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:

64.66499 71.6207

Sample estimates:

mean of x

68.14286

Since, p-value is less that 0.01 ∴ we reject $H_0: \mu_0 = 68$

A.6

Sol^n H_0 = population is Same

```
>x = c(Data)
>y = c(Data)
>f = var.test(x,y)
>f
```

F Test to Compare two Variance

data: x and y

F = 0.70686, num df = 6, denom df = 10, p-value = 0.6359

alternative hypothesis: true ratio of Variance is not equal to 1

95 percent Confidence Interval:

0.1833662 3.0360393

Sample estimates:

ratio of Variances

0.7068567

Since, p-value is greater than 0.05, ∴ we accept $H_0: \mu_0 =$ ∴ The population have Same Variance

Scanned with CamScanner

68

PRACTICAL - 10

ANOVA & Chi - Square

Analysis of Variance

Q.1 Use the following data to test whether the cleanliness of home & cleanliness of the child independent or not

		Cleanliness of Home: Clean	Dirty
Cleanliness of child	Clean	70	50
	Fairly clean	80	20
	Dirty	35	45

Ho: CC & CH are independent

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

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


data: y
X-squared = 25.646, df = 2, p-value = 2.698e-06

Since, p-value is less than 0.05, we reject Ho: CC & CH are ~~depen~~ independent.

Q.2 Use the following data to find a vaccination & a particular disease are independent or not.

		Disease Affected	Not Affected
Vaccination	Given	20	30
	Not Given	25	35

Ho: Vaccination & disease are independent

```
> x = c(20, 25, 30, 35)
> m = 2
> n = 2
> y = matrix(x, nrow = m, ncol = n)
> y
      [,1]   [,2]
[1,]   20     30
[2,]   25     35
> pv = chisq.test(y)
> pv
```

Pearson's chi-squared test with Yates' continuity correction

data: y
X-squared = 0, df = 1, p-value = 1

Since, p-value is more than 0.05, we accept Ho: Vaccination & disease are independent.

Q.3 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

Ho: The means of the Varieties are equal

```
> 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] "value" "ind".
> Oneway.test(values ~ ind, data = d, var.equal=T)
        One-way analysis of means
data: Values & ind
F = 11.735, num df = 3, denom df = 9, p-value = 0.00183
> anova = aov(values ~ ind, data = d)
> anova
```


Call:
aov(formula = values ~ ind, data = d)
Terms:

	ind	Residuals
Sum of Squares	71.06410	18.16667
Deg. of Freedom	3	3

Residual standard error: 1.420746
Estimated effects may be unbalanced

∴ Since, p-value is less than 0.05, we reject Ho: The means of the Varieties are equal.

Q.4. Following data gives lifes of ~~tear~~ type of four brands

Type	Observations
A	(20, 23, 18, 17, 18, 22, 2
B	(19, 15, 17, 20, 16, 17)
C	(21, 19, 22, 17, 20)
D	(15, 14, 16, 18, 14, 16)

Test the hypothesis that the average for the four ~~Br~~ brands are same

Ho: The average life of four type of brand are same

15

```
> x1=c( 20,23,18,17,18,22,24)
> x2=c(19,15,17,20,16,17)
> x3=c(21,19,22,17,20)
> x4=c(15,14,16,18,14,16)
> d=stack(list(b1=x1, b2=x2, b3=x3, b4=x4))
> d
> names(d)
[1] "values"   "ind"

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

        One-way analysis of means
data: values and ind
F = 6.8445, num df = 3, denom df = 20, p-value = 0.0023

> anova = aov(values ~ ind, data=d)
> anova
Call:
   aov(formula = values ~ ind, data = d)
Terms:
                      ind    Residuals
Sum of Squares     91.4381    89.0619
Deg. of Freedom          3         20

Residual standard error : 2.110236
Estimated effects may be unbalanced.
```

Since p-value is less than 0.05, we reject the H0: The average life of four type of brand are same.

Q.5. One thousand Students of a College are graded according to their IQ & the economic Condition of their home. Check that, is there any association between the economic condition of the home and IQ.

		IQ High	IQ low
Economic Condition	High	460	140
	Medium	330	200
	low	240	160

H0: EC & IQ are independent

```
> x=c(460, 330,240,140,200,160)
> m=3
> n=2
> y=matrix(x,nrow=m, ncol=n)
> y
       [,1]   [,2]
[1,]   460    140
[2,]   330    200
[3,]   240    160
> pv=chisq.test(y)
> pv

        Pearson's chi-Squared test

data: y
X-squared = 39.726, df = 2, p-value = 2.364e-0
```

AM 17.2.22

∴ Since, p-value is less than 0.005, we reject H0: EC & IQ are independent.

Pr-11 Non-parametric Test

Q.1 Following are the amounts of Sulphur oxide emitted by industries in 20 days. Apply Sign Test. To test the hypothesis that the population median is 21.5

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

Ho: population median is 21.5

```
> x = c (Data)
> Median = 21.5
> sn = length (x[x< me])
> n = sp + sn
> sp = length (x[x>me])
> n
[1] 20
> pv = pbinom (sp, n, 0.5)
> pv
[1] 0.4119015
```

Since p-value is more than 0.05 ∴ we accept Ho: population median is 21.5

Q.2 Following are the 10 observations 612, 619, 631, 628, 643, 640, 655, 640, 670, 663) Apply Sign test to test the hypothesis that the population median is ~~615~~ 625 against the alternative it is greater than Ho = 625 at 1% LOS.

[Note: If the alternative is greater than pv = pbinom (sn, n, 0.5)

~~> x = c(sp Ho:~~

Ho: Population median is 625

```
> x = c (Data)
> Med = 625
> sn = length (x[x< med])
> sp = length (x[x>med])
> n = sp + sn
[1] 10
> pv = pbinom (sn, n, 0.5)
> pv
[1] 0.0546875
```

∴ Since, p-value is ~~less~~ more than 0.01, ∴ we accept Ho: ~~po~~ population median is 625.

85

3. 10 observations are
36, 32, 21, 30, 24, 25, 20, 22, 20, 18
Using Sign test. Test the hypothesis is 25 against the alternative it is less than 25 at 5% LOS.

Soln

H0: population median is 25
```
>x= c (Data)
> med= 25
> sp= length (x[x> med])
> sn= length(x[x< med])
> n= sp +sn
> n
[1] 9
> pv = pbinom (sp, n, 0.5)
> pv
[1] 0.2539063
```

Since, p-value is more than 0.05 we accept H0: population median is 25

Q.4. The following are some measurements - 71
63, 65, 60, 89, 61, 71, 58, 51, 69, 62, 63, 39, 72, 65
Using wilcoxon Signed Rank test, Test the hypothesis that the population median is 60 against the alternative it is greater than 60 at 5% LOS.

Soln
```
> H0: population median is 60
>x=c (Data)
>wilcox.test(x, alt="greater", mu=60)
```
wilcoxon signed rank test with Continuity Correction

data: x

V= 68 , p-value= 0.06186

alternative hypothesis: true location is greater than 60

Since, p-value is greater than 0.05, we accept H0: Population median is 60.

Q.5.
15, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26
wilcoxon signed rank test ~~with Continuity Corr~~
Test the hypothesis that the population median is ~~less~~ 20 against the alternative it is less than 20 at 5% LOS

Soln
```
> H0: population median is 20
> x= C(Data)
> wilcox.test (x, alt=" less", mu=20)
```
wilcoxon Signed rank test with continuity Correction

data: x

V= 48.5 p-value= 0.932

alternative hypothesis: true location is less than 20

∴ Since, p-value is greater than 0.05, we accept H0: population median is 20.

Q6. Data = (20, 25, 27, 30, 18)
Wilcoxon. Signed rank test. Test the hypothesis at population median is 25 against the alternative population median is not equal to 25 at 5% LOS

Sol:
H0: population median is 25

```
> x = c(Data)
> wilcox.test(x, alt = "two.sided", mu = 25)
```

Wilcoxon signed rank test with continuity correction

data: x
V = 3.5   p-value = 0.7127
alternative hypothesis: true location is not equal to 25

Since, p value is greater than 0.05, we accept
H0: population median is 25

AM
9.3.20