CS PRACTICAL - 1.

TITLE - Random variable

Q1] Find the mean & variance for the following:

a)

X	-1	0	1	2
P(X)	0.1	0.2	0.3	0.4

Solution :

X	P(X)	X·(Ep(X))	$E(X)^2$	$[E(X)]^2$
-1	0.1	-0.1	0.1	0.01
0	0.2	0	0	0
1	0.3	0.3	0.3	0.09
2	0.4	0.8	1.6	0.64
TOTAL	$\Sigma = 1$	$\Sigma = 1$	$\Sigma E(X)^2 = 2$	$\Sigma [E(X)]^2 = 0.74$

$\therefore$ Mean $= E(X) = \Sigma x_i \, p(x) = 1$

$\therefore$ Variance $= V(X) = \Sigma E(X)^2 - \Sigma [E(X)]^2$

$= 2 - 0.74$

$= 1.24$

$\therefore$ Mean $E(X) = 1$ & Variance $V(X) = 1.24$

b)

X	-1	0	1	2
P(X)	1/8	1/8	1/4	1/2

Solution :

X	P(X)	X.P(X)	$E(X)^2$	$[E(X)]^2$
-1	1/8	-1/8	1/8	1/64
0	1/8	0	0	0
1	1/4	1/4	1/4	1/16
2	1/2	1	2	1
TOTAL	$\Sigma = 1$	$\Sigma = 9/8$	$\Sigma = 19/8$	$\Sigma = 69/64$

$\therefore$ Mean $= E(X) = \Sigma X \cdot P(X) = 9/8$

$\therefore$ Variance $= V(X) = \Sigma(X)^2 - \Sigma[E(X)]^2$

$$= \frac{19}{8} - \frac{69}{64}$$

$$= \frac{152 - 69}{64}$$

$$= \frac{83}{64}$$

$\therefore$ Mean $E(X) = 9/8$ & variance $V(X) = 83/64$

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c)

X	-3	10	15
$P(X)$	0.4	0.35	0.25

Solution :

X	$P(X)$	$X \cdot P(X)$	$E(X)^2$	$[E(X)]^2$
-3	0.4	-1.2	3.6	1.44
10	0.35	3.5	35	12.25
15	0.25	3.75	56.25	14.0625
TOTAL	$\Sigma = 1$	$\Sigma = 6.05$	$\Sigma = 94.85$	$\Sigma = 27.7525$

$\therefore$ Mean $= E(X) = \Sigma X \cdot P(X) = 6.05$

$\therefore$ Variance $= V(X) = \Sigma E(X)^2 - \Sigma[E(X)]^2$

$= 94.85 - 27.7525$

$= 67.0975$

$\therefore$ Mean $E(X) = 6.05$ & variance $V(X) = 67.097$

Q.2] If $P(X)$ is pmf of a random variable x
If $P(X)$ represents pmf for random variable X.
Find value of K. Then evaluate mean & variance.

Solution : As $P(X_i)$ is a pmf it should satisfy the properties of pmf which are

a) $P(X_i) > 0$ for all sample space

b) $\Sigma P(X_i) = 1$

X	-1	0	1	2
P(X)	K+1/13	K/13	1/13	K-4/13

$\therefore \Sigma P(X_i) = 1 = \frac{K+1}{13} + \frac{K}{13} + \frac{1}{13} + \frac{K-4}{13}$

$1 = \frac{K+1+K+1+\cancel{K}-4}{13}$

$13 = 3K - 2$

$15 = 3K$

$\boxed{K=5}$

X	P(X)	X.P(X)	E(X)²	[E(X)]²
-1	6/13	-6/13	6/13	36/189
0	5/13	0	0	0
1	1/13	1/13	1/13	1/189
2	1/13	2/13	4/13	4/189
TOTAL	Σ = 1	Σ = -3/13	Σ = 11/13	Σ = 41/189

$\therefore$ Mean $= E(X) = \Sigma X \cdot P(X) = -\frac{3}{13}$

$\therefore$ Variance $= V(X) = \Sigma E(X)^2 - \Sigma [E(X)]^2$

$= \frac{11}{13} - \frac{41}{169}$

$= \frac{143-41}{169}$

$= \frac{102}{169}$

$\therefore$ Mean $= -3/13$ & variance $= 102/169$

Q3] The pmf of random variable X is given by

X	-3	-1	0	1	2	3	5	8
$P(X)$	0.1	0.2	0.15	0.2	0.1	0.15	0.05	0.05

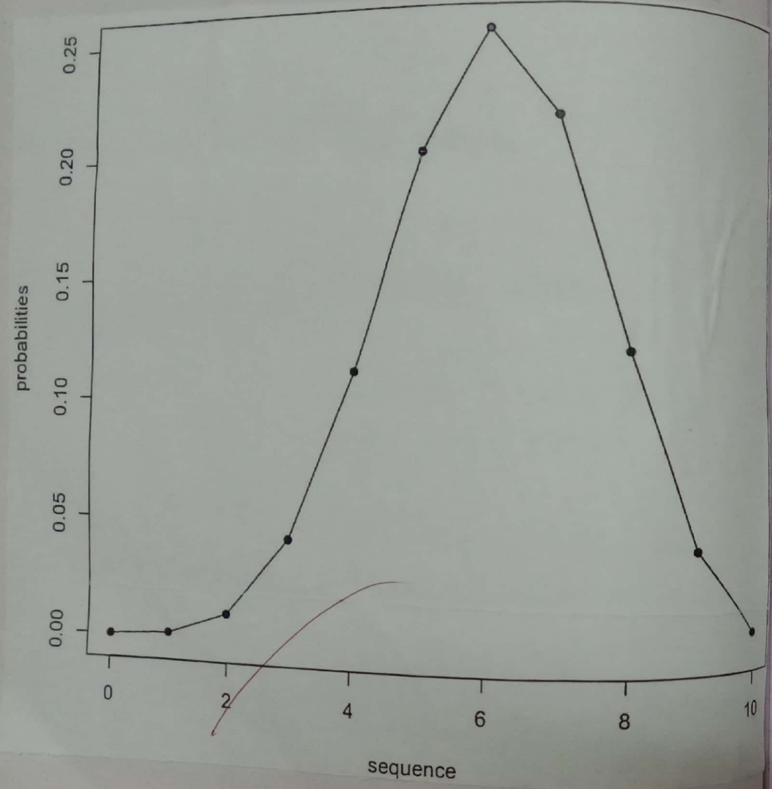
Obtain cdf. Find ① $P(-1 \le x \le 2)$
② $P(1 \le x \le 5)$ ③ $P(X \le 2)$ ④ $P(X \ge 0)$

Solution :

X	-3	-1	0	1	2	3	5	8
$P(X)$	0.1	0.2	0.15	0.2	0.1	0.15	0.05	0.05
$F(X)$	0.1	0.3	0.45	0.65	0.75	0.90	0.95	1.0

① $P(-1 \le x \le 2) = P(X \le 2) - P(X \le -1) + P(X = -1)$
$= F(X_b) - F(X_a) + P(a)$
$= F(2) - F(-1) + P(-1)$
$= 0.75 - 0.3 + 0.2$
$= 0.25$

② $P(1 \le x \le 5) = F(X_b) - F(X_a) + P(a)$
$= F(5) - F(1) + P(1)$
$= 0.95 - 0.65 + 0.2$
$= 0.15$



③ $P(X \leq 2) = P(X=-3) + P(X=-1) + P(X=0) + P(X=1) + P(X=2)$

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

$= 0.75$

④ $P(X \geq 0) = 1 - F(0) + P(0)$

$= 1 - 0.45 + 0.15$

$= 0.40$

Q4] Let f be continuous random variable with pdf

$f(x) = \frac{x+1}{2} \quad -1 < x < 1$

$= 0$ otherwise

~~obj~~ obtain cdf of x. Find mean & variance

Solution : By definition of cdf we have

$F(X) = \int_{0-1}^{+1} t\,dt$

$= \int_{-1}^{1} \frac{x+1}{2}\,dx$

$= \frac{1}{2}\left(\frac{1}{2}x^2 + x\right) \quad$ for $-1 \leq x \leq 1$

Hence the cdf is

$F(X) = 0 \quad$ for $x < \cancel{0}\ -1$

$= \frac{1}{4}x^2 + \frac{1}{2}x \quad$ for $-1 \leq x \leq 1$

$= 0 \quad$ for $x \geq 1$

Q.5] Let f be continuous random variable with pdf

$f(x) = \frac{x+2}{18}$ $\quad -2 \le x \le 4$

$= 0$ $\quad$ otherwise

Calculate cdf

Solution : By definition of cdf we have

$F(X) = \int_{-2}^{4} t \, dt$

$= \int_{2}^{4} \frac{x+2}{18} \, dx$

$= \frac{1}{18}\left(\frac{1}{2}x^2 + 2x\right)$

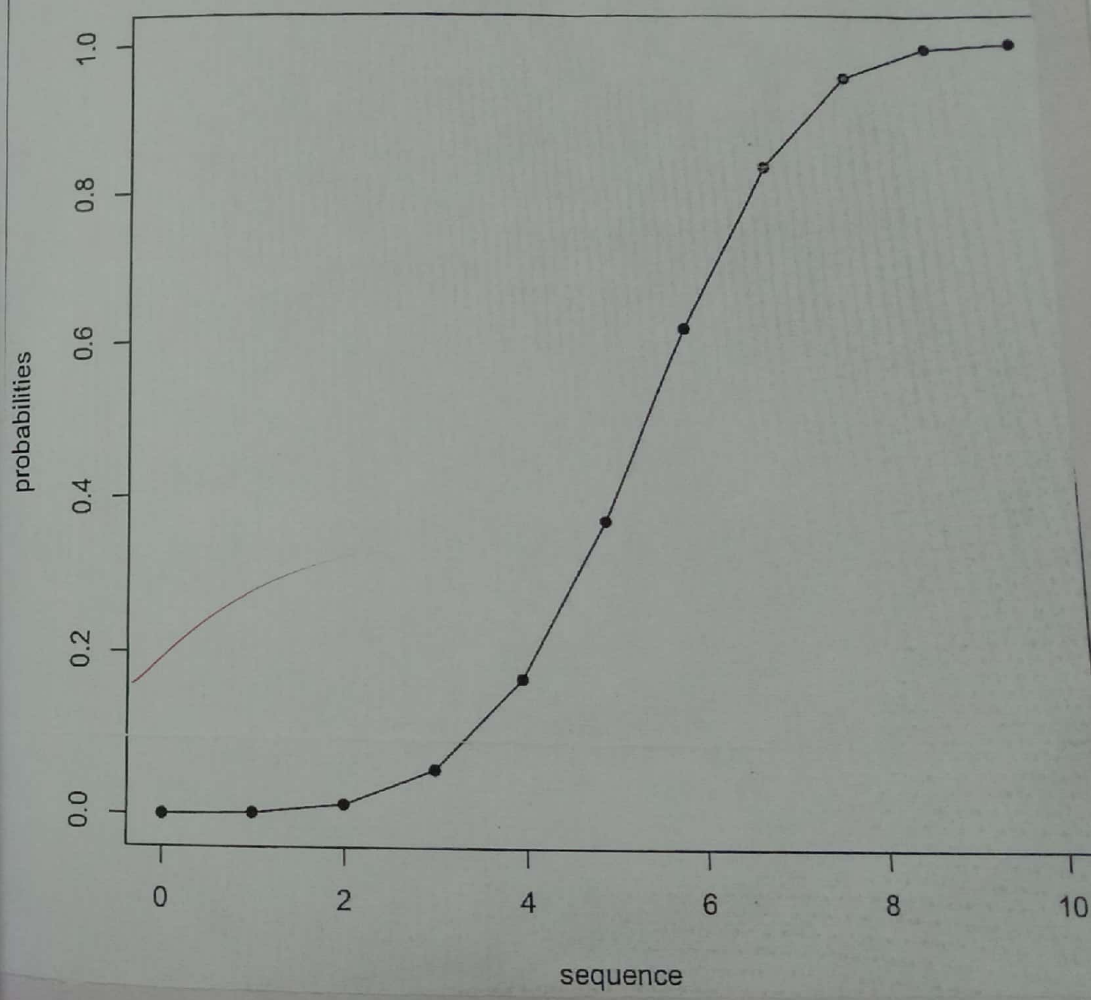
for $-2 < x \le 4$

Hence cdf is

$F(X) = 0$ $\quad$ for $X < -2$

$= \frac{1}{18}\left(\frac{1}{2}x^2 + 2x\right)$ $\quad$ for $-2 < x < 4$

$= 0$ $\quad$ for $x \ge 4$



PRACTICAL - 02

TITLE - Binomial Distribution

1) An unbiased coin is tossed 4 times calculate the probability of obtaining no head, at least one head & more than one tail.

NO HEAD :

```
> dbinom(0,4,0.5)
[1] 0.0625
```

ATLEAST ONE HEAD

```
> 1- dbinom(0,4,0.5)
[1] 0.9375
```

MORE THAN ONE TAIL :

```
> pbinom(1,4,0.5, lower.tail=F)
[1] 0.9375
```

2) The probability of that student is accepted to a prestigous college is 0.3. If 5 students supply, what's the probability of almost 2 are accepted

```
> pbinom(2,5,0.3)
[1] 0.83692
```

Q.3] An unbiased coin is tossed 6 times the probability of head at any toss = 0.3. Let x be no of heads that comes up. Calculate P(X = 2), P(X = 3), P(1 < x < 5).

```
> dbinom (2,6, 0.3)
[1] 0.324135
> dbinom (3,6,0.3)
[1] 0.18522
> dbinom (2,6, 0.3) + dbinom (3,6,0.3) + dbinom(4,6,0.3
[1] 0.74373
```

Q.4] For n = 10, P = 0.6. Evaluate binomial probabilities & plot the graphs of pmf & cdf

```
> x = seq (0,10)
> y = dbinom (x,10,0.6)
> y
[1] 0.0001048576   0.0015728640   0.0106168320
    0.0424673280   0.1114767360   0.2006581248
    0.2508226560   0.2149908480   0.1209323520
    0.0403107840   0.0060466176

> plot (x, y, xlab = "sequence", ylab =
  "probabilities", "b", pch = 16)
```

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```
> x = seq (0, 10)
> y = pbinom (x, 10, 0.6)
> plot (x, y, xlab = "sequence", ylab = "probabilities",
        "b", pch = 16)
```

5] Generate a random sample of size 10 for a B.D → B(8, 0.3). Find the mean & the variance of the sample.

```
> x = rbinom (8, 10, 0.3)
[1] 2 2 3 4 3 4 2 3
> ~~rbinom (8, 10, 0.3)~~ summary (x)
[1] 2.375
> var (x)
[1] 3.125
```

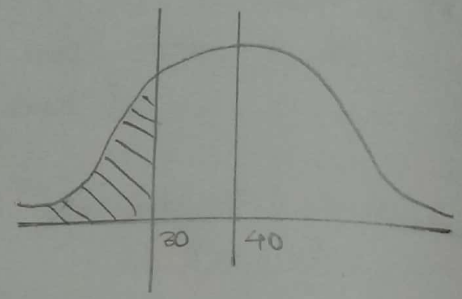
6] The probability of men hitting the target is 1/4 if he shoots 10 times what is the probability that he hits the target exactly 3 times, probability that he hits target atleast one time.

```
> dbinom (3, 10, 0.25)
[1] 0.2502823
> 1- dbinom (1, 10, 0.25)
[1] 0.8122883
```

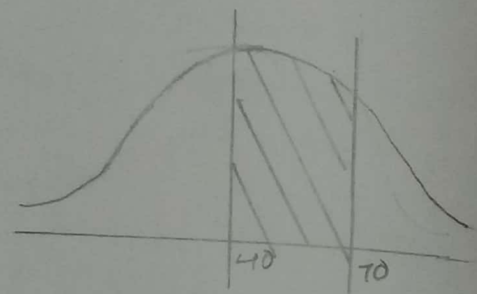
Q6] Bits are sent for communication channel in packet of 12. If the probability of bit being corrupted is 0.1. What is the probability of no more than 2 bits are corrupted in a packet?

```
> pbinom (2,12,0.1 , lower.tail = F ) + dbinom
                                   ( 2,12,0.1)
[1] 0.3409977
```

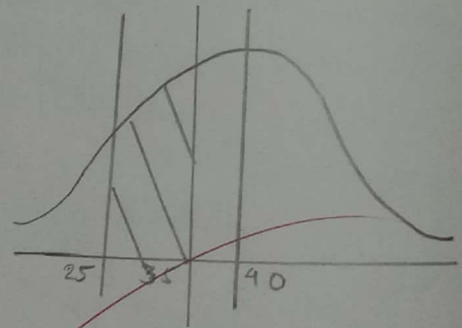
Q1]
a)



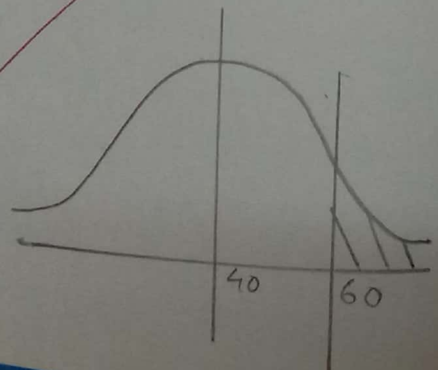
b)



c)



d)



TITLE - Normal Distribution

1] A normal distribution of 100 students with mean = 40, SD = 15. Find no. of students whose marks are ① $P(X<30)$ ② $P(40 < x < 70)$ ③ $P(25 < X < 35)$ ④ $P(X > 60)$

```
> pnorm (30,40,15)
[1] 0.2524925
```

```
> pnorm(70, 40, 15) - pnorm (40,40,15)
[1] 0.4772499
```

```
> pnorm (35 , 40, 15) - pnorm ( 25, 40, 15)
[1] 0.2107861
```

```
>1-pnorm ( 60 ,40, 15)
[1] 0.09121122
```

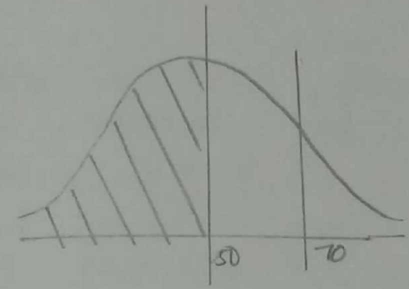
Q.2] If the random variable x follows a normal distribution with mean = 50, V = 100. Find
① $P(X \le 70)$ ② $P(X > 65)$ ③ $P(X \le 32)$
④ $(35 < x < 60)$ ⑤ $P(20 < x < 30)$

```
> pnorm ( 70,50,10)
[1] 0.9772499

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

> pnorm (32,50,10)
[1] 0.03593032

> pnorm (60,50,10) - pnorm (35,50,10)
[1] 0.7745375

> pnorm (30, 50,10) - pnorm (20,50,10)
[1]   0.02140023
```

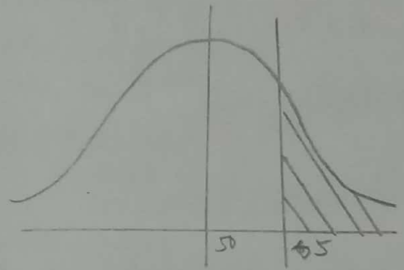
Q3] Let $X \sim N(160, 400)$ find k_1 & k_2 such that $P(X < k_1) = 0.6$ & $P(X > k_2) = 0.8$

```
> qnorm (0.6, 160, 20)
[1]   165.0669
> qnorm (0.8 , 160 , 20)
[1]  176.8324
```

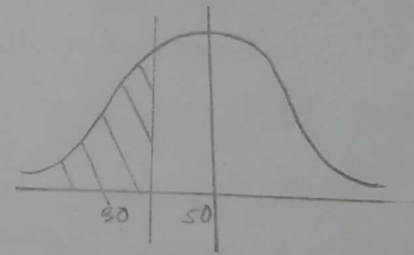

Q.2
a]



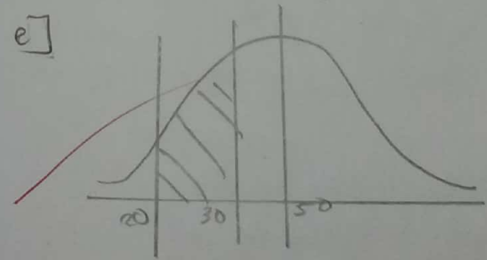
b]



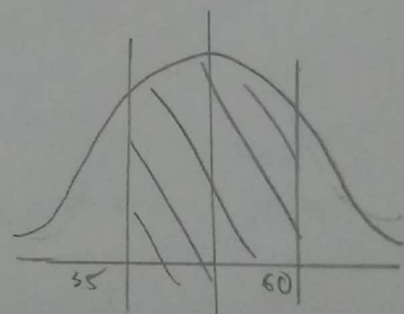
c]



e]



d]



4] A random variable X follows normal distribution with $\mu = 10$, $\sigma = 2$, Generate 100 observations & evaluate its mean, median & variance.

```
> x - rnorm(100, 10, 2)
> summary(x)
[1]  Min    1st Q   Median   Mean    3rd Q    Max
     5.713  8.444   9.723    9.914   11.325   14.238
> var(x)
[1] 3.648924
```

5] Write a command to generate 10 random numbers for normally distribution with $\mu = 50$, $\sigma = 4$. Find the sample mean & median.

```
> x = rnorm(10, 50, 4)
> summary(x)
   Min    1st Q   Median   Mean    3rd Q    Max
   44.73  50.46   52.01    52.35   54.39    58.85
```

E.A

PRACTICAL – 4

Title : Testing of Hypothesis

Q] Sample mean and deviation given single population.

1] Suppose the food level on the cookie states that it has atmost 2g of saturated fats in a single ~~2g of saturated~~ fa cookie. In a sample of 35 cookies, it was found that mean amt of saturated fat per cookies 2.1g. Assume that the sample is 0.3 at (5% level of conf) can be rejected the claim on food label

$H_0 = \mu < 2$

$H_1 = \mu > 2$

```
> z = (2.1 - 2) /(0.3/ sqrt (35))
[1] 1.972027
> 1 - pnorm (z)
[1] 0.0243
```

∴ Reject the null hypothesis

∴ Accept H_1

2] A sample of 100 customers was randomly selected & it was found that average spending was 275/-. The SD = 30. Using 0.05 level of significance would you conclude that amount spent by customer is more than 250/-

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$H_0 : \mu < 250$

$H_1 : \mu > 250$

```
> z = (275 - 250)/(30/ sqrt(100))
> z
[1]  8.333
> 1- pnorm (z, 99)
[1]  2.3057
```

∴ Reject the null Hypothesis

∴ Accept H_1

A quality control of engineer finds that sample of 100 light have average life of 470 hours. Assuming population SD=25 test whether the population mean is 480 hours. LOS → 0.05

$H_0 = \mu < 480$

$H_1 = \mu > 480$

```
> z = (470 - 480)/(25/ sqrt (100))
> z
[1] - 4
> pt (z, 99, lower.tail = T)
[1] 6.11257
```

∴ Reject null hypothesis

∴ Accept H_1

Q.4] A principle at school claims that the IQ is 100 of the students. A random sample of 30 students whose IQ was found to 118. The SD of population = 15 test the claim of principal

$H_0 = \mu = 100$

$H_1 = \mu > 100$

```
> z = (112 -100) /(15/sqrt(30))
> z
[1] 4.38178
> pt (z, 99, lower.tail = F)
[1] 5.8856 e - 06
```

∴ Reject null hypothesis

Q single population proportion.

1] It is believed that coin is fair. The coin is tossed 40 times; 25 times head occurs. Indicate whether the coin is fair or not at 95% LOC

$p_0 = 0.5$, $q_0 = 1 - p_0 = 0.5$

$p = 28/40 = 0.7$, $n = 40$, $H_0 = \mu = 0.5$ $H_1 = \mu \neq 0.5$

```
> z = (0.7-0.5) / sqrt ((0.5 * 0.5) /40))
> z
> 2* (1- pnorm (abs (z))
[1] 0.01141204
```

Reject null hypothesis
Accept the H_1

In a hospital 400 females & 520 males & born in a week. Do this confirm male & female are born equal in number.

$H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

```
> z = (0.52-0.5) / ( sqrt((0.5*(0.5) /1000))
> z
[1] 1.2645
> 2 *(1- pnorm (abs(z))
[1] 0.2060506
```

~~[1] 0~~

Reject H_0

Accept H_1

In a big city, 325 men out of 600 men were found to be self employed. conclusion is that maximum men in city are self employed.

$H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

```
> z = (0.5 - 0.325) / sqrt((0.5 * 0.5) /600)
> 2* 1-pnorm (abs (z))
[1] 0.04155 239
```

Reject H_0

Accept H_1

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4] Experience shows that 20% of manufacturer products are of top quality. In 1 day production of 400 articles only 50 are top quality. Test hypothesis that experience of 20% of manufactured is wrong.

$H_0 = \mu = 0.2$

$H_1 = \mu \neq 0.2$

```
> z = (0.125 - 0.20) / sqrt((0.2 * 0.8) / 400)
> 2* 1 - pnorm (abs(z))
[1] 0.0001768346
```

Reject H_0, Accept H_1

Q. Equality of 2 population proportion.

i] In an early election campaign a telephone ~~pole~~ of 800 registered voters shows favor 460. In second pole opinion 520 of 1000 registered voters favored the candidate at 5% level of confidence is there sufficient evidence that popularity has decreased.

$H_0 = P_1 = P_2$

$H_1 = P_1 \neq P_2$

```
> P = (460* 800 + 520* 1000) / (520 + 1000)
> P
> [].544
```

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> 1 - 0.544

> 0.456

> z = sqrt (0.544 * 0.456 * (1/520 + 1/1000))

> 2 * (1- pnorm (abs(z))

[1] 0.5444

Accept H_0

2) From a consinment 200 articles are drawn & 44 was found defective from consinment B, 200 samples are drawn out of which 30 was found defective. test whether the proportion of defective items in 2 consinment are significantly differme

$H_0 = P_1 = P_2$

$H_1 = P_1 \neq P_2$

> (0.22 * 200 + 0.15 * 200/~~2~~ (1/200 + 1/200))

> 0.185

> 1 - 0.185

> 0.815

> z = sqrt (0.185 * 0.815 * (1/200 + 1/200))

> 2 * (1 - pnorm(abs(z))

[1] 0.9969018

Accept H_0

CA.

Pracdical - 5

TITLE - chi - square test

1. Use the following data to test whether the attribute conditions of home & child are independent.

		Condition of Homes	
		Clean	Dirty
Condition of a child	Clean	70	50
	f. clean	80	20
	Dirty	35	45

Ho = Both are independent, H1 = Both are dependent

```
> x = c(70,80,35)
> y = c(50,20,45)
> z = data.frame(x,y)
> z
[1]     x     y
    1   70    50
    2   80    20
    3   35    45
> chisq.test(z)
```

Pearson's Chi squared test

data: z

x - squared = 25.646, df = 2, p-value = 2.698e-06

Q.2 A dice is tossed 120 times & following results are obtained

No. of terms	Frequency
	30
1	25
2	18
3	10
4	22
5	15
6	

Test the hypothesis that dice is unbiased.

∴ H_0 = dice is unbiased, H_1 = dice is biased

```
> abs = c(30, 25, 18, 10, 22, 15)
> exp = sum(abs) / length(obs)
> exp
[1]  20

> z = sum((obs - exp)^2 / exp)
> pchisq (z, df = length (obs) - 1)
[1] 0 9 5 6 6 5 9
```

∴ Accept the null hypothesis

∴ Dice is unbiased

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Q.3] An IQ test was conducted & the students were observed before & after training the result are following

Before	After
110	120
120	118
123	125
132	136
125	121

Test whether there is change in the IQ after the training

H_1 = no change in IQ
H_0 = IQ increased after training

```
> a = c(120, 118, 125, 136, 121)
> b = c(110, 120, 123, 132, 125)
> z = sum((b-a)^2)/a)
> pchisq(z, df = length(b)-1)
[1] 0.1135959
```

Accept the null hypothesis
∴ There is change in IQ after training.

8.4]

	Graduate	Undergraduate
Online	20	25
face to face	40	5

Is there any association between student's preference for type of education & method.

∴ H_0 = Independent, H_1 = Dependent

```
> x = c(20, 40, 25, 5)
> z = matrix(x, nrow = 2)
> chisq.test(z)
```

Pearson's chi-squared test with Yates continuity correction

data : z

χ-squared = 18.03, df = 1, p-value = 2.15e-05

∴ Reject null Hypothesis

∴ Both are dependent

Q.5 A dice is tossed 180 items.

No. of terms	frequency
1	20
2	30
3	35
4	40
5	12
6	43

Test the hypothesis that dice is unbiased

H_0 = dice is biased
H_1 = dice is unbiased

```
> x = c (20, 30, 35, 40, 12, 43)
> chisq.test (x)
```

chi squared test for given probabilities

data : z

x-squared = 23.933, df = 5, p-value = 0.000227

Reject null hypothesis

Dise is unbiased

Next

PRACTICAL - 6

TOPIC - t test.

1] Let x = 3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3398, 3424, 3388, 3374, 3384, 3374

write the R command for following to test hypothesis

① $H_0 : \mu = 3400$, $H_1 : \mu \neq 3400$

② $H_0 : \mu = 3400$, $H_1 : \mu > 3400$

③ $H_0 : \mu = 3400$, $H_1 : \mu < 3400$

at 95% level of confidence. Also check at 97% level of confidence.

→ ① $H_0 : \mu = 3400$

$H_1 : \mu \neq 3400$

```
> x = c(3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356,
  3376, 3382, 3377, 3355, 3408, 3401, 3398, 3429, 3283,
  3374, 3384, 3374)
> t.test (x, mu = 3400, alter = "two.sided", conf.level = 0.95)
```

one sample t-test

data: x

t = -4.4865, df = 19, p value = 0.0002528

alternative hypothesis: True mean is not equal to 3400

95 percent confidence level:

3361.797 3386.103

sample estimates:

mean of x

33739.5

∴ Reject H_0
∴ Accept H_1
> t.test (x, mu = 3400, alter = "two.sided",
conf.level = 0.97)
one sample test
data : x
t = -4.4865, df = 19, p-value = 0.0002528
alternate hypothesis : true mean is not equal to 3400
3360.33 3387.57
sample estimates:
mean of x :
3373.95
∴ Reject H_0
∴ Accept H_1

(2) $H_0 = \mu = 3400$
$H_1 = \mu > 3400$
> t.test (x, mu = 3400, alter = "greater", conf.level = 0.95)
one sample t-test.
data : x
t = -4.4865, df = 19, p-value = 0.9999
alternative hypothesis : true mean is greater than 3400
3363.91 Inf
sample estimates:
mean of x:
3373.95
∴ Accept H_0

95 percent level of confidence
∴ Inf 3385.563
sample estimates:
mean of x:
337395
∴ Reject H_0
Accept H_1

2] Below all the data of gain in weights on 2 different diets A & B.

Diet A : 25, 32, 30, 43, 24, 14, 32, 24, 31, 31, 35, 25

Diet B : 44, 34, 22, 10, 47, 31, 40, 30, 32, 35, 18, 21

→ ∴ H_0 = $a - b = 0$
∴ H_1 = $a - b \neq 0$

```
> a = c(25, 32, 30, 43, 24, 14, 32, 24, 31, 18, 21)
> b = c(44, 34, 22, 10, 47, 31, 40, 30, 32, 35, 18, 21)
> t.test(a, b, paired = T, alter = "two sided", conf.level = 0.95)
```

Paired t-test

data: a and b
t = -0.62787, df = 11, p-value = 0.5429
alternative hypothesis: true difference in means is not equal to 0.

95 percent confidence interval:
-14.267330 7.933997

sample estimates
mean of the difference
-3.166667

∴ Accept H_0
∴ There is no difference in weights

3 Eleven students gained the test after 1 month they again gave the test after the tutions, do the marks gives evidence that students have benifits by coaching.

E_1 : 23, 20, 18, 21, 18, 20, 18, 17, 23, 16, 19.
E_2 : 24, 19, 22, 18, 20, 22, 20, 23, 20, 17.
test at 79 level of confidence

```
> E1 = c(23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19.
> E2= c(24, 19, 22, 18, 20, 22, 20, 23, 20, 17
```

∴ H_0 : $e_1 = e_2$
∴ H_1 : $e_1 < e_2$

```
> t.test(e1, e2, paired = T, alter = "less", conf.level = 0.98)
```

paired t-test.
data : e_1 and e_2
t = -1.4832, df = 10, p-value = 0.0844,
alternative hypothesis : true difference in mean is less than 0
79 percent confidence interval
-Inf 0.863333
sample estimates :
mean of the differences :
-1
∴ Accept H_0

> t.test (x, mu = 3400, alter = "greater", conf.level = 0.97)

one sided t-test

data : x

t = -4.4865, df = 19, p value = 0.9999 alternative

hypothesis : true mean is greater than 3400

3367.37 Inf

sample estimates :

mean of x :

3373.95

∴ Accept H_0

H_0 : μ = 3400

H_1 : μ < 3400

> t.test (x, mu, 3400, alter = "less", conf.level = 0.95

one sided t-test

data : x

~~t = test~~ -4.4865 df = 19, pvalue = 0.0001864

Alternative hypothesis : true mean is less than 3400

95 percent level of confidence - Inf 3383.99

sample estimates :

mean of x :

3373.95

∴ Reject H_0

∴ Accept H_1

> t.test (x, mu = 3400, alter = "less", conf.level = 0.94)

one sample t.test

data : X

t = -4.4865, df = 19, p value = 0.0001264

alternative hypothesis : true mean is less than 3400.

Q.4] Two drugs for BP was given & data was collected

D1 : 0.3, 7.6, -6.2, -1.2, -0.1, 3.4, 3.7, 0.8, 0.2

D2 : 1.9, 0.8, 1.1, 0.1, 0.1, 4.4, 5.5, 1.6, 4.6, 3.4.

The two drugs have same effect, check whether two drugs have same effect on patient or not

→ $H_0 : d_1 = d_2$

$H_1 : d_1 \neq d_2$

> d_1 = c (0.7, -1.6, -1.2, -0.1, 3.4, 3.7, 0.8, 0.2.

> d_2 = c(1.9, 0.8, 1.1, 0.1, -0.1, 4.4, 5.5, 1.6, 4.6, 3.4

> t.test (d_1, d_2, alter = "two.sided", paired = T, conf.level=0.95)

Paired t-test

data : d_1 and d_2

t = -4.0621, df = 4, pvalue = 0.002833

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

95 percent confidence interval:

mean of the differences:

-1.58

∴ Reject H_0

∴ Accept H_1

Q.5 If there is difference in salaries for the same job in 2 different countries

CA : 53000, 49958, 41974, 44366, 40476, 36963.

CB : 62940, 58850, 9495, 52263, 47674, 43552 -

$\therefore H_0 : S_1 = S_2$

$\therefore H_1 : S_1 \neq S_2$

```
> CA = c(53000, 49958, 41974, 44366, 40470, 36963)
> CB = c(62490, 58550, 47495, 52263, 47674, 43552)
> t.test(CA, CB, paired = T, alter = "two-sided", conf.level = 0.95)
```

paired t test

data: ca and cb

t = -4.4569, df = 5, p-value = 0.0066,

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

95 percent confidence interval:

-10404.821 -2792.846

sample estimates:

mean of the differences:

-6598.833

$\therefore$ Reject H_0

$\therefore$ Accept H_1

19

PRACTICAL-7 TOPIC - F-test

Q.1] Life expectancy in 10 regions of India in 1990 & 2000 are given below. Test whether var at the two time are the same.

1990 : 37, 39, 36, 42, 43, 44, 46, 49, 50, 51
2000 : 44, 45, 47, 43, 42, 49, 50, 41, 48, 52, 58, 42.

→ > x = c (37, 39, 36, 42, 45, 44, 46, 49, 50, 51)
> y = c (44, 45, 47, 43, 42, 49, 49, 50, 41, 48, 52, 42, 58)
> var. test (x, y)

F test to compare two variances:
data : x and y
F = 1.1449, num df = 9, denom df = 11, p value = 0.8185 alternative hypothesis : true ratio of variances is not equal to 1.
95 % confidence ~~level~~ interval :
0.3191005 4.4789350

sample estimates :

ratio of variances :

1.1449

27) For following data, test hypothesis for -

① Equality of two population mean (→ T-test)

② Equality of two proportion variance (→ f-test)

sample 1 : 175, 168, 145, 190, 181, 185, 175, 200
sample 2 : 180, 170, 153, 180, 179, 183, 187, 205.

→ > x = c(175, 108, 145, 190, 181, 185, 175, 200)
> y = c(180, 170, 153, 180, 179, 183, 183, 187, 205)
> var.test (x, y)

F test to compare two variances.
data : x and y.
F = 1.25, num df = 7, denom df = 7, p-value alternative
hypothesis : true ratio of variances is not equal to 1.
0.2502589 0.2437398
sample estimates
ratio of variances
1.250021
t-test (x)
one sample t-test
data : 0
sample estimate :
mean of x :
177.375

Q.3 The following are prices of commodities in sample of shops selected at random from different cities.

CA : 74.10, 77.70, 75.35, 74, 73.80, 79.30, 75.80, 76.86, 77.70, 76.40

CB : 70.80, 74.90, 76.20, 72.80, 78.10, 74.80, 69.80, 81.20

→ >a=c(74.10, 77.70, 75.35, 74, 73.80, 79.30, 75.80, 76.86, 77.70, 76.40)

>b=c(70.80, 74.90, 76.20, 72.80, 78.10, 74.80, 69.80, 81.20)

> var.test(a,b)

F- test to compare two variants

data a and b

F = 0.22579, num df = 9, denom df = 7, pvalue = 0.04241

alternative hypothesis true ratio of variance is not equal to 1

95% confidence level

sample estimates

ratio of variance :

0.22579

4.] Prepare CSV file in excel, import file in R & apply the test to check equality of variance of 2 datas.

obs. 1 → 10, 15, 17, 11, 16, 20
obs. 2 → 13, 14, 16, 11, 12, 19

```
> Data = read.csv(file.choose(), header = TRUE)

> Data
   obs.1   obs 2
1   10      15
2   15      14
3   17      16
4   11      11
5   16      12
6   20      19

> attach(Data)
> var.test(obs1, obs)
```

F test to compare two variances

data = obs. 1 and obs 2

F = 1.7068, num df = 5, denom df = 5, P value = 0.5717

alternative hypothesis : True ratio of variances is not equal to 1

95% confidence interval.

0.238838   12.197840

sample estimates.

Q5) I : 25, 28, 26, 22, 22, 29, 31, 31, 31, 26, 31
II : 30, 25, 31, 32, 23, 25, 31, 32, 32, 27, 31, 38, 24

at 95% of confidence level, check the ratio of population variation.

$\therefore H_0 = \sigma_1^2 = \sigma_2^2$
$\therefore H_1 = \sigma_1^2 \neq \sigma_2^2$

> x = c(25, 28, 26, 22, 22, 29, 31, 31, 31, 26, 31)
> y = c(30, 25, 31, 32, 32, 23, 25, 36, 25, 31, 32, 24)
> var.test(x, y)

F test to compare two variance
p - value = 0.4535
$\therefore$ Accept H_0
$\therefore$ Variance of I & II are same

Klee

Scanned with CamScanner

PRACTICAL - 8

TOPIC - NON - PARAMETRIC TEST

The time of (in hrs) of 10 randomly selected 9 volt battery of a certain company is as follows 28.9, 15.2, 28.7, 72.5, 48.6, 52.4, 37.6, 49.5, 62.1, 54.5
Test the hypothesis that the population median is 63 against the alternative hypothesis less than 63%. at 5% level of significance.

Soln -

```
> x = c(28.9, 15.2, 28.7, 72.5, 48.6, 52.4, 37.6, 49.5, 62.1, 54.5)
> Sp = which(x>63)
> a=length(sp)
[1] 1
> Sn = which(x<63)
> length(Sn)
[1] 9
> qbinom(0.05, 10, 0.5)
[1] 2
```

∵ The value of qbinom is less than Sn

∴ Accept the null hypothesis

2.] The following data ~~is~~ gives the weight of 40 students in random sample -

46, 59, 64, 46, 67, 54, 48, 69, 61, 57, 54, 50, 48, 65, 61, 68, 54, 50, 48, 49, 62, 47, 49, 55, 59, 63, 53, 56, 67, 49, 60, 64, 53, 50, 48, 51, 52, 54.

Soln.

```
> x= c(46,59,64,46,67,54,48,69,61,57,54,50,48,65,61,
       68,54,50,48,49,62,47,49,47,55,59,63,53,
       56,67,49,60,64,53,50,48,51,52,54)
> Sp = which(x>50)
> length(Sp)
[1] 25
> Sn = which(x<50)
[1] 12
> qbinom(0.05, 40, 0.5)
[1] 15
```

∵ The value of qbinom is greater than Sn

∴ Reject the null hypothesis

3. Median age of Tourist visiting a certain place is acclaimed to be 41 years. A random sample of 17 tourists have the age 25, 29, 52, 48, 57, 39, 44, 63, 32, 65, 42.
Use the sign test to check the claim.

→
```
> x = c(25, 29, 52, 48, 57, 39, 44, 63, 32, 68, 42)
> Sp = which(x > 41)
[1]   9
> Sn = which(x < 41)
[1]   8
> qbinom (0.05, 17, 0.5)
[1]   5
```

∴ Accept the null hypothesis

4. The time in minutes that the patient has to wait is recorded as -
15, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26.
Use wilcox sign test to check whether the median waiting line is more than 20 at 5% level of significance.

Soln :

```
> x = c(15, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26)
> ~~wilcox.test(x, alternative = "greater")~~
> Sp = which (x > 20)
> length (Sp)
[1]   8
```

63

> sn = which (x < 20)
> length (sn)
[1] 3
> wilcox. test (x, alternative = "greater")

[1] wilcox signed rank-test with continuity correction.

data : X
V = 78, p-value = 0.001283
alternative hypothesis is true location than 0

∴ Accept null hypothesis

Q.5] The weight in kgs of the person before & after they stopped smoking

weight before - 65, 75, 75, 62, 72
weight after - 72, 82, 72, 66, 73

Use wilcoxon test to check whether the weight of person increases after stopping the smoking. Use 5% level of significance. @ 5% level of significance.

Sol^n :

```
> x = c(65, 75, 75, 72, 62)
> y = c(72, 72, 78, 62, 82)
> z = x-y
> z
[1]   -7   0   3   -7   -4

> wilcox.test(z, mu = 0, alternative = "less")
[1]
        wilcoxon signed rank test with continuity
   correction

data : z
  V = 1      ,    p- value = 0.09873
alternative hypothesis : true location is less than 0.
```

∴ Reject null hypothesis

PRACTICAL - 9

1] The following data gives the effect of 3 treatments

T_1	T_2	T_3
2	10	10
3	8	13
7	7	14
2	5	13
6	10	15

Test the hypothesis that all treatment are equally effected.

```
> t1 = c(2,3,7,2,6)
> t2 = c(10,8,7,5,10)
> t3 = c(18, 13,14,13,15)
> data = data.frame(t1,t2,t3)
> data
   t1  t2  t3
1  2   10  10
2  3   8   13
3  7   7   14
4  2   5   13
5  6   10  15
> e = stack(data)
> e
```

The numbers are arranged in the form of data

```
> aov (values ~ ind, e)
Terms:
                        ind        Residual's
sum of squares          203.333    54.000
Degree of Freedom       2          12
Residual standard error : 2.12132
> oneway.test (values ~ ind, e)
   data : values and ind
   F = 21.537, num df = 2000, dinom dF = 7.9317
   p-value = 0.0006232
   Reject the null hypothesis
```

2] The following gives the life of Types of board. Test the hypothesis.

A	B	C	D
20	18	21	15
23	15	19	14
18	17	22	16
17	20	17	18
22	16	20	14
24	17		16

```
> a = c (A)
> b = c (B)
> c = c (C)
> d = c (D)
```

> L = list (a1 = a, b1 = b, c1 = c , d1 = d)

> L

$ a1

[1] 20 23 18 17 22 27

$ b1

[1] 18 15 17 20 16 17

$ c1

[1] 21 19 22 17 20

$ d1

[1] 15 14 16 13 14 16

> e = stack (L)

> e

The data is formed in the way of continuous data.

> one way. test (values ~ ind, e)

data : P value and ind

F = 6.6498, num dF = 3.000, denom dF = 10.093

p value = 0.009376

∴ Reject the null hypothesis.

3] Three types of wax is applied for the protection of care Eg no. of days of protection were needed. Test them are equally effective.

A	B	C
44	40	50
45	42	53
46	51	58
47	52	59
48	55	
49		

Test whether 3 are equally effective

```
> a= c (data of A)
> b = c ( data of B)
> c= c (data of c)
> L = list (a1= a, b1 = b, c1 = c)
> L
$ a1
[1]   44   45   46   47   48   49

$ b1
[1]   40   42   50   52   55

$c1
[1]   50   53   58   59
```

> e = stack (L)
> e

The data is arranged in continuous form
> oneway.test (values ~ ind, e)
Data : values and ind
F = 6.325, num dF = 2.000, denom dF = 5.413,
p-value = 0.0382

Reject the null hypothesis.

4] An experiment was conducted on 8 person & the observation noted are.

No exercise - 23, 26, 51, 48, 58, 37, 29, 44
20 min - 22, 27, 29, 39, 46, 48, 49, 65
60 min - 59, 66, 38, 49, 56, 60, 56, 62

Test the hypothesis are equal.

```
> s = c (data of no-exercise)
> p = c (data of 20 min)
> q = c (data of 60 min)
> L . list (a1 = o, b1 = p, c1 = q)
> L
```

$ [a,]

23 26 31 48 58 37 29 44

$ [b,]

22 27 29 39 46 48 49 65

$ [c,]

59 66 38 49 56 60 56 62

> e = stack (L)

> e

Data is arranged

> oneway.test (values ~ ind, e)

data: values and int

F = 5.9169, num dF = 2.000, denom dF = 13.334

p-value = 0.01633

∴ Reject null hypothesis.