Practical 1:-

Title:- Random Variable.

Q1/ Find the mean & the variance for the following

a)

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

Solⁿ:-

X	P(X)	X.P(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	$\Sigma = 1$	$\Sigma = 1$	$\Sigma E(X)^2 = 2.0$	0.74

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

$\therefore$ 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

Solⁿˢ:-

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 = $E(X) = \Sigma X.P(X) = 9/8$

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

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

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

$= \frac{83}{64}$

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

c)

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

Soln:-

X	P(X)	X.P(X)	E(X)^2	[E(X)]^2
-3	0.4	-1.2	3.6	1.44
10	0.35	3.5	3.5	12.25
15	0.25	3.75	56.25	14.0625
Total	Σ=1	Σ=6.05	Σ=94.85	Σ=27.7525

∴ Mean = $E(X) = \Sigma X.P(X) = 6.05$

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

$= 94.85 - 27.7525$

$= 67.0975$

∴ Mean E(X) = 6.05 & variance V(X) = 67.0975

Q2) If P(X) is pmf of random variable X. If P(X) represents pmf for random variable X. Find value of K. Then evaluate mean & variance

Soln:- As P(xi) is a pmf it should satisfy the properties of pmf which are

a) $P(x_i) \geq 0$ 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

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

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

$1 = \frac{3K-2}{13}$

$13 = 3K - 2$

$15 = 3K$

$K = 5$

X	P(X)	X.P(X)	E(X)^2	[E(X)]^2
-1	6/13	-6/13	6/13	36/169
0	5/13	0	0	0
1	1/13	1/13	1/13	1/169
2	1/13	2/13	4/13	4/169
Total	Σ=1	Σ=-3/13	Σ=11/13	Σ=41/169

∴ Mean = $E(X) = \Sigma X.P(X) = -3/13$

∴ Variance = $V(X) = \Sigma (E(X))^2 - \Sigma(E(X))^2$

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

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

$= \frac{102}{169}$

∴ 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 $P(-1 \le x < 2)$ ② $P(1 \le x \le 5)$ ③ $P(X < 2)$ ④ $P(X \ge 0)$.

Soln:-

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 $P(-1 \le x < 2) = P(X \le 2) - P(X \le -1) + P(X = -1)$
$= F(X b) - F(X a) + P(a)$
$= F(2) - F(-1) + P(-1)$
$= 0.75 - 0.3 + 0.2$
$= 0.75$

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

③ $P(X \le 2) = P(X = -3) + P(X = -1) + P(X = 0) + P(X = 1) + P(X = 2)$
$= 0.1 + 0.2 + 0.15 + 0.2 + 0.1$
$= 0.75$

④ $P(X \ge 0) = 1 - F(0) + P(0)$
$= 1 - 0.45 + 0.15$
$= 0.70$

① Let f be continuous random variable with pdf.

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

$= 0. \quad$ otherwise

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find cdf of x.

Soln:- By defn of cdf we have

$F(x) = \int_{-1}^{x} t\,dt$

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

$= \frac{1}{2}\left[\frac{1}{2}x^2 + x\right)$ for $-1 \le x \le 1.$

Hence the cdf is

$F(X) : 0 \quad$ for $x \le -1$

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

$= 9. \quad$ for $x \ge 1$

Hen

Q5) let f be continuous random variable with p.d.f.

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

$= 0 \quad$ otherwise.

Calculate cdf.

Solⁿ:- By defⁿ 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 $-2 \le x < 4$.

Hence cdf is

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

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

for $-2 < x < 4$

$= 0 \quad$ for $x \geq 4$.

Practical 2:-

Title:- Binomial distribution:-

Q1) An unbiased coin is tossed 4 times. Calculate the probability of obtaining no head, atleast 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)
```

MORE THAN ONE TAIL:

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

Q2) The probability that student is accepted to a prestigious college is 0.3. If 5 students apply, what's the probability of almost 2 are accepted.

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

Q3) 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

```
> 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,
[1] 0.74373
```

Q4) 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",
  "a", pch = 16).
```

>x = seq (0,10)
>y = pbinom (x, 10, 0.6)
, plot (x, y, xlab = "Sequence", ylab = "probabilities", "o", pch = 19,

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

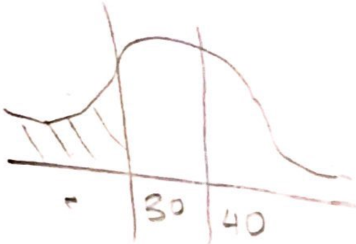
>rbinom(8,10,0.3)
[1] 2 2 3 4 3 4 2 3
>mean(rbinom(8,10,0.3))
[1] 2.375
>var(rbinom(8,10,0.3))
[1] 1.696469

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] 0.8122083

Q.7) 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] 0.340997



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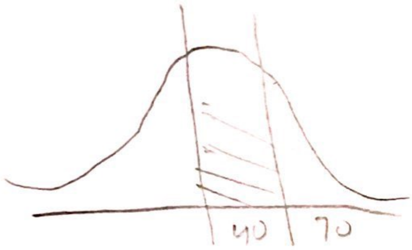
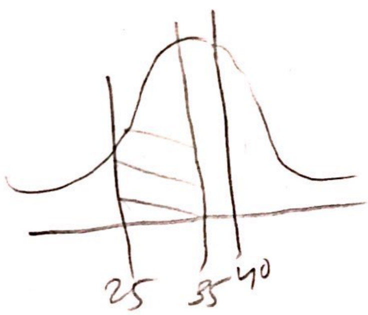


c)



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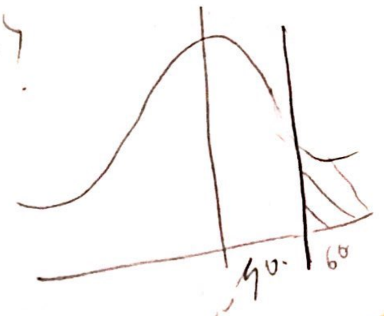


Practical 3:-

① A normal distribution of 100 students with mean marks 40 & std. deviation → 15. Find the no. of students whose marks are ① less than 30, ② b/w 40 & 70 ③ b/w 25 & 35 ④ more than 60.

→ mean = 40
sd = 15
0.5 - pnorm (30,40,15)
0.2524125
pnorm (70,40,15) - pnorm (40,40,15).
0.4839377
pnorm (35,40,15) - pnorm (25,40,15).
0.2107861
pnorm (60,40,15, lower.tail=F).
0.09121122.

② If the random variable 'x' follows the normal distribution with mean 50, variance 100 std. deviation 10. Find ① P(x < 70) ② P(x > 65) ③ P(x < 30) ④ P(35 < x < 60) ⑤ P(20 < x < 32).

→ pnorm (70,50,10)
0.9772499
pnorm (65,50,10, lower.tail=F)
0.0668072
pnorm (30,50,10)
0.02275013
pnorm (60,50,10) - pnorm (35,50,10)
0.7745

100.

pnorm (52, 50, 10) - pnorm (20, 50, 10).
0.03458042

(8) let X ~ N (160, 400), find k1 and k2 such that
P(X < k1) = 0.6 P(X > k2) = 0.8.

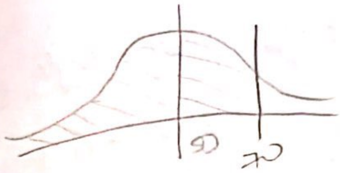
qnorm (0.6, 160, 20)
165.0667
qnorm (0.2, 160, 20).
143.1676

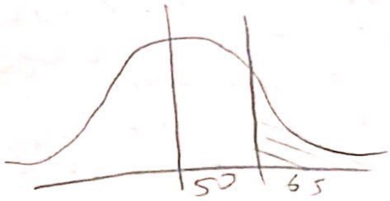
(9) A random variable X follows normal distribution with μ = 10, σ = 2. Generate 100 observations & evaluate its 'mean, median & variable'.

-> rnorm (100, 10, 2)
mean = 9.911
median = 9.978
variable = 4.137851

) Write a command to generate 10 random no.s for normally distribution with mean 50, std. deviation 4. Find the sample mean & median.

rnorm (10, 50, 4)
mean = 51.45792
median = 51.79231
variance = 14.88388.





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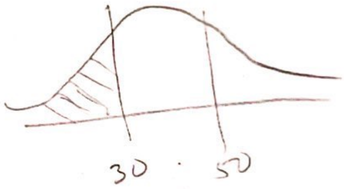

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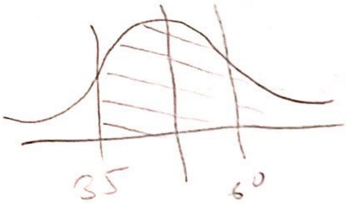

e)


Practical 4

...ing for n > 30 :-

Sample mean & std. deviation given single population

Suppose the food level on the cookie bags states that it has atmost 2 gms of saturated fat in a single cookie. In a sample of 35 cookies, it was found that mean amt. of saturated fat per cookie is 2.1 gm. Assume that the sample std. deviation is 0.3 at (5% level of significance) can be rejected the claim on food label.

$\sigma = 0.3$
$n = 35$
$\bar{x} = 2.1$
$\mu = 2$

To check whether reject or accept null hypothesis at 95% level of confidence or 5% level of significance.

H_0 (null Hypothesis) $= \mu < 2$
H_1 (alt. Hypothesis) $= \mu > 2$

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$z = \frac{2.1 - 2}{\frac{0.3}{\sqrt{35}}} = 1.972027$$

p value = 1 - pnorm(z)
= 0.0243.

Reject the null hypothesis ∵ p value < 0.05
Accepted alternate hypothesis - [$\mu > 2$]

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 the amt. spent by the customer is more than 250/- whereas the restaurant claims that it is not > 250/-.

$\bar{x} = 275$, $\mu = 250$, $\sigma = 30$, $n = 100$.
$H_0 : \mu < 250$
$H_1 : \mu > 250$

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$= \frac{275 - 250}{\frac{30}{\sqrt{100}}} = 8.333$$

pt (z, 99, lower. tail = F)
∴ pvalue = 2.305736e-13.

Reject the null hypothesis. ∵ Pvalue < 0.05
∴ Accept the alternate hypothesis ∴ [$\mu > 250$]

Q. A quality control engineer finds that sample of 100 lights have average life of 470 hours. Assuming population SD = 25, test whether the population mean is 480 hours vs. the population mean < 480 hrs. at LOS → 0.05.

$n = 100$, $\bar{x} = 470$, $\mu_1 < 480$, $\sigma = 25$, $\mu = 480$

$$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} = -4$$

» ~~pt(z, 99, lower. tail = T)~~ pt(z, 99, lower. tail = T) `pt(z, df=n-1, lower.tail=F)`

$= 6.11257\,6e{-05}$

→ Reject the null hypothesis ∵ $p < 0.05$

∴ Accept the alternate hypothesis ($\mu_1 < 480$).

Q47 A ~~principals at~~ principal at school claims that the IQ is 100 of the students. A random sample of 30 students whose IQ was found to be 112. The SD of population $= 15$. Test the claim of principal.

→ Method 1 : 1 tail test

$H_0 = \mu = 100$

$H_1 = \mu > 100$.

» $\bar{x} = 112$, $SD = 15$, $\mu = 100$, $n = 30$.

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$= \frac{112 - 100}{\frac{15}{\sqrt{30}}}$$

$z = 4.38178$

pvalue $= 6.88567e{-06}$

Reject the null hypothesis = claim of principal. [$\mu = 100$].

Method 2 : 2 tail test.

$H_0 = \mu = 100$

$H_1 = \mu \neq 100$

Pvalue $= 2 \times (1 - \text{pnorm}(\text{abs}(z))) = 1.177134e{-05}$

∵ pvalue < 0.05.

→ Reject the null hypothesis

② Single population ~~propo~~ proportion :-

Q) It is believed that coin is fair. The coin is tossed 40 times; 28 times - Head occurs. Indicate whether the coin is fair or not at 95% LOC.

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

p → probability of sample

p_0 → probability of population.

$p_0 = 0.5$

$q_0 = 1 - p_0 = 0.5$

$p = \frac{28}{40} = 0.7$

$n = 40$.

$$z = \frac{0.7 - 0.5}{\sqrt{\frac{0.5 \times 0.5}{40}}}$$

$H_0 : \mu = 0.5$

$H_1 : \mu \neq 0.5$

» Pvalue $= 2 \times (1 - \text{pnorm}(\text{abs}(z)))$

∴ pvalue $= 0.01141209$

→ Reject the null hypothesis ∵ $p < 0.05$

Accept the alternate hypothesis.

Neat

Q1) In an hospital 480 females & 520 males are born in a week. Do confirm that male & female born are equal in no.

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

$p \rightarrow \frac{520}{1000} = 0.52$, $p_0 = 0.5$, $q_0 = 0.5$, $n = 1000$.

$H_0 = [p = p_0]$

$H_1 = [p \neq p_0]$

>>> z = (p - p0)(sqrt (p0q0/n))

>>> z = 1.2645

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

∴ pvalue = 0.2060506

∴ Reject the null hypothesis ∵ pvalue < 0.5

∴ Accept the alternate hypothesis i.e. $p \neq p_0$.

Q2) In a big city, 325 men out of 600 men are found to be self employed. Conclusion is that maximum men in city are self employed.

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

$p \rightarrow 325/600 = 0.541667$, $p_0 = 0.5$, $q_0 = 0.5$, $n = 600$

$H_0 : [p_0 = p]$

$H_1 : [p \neq p_0]$.

>>> z = (0.5416 - 0.5)/(sqrt(0.5 * 0.5 / 600)).

>>> z = 2.0379.75

>>> pvalue = 2 x (1 - pnorm(abs(z)))

∴ pvalue = 0.04155239

∴ Reject the null hypothesis ∵ pvalue < 0.5

∴ Accept the ~~null~~ alternate hypothesis i.e. $p \neq p_0$.

Experience shows that 20% of manufactured 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 products is wrong.

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

$p = 0.125$ (50/400), $p_0 = 0.2$, $q_0 = 0.8$, $n = 400$

$H_0 = [p = 0.2]$

$H_1 = [p \neq 0.2]$

z = (0.125 - 0.2) / (sqrt (0.2 * 0.8 / 400)).

>>> z = -3.75

>>> pvalue = ~~2 x~~ (1 - pnorm (abs (z)))

∴ pvalue = 0.0001768346

∴ Reject the null hypothesis ∵ pvalue < 0.2.

∴ Accept the alternate hypothesis i.e. $p \neq 0.2$

Formula:-

(*) $z = \sqrt{pq\left(\frac{1}{n}+\frac{1}{m}\right)}$ where $p = \frac{p_1 n + p_2 m}{n+m}$.

Q1) In an election campaign, a telephone thone of 800 registered voters shows favour 460. second pole opinion 520 of 100 registered voters favored the canditate at 0.5 .p LOC (level of confidence), is there sufficient evidence that popularity has decreased.

$n = 800$, $p_1 = 460/800 = 0.575$

$p_2 = 520/1000 = 0.52$, $m = 1000$

$p = (0.575 * 800 + 0.52 \times 1000) / (1800)$.

$p = 0.54444$.

$z = sqrt(0.54 * 0.46) * 1/8$

$z = \underline{0.001121394}$.

$H_0 = p = 0.544$

$H_1 = p < 0.544$.

pvalue = (2 × (1 − pnorm(abs(z))).

∴ pvalue = $\underline{0.9991053}$

∴ Accept the null hypothesis ∵ pvalue > 0.5

∴ Accept $p = 0.5444$

Q) From a consignment A, 100 articles are drawn & 44 was found defective from consignment B, 200 samples are drawn out of which 30 are defective. Test whether the proportion of defective items in consignments are significantly different.

$H_0 = p_1 = p_2$

$H_1 = p_1 \neq p_2$

$p_1 = 44/200 = 0.22$

$n = 200 = m$

$p_2 = 30/200 = 0.15$

⇒ $p = \left(\frac{p_1 n + p_2 m}{n+m}\right)$

⇒ $p = (0.22 * 200 + 0.15 * 200)/400$

⇒ $p = \underline{0.185}$

⇒ z = (sqrt(0.185 * 0.815) * (2/200))

⇒ $z = \underline{0.003882976}$

⇒ pvalue = 2 * (1 − pnorm(abs(z))).

∴ pvalue = $\underline{0.9969018}$

∴ pvalue > p.

∴ Accept the null hypothesis i.e. $p_1 = p_2$.

Practical 5 - Chi Square Test

Q17 Use the following data to test whether the attribute conditions of home and child are independent.

condition of Homes.

condition of child		clean	dirt
	clean	70	50
	f. clean	80	20
	dirty.	35	45

H_0 = Both are independent, H_1 = 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 = 2.678e-06

∴ Reject the null hypothesis

∴ Both are dependent.

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

No. of times	frequency.
1	30
2	25
3	18
4	10
5	22
6	15

Test the hypothesis that dice is unbiased

∴ H_0 = dice is unbiased

∴ H_1 = dice is biased.

```
>obs = c(30,25,18,10,22,15)
>exp = sum(obs)/length(obs)
>exp
[1] 20
>z = sum((obs-exp)^2/exp).
>pchisq(z, df = length(obs)-1).
[1] 0.956657.
```

∴ Accept the null hypothesis.

∴ dice is unbiased.

Scanned with CamScanner

JO

Q3) An IQ test was conducted f the students were observed before f 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] 0.1135957.
```

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

DE8

	Graduate	undergraduate
	20	25
	40	5

there any association between students-preference type of education f 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
X-squared = 18.05, df = 1, p-value = 2.137e-05.
```

∴ Reject null hypothesis
∴ Both are dependent.

Q5) A dice is tossed 180 times.

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 : 2

X-squared = 23.933, df = 5, p-value = 0.0002236.

∴ Reject null hypothesis.

∴ dice is unbiased.

NUCL

Practical-6.

x = c (3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3390, 3424, 3383, 3374, 3384, 3374.

Test the hypothesis

$H_0 = \mu = 3400$, $H_1 = \mu \neq 3400$.

$H_0 = \mu = 3400$, $H_1 = \mu > 3400$ } at 95% LOC.

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

Also check at 97% LOC.

shapiro.test(x).

p.value = 0.987.

t.test(x, mu = 3400, alter = "two sided", conf.level = 0.95). p.value = 0.000258.

p.value < 0.05.

∴ Reject null hypothesis.

t.test(x, mu = 3400, alter = "less", conf.level = 0.75).

p.value = 0.0001224.

t.test(x, mu = 3400, alter = "greater", conf.level = 0.75.

p.value = 0.9997.

t.test(x, mu = 3400, alter = "less", conf.level = 0.97) p.value = 0.000124.

Q) Below are the data of gain in weights onto 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 ≠ 0

> a = c(25, 32, 30, 43, 24, 14, 32, 24, 31, 31, 18, 21)

> b = c (44, 34, 22, 10, 47, 31, 40, 30, 32, 35, 18, 21)

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 : 2
X-squared = 23.733, df = 5, p-value = 0.0002236.
∴ Reject null hypothesis.
∴ dice is unbiased.

Practical - 6.

> x = c(3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3390, 3424, 3383, 3374, 3384, 3374).
Test the 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% LOC.
Also check at 97% LOC.
> shapiro.test(x).
p value = 0.987.
t.test(x, mu = 3400, alter = "two sided", conf.level = 0.95) . p.value = 0.000258.
p.value < 0.05.
∴ Reject null hypothesis.
t.test(x, mu = 3400, alter = "less", conf.level = 0.95).
p.value = 0.0001264.
t.test(x, mu = 3400, alter = "greater", conf.level = 0.95)
p.value = 0.9997.
t.test(x, mu = 3400, alter = "less", conf.level = 0.97) p.value

Q) Below are the data of gain in weights onto 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 ≠ 0

t. test (a, b, paired = T, alter = "two sided", conf.level = 0.9)

Paired t test

data: a and b

t = 0.62787, df = 11, p-value = 0.3427.

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

95 percent confidence interval:

-14.267330 7.933997.

sample estimates:

mean of the differences

-3.166667

∴ Accept H_0

∴ there is no difference in weights.

Q2) 11 students gave the test after 1 month. They then gave their test after the tuitions, do the marks give evidence that students have benefitted by coaching.

E1: 23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19.

E2: 24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17

test at 99 level of confidence.

> E1: 23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19

E2: 24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17

∴ H_0: e1 = e2

∴ H_1: e1 < e2

> t. test (e1, e2, paired = T, ~~alt~~ alter = "less", conf. level = 0.99).

Paired t test

070

data: e1 and e2

t = -1.4832, df = 10, p-value = 0.08441

alternative hypothesis: true difference in mean is less than 0.

99 confidence interval:

- Inf 0.863333

sample estimates:

mean of the differences:

-1

∴ Accept H_0

Q4) Two drugs for BP was given & data was

D1: 0.7, -1.6, -0.2, -1.2, -0.1, 3.4, 3.7, 0.8

D2: 1.9, 0.8, 1.1, 0.1, -0.1, 4.4, 5.5, 1.6, 4.6

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

> H_0: $d_1 = d_2$

H_1: $d_1 \neq d_2$

> d1 = c(0.7, -1.6, -0.2, -1.2, -0.1, 3.4, 3.7, 0.8

> d2 = c(1.9, 0.8, 1.1, -0.1, 0.1, 4.4, 5.5, 1

> t. test (d1, d2, alter = "two sided", paired

conf. level = 0.95)

Paired t. test

data: d1 and d2

t = -4.0621 df = 9. p-value = 0.002833

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

95 % confidence interval.

mean of the differences:

-1.58

∴ Reject H_0

∴ Accept H_1

Q5) If there is difference in salaries for the same job in 2 different countries.

CA: 53000, 49958, 41974, 44366, 40470, 36963

CB: 62490, 58850, 49495, 52263, 47674, 43552.

→ ∴ H_0: $S_1 = S_2$

∴ H_1: $S_1 \neq S_2$

```
> CA = c(53000, 49958, 41974, 44366, 40470, 36963)
> CB = c(62490, 58850, 49495, 52263, 47674, 43552)
> t.test(ca, cb, paired = T, alter = "two.sided",
    conf.level = 0.95)
```


Paired t test

data: ca and cb

t = -4.4567, df = 5, p-value = 0.00666

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

95 % confidence interval:

-10404.821 -2792.845

sample estimates:

mean of the differences:

- 6598.833

Reject H_0

Accept H_1

Neat

Practical-7 - F test

Q1) Life expentancy in 10 region of Indian in 1990 & 2000 are given below. Test whether the variance at the 2 times are same.

1990 : 37, 39, 36, 42, 45, 44, 46, 49, 50, 51

2000 : 44, 45, 47, 43, 42, 49, 50, 41, 48, 52, 42, 57.

$H_0 : \sigma_1^2 = \sigma_2^2$

$H_1 : \sigma_1^2 \neq \sigma_2^2$

s1 = c(37, 39, 36, 42, 45, 44, 46, 49, 50, 51)

s2 = c(44, 45, 47, 43, 42, 49, 50, 41, 48, 52, 42, 57)

var.test (s1, s2) p.value = 0.9176.

Accept H_0.

Q2)

I	25, 28, 26, 22, 22, 29, 31, 31, 26, 31
II	30, 25, 31, 32, 23, 25, 36, 26, 31, 32, 32, 27, 31, 38, 29.

$H_0 : \sigma_1^2 = \sigma_2^2$

$H_1 : \sigma_1^2 \neq \sigma_2^2$

s1 = c (25, 28, 26, 22, 22, 29, 31, 31, 26, 31)

s2 = c (30, 25, 31, 32, 23, 25, 36, 26, 31, 32, 32, 27, 31, 38, 29)

p.value = 0.5541.

∴ Accept H_0.

Q3) For the foll. data test the hypothesis for

(1) equality of 2 population mean

(2) " " population variance.

$H_0 : \sigma_1^2 = \sigma_2^2$

$H_1 : \sigma_1^2 \neq \sigma_2^2$

x = c (175, 168, 175, 190, 181, 185, 175, 200)

y = c (180, 170, 153, 180, 179, 183, 187, 205) .072

var.test (x, y).

p-value = 0.7759

∴ Accept H_0.

t.test (x, y).

p-value = 0.8216

Accept H_0.

Q4) The foll. are the prices of commodity in the sample of shops selected at random from different cities.

city A = 74.10, 77.70, 75.35, 74, 73.80, 79.30, 75.80, 76.80, 77.10, 76.40.

city B = 70.80, 74.90, 76.20, 72.80, 78.10, 74.70, 69.80, 81.20.

x = c(74.10, 77.70, 75.35, 74, 73.80, 79.30, 75.80, 76.80, 77.10, 76.40).

y = c(70.80, 74.90, 76.20, 72.80, 78.10, 74.70, 69.80, 81.20).

> shapiro.test (x).

p.value = 0.6559.

∴ data is normal

> shapiro.test (y)

p.value = 0.9304.

∴ data is normal.

$H_0 : \sigma_1^2 = \sigma_2^2$

$H_1 : \sigma_1^2 \neq \sigma_2^2$.

p.value = 0.04249.

∴ 2 variances are not equal ∴ Reject H_0 ∴ Accept H_1.

$H_0: \overline{X_1} = \overline{X_2}$
$H_1: \overline{X_1} \neq \overline{X_2}$

```
> t.test (x, var.equal=F)
  p.value = 3.488 e-16
> t.test (y, var.equal = f)
  p.value = 1.46e-10
```

∴ Accept H_0.

Q5) Prepare a csv file in excel. Import the file in R and apply the test to check the equality of variance of 2 datas.

Obs1: 10, 15, 17, 11, 16, 20 $H_0: \sigma_1^2 = \sigma_2^2$
obs2: 15, 14, 16, 11, 12, 19. $H_1: \sigma_1^2 \neq \sigma_2^2$

```
> Data = read.csv(file.choose(), header = T)
> Data
  observation1   observation2
      10              15
      15              14
      17              16
      11              11
      16              12
      20              19
```

~~Neelu~~

```
> attach (Data).
> mean (observation 1)
  14.83333.
> var.test (Data) (observation1, observation2)
  p.value = 0.5717.
```

∴ Accept H_0.

Practical 8 - Non Parametric Test.

The times of failure (in h) of 10 randomly selected 9 volt batteries 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 that it is less than 63 at 5% LOS:

H_0: median = 63
H_1: median < 63.

```
> 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) → 4
> sn = which (x < 63).
> b = length (sn)
> a
1
> b
9
> n = a + b
> n
10.
> qbinom(0.05, n, 0.5)
2
> pbinom (b, n, 0.5)
0.9990234.
```

Accept H_0.

If qbinom value < sn, accept; else reject.

Q2) The following data gives the weight of 40 students in random sample: 46, 49, 57, 64, 46, 67, 54, 48, 67, 61, 57, 54, 50, 48, 45, 61, 66, 54, 50, 48, 49, 62, 47, 49, 47, 55, 59, 63, 53, 56, 67, 49, 60, 64, 53, 50, 48, 51, 52, 54. Use the sign test to test whether the ~~a~~ median weight of population is 50 kgs against the alternative that is greater than 50 kgs.

```
> x = c(              )
> sp = which(x > 50)
> sn = which (x < 50)
> a = length(sp)
25
> b = length(sn)
12
> n = a+b
> n
37
> qbinom (0.05, n, 0.5)
14.
```

H_0: median = 50.
H_1: median > 50.

Accept H_1, Reject H_0.

Q3) The median age of tourists visiting the certain place is claimed to be 41 yrs. A random sample of 17 tourists have the age 25, 29, 52, 48, 57, 39, 45, 36, 30, 49, 28, 39, 44, 63, 32, 65, 72. Use the sign test to check the claim.

H_0 = median = 41 yrs
H_1 = median ≠ 41 yrs.

```
x = c(              ).
```



```
= which (x > 41)
= which (x < 41)

length (sp) = 7
length (sn)

+b

binom (0.05, n, 0.5, =5)
```

Accept H_0.

Q) The times in minute that a patient has to wait for consultation is recorded as follows:- 5, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26. Use wilcoxon sign test to check whether the median ~~wait~~ waiting time is more than 20 at 5%. ~~whether the the~~

H_0 = median > 20
H_1 = median < 20.

```
x = c (        ).
wilcox. test (x, alternative = "less")
Pvalue = 0.949.
```

Accept H_0.

Q5) The wt. in kgs of the person before after they stop smoking are as follows:- Before - 65, 75, 75, 65, 72. After - 72, 82, 72, 66, 73. Use wilcox test to check whether the wt. of person increases after stopping the smoking. Use 5% LOS.

H_0 = Increases after the stopping of smoking.
H_1 = does not increase after the stopping of smoking.

```
x = c  (
y = c        )
```

> z = x - y
> z
> wilcox.test (z, mu = 0)
> P value = 0.1756
Accept H0

Nearly

The times in minutes that a patient have to wait for consultation is recorded as follows: 15, 17, 24, 25, 20, 2
32, 28, 12, 25, 24, 26.
Use wilcoxon's sine test to check wheter is the median waiting time is more than 20 minutes at 5% LOS.

Practical 9 : A-nova

2) The following data gives the effect of 3 treatments
T1: 2, 3, 7, 2, 6.
T2: 10, 8, 7, 5, 10
T3: 10, 13, 14, 13, 15.
Test the hypothesis that all treatments are equally effec

H0 = T1 = T2 = T3.
H1 = T1 ≠ T2 ≠ T3

```
a = c( 2,3,7,2,6)
b = c( 10, 8, 7, 5, 10).
c = c( 10,13,14,13,15)
d = data.frame (a,b,c).
d
x = as.matrix(d)
e = stack(d)
aov(value ~ Ind, data = e).
oneway.test (values ~ Ind, data = e).
```

P value : 0.0006232.
∴ ~~Accep~~ Reject H0.

Q27 ⇒ The life cycle of different brands of tyres is given. Test whether the driving life of all the tyres is same.

H_0 :- Life of all brands of tyres is same.

H_1 :- Life of all brands of tyres is not same.

a = c(20, 23, 18, 17, 22, 24)
b = c(17, 15, 17, 20, 16, 17)
c = c(21, 29, 22, 17, 20)
d = c(15, 14, 12, 18, 14, 16)
m = list(a, b, c, d)
m.
e = stack(m)
m : list (p = a, q = b, r = c, s = d)
m
e = stack(m)
e
oneway.test (value ~ ind, data = e, var.equal = TRUE)
p value = 0.004058.
∴ Reject H_0.

Three types of wax is applied for the protection of cars and no. of days of protections were noted. Test whether these are equally effective.

H_0 :- Equally effective.

H_1 :- Not equally effective.

a = c(44, 45, 46, 47, 48, 49)
b = c(40, 42, 51, 52, 55)
c = c(50, 53, 58, 59)
m = list (p = a, q = b, r = c)
m
e = stack (m)
e.
oneway.test (values ~ ind, data = e)
p value :- 0.03822.
∴ Reject H_0.

Nur

iii) An experiment was conducted on 8 persons & the observations were noted. Test the hypothesis that all groups have equal results on their health.

H_0 :- Equal results on their health.

H_1 :- Not equal results.

a = c(23, 26, 51, 48, 58, 37, 29, 45)
b = c(22, 27, 29, 39, 46, 48, 49, 65)
c = c(59, 66, 38, 49, 56, 60, 56, 62)
d = data.frame(a, b, c)
d
x = as.matrix(d)
e = stack(d)

aov(values ~ ind, data = e)
oneway.test(values ~ ind, data = e
p value = 0.01633.
∴ Reject H_0.