Practical : 01

RANDOM VARIABLE :-

Q1) Find the mean and variance for the following:-

a)

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

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	16	0.64
TOTAL	$\Sigma=1$	$\Sigma=1$	$\Sigma E(x)^2=20.$	$\Sigma[E(x)^2]^2=0.74$

Mean = $E(x) = \Sigma x^2 \cdot P(x) = 1$

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

$= 2 - 0.74$

$= 1.24$

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

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	Σ=1	Σ=9/8	Σ 19/8	Σ=69/64

∴ Mean $= E(x) = \Sigma x P(x) = 9/8$

∴ variance $= V(x) = \Sigma E(x)^2 - \Sigma(E(x))^2$

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

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

$= \frac{83}{64}$

Mean $E(x) = 9/8$ and variance $V(x) = 83/64$

c]

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

→

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	35	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 $V(x) = 67.0975$

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.

→ 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

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

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

$13 = 3K - 2$

$15 = 3K$

$K = 5$

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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 $= E(x) = \Sigma x \cdot P(x) = -\frac{3}{13}$

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 $= 102/169$

Q.3] 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	0.20	0.1	0.15	0.05	0.05

2) $P(1 \le x \le 5)$ 3) $P(x \le 2)$ 4) $P(x \ge 0)$

1) & $P(-1 \le x \le 2)$

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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) $P(1 \le x \le 5) = F(x_b) - F(x_a) + P(a)$

$= F(5) - F(1) + P(1)$

$= 0.95 - 0.65 + 0.2$

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

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

$\therefore$ 0.75

4) $P(x \ge 0) = 1 - F(0) + P(0)$

$= 1 - 0.4 + 0.15$

$= 0.40$.

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7] Let f be continous random variable with pdf

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

Obtain cdf of x otherwise.

→ By definition of cdf we have

$F(x) = \int^{x} f\,dt$

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

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

Hence the cdf is

$F(x) = 0$ for $x \le -1$

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

$= 0$ for $x \ge 1$

Q.8] Let f be contonious random variable with pdf

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

$= 0$ otherwise

calculate cdf

→ By definition of cdf we have

$F(x) = \int_{2}^{x} f\,dt$

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

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

Hence cdf is

$F(x) = 0$ for $x < 2$

$= \frac{1}{18}\left(\frac{1}{2} < x < 4\right.$

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

Practical : 2

Title : Binomial distribution.

Q1] An unbiased coin is tossed 4 times calculate the probability of obtaining no head, atleast one head and 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)
```

Q2] The probability that student is accepted to a prestigious college is 0.3. If 5 students of supply, whats the probability of almost 2 are accepted.

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

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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] dbinom (2,6,0.3) + dbinom (3,6,0.3)+
    dbinom (4,6,0.3)
```

4] For n=10 p=0.6, evaluate binomial probabilities and plot the graphs of pmf & cdf.

```
> x= seq(0,10)
> y = dbinom (x,10,0.6)
> y
[1] 0.0000104858 76   0.0015728640   0.0106168320
0.0424673280   0.1114767360   0.2006581248
0.2508226560   0.2149908480   0.1209323520
0.4031078840   0.0066466176

> plot (x,y, xlab ="sequence", ylab =
  "probability", "o", pch=16)
```

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

5) Generate a random sample of size for a B-D → B(0.3. Find the mean & the variance of the samp.

```
> 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))
```

Q.6) The probability of men hitting the target is 1/4 if he shoots 10 times what is the probability that he hits that he hits target atleast

```
> dbinom (3, 10, 0.25)
[1] 0.2502823
> 1- dbinom (1, 10, 0.25)
[1] 0.9122883
```

27) Bits are sent for communication channel in packet of 12 if the prob of bit being corrupted is 0.1 what is the prob of no more than 2 bits are corrupted in a packet.

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

Practical: 03

Q1] A normal distribution of 100 students with mean marks 40 & s.d deviation 15. Find the no. of students whose marks are ① less than 30 ② 40 & 70 ③ 25 & 35 ④ more than 60

→ mean = 40
s.d = 15
0.5 - pnorm (30, 40, 15)
0.2524725
pnorm (70, 40, 15) - pnorm (40, 40, 15)
0.4839377
pnorm (35, 40, 15) - pnorm (25, 40, 15)
0.2107861
more than 60
pnorm (60, 40, 15, lower.tail = F).
0.09121122.

Q2] If the random variable 'x' follows the normal distribution with mean 50, variance 100, s.d deviation 10 find ① $P(X \le 70)$ 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)
0.0224013
Pnorm(60, 50, 10) - Pnorm (35, 50, 10) - 0.7745

Pnorm (32, 50, 10) - Pnorm(20, 50, 10) - 0.03458226

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Q3] Let x ~ (160, 400), find k1 & k2 such that $P(x < k_1) = 0.6$, $P(x > k_2) = 0.8$

→ qnorm (0.6, 160, 20)
165.0669
qnorm (0.2, 160, 20)
143.1676

4) A random variable x follows normal distribution ~~exactly its~~ (mean. with $\mu = 10$, $\sigma = 2$. generate ~~10 random nos for normally to ge~~ 100 observation and find mean, median & variable.

→ rnorm (100, 10, 2)
mean = 9.911
median = 4.97.8
variable - 4.137887

5) Write a command to generate 10 random nos for normally distribution with mean 50 s.d deviation 4. ~~find~~ the sample mean & median

→ rnorm (10, 50, 4)
mean = 51.45792
Median = 51.7923)
variance = 14.68388.

Prac : 04

1) Sample mean & std. deviation given single population.

01] Suppose the food level on the bags starts that it has almost the code of saturated fats in a single 9h a sample of 35 cookie is 2.1 cookie. Assume that the sample std. deviation is 0.3 at 15% level of significance can be rejected the claim on the label

$\sigma = 0.3$

$n = 35$

$\bar{x} = 2.1$

$\mu = 2$

H_0 (null Hypothesis) : $\mu < 2$

H_1 (alt. '') : $\mu > 2$

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

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

>> Pvalue = 1 - pnorm(z)
= 0.0243

Reject the null hypothesis ∵ Pvalue < 0
Accepted alternate hypothesis . [$\mu > 2$]

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 was amt. spent by the customer is more than 250/- whereas the restaurant claims that 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 hypo ∴ Pvalue < 0.01
Accept the alternate hypothesis ($\mu > 250$)

Q.3] A quality control of engineer finds that sample of 100 lights have average life of 470 hours. Assuming population test whether the population mean 480 hours vs the population mean < 480 hrs. at LOS → 0.05

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

→ $z = \frac{\bar{x} - \mu}{\,} = -4$

pt (?, 99 lower tail = T)
: 6.11275 e.05

→ Reject the null hypothesis ∴ p < 0.05 accept the alternate hypothesis ($\mu_1 < 480$)

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 be 112. The S.D of population = 15. Test the claim of principal

→ Tail test

$H_0 = \mu = 100$

$\bar{x} = 112$, 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 = 5.8856 7e - 06

Reject the null hypothesis
∴ claims of principal ($\mu = 100$)

Method 2 : 2 tail test

$H_0 = \mu = 100$

$H_1 = \mu \neq 100$

>> Pvalue = 2x (1 - pnorm (abs (z)))
= 1.177134 e - 0.5

→ Reject the null hypothesis ∵ Pvalue < 0.05

(A) 3 Single population portion :-

Q1] 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.

$\Rightarrow z = \dfrac{p - p_0}{\sqrt{\dfrac{p_0 q_0}{n}}}$ — p: prob of sample, p_0 → probability of population

$p_0 = 0.5$

$q_0 = 1 - p_0 = 0.5$

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

$n = 40$

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

$H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

$\Rightarrow$ Pvalue = 2 × (1 − Pnorm (abs(z)))

Pvalue = 0.014|204

Reject the null hypothesis. $p < 0.05$
Accept the alternate hypothesis

Neat

Q2] In an hospital 480 females & 520 males are born in a week. Do confirm the male and female born in equal no.

$z = \dfrac{p - p_0}{\sqrt{p_0 q_0 / n}}$, $p \to \dfrac{520}{1000} = 0.52$, $p_0 = 0.5$, $q_0 = 0.5$

$n = 1000$.

$H_0 = [p = p_0]$

$H_1 : [p \neq p_0]$

>>> z = (p − p0) (sqrt (p0q0/n))

>>> z = 1.247.

pvalue = 2 × (1 − Pnorm (abs (z))

pvalue = 0.2060506.

Reject the null hypothesis pvalue < 0.5
Accept the alternate hypothesis, p ≠ 100.

Q3] 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.

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

$p \to 325/600 = 0.5416$, $p_0 = 0.5$

$p_0 = 0.5$, $n = 600$

$H_0 = [p_0 = p]$

$H_1 = [p \neq p_0]$

>>> z = (0.5416 − 0.5) / (sqrt (0.5 * 0.5/600))

>>> = 2.037975

>>> pvalue = 2 * (1 − pnorm (abs (z)))

pvalue = 0.04155239.

Reject the null hypothesis ∴ pvalue < 0.5

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

Q.3) 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 manufacturing 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 * (1 − pnorm (abs z))

>>> pvalue = 0.000176 846.

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Reject the null hypothesis pvalue < 0.2

Accept the alternate hypothesis is : $p \neq 0.2$

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 of 800 registered voters shows favour 46.0. second pole opinion 520 of 1000 registered voters favoured the candidate at 0.5%. LOC is there sufficient evidence that popularity has decreased.

→ $H_0 = p = 0.544$, $n = 800$, $p_1 = 460/800$

$H_1 = p < 0.544$ $p_2 = 520/1000$ 0.575, $m = 1000$

p = (0.575 * 800 + 0.52 × 1000) / (1800)

p = 0.54444

z = sqrt (0.544 * 0.46) * 1/8

z = 0.00112139

H_0 = ~~p = 0.544~~

H_1 = ~~p < 0.544~~

pvalue = 0.9991053

accept the null hypothesis is pvalue > 0.

Accept $p = 0.5444$

9.2) From a consignment A, 100 articles are drawn of 44 was found defective are consignment B, 200 samples are drawn out of which 30 are defective. Test whether the proportion of defective in 2 consignments are significantly different

→ H_0 : $P_1 = P_2$

$H_1 = P_1 \neq P_2$

$P_1 = 44/200 = 0.22$

$n = 200 = m$

$P = 30/200 = 0.15$

>>> $P = \dfrac{(P_1 n + P_2 m)}{n+m}$

>>> P=(0.22 * 200 + 0.15 * 200)/400

>>> P = 0.125

>>> z = (sqrt (0.105 * 0.815) * (2/200))

>>> z = 0.00388297-6

>>> p value = 2 * (1-pnorm (abs(z)))

pvalue = 6.996918

pvalue > P

Accept the null hypothesis $P_1 = P_2$

Practical : 05

Title : Chi square test

Q1) Use the following data to test whether the attribute conditions of name and child are independent.

		condition of homes clean	dirth.
condition	clean	70	50
of child	f. clean	80	20
		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)
  [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
  = 2.698e-06
```

∴ Reject the null hypothesis
∴ Both are dependent.

Q2] A die is tossed 120 times and following results are obtained

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

Test the hypothesis that die is unbiased.

∴ Ho = die is unbiased
∴ H1 = die 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] 0.956659.
```

∴ Accept the null hypothesis
∴ die is unbiased.

Q3) An IQ test was conducted & the students were observed before and 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

∴ H1 = no change in IQ
∴ Ho = 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

Q.4)

	graduate.	undergraduate
online	20	25
face to face	40	5

Is there any association betn students preference for type of education and 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 = 2.157e-0.5

Reject null hypothesis
Both are dependent.

Q.5) A die is tossed 180 times

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

Test the hypothesis that die is unbiased.

H0: die is biased
H1 = die is unbiased.

> x = c(20, 35, 35, 40, 12, 4, 3)

> chisq.test(x)

Chi-squared test for given probabalities

data: z

X-squared = 23.933, df = 5
p value : 0.000223

Checked

∴ Reject null hypothesis
∴ die is unbiased

Practical: 06

Q.1] Let x = 3366, 3337, 3361, 3410, 3316, 3331, 3348, 3356, 3371, 3382, 3377, 3355, 3402, 3401, 3390, 3429, 3383, 33374, 3334, 3316

write the R command for the foll. to test the hypothesis

① H0 = μ = 3400
H1 : μ ≠ 3400
H0 = μ = 3400, H1 = μ > 3400
H0 = μ = 3400, H1 = μ < 3400.

Also check at 97% l.o.

Ans:
> shapiro.test (x) → pvalue = 0.987
> p.value < 0.05 Reject null hypothesis
> 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 = 0.97)
p.value = 0.0001264.

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

pvalue = 0.9999.
t.test (x, mu = 3400, alter = "less", conf level = 0.971 p.value = 0.00)

Q] Show 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.

H0 = a − b = 0
H1 = a − b ≠ 0

> a = c(25, 32, 30, 43, 24, 14, 32, 24, 31, 31, 21, 25)
> 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 = 0.61287, df = 11, p. value = 0.5429
alternative hypothesis the difference in mean is not equal to 0
95 percentage conf interval

97.

-14.267330 7.933997

sample estimates :
mean of the differences
-3.16667

∴ Accept H0
there is no difference in weights.

(Q3) 11 Students gave the test after 1 month they again gave this test, the tutor, 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, 14
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,

∴ H0 = e1 = e2

H1 e1 < e2

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

Paired t test

data e1 and e2
t = -1.4892, df = 10, p-value = 0.08441
alternative hypothesis: true diff. once its mean is less than 0.
99.1 confidence interval
- inf 0.86333
sample estimates
mean of the differences
Accept H0.

(Q4) Two drugs for BP was given and data was collected

d1 : 0.7, -1.6, -0.2, -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 patients on ne.

H0 : $d_1 = d_2$
H1 : $d_1 \neq d_2$
> d1 = c(0.7, -1.6, -0.2, -1.2, -0.1, 3.4,
0.8, 0.2)

```
> d2 <- c(1.9, 0.8, 1.1, -0.1, 4.4, 5.5, 1.6, ...
> t.test(d1, d2, alter = "two sided", paired = T, conf.level = 0.95)
```

Paired t test

data: d1 and d2

t = -4.0621 df = 9. p-value = 0.00...

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

95 % confidence interval

mean of the difference

-1.58

∴ Reject H0
Accept H1

Q.5) If there is difference in salaries for the same job in 2 diff countries:-

CA : 53000, 49958, 41974, 443..., 40470, 36963.

CB : 62490, 5350, 49495, 522..., 47674, 43552.

→ H0 = $S_1 = S_2$
H1 $S_1 \neq S_2$

```
> t.test(ca, cb, paired = T, alter = "two sided", conf.level = 0.95)
```


Paired t test.

data = ca and cb

= -45679, df = 5, p-value = 0.00068

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

95 % of confidence interval

-10404.821 -2702.846

sample estimates

mean of the differences

-3593.33

Reject H0
Accept H1

Practical - 07 F - test

Q1] Life expectancy in 10 region of India 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, 52, 42, 59.

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

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

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

s2 = c(44, 45, 45, 43, 42, 49, 50, 41, 52, 42, 59)

var.test(s1, s2) p.value = 0.91...

Accept Ho.

[Q.2] I : 25, 28, 26, 22, 22, 29, 31, 31, ...

II : 30, 25, 31, 32, 25, 36, 26, 31, 3...
33, 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, 3..., 26, 31)

s2 = c(30, 25, 31, 32, 25, 36, 31, 32, 9..., 22, 31, 38, 32)

p.value = 0.5341
Accept Ho

Q3] For the foll data test the hypothesis for equality of 2 population ~~mean~~ variance proportion

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

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

x = c(175, 168, 145, 190, 181, 185, 175, 200)

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

var.test(x, y)

p-value = 0.7759

Accept Ho

t.test(x, y)

p-value = 0.7716

Accept Ho.

[Q4] The foll are the prices of commodity in the sample of shops selected at random from diff cities.

city A : 74.10, 77.70, 75.35, 74, 73.8, 79.30, 75.80, 76.80, 76.40

city B : 70.80, 74.90, 76.20, 72.80, 78.10, 74.70, 69.10, 71.20

15

y <- c(79.80, 74.90, 76.20, 72.80, 110, 79, 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 = 0.4249
? variance are not equal
∴ Reject H0.
Accept H1.

$H_0: \bar{X}_1 = \bar{X}_2$

$H_1: \bar{X}_1 \neq \bar{X}_2$

> t.test (x, var.equal = T)
p.value = 3.486e-16
> t.test (y, var.equal = T)
p.value = 1.462-10
∴ Accept H0.

Q.5] Prepare a csv file in excel. Import the file in R and apply the test to check the equality of var of 2 datas — 72

obs1 : 10, 15, 17, 11, 16, 20
obs2 : 15, 14, 16, 11, 12, 19

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

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

> data = read.csv (file.choose(), header = T)

> data

obs1	obs 2
10	15
15	14
17	16
11	11
16	12
20	19

> attach (data)
> mean (observation)
14.8222
> var.test (observation 1, observation 2)
p.value = 0.5717
∴ Accept H0

Neel

Practical: 08

1) The times of failures in hours of 10 randomly selected of volt batteries of 10 randomly selected as follows. Test the hypothesis that the population median is 63 against the alternative is less than 63 at 5 % of level of significance.

→ H0 = median = 63
H1 = median < 63
x = c(28.9, 15.2, 28.7, 72.5, 48.6, 52.4, 37.6, 49., 54.5)
sp = which (x > 63)
> a = length (sp) → 4
sn = which (x < 63)
> b = length (sn)
9
> n = a + b
> n
10
> qbinom (0.05, n, 0.5)
2
> pbinom (b, n, 0.5)
0.9990234

Accept H0

If qbinom value < sn, accept, else reject

2) The following data gives the weight of 40 students in random sample. Use the sign test to test whether the mean weight of population is 50 kgs against the alternative that is greater than 50.

> x = c(( )) H0 = median = 50
H1 = median > 50

> 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
Accept ~~the~~ H1 Reject H0.

3) 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, 35, 48, 57, 39, 45, 36, 30, 49, 44, 63, 39, 42, Use the sign test to check the claim.

Ho: median = 41 yrs
H1: median ≠ 41 yrs
x = c(   ).

> sp = which (x > 41)
> sn = which (x < 41)
> sp
> sn
> a = length (sp) = 9
> b = length (sn)
8
> n = a+b
> n
12
qbinom (0.05, n, 0.5, = 5)
Accept Ho.

Q.4) The times in minute that a patient has to wait for consultation is 71 recorded as follows:- 15, 17, 24, 25, 20, 21, 32, 28, 12, 25, 24, 28. Use wilcoxon sign test to check whether median waiting test more than 20 at 5% l.o.s.

→ Ho: median > 20
H1 = median < 20
x = c(   )

wilcox.test (x, alternative = "less")
pvalue = 0.999
Accept Ho.

Q5) The wt in kgs of the person before after they stop smoking are as follows: 65, 75, 75, 15, 72. After: 72, 82, 72, 66, 73. Use wilcox test to check whether the wt of person increases after the stopping smoking. use sal les.

→ Ho = increases after the stopping of smoking.
H1 = does not increase after s of smoking.

x = (   )
y = (   )

> z = x - y
> z
> wilcox.test (z, mu = 0)
p value = 0.1736
Accept H0

Practical: 9

ANOVA

The following data given the effect of treatments. Test the hypothesis that they have the same effect.

Soln :
H0 : Treatments are equally effective
H1 : Treatments are not equally effective

> 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)
> e = stack (d)
> oneway.test (values ~ ind, data = e)
p- value = 0.0066232

∴ This is enough evidence to reject H0.

2. The life cycle of different brands of tyres are given. Test wether the average life of all the tyres is same.

→ H0 : Life of all brands of tyres is same

H1 : Life of all brands of tyres is not same.

a = c (20, 23, 18, 17, 22, 24)
b = c (19, 15, 11, 20, 16, 17)
c = c(21, 29, 22, 17, 20)
d = c(15, 14, 16, 18, 14, 16)
m = list (a, b, c, d)
m

e = stack (m)
m = list (p = a, q = b, r = c, d = d)
m
l = stack (m)
e
one way. test(value ~ ind, data = e, var.equal = TRUE)

P. value = 0.004057
Reject H0.

Q3] Three types of max is applied for the protection of case and no of days of protection were noted. Test whether these are equally effective

H0 : Equally effective.
H1 : 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, a = b, r = c)
e.m
e = stack (m)
e
oneway. test (values ~ ind, data = e)

P. value = 0.0322
Reject H0.

Q.4)]. An experiment was conducted on 8 persons and observatⁿ were noted. Test the hypothesis that all groups have equal issues on their health.

H_0 : Equal results on their health

H_1 : Not equal results.

```
a = c(23,26,51,48,58,37,29,44)
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)
a = as.matrix(a)
e = stack(a)
e

aov(values ~ ind, data = e)
oneway.test(values ~ ind, data = e)
p value = 0.0163
```

∴ Reject H_0