Practical No. 1

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

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	$\Sigma = 1$	$\Sigma = 1$	$\Sigma E(x)^2 = 20$	$\Sigma[E(x)]^2 = 0.74$

Mean $= E(x) = \Sigma xi . P(x) = 1$

variable $= v(x) = \Sigma E(x)^2 - \Sigma[E(x)]^2$

$= 2 - 0.74$

$= 1.24$

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

Soln:

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
	$\Sigma=1$	$\Sigma = 9/8$	$\Sigma = 19/8$	$\Sigma = 69/64$

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 $E(x) = 9/8$ & 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	0.5	-12	3.6	1.44
10	0.35	3.5	35	12.35
15	0.25	3.75	56.25	14.0625
Total	$\Sigma=1$	$\Sigma = 6.05$	$\Sigma = 94.85$	$\Sigma = 27.7525$

Mean = $E(x) = \Sigma\, x.q(x) = 6.05$

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

$= 94.85 - 27.7525$

$= 67.0925$

Mean = $E(x) = 6.05$ & variance $v(x) = 67.0975$

Q2.

x	-3	10	15
P(x)	0.4	0.35	0.75

Soln:

x	P(x)	x.P(x)	$E(x)^2$	$[E(x)^2]$
-3	0.4	-12	3.6	1.44
10	0.35	3.5	3.5	12.25
15	0.25	3.75	56.25	14.0625
Total	$\Sigma=1$	$\Sigma = 605$	$\Sigma = 94.75$	$\Sigma = 27.7525$

SE

Mean = $E(x) = \sum x\,p(x) = 6.05$

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

$= 94.85 - 27.7525$

$= 67.0975$

Mean $E(x) = 6.05$ & variance $V(x) = 67.0975$

Q3.

x	-1	0	1	2
$P(x)$	$k+1/13$	$k/13$	$1/13$	$k-4/13$

$\because \sum P(x) = 1 = \frac{k+1}{13} + \frac{k}{13} + \frac{1}{13} + \frac{k-4}{13}$

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

$13 = 3k-2$

$15 = 3k$

$k = 5$

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	$\Sigma = 1$	$\Sigma = -3/13$	$\Sigma = 11/13$	$\Sigma = 41/169$

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

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

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

$= \frac{102}{169}$

$\because$ Mean $= -3/13$ &

Variance $= 102/169$

Q4. Let be continuous random variable with pdf

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

Obtain cdf of x otherwise

Sol:

By definition of cdf

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

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

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

33

Hence the cdf is

$f(x) = 0$ for $x \leq 0.1$

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

$= 0$ for $x > 1$

Q5. Let be continuous random variable with pdf

$\therefore f(x) = \frac{x+2}{18}$ $-2 \leq x \leq 4$

$= 0$ otherwise,

Soln:

By definition of cdf we have

$f(x) = \int_2^4 t\,dt$

$= \int_2^4 \frac{x+2}{18}\,dx$

$= \frac{1}{18}\left(\frac{1}{12}x^2 + 2x\right)$

Hence cdf is ~~for~~ $f(x) = 0$ for $x < -2$

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

for $x \geq 4$

Red...

Practical No. 2

Binomial distribution

Q1. An unbiased coin is tossed 4 times. Calculate the probability of obtaining on head, at least one head & more than one tail

NO Head :

```
> pbinom (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
```

Q2. The probability that student is accepted to a prestigious college is 0.3 if 5 students supply what's the probability of amount 2 are accepted.

```
> pbinom (2, 5, 0.3)
[1] 0. 83692
```

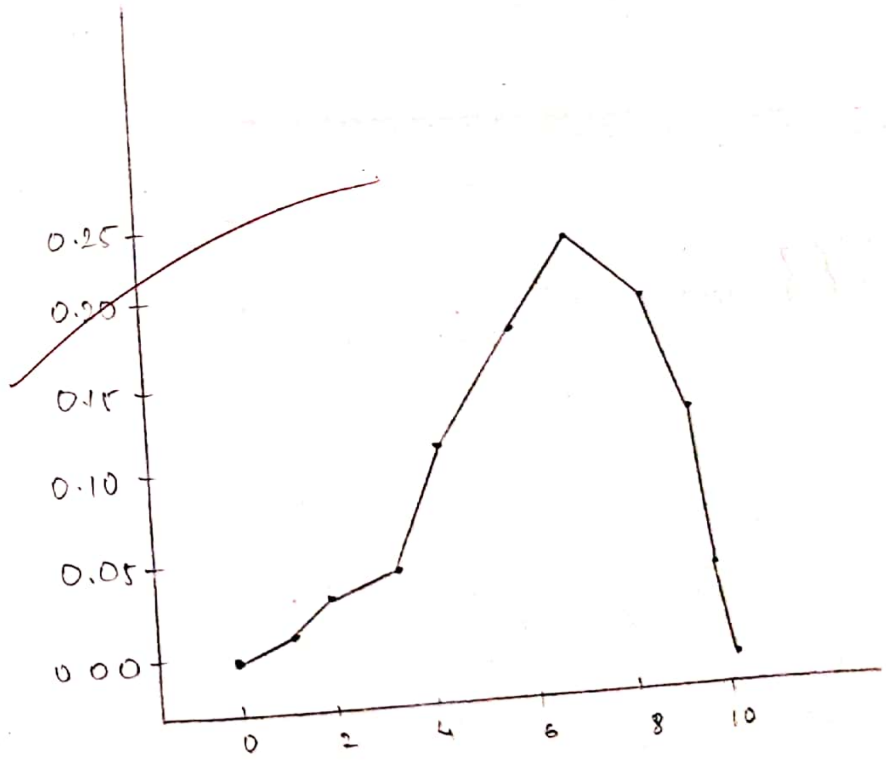
Q3 An unbiased coin is tossed 6 times the probability of head at any toss = 0.3 der x be no. of p (x = 3), p (1 < x < 5)

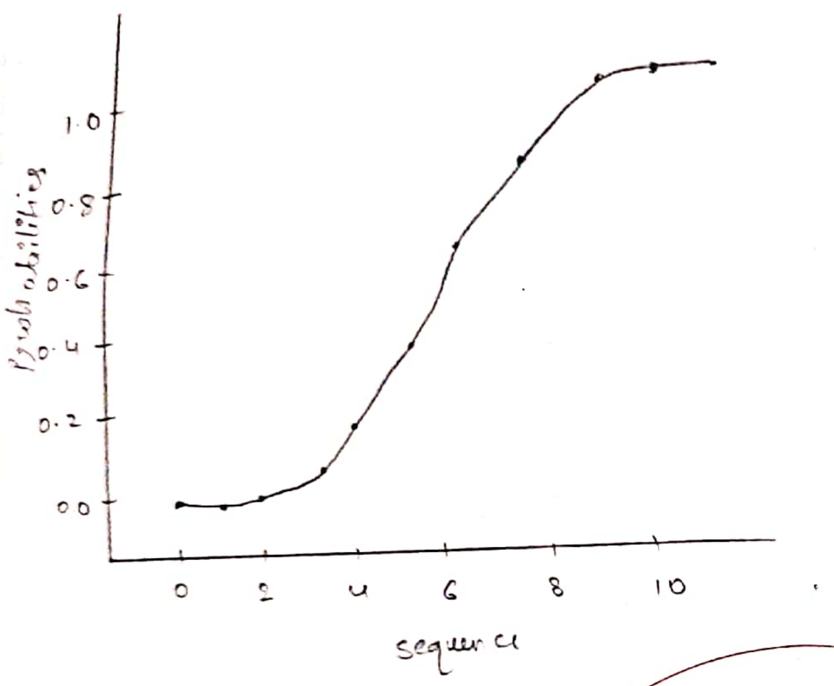
p (x = 3), p (1 < x < 5)

```
> 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
```

Q4 for n = 10 p = 0.6, pvalue binomial probabilities and plot the graph 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  0.1209323562
    0.0403107840  0.0060466176
> plot (x, y, xlab = "sequence", ylab = "probability",
  "b" pch = 16)
```






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

5. Generate a random sample of size 10 for a BD → B (8, 0.3). Find the mean & 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))
> var (rbinom (8, 10, 0.3))
[1]  1.696469
```

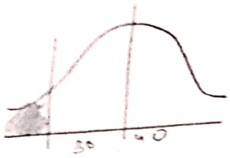
6. The probability of man hitting the target is 1/4 if he shoots 10 times what is the probability that he hits.

```
> dbinom (3, 10, 0.25)
[1] 0.2502823
> 1- dbinom (1, 10, 0.25)
[1] 0.812283
```

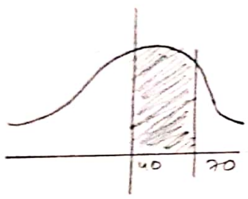
Q7. Bits are sent for communication chan- in packet of 12 If the probability of bits being corrupt in a packet?

```
> pbinom (2, 12, 0.1, lower.tail = F) +
      dbinom (2, 12, 0.1)
[1] 0.3409777
```

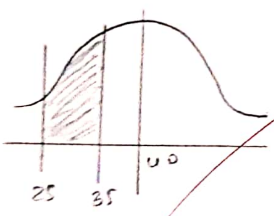
a



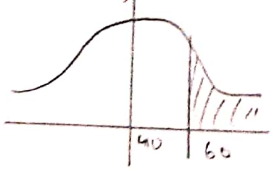
b



c



d



Practical no. 03

"Normal distribution"

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)

1. > pnorm (30, 40, 15)
[1] 0.252499

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

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

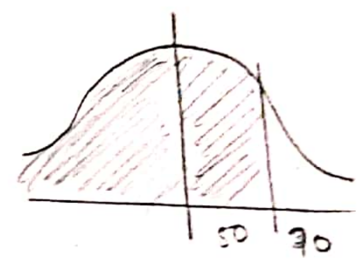
4. > 1 - pnorm (60, 40, 15)
[1] 0.09121122

Q2 If the random variable x follows normal distribution with mean · 50, V = 100 find :

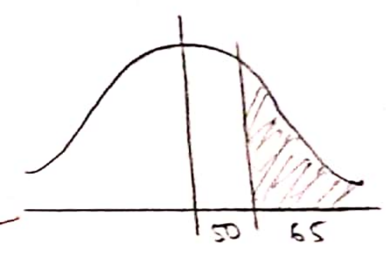
1. P (x ≤ 70)
2. P (x > 65)
3. P (x ≤ 32)
4. P (35 < x < 60)
5. P (20 < x < 30)

```
> 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
```

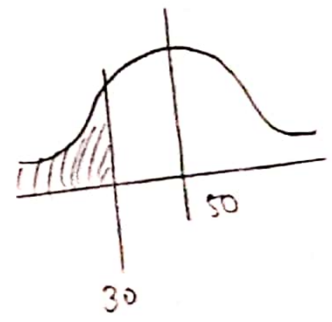
a.

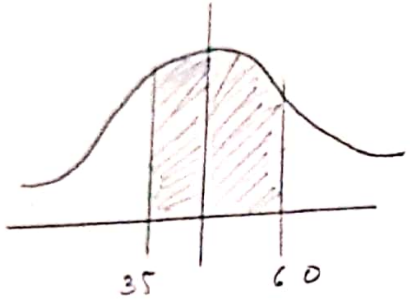


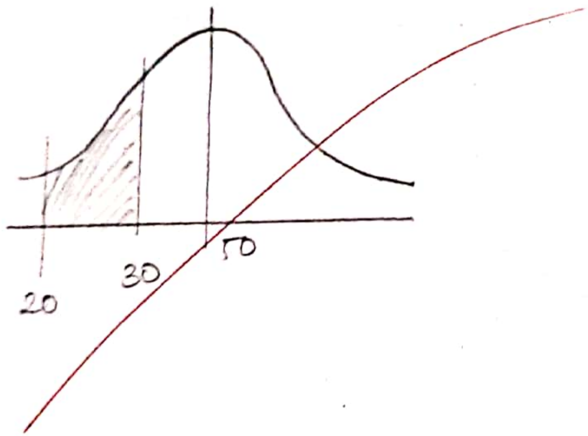
b.



c.







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] 165.6669

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

Practical NO. 4.

Sample mean & std. deviation given single population.

Q.1. Suppose the food level on the cookie bags states that it has almost 2gms of saturated in a single cookie. In a sample of 35 cookies, it was found that mean and of saturated fat per cookie is 2.1gm. Assume that the sample std. division deviation is 0.3 at 15% level of significance can be rejected the claim on food label.

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

Ans

$\sigma = 0.3$

$n = 35$

$\bar{x} = 2.1$

$u = 2$

H_0 (null hypothesis) $= u < 2$

H_1 (alternate hypothesis) $= u > 2$

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

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

= pvalue = 1 − pnorm(z)

= 0.0243

∴ reject the null hypothesis

∵ pvalue < 0.05

∴ Accepted alternate hypothesis.

Q2. A sample of 100 customers was randomly elected & it was found that average spending was 275/-. The SD = 30. using 0.05 level of significance, would you conclude that the amount spend by the customer is more than 250/- whereas the restaurant claims that it is not 250/-

Ans

$\bar{x} = 275$, $\mu = 250$, $\sigma = 30$, $n = 100$

$H_0 = u < 250$

$H_1 = u > 250$

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

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

pt (2, 99, lower.tail = F)

∴ pvalue = 2.30576e-13

∴ Pvalue < 0.05

⇒ Reject the null hypothesis –

∴ Accept the alternate hypothesis ($u > 210$)

Q3. A quality control engineer finds that sample of 100 have average life of 470 hours. Assuming population test whether the population mean is 480 hours or population mean < 480 hrs. at LOS → 0.05

$n = 100$, $\bar{x} = 470$, $u_1 < 480$, $\sigma = 25$, $u = 480$

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

pt(z, 99, lower. tail = T)

6.112576e.05

∴ Reject the null hypothesis

∴ $p < 0.05$

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

Q4. A principal at school claims that IQ is 100 of the students. A random sample of 30 students whose IQ was found to be 112. The SD of population is 15. Test the claim of principal.

Method - 1

$H_0 = u = 100$

$H_1 = u = 100$

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

$$\bar{x} = \frac{\bar{x} - u}{\sigma/\sqrt{n}} = \frac{112 - 100}{15/\sqrt{30}}$$

$= 4.38178$

∴ pvalue = 5.88567e.06

∴ Reject the null hypothesis claim of principal [$u = 100$]

Method - 2.

$H_0 = \mu = 100$

$H_1 = \mu = 100$

∴ Pvalue = 2 (1 - pnorm (abs(z)))
= 1.177134e.05

∴ Reject the null hypothesis
∴ pvalue < 0.05

Single population proportion:

Q. It is believed that coin is fair. The coin is tossed 40 times, 25 times head. Indicate whether the coin is fair as at 95 % LOL

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$ $p \rightarrow$ Probability of sample. $p_0 \rightarrow$ probability of population.

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

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

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

$\therefore H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

$\therefore$ Pvalue = 2(1 - pnorm (abs(z)))

= 0.01141209

Reject the null hypothesis

$\therefore p < 0.05$

$\therefore$ Accept the alternate hypothesis.

Q. In an hospital 480 females & 520 males are born in a week to confirm male & female are equal in is :

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

$p \rightarrow \frac{520}{1000} = 0.52$ $p_0 = 0.5$

$q_0 = 0.5$, $n = 1000$

$h_0 = [p = p_0]$

$h_1 = [p \neq p_0]$

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

z = 1.2645

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

$\therefore$ pvalue = 0.20 60 506

$\therefore$ Reject the null hypothesis < 0.5

$\therefore$ Accept the alternate hypothesis.

i.e $p \neq 100$

Q. In a big city 325 user out of 600 user are found to be self-employed conclusion is that maximum user in the city are self employed.

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

$p \rightarrow \frac{325}{600} = 0.541607$ $p_0 = 0.5$

$q_0 = 0.5$ $n = 600$

$h_0 = [p_0 - p]$

$h_1 = [p \neq p_0]$

.5416 - 0.5] / (sqrt (0.5 * 0.5 / 600))

z = 2.03975

pvalue = 2 × (1 - pnorm (abs (z)))

pvalue = 0.04155289

∴ Reject the null hypothesis

∵ pvalue < 0.5

Accept the alternate hypothesis

i.e $p \neq p_0$

Q. Experience shows that 20% of manufacturers products are top quality. In 1 days production of 400 articles only 50 are top quality. Test hypothesis that experience that experience of 10% 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 × (1 - pnorm (abs (z)))

Pvalue = 0.000176 8346

Reject the null hypothesis ∵ pvalue < 0.5

Accept the alternate hypothesis

∴ $p \neq 0.2$

* Formula :

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

Q. In an election campaign a telephone of 800 registered where shows pvalue 460. Second pole opinion 620 of 100 registered voters favoured the candidate at 0.5%. LOC (level of confidence) is there sufficient evidence that popularity has decreased.

n = 800 , p1 = 460 / 800 = 0.575

m = 100

p = (0.575 * 800 + 0.52 × 1000) / (1300)

p = 0.5444

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

z = 0.01121 1894

H_0 = p = 0.544

H_1 = p < 0.544

pvalue = 2 × (1 - pnorm (abs (z)))

∴ pvalue = 0.9991053

∴ Accept the null hypothesis

∵ pvalue > 0.5

∴ Accept p = 0.5444

Q. From a consignment A 100 articles are drawn & 44 were found defective from consignment 200. samples are drawn out of which 30 are defective. Test whether the proportion of defective times in 2 consignments are significantly different.

$H_0 = p_1 = p_2$
$H_1 = p_1 \neq p_2$
$p_1 = 44/200 = 0.22$
$n = 200 = m$
$p_2 = 30/200 - 0.15$
$$p = \frac{(p_1 n + p_2 m)}{n+m}$$

$p = (0.22 * 200 + 0.15 * 200)/400$
$p = 0.125$
$z = (\text{sqrt}(0.18 + 0.815) * (2/200)$
$z = 0.00388976$

pvalue = 2* (1-pnorm (abs(z)))
∴ pvalue = 0.9969018
∴ pvalue = 0.9969018
pvalue > p
∴ Accept the null hypothesis
i.e $p_1 = p_2$

Neelu

Practical No. 5

Chi-square test.

Q1. Use the following data to test whether the attribute condition of name & child is independent.

Condition of Home.

Clean	Dirty
70	30
80	20
35	45

H_0 = Both are independent. H_1 = Both are dependent

~~dp~~

```
x = c(70, 80, 35)
y = c(50, 20, 45)
z = data.frame(x, y)
z
```

x	y
70	30
80	20
35	45

chisq.test(z)

Reject null hypothesis
Both are dependent

Q2. A dice is tossed 120 times and the following result are obtained.

No of terms	freq.
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, 15, 10, 22, 15)
exp = sum(obs(length(obs))
exp
[1] 20
~~x~~ sum(
pchisq(z, df = length(obs) - 1)
```

∴ Accept the null hypothesis
∴ dice is unbiased.

Q3. A IQ test was conducted & the student observed before & after training, the result are following.

Before	After.
110	120
120	118
123	125
152	136
125	121

Test whether there is a change in IQ after the training.

Ho = No change is IQ
H = Change in IQ

```
a = c(120, 118, 125, 136, 121)
b = c(110, 120, 123, 132, 125)
z = sum(((a-b)^2)/a)
> pchisq(z, df = length(h)-1)
[1] 0.7135909
```

∴ There is change in IQ after training.

Q4.

	Graduate	Undergraduate 48
online	20	25
Before	40	5

Is there any association between student interference for type of education & method.

∴ Ho = Independent.
H₁ = Dependent

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

data: 2.

X-squared = 18.5, df = 1, pvalue = 2.157e-05

Reject null hypothesis
Both are independent

Q5. A dice is tossed 120 times.

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

Test the hypothesis that data is unbiased

H_0 = dice is biased

H_1 = dice is unbiased.

x = c (20, 30, 35, 40, 12, 43)

chisq.test (x)

data: x.

x - squared = 23.933, df = 5, pvalue = 0.000226

∴ Reject null hypothesis

∴ Dice is unbiased.

Practical no. 6.

t-test

Q1. Let x = 3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3398, 3424, 3383, 3374, 3384, 3374.

write the R command for following

$H_0 = \mu = 3400$; $H_1 = \mu \neq 3400$

$H_0 = \mu = 3400$; $H_1 = \mu > 3400$

$H_0 = \mu = 3400$; $H_1 : \mu < 3400$

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

2. $H_0 : \mu = 3400$

$H_1 : \mu \neq 3400$

x = c (3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3398, 3423, 3383, 3374, 3384, 3374)

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

data: x.

t = -4.4865 , df = 19, pvalue = 0.000258

alternative hypothesis : true mean is

not equal to 3400
& p.t 95% confidence level : 3361.797
3386.103

Sample of estimates:
mean of x : 3373.95
∴ Reject H_0
∴ Accept H_1
t.test (x, mu = 3400 , alt = "two. sided",
conf. level = 0.97)

data : x
t = -4.4865 , df = 14 , p-value = 0.000254
alternative hypothesis : true mean is not equal to 3400.

97 percent confident level = 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, alt = "greater",
conf. level = 0.95)

data : x
t = -4.4865 , df = 19 , p-value = 0.9999
alternative hypothesis : true mean is greater than 3400

3363.91
Sample alternative estimates.
Mean of x : 3373.95
∴ Accept H_0

t. test (x, mu = 3400 , alt = "greater",
conf. level = 0.17 , one sided t-test)
data: x
t = -4.4 865 , df = 19 , p-value = 0.999
alternative hypothesis . true mean is greater than 3400 3367.337

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 = − 4.4865, df = 19, p-value = 0.0001264.

alternative hypothesis : true mean is less than 3400

95 percent confidence level.

= Int 3383.99

sample estimates :

Mean of x :

3373.95.

∴ Reject H_0

∴ Accept H_1

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

One sided t-test

t = -4.4865, df = 19, p-value = 0.0001264
alternative hypothesis : true mean is less than 3400
95 % level of confidence
-Int 3385.563

Sample estimates.

Mean of x :
3373.95

∴ Reject H_0
∴ Accept H_1

Q2. Below are the data of gain in weights of 2 different data A & B

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

Data B : 44, 34, 22, 10, 42, 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, 31, 25, 35

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)

data: a and B

alternative hypothesis : the difference in
mean is not equal to 0
95% level of confidence.
-14.26730 : 7.933997.
Sample of estimates.
Mean of the differences.
= 3.166667.

∴ Accept Ho
∴ There is no difference in weights.

03. If students gave the test after 1 month they again give the test after coaching, do the marks gives evidence that students have benifitted by coaching.

G_1 = 23, 20, 19, 21, 18, 20, 18, 12, 23, 16, 19
G_2 = 24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17
test at 99% level of confidence.

$E_1 = c(23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19)$

$E_2 = c(24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17)$

$\therefore H_0 : E_1 = E_2$

$\therefore H_1 : E_1 < E_2$

t.test (E1, E2, paired = T, alter = "less", conf. level = 0.9)

Paired t-test.

data: E_1 and E_2

alternative hypothesis

$t_2 = -1.4832$, df = 10, p-value = 0.08401

alternate hypothesis : true mean difference in mean less than 0.

99 percent confidence level

- Int 0.863333

Sample estimates:

Mean of the differences.

-1

$\therefore$ Accept H_0

Q. Two drugs for BP was given and data was collected

D1 = 0.7, -1.8, -0.2, -1.2, -0.1, 3.4, 5.5, 1.6, 4.6, 3.4

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 pah 1 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, 0.2)~~
~~> D2 = c(1.9, 0.8, 1.1, 0.1, -0.1, 4.4, 5.5, 1.6, 4.6, 4.4)~~

t.test(D1, D2, alter = "two sided", paired = T, confidence = 0.95)

22

Paired t-test

data : D1 and D2
t = -4.0621 , df = 9, p-value = -0.002,
alternate hypothesis : true difference in mean is not equal to 0.

95 % level of confidence
Mean of the difference.
-1.58
∴ Reject H_0
∴ Accept H_1

Or. If there is diff 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 : CA = CB
H_1 : CB ≠ CA
> 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 = -4.4569, df = 5, p-value = 0.00666

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

95 % level of confidence level.
-10404.821 - 2792.846

Sample estimates:
Mean of the differences
-6598.833
∴ Reject H_0
∴ Accept H_1

Practical No. 7.

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, 43, 45, 44, 46, 49, 50, 51.

2000 : 44, 45, 47, 42, 49, 50, 41, 48, 52, 42, 54.

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

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

S1 = c(37, 39, 36, 43, 45, 44, 46, 49, 50, 51)

S2 = c(44, 45, 47, 42, 49, 50, 41, 48, 52, 42, 54)

var.test(S1, S2)

p.value = 0.9176

Accept H_0.

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I - 25, 28, 26, 22, 29, 31, 31, 26, 31)
II - 30, 25, 31, 32, 23, 23, 36, 26, 31,
32, 33, 27, 31, 38, 29

$H_0 = \sigma_1^2 = \sigma_1^2$
$H_1 = \sigma_1^2 \neq \sigma_1^2$
S1 = c (25, 28, 26, 22, 29, 31, 31, 26, 31)
S2 = c (30, 25, 31, 32, 23, 25, 36, 26, 31, 32,
32, 37, 31, 38, 29.)
p.value = 0.5541
∴ Accept H_0

3. For the foll data test the Hypothesis for
1. equality of 2 population mean.
2. equality of proportion variance.

$H_0 = \sigma_1^2 = \sigma_1^2$
$H_1 - \sigma_1^2 \neq \sigma_1^2$

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 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 rand form different cities.

City A : 74.10, 77.70, 75.35, 74, 73.80, 79.30, 75.30, 76.80, 77.10, 76.1

City B : 70.80, 74.90, 76.20, 72.80, 78.1 74.70, 69.80, 81.20.

x = c(74.10, 77.70, 75.35, 74, ~~8~~73.80, 79.30, 75.30, 76.80, 77.10, 76.

~~x~~ y = c(70.80, 74.90, 76.20, 72.80, 78.1 74.70, 69.80, 81.20)

shapiro.test (x)
p.value = 0.6559
∴ Data is normal
∴ ~~Bo~~ Shapiro.test (y)
p.value = 0.7304
∴ data is normal
> ~~shapiro.ts~~

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

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

p.value = 0.04249
∴ 2 variances are not equal
∴ Reject H_0
∴ Accept H_1

Neat

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Practical NO. 8

Non- parametric test

The times of failure in hours of 10 randomly selected 9 volt batteries is given.
28.9, 15.2, 28.7, 72.5, 48.6, 52.4, 37.6
39.5, 62.1, 54.5
test the hypothesis that the population median is 63 against the alternative that is less than 63 at 5% level of significance

H_0: median = 63
H_1: median < 63

x = c(28.9, 15.2, 28.7, 72.5, 48.6, 52.4,
37.6, 39.5, 62.1, 54.5)

Sn = length (which (x < 63))
Sp = length (which (x >63))
n = Sn + Sp
qbinom (0.05, n, 0.5)
2

Sn
9

Since binom < Sn, H_0 is accepted.
pbinom (Sn, n, 0.5)
0.999024

Since pbinom > 0.05, Accept H_0

∴ H_0 is accepted.

2. Weights of 40 students in random sample. Test the hypothesis that the median is 50 against it is greater than 50

Soln:

x = c(46, 49, 57, 64, 46, 67, 54,
48, 69, 61, 57, 50, 48, 65,
61, 66, 54, 50, 48, 49, 62,
64, 53, 50, 48, 51, 52, 54.

Sn = length (x[x < 50])
Sp = length (x[x > 50])
n = Sp + Sn
qbinom (0.05, n, 0.5)
14
Sn
13
Since qbinom > Sn, Reject H_0
∴ H_0 is rejected.

The median age of tourist visiting the certain place is claim to be 41 years, a random sample of 17 tourist have the age. Use the sign-test to check the claim.

→

Ho : median = 41

H1 : median ≠ 41

x = c(25, 24, 48, 52, 57, 39, 45, 36, 30, 49, 28, 39, 44, 63, 32, 65, 42)

sp = length (which (x > 41))

sn = length (which (x < 41))

pbinom (0.05, n, 0.5)

5

Sn

8

Since qbinom < Sn , Ho in accepted

median = 41 is accepted.

4. The times in minute that a patient has to wait for consultation is recorded as follows.
Use the wilcoxon sign test to check whether the median waiting time is more than 20 at 5% level of significance.

Sol^n: H0 : median > 20, H1 : median < 20

x = c(15, 17, 24, 25, 20, 21, 32, 28, 72, 25, 24, 26)

wilcox.test (x, alternative = "less")

0.999

∴ Accept H0.

5. The weight in kg of person before and after he stops smoking are as follows. Use wilcoxon test to check whether the weight of person increases after stoping the smoking use 5% level of significance.

Sol^n:

H0 : height increases after years
H1 : Height don't chang.

b = c ((65, 75, 75, 62, 72)
a = c (72, 82, 72, 66, 73)

x = b - a

~~-7, 3~~

-7, -7, 3, -4, -1

wilcox.test(x, mu=0)

p.value = 0.1756

∵ pvalue > 0.05

∴ Accept H_0

Renuka

Practical NO. 9

Q1. The following data gives the effect of three treatment

Treatment 1	Treatment 2	Treatment 3
2	10	10
3	8	13
7	7	14
2	5	13
6	10	15

```
t1 = c(2, 3, 7, 2, 6)
t2 = c(10, 8, 7, 5, 10)
t3 = c(10, 13, 14, 13, 15)
```

H_0 : Treatment are equally effective.
H_1 : Treatment are not equally effective.

```
d = data.frame(t1, t2, t3)
e = stack(d)
oneway.test(values ~ ind, data = d)
```

p-value = 0.006252

$\therefore$ Reject H_0

The foll. is list of types of 4 branches.

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

```
A = c(20, 23, 18, 17, 22, 24)
B = c( 19, 15, 17, 20, 16, 17)
C = c( 21, 19, 22, 17, 20)
D = c (15, 14, 16, 18, 14, 16)
z = list (f=A ,g=B , h=C ,i=D)
b = stack (z)
Oneway.test ( values ~ ind, data = z)
```

p- value = 0.01762

H_0 is rejected.

Q3. Three types of wax are applied for protection of cars and days of protection were noted. Test whether these are equally effective.

```
w1 = c(44, 45, 46, 47, 48, 49)
w2 = c(40, 42, 51, 52, 55)
w3 = c(50, 53, 58, 59)
u = list(t = w1, y = w2, e = w3)
v < stack(u)
oneway.test(values ~ ind, data = v)
```

p-value = 0.03822

We have enough evidence to reject Ho.

Q4 An experiment was conducted on 8 persons and the observations were conducted.

```
q1 = c(23, 26, 51, 48, 58, 37, 29, 44)
w1 = c(22, 27, 29, 39, 46, 48, 49, 65)
e1 = c(59, 66, 38, 49, 56, 60, 56, 62)
f1 = list(x = q1, y = w1, p = e1)
d1 = stack(f1)
```

oneway.test (values ~ ind, data = t1)

p-value = 0.01633

∴ Ho is rejected.

Neat