Practical 1:-

Topic:- Random Variable

Find the mean & variance for the foll

a]

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

Solution :

X	$P(x)$	$X \cdot P(x)$	$E(x)^2$	$[E(x)]^2$
-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	$\Sigma = 1$	$\Sigma = 1$	$\Sigma E(x)^2 = 2.0$	$\Sigma [E(x)]^2 = 0.74$

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

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

$= 2 - 0.74$

$= 1.24$

$\therefore$ 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	Σ = 1	Σ = 9/8	Σ = 19/8	Σ = 69/64

∴ Mean = $E(x) = \Sigma x \cdot P(x) = 9/8$

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

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

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

$= \frac{83}{64}$

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

c)

X	-3	10	18
P(x)	0.4	0.35	0.25

Solution:-

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	12.23
15	0.25	3.75	36.25	14.0
Total	Σ = 1	Σ = 6.05	Σ = 96.85	Σ = 27.52

Mean = $E(x) = \Sigma x \cdot P(x) = 6.05$

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

$= 94.85 - 27.7525$

$= 67.0975$

d) If P(x) is Pmf of a ~~sudden~~ r.v. If P(x) represents pmf for r.v. X. Find value of mean & variance.

Solution:- As P(x) is a Pmf it should satisfy properties of Pmf which are

$P(x \geq 0)$ for all sample space

$\Sigma P(x_i) = 1$

e)

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

$$\therefore \Sigma\, p(x_i) = 1 = \frac{k+1}{13} + \frac{k}{13} + \frac{1}{13} + \frac{k-4}{13}$$

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

$$13 = 3k-2$$

$$\frac{15}{3} = k$$

$$k = 5$$

f)

X	$P(x)$	$X\,P(x)$	$E(X)^2$	$[E(X)]^2$
-1	$6/13$	$-6/13$	$6/13$	$36/164$
0	$5/13$	0	0	0
1	$1/13$	$1/13$	$1/13$	$1/164$
2	$1/13$	$2/13$	$4/13$	$4/164$
Total	$\Sigma = 1$	$\Sigma = -3/13$	$\Sigma = 11/13$	$\Sigma = 41/164$

$$\text{Mean} = E(x) = \Sigma \cdot X\,P(x) = -3/13$$

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

$$= 11/13 - 41/164$$

$$= 102/164$$

$\therefore$ Mean $= -3/13$ & variance $= 102/164$

9) The pmf of a r.v. X in 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 i) $P(-1 \le x \le 2)$ ii) $P(1 \le x \le 5)$ iii) $P(x \le 2)$ iv) $P(x \ge 0)$

Solution:-

X	−3	−1	0	1	2	3	5	8
P(X)	0.1	0.2	0.15	0.2	0.1	0.1	0.15	0.03
E(X)	0.1	0.3	0.45	0.65	0.65	0.75	0.4	0.93

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

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

iii) $P(X \le 2) = P(X = -3) + P(X = -1) + P(X=0)$
$= 0.1 + 0.2 + 0.13 + 0.2 + 0.1$
$= 0.75$

iv) $P(X \le 0) = 1 \cdot F(0) + T(0)$
$= 1 - 0.45 + 0.15$
$= 0.40$

Q5) Let f be contiⁿ r.v with

$f(x) = \frac{x+1}{2}$ — $-1 < x < 1$

$= 0$ otherwise

obtain cdf of x

Solution:- By defⁿ of cdf

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

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

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

Here the cdf is

$F(X) = 0$

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

for $x \ge 1$

$= 0$

Q5) Let f be continous r.v. with pdf

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

$$= 0 \quad - \text{otherwise}$$

Calculate cdf

Solution:- By definition of cdf we have,

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

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

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

for $-2 \le x \le 4$

Hence cdf is

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

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

for $-2 < x < 4$

$= 0$ for $x \geq 4$

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```
> dbionom(3,6,0.3)
[1] 0.18527
> dbinom(2,6,0.3) + dbinom(3,6,0.
+dbinom(4,6,0.3)
[1] 0.74373
```

Q4] For n = 10, p = 0.6 evaluate bionomial probabilities and plot the graph of p.
& c.d.f.

```
> x = seq (0,10)
> y = dbinom (x,10,0.6)
> y
[1] 0.0001048576  0.0015728640
    0.0106168320  0.0424673280
    0.1114767360  0.2006581244
    0.2508226560  0.2149908480
    0.1209323520  0.0403107840
    0.0060466176
> plot (x, y, xlab="Sequence", ylab=
  "probabilities", "p.")
> x = seq (0,10)
> y = pbinom (x,10, 0.6)
> plot(x, y, xlab = "Sequence", ylab=pro
  , "o", plot=10).
```

Generate a r.s of size 10 for a B.D → B(8, 0.3) find mean & 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 (r 10, 0.3))
[1] 1.696469

The probability of men hitting the target is 1/4 if he shoots 10 times what is the probabilities that he hits the target exactly 3 times probability that he hits the targets at least one time

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

Bits are sent for communication channel in packet of 12. If the probabilty of bit being corrupted is of 0.1. What is probability of more than 2 bits are corrupts in a packet 12.

> pbinom (2, 12, 0.1, Lower.tail = F) + dbinom (2, 12, 0.1)
[1] 0.3404977

Practical 3:-

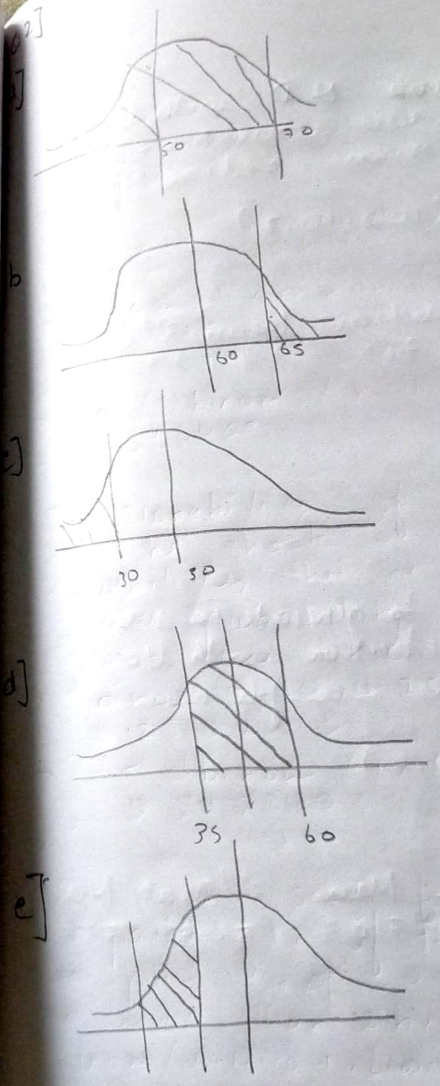
Title : Normal Distribution.

1) A normal distribution of 100 students with mean = 40, 50. Find the no. of whose marks are :-

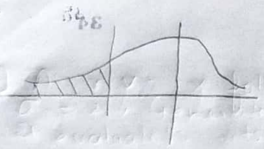
1) P(x < 30)   2) P(40 < x < 70)

3) P(25 < x < 35)   4) P(x > 40)

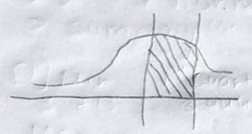
```
> Pnorm (30,40,15
[1] 0.2524925

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

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

> 1 - Pnorm (60,40,15)
[1] 0.07,21122
```



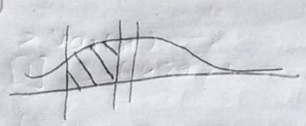
a]



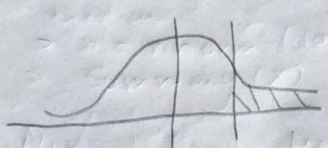
b]



c]



d]



1] If the r.v. follows the normal distribution with mean = 50, v = 100, Find ① $P(X<75)$ ② $P(X>65)$, ③ $P(X \le 32)$ ④ $P(35<x<60)$ ⑤ $P(20<x<30)$

> pnorm (70, 50, 10)
[1] 0.97734

> 1 - pnorm (65, 30, 10)
[1] 0.06680072

> pnorm (37, 50, 10)
[1] 0.03593032

> pnorm (60, 40, 10) - pnorm (35, 50, 10)
[1] 0.7723375

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

2] Let X = N (100, 400), Find k_1 & k_2 such that $P(X < X_2) = 0.1$ & $P(X > K_2) = 0.6$

> qnorm (0.6, 160, 20)
[1] 165.0168

> pnorm (88, 160, 20)
[1] 176.8524

Q4] A r.v. x follows N.D. with $\mu = 10$, $\sigma = 2$, Generate 100 ~~reservations~~ obs. & evaluate's its mean, median & variance.

```
> x = rnorm (100,10,2)
> summary(x)
```

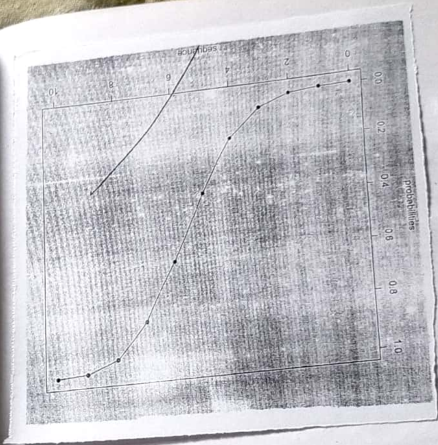
[1] Min	1st Quart	Median	Mean	3rd Q	Max
5.713	8.444	9.723	9.914	1.325	14.23

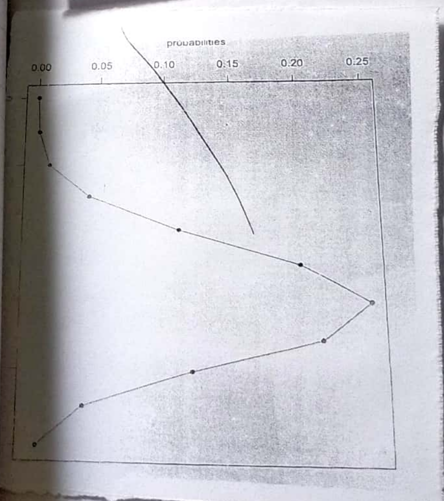
```
> var(x)
[1] 3.648924
```

Q3] Write a command to generate 10 r.v. for normally distribution with $\mu = 50$, $\sigma = 4$. Find the sample mean & median

```
> x = rnorm (10,50,4)
> summary (X)
```

Min	1st Quart	Median	Mean	3rd Quat	Max
44.73	50.46	52.01	52.03	52.35	53.8





Practical 4:

Aim:- Sample mean & deviation given single population.

Q] Suppose the food level on the cookie bag that it has almost of saturated salt in single cookie. In a sample of 55 cookies it was found that mean and avg of saturated salt is 2.1 g. Assume the S.D. is 0.3 at (5% level of significance)

⇒ $\sigma = 0.3$

$n = 35$

$\bar{x} = 2.1$

$x = 2$

x_0 (null hypothesis) $= \mu < 2$

x_1 (Alt hypothesis) $= \mu > 2$

$$z = \frac{\bar{x} - u}{\frac{6}{\sqrt{n}}}$$

$$\therefore z = \frac{2.1 - 2}{\frac{0.3}{\sqrt{35}}} = 1.972021$$

p-value $= 1 - \text{pnorm}(z)$

$= 0.0243$

∴ Reject the null hypothesis ; pvalue < 0.05

∴ Accepted alternate hypothesis

Q] A sample of 100 customers was randomly selected & it was found that average 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 claim that it is not = 250%.

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

$H_0 = \mu < 250$

$H_1 = \mu \ngtr 250$

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

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

» pt (z, 99, lower.tail = F)

∴ p-value = 2.30577 36 e.13

=> Reject the null hypothesis ∵ p-value < 0.05

Accept the alternate hypothesis (μ > 2...

3] A quality control engineer finds that sample of 100 have average life of 470 hours. Assuming population test whether the population means is 480 hours vs population means < 480 hours at 1-05 → 0.05

$n = 100$, $\bar{x} = 420$, $\mu_1 < 480$, $\sigma = 25$,
$\mu = 480$

$\Rightarrow Z = \dfrac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = -4$

$\Rightarrow$ pt (z, 99, lower.tail = F)
= 6.1125 7ce.05

$\Rightarrow$ Reject the null hypothesis $\because p < 0.05$
Accept the alternate hypothesis ($\mu_1 < 480$)

4] A principal at school claims 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 is 15.
The Test of principal
Method 1:- 1 Tail test
$x_0 = \mu = 100$
$x_1 = \mu = 100$
$\bar{x} = 112$, S.D $= 15$, $\mu = 100$, $n = 20$

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

$$= \frac{112 - 100}{\frac{15}{\sqrt{30}}} = 4.38118$$

p-value $= 6.8856$

→ Reject the null hypothesis = Claims of principle

* <u>Single population portion:-</u>

Q] 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 % l.o.c.

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

$\therefore p_0 = 0.5$; $q_0 = 1 - p_0 = 0.5$

$p = \frac{28}{40} = 0.7$ $n = 90$

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

$H_0 = \mu = 0.5$

$H_1 = \mu \neq 0.5$

→ p-value = 2 × (1 - pnorm(abs(z)))

∴ p-value = 0.01141209

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

] In an hospital 480 females & 520 males are born in ~~a~~ To confirm that male & female are equal in

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

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

$H_0 = [P = P_0]$

$H_1 = [P \neq P_0]$

⇒ z = (p-p0) (sqrt (p0q0/n))

⇒ z = 1.2645

pvalue = 2 × (1-pnorm (abs(z)))

∴ pvalue = 0.2060506

Reject the null hypothesis ∵ pvalue < 0.5

∴ Accept the alternate hypothesis i.e. $P \neq P_0$

Q] In a big city, 325 men out of 600 men are found to be self employed. Conclude is that maximum men in city are self improved.

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$ $p \rightarrow 325/600 = 0.541607$, $p_0 = 0.5$, $q_0 = 0.5$, $n = 600$

$H_0 = [p_0 = p]$
$H_1 = [p \neq p_0]$

>>> z = ((0.5416 - 0.5)) / sqrt(0.5 * 0.5 / 600))
>>> z = 2.037975

>>> P value = 2 * (1 - pnorm (abs (z)))
>>> P value = 0.4155239

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

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

$$z = \frac{p - p_0}{\sqrt{\frac{p_0 - q_0}{n}}}$$, $p = 0.125$ (50/400), $p_0 = 0.2$, $q_0 = 0.8$, $n = 4$

$H_0 = [p_0 = 0.2]$
$H_1 = [p_0 \neq 0.2]$

>> z = (0.125 - 0.2) / sqrt (0.2*0.8 */400))
>> z = -3.75
> p-value = 2 x (1- pnorm (abs (z)))
pvalue = 0.0001768346

Reject the null hypothesis ∵ pvalue < 0.2

Formula:

$$z = \sqrt{pq\left[\frac{1}{n} + \frac{1}{m}\right]} \quad \text{where } p = \frac{P_1 n + P_2 m}{n+m}$$

1] In an election campaign, a telephone of 800 registered ~~voter~~ voters shows favours 460. Second pole opinion 520 of 100 registered voters favored the condition of 0.5% (level of confidence) is there sufficient evidence that popularity has decreased.

n = 800, p1 = 460 / 800 = 0.575, m = 1000, p2 = 520/1000 = 0.52
p = (0.575 * 800 + 0.52 x1000) / (1800)
p = 0.54444

z = sqrt (0.54 * 0.46) + 1/8
z = 0.0011213a4

$h_0 = p = 0.544$
$h_1 = p < 0.544$

pvalue = (2x(1- pnorm (abs (z)))
∴ pvalue = 0.9991053

Accept the null ~~p~~ hypothesis
∴ p-value = ~~0.9991053~~ 0.5444

Q2] From a consignment A, 100 articles are drawn & 44 were found defective from consignment B, 200 samples are drawn out of which 30 are defective : Test whether the proportion of defective items in 2 consignments are significantly different.

$h_0 = p_1 = p_2$
$h_1 = p_1 \neq p_2$
$p_1 = 44/200 = 0.22$
$n = 200 = m$
$p_2 = 30/200 = 0.15$
>>> $p = \frac{(p_1 n + p_2 n)}{n+m}$
>>> p = (0.22 * ~~0~~ 200 + 0.15 * 200)/400
>>> p = 0.125
>>> z = (sqrt (0.185 * 0.185) * (2/200))
>>> z = 0.00 3882926

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

∴ pvalue = 0.99620018
p value > p

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

Practical 5:-

Aim:- Chi - Square Test.

Q1] Use the foll data to test whether the condition of home & child are independent

		Condition of homes Clean	Dirty
Condition of Child	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

> Chi sq.test (z)
```

Pearson chi sq test
data : z
x-squared test = 25.646
df = 2, p value = 2.698 e^{-06}

Reject the null hypothesis

12] A dice is tossed 120 times and foll results are obtained

No. of terms	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] = 0.956654
Accept the null hypothesis
∴ Dice is unbiased

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Q3] An IQ test was conducted & the students observed before & after training the results are following

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

Test whether there is change in IQ after training

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

```
> a = c(120, 118, 125, 136, 121)
> c2 = c(110, 120, 123, 132, 125)
> z = sum((b-a)^2)(a)
> pchisq(z, df = length(b)-1)
[1] 0.1135954
```

Accept the null hypothesis

There is change in IQ after training.

	Graduate	Undergraduate
online	20	25
face-face	40	5

Is there any 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 chisq test with yates continuity correction

data : z
x-squared = 18.05, df = 1,
p-value = 2.157e-05

Reject the null hypothesis
Both are dependent.

05] A dice is tossed 180 times

No. of times	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)
Chisquared test for given probabilities
data = x
x-squared = 23.933
df = 5, p-value = 0.000223
```

Reject the null hypothesis
Dice is unbiased.

29/2/2020

actical 6:

Title : T- test

t x = 3366, 3337, 3361, 3410, 3316, 3357, 3348, 3856, 3376, 3382, 3377, 3355, 3408, 3401, 3398, 3424, 3383, 3374, 3384, 3374

rite the R-command for the foll to test the hypothesis.
$H_0 = \mu = 3400$, $H_1 : \mu \neq 3400$
$H_0 = \mu = 3400$, $H_1 = \mu > 3400$
$H_0 = \mu = 3400$, $H_1 = \mu < 3400$
t 95% level of confidence. Also check at 97%. vel of confidence.

$= \mu = 3400$
$= \mu \neq 3400$
= c (3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376, 3382, 3377, 3355, 3408, 3401, 3398, 3424, 3383, 3374, 3384, 3374).
. test (x, mu = 3400, alter = "two.sided", conf.level = 0.95
one sample test:—
ta = x
= -4.4865, df = 19, p-value = 0.0002528
ternative hypothesis : true mean $\neq$ 3400
95% level of confidence :
3361.797 & 3386.103

mple estimate : mean of x = 3373.95

∴ Reject H0
∴ Accept H1

> t.test(x, mu=3400, alter="two.sided", conf.level
one sample test
data = x
t = -4.4865 , df = 19 , p-value = 0.000252
alternative hypothesis: true mean is not equal to
3360.33 3387.57

Sample estimate:
mean of x = 3373.95 ∴ Reject H0 ∴ Accept

2) H0 = μ = 3400
H1 = μ > 3400.
> t.test (x, mu = 3400, alter = "greater", conf.level
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
Sample estimates:
mean of x
3373.95

∴ Accept H0

> t.test (x1 , mu = 3400 , alter = "greater", conf
0.97) one sided t-test

data : x

t = -4.4865 , df = 19, pvalue = 0.9999

alternative hypothesis : true mean is greater than 3400

3367.337

Sample estimates

mean of x :

3373.95

∴ Accept Ho

Below are the data of gain in wts on 2 diff 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

∴ Ho = a - b = 0

H1 = a - b ≠ 0

> a = c(25, 32, 30, 43, 24, 14, 32, 24, 31, 31, 35, 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)

data = a & b

t = -0.62787 , df = 11 , p-value = 0.5429

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

95% confidence interval
-14.267330 7.933997
Sample estimates:
mean of the differences -3.16667
∴ Accept H_0
∴ There is difference in weights.

Q3] 11 Students gave the test after 1 month they again gave the test after the tuitions do the marks give evidance that students have benefitted from the coaching.

E_1 = 23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19
E_2 = 24, 19, 22, 18, 20, 22, 20, 20, 23, 20, 17
Test at 99% lot 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 : $e_1 = e_2$
∴ H_1 : $e_1 < e_2$
> t.test(e1, e2, paired = T, alter = "less", conf.level

data: e1 & e2
t = -1.4832, df = 10, p-value = 0.0844
alternative hypothesis: true difference in mean is less than 10
99% conf interval
-Inf 0.863333

Sample estimates:
Mean of difference = -1
Accept Ho

Two drugs for B.P was given & data was collected

D1:-0.7, -1.8, -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 effects, check whether 2 drugs have same effect on patient or not.

Ho = d1 = d2
H1 = d ≠ d2
> d1 = c (0.7, 1.6, -0.2, -12, -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, 3.4)
> t.test (d1, d2, alter = "two sided" paired=T, conf level = 0.95)

Paired t. test

data = d1 & d2
t = -4.0621 , df = 9, p-value = -0.002833
Alternative hypothesis: true difference in means is not equal to 0.

95 % level of confidence.
Mean of the difference :-1.58
Reject Ho
Accept H1

Q5) If there is differen in Salaries for the sa
job in 2 diff countries

CA = 53000, 49958, 41974, 44366, 40470, 369..

CB = 62490, 5850, 49495, 52263, 47674, 43..

→ $\mu_0 = \mu_1 = \mu_2$

$\mu_1 = \mu_1 \neq \mu_2$

> t.test (ca, cb, paired = T, alter = "2-sided", conf.
level = 0.95

paired t-test
data = ca & cb
t = -4.4569, df = 5, p-value = 0.0066

95% level of conf.

Sample estimate : -6698.833

∴ Reject H_0
∴ Accept H_1

Practical 7:-

1) Life expentancy in 10 region of India in 1990, 2000 are given below. Test whether the variance of the 2 time are same

1990 = 37, 39, 36, 43, 45, 44, 46, 49, 50, 51

2006 = 44, 45, 47, 43, 42, 47, 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~~

var. test (1990, 2006) pvalue = 0.9196

Accept H_0.

I - 25, 28, 26, 22, 22, 29, 31, 31, 26, 31, 32

II - 30, 25, 31, 32, 23, 25, 36, 26, 31, 32, 27, 31, 38, 27

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

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

p-value = 0.5341

Accept H_0

Test hypothesis for the foll.-

Equality of 2 population mean

Equality of proportion variance.

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

38

x=c(175, 168, 145, 190, 181, 185, 179, 200)
y=c(180, 170, 155, 180, 170, 183, 187, 205)
var.test(x,y)
p.value = 0.7759

Accept H0
t.test (x,y)
p.value=0.8216
Accept H0

Q4) The foll are prices of commodity in the sa of shops selected at random from different cities:
city A = 74.10, 77.20, 75.35, 74, 73.80, 79.30, 75 76.80, 77.10, 76.40.
city B = 70.80 74.90, 76.20, 72.80, 78.10, 74.70, 69.90, 81.20

> shapiro.test(city A)
pvalue = 0.6559
∴ data is normal

> shapiro.test(city B)
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
$H_0 = \bar{x_1} = \bar{x_2}$
$H_1 = \bar{x_1} \neq x_2$
> t.test(x, var. equal=F)
p.value (3.488e-16

> t.test(y, var equal=F)
p.value = 1.46e-10
∴ Accept H_0

Prepare a csv file in excel. Import the file in R & apply the t test to check the equality of variance of 2 data

Obs1 :- 10, 15, 17, 11, 16, 20
Obs 2 :- 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
> Data

Observation 1	Observation 2
10	15
15	17
19	16
11	11
16	14
20	19

> attach (Data)
> mean (Observation 1)
14.9333

> var.test (observation 1 , observation 2)
p.value = 0.5717
∴ Accept Ho

Practical 8:

Title :- Non parametric test

The [illegible] of [illegible] [illegible] of 10 randomly selected a well [illegible] of a credit company is as follows

79.9, 15.2, 29.1, 72.8, 49.6, 52.4, 37.6, 49.3, 62.1, 54.5

Test the hypothesis that the population median is 63 against alternative is that 63 at 5% level of significance

H0 : median = 63

H1 : median ≠ 63

```
> x = c(79.9, 15.2, 29.1, 72.8, 49.6, 52.4, 37.6,
      49.3, 62.1, 54.5)
> sp = length(which(x>63))
> sn = length(which(x<63))
> sp
  2
> sn
  8
> n = sp + sn
> qbinom(0.05, n, 0.5)
  2
```

∴ qbinom < sn

Accept H0

∴ median ≠ 63

Q2] The foll data gives the weight of 40 students in random sample
46, 49, 57, 64, 46, 67, 75, 54, 48, 69, 61,
57, 54, 50, 47, 65, 61, 66, 54, 50, 48, 47, 62,
49, 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 median rate of population in sohg against alternative it is > 50 kg

∴ Ho : median = 50
H1 : median > 50

```
x = c(46, 48, 57, 64, 46, 67, 54, 48, 69, 61, 57, 50, 48, 49, 62, 47, 49, 55, 59,
48, 65, 61, 66, 54, 50, 48, 51, 52, 54)
53, 56, 67, 49, 60, 64, 53, 50, 48,
> sp = length(which(x>50))
> sp
> 25
> sn = length(which(x< 50))
> sn
12
> n = sp+sn
> qbinom(0.05, n, 0.5)
14
```

∴ qbinom > sn
∴ Reject Ho

The median age of tourists visiting a certain place is claim to the 41 yrs. A r.v. of 70 tourists have the age
25, 29, 52, 48, 57, 39, 45, 36, 30, 49, 28, 39, 44, 63, 32, 65, 42.
use the sign test to check the claim

H_0 = median = 41
H_1 = median ≠ 41
> sp = length (which (x > 41))
> spn = length (which (x < 41))

> sp
9
> sn
8
∴ qbinom < sn
∴ Accept H_0
median = 41

Q4] The times in minute that a patient has wait for consultation is recorded as follows
x = c(15, 24, 25, 20, 21, 32, 28, 12, 25, 24, 26)
Use wilcoxon sign test to check the median weight in time is more than 20 when 5% level of significance

→ H_0 = median ≥ 20
H_1 = median < 20

wilcox.test (x, alternative = "less")
pvalue = 0.999
Accept H_0

Q5] The weight in kg of the person before after this ~~weight before~~

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

Use wilcoxon test to check whether the weight of person increases after stopping the smoking use 5% level of significance is 5% of confidence

H0 : increases after stopping to smoking
H1 = does not increases after stopping smoking

x = c(65, 75, 75, 62, 72)
y = c(72, 82, 72, 66, 73)

z = x - y
z
wilcoxon.test(z, mu = 0)
pvalue = 0.1736
Accept H0

Practical 9:-

Title : Anova test.

Q1) The following data gives the effect of 3 treatment

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 effected

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

> stack(z)
```

	values	ind
1	2	t1
2	3	t1
3	7	t1
4	2	t1
5	6	t1
6	10	t2
7	8	t2
8	7	t2
9	5	t2
10	10	t2
11	10	t3
12	13	t3
13	14	t3
14	13	t3
15	15	t3

l= stack (2)
aov(values ~ ind , data = l)

Terms	ind	Residuals
Sum of squares	203.333	54.000
Deg of Freedom	2	12

Residual standard error : 2.12132
Estimated effects may be unbalanced
One way.test (values ~ ind , data = l)

58

data: values and ind
F = 21.537, num df 2.000, denom df = 7.9134, p-value = 0.0006232

Q] The following data give life of type tyres of 4 brands

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

Test the hypothesis that average life of all tyres is same

z = list (a, b, c, d)
>z
[[1]]
[1] 20 23 18 17 23 24

[[2]]
[1] 19 15 17 20 16 17

[[3]]
[1] 21 19 22 17 20

[[4]]
[1] 15 14 16 18 14 16

> l = list (i = a, j = b, k = c, l = d)
> l

$ i
[1] 20 23 18 17 23 24

$ j
[1] 19 15 17 20 16 17

$ k
[1] 21 19 22 17 20

$ l
[1] 15 14 16 18 14 16

o = stack (l)
o
aov (values ~ ind, data = o)
oneway.test (values ~ ind, data = o)
p-values = 0.04059
Ho is rejected.

Q] 3-types of wax is applied for the protection of car No. of days of protection were noted. Test whether these are equally effected

-> H0: The wax are equally effective
H1: The wax are 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(a1= a, b1=b, cc=c)
z=stack(m)

> oneway.test (values ~ ind, data=z)
```

p-value = 0.03822
Reject H0

n experiment was conducted on 8-people & the
.ts were noted. Test whether the hypothesis
that the group has equall results on their
health

Ho = The result are equal
H1 = The result are unequal

```
n   = c(23,26,51,48,58,37,29,44)
n20 = c(22,27,29,39,46,48,49,65)
n60 = c(59,66,38,49,56,60,56,62)
m = list(a=n, b=n20, c=n60)
e = stack(m)
oneway.test(values ~ ind, data(e))
```

p-value 0.1412

H0 is rejected.