Prob - 1

(a) $\mu = 25$

$\mu \neq 25$.

This is correct because we can see that Ho contained the no difference term and H1 is contradictory to Ho

(b) $H_0 : \sigma > 10$

$H_1 : \sigma = 10$

This is wrong because Ho contains the type of Expression $\sigma = 10$ Since it is the hypothesis of no difference

(c) $H_0 : \bar{x} = 50$

$H_1 : \bar{x} \neq 50$

This is correct because we can see that Ho contains the no difference term and H1 is contradictory to Ho

(d) $H_0 : P = 0.1$

$H_1 : P = 0.5$

This is wrong because H1 contains the no diff. Claim and Ho is not contradictory to H1 with Equal right hand side.

Problem Statement - 2

Soln

$H_0: \mu \leq 52$

$H_1: \mu > 52$

$\mu = 52$

$\sigma = 4.50$

$\therefore$ It is one tailed Right hand test

$n = 100$

$$S.E = \frac{\sigma}{\sqrt{n}} = \frac{4.50}{\sqrt{100}}$$

$\bar{x} = 52.80$

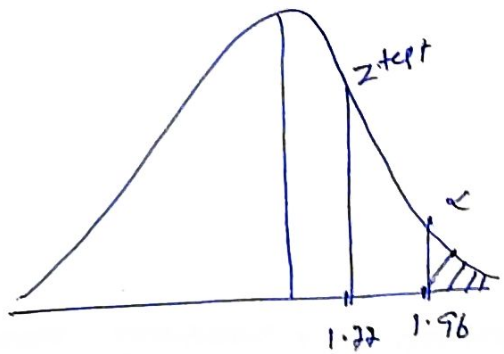
$\alpha = 0.05$

$$\boxed{S.E = 0.45}$$

$$Z(\text{test}) = \left(\frac{\bar{x} - \mu}{S.E}\right)$$

$$= \frac{52.80 - 52}{0.45}$$

$$\boxed{Z(\text{test}) = 1.77}$$



$\alpha = 0.05$

$Z(\alpha) = 1.96.$

$\therefore$ Here Z value doesn't fall under critical region.

Hence Accept the null hypothesis

Reject the Alternate hypothesis

Prob - 3

$\mu = 34$ ppm

$\sigma = 8$ ppm

$\bar{x} = 32.5$ ppm

$n = 50$

$\alpha = 1\%$

$H_0: \mu = 34$

$H_1: \mu \neq 34$

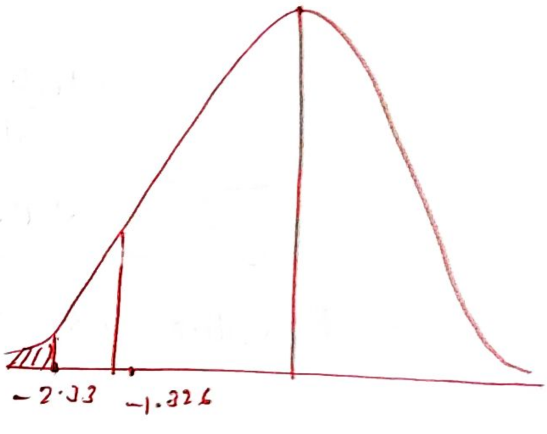
$$Z = \frac{x - \mu}{S.E}$$

$$SE = \frac{Sd}{\sqrt{n}} = \frac{8}{\sqrt{50}}$$

$$\boxed{SE = 1.131}$$

$$Z = \frac{32.5 - 34}{1.131}$$

$$\boxed{Z = -1.326}$$



$\alpha = 1\% = 0.01$

$Z_{0.01} = -2.33$

$\therefore$ Z value Doe's't fall under the critical region Hence Accept the null hypothesis.

Prob - 4

$H_0 : \mu = 1135$

$H_1 : \mu \neq 1135$

$\alpha = 0.05$

$\mu = 1135$

$S = 240.37$

$n = 22$

$\bar{x} = 1031.22$

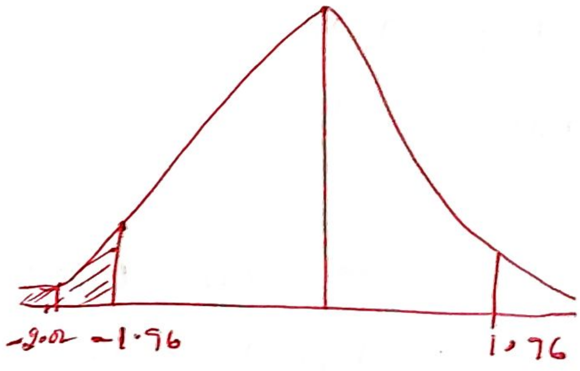
$$Z = \frac{x - \mu}{S/\sqrt{n}}$$

$$= \frac{1031.32 - 1135}{240.37/\sqrt{22}}$$

$$= \frac{-103.68}{51.25}$$

$$\boxed{Z = -2.02}$$

The critical value is z is -1.96 and $+1.96$



∴ Z value falls under the critical region Hence reject the null hypothesis

Accept Alternate hypothesis

Problem - 5

$\mu = 48,432$

$S : 2000$

$n = 400$

$\bar{x} = 48,574$

Consider $\alpha = 10\%$

$H_0 : \mu = 48,432$

$H_1 : \mu \neq 48,432$

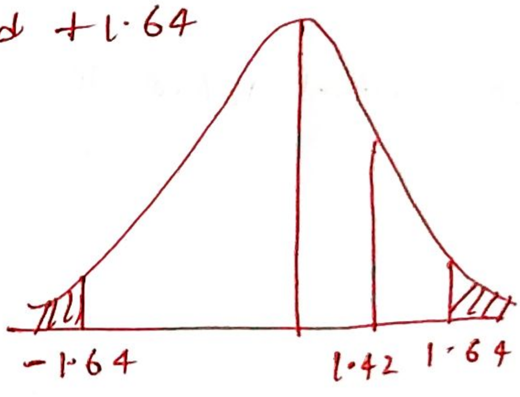
$$Z = \frac{\bar{x} - \mu}{S/\sqrt{n}}$$

$$= \frac{48,574 - 48,432}{\frac{2000}{\sqrt{400}}}$$

$$= \frac{142}{100} = 1.42$$

$$\boxed{Z = 1.42}$$

The critical value z is -1.64 and $+1.64$



$\therefore$ Z value doesn't fall under the critical region

Hence accept the null hypothesis

Prob - 6

$\mu = 32.28$

$S = 1.29$

$n = 19$

$\bar{x} = 31.67$

$\alpha = 0.05$

$H_0: \mu = 32.28$

$H_1: \mu \neq 32.28$

$\therefore$ two tail test

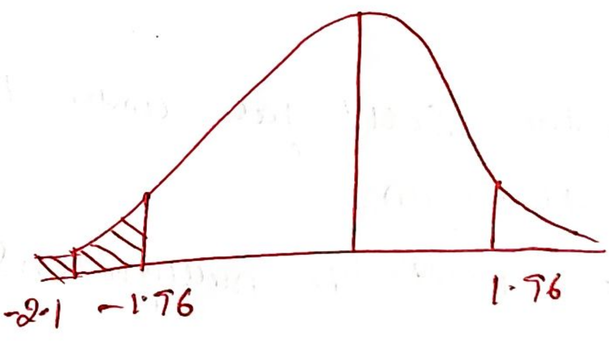
$$Z = \frac{\bar{x} - \mu}{S/\sqrt{n}}$$

$$= \frac{31.67 - 32.28}{1.29/\sqrt{19}}$$

$$= \frac{-0.61}{0.29}$$

$$\boxed{Z = -2.1}$$

The critical value is -1.96 and $+1.96$



$\therefore$ Z value fall under the critical region Hence Accept the Alternate hypothesis

Prob - 8

$n = 16$

$\mu = 10$

$\bar{x} = 12$

$\sigma = 1.5$

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

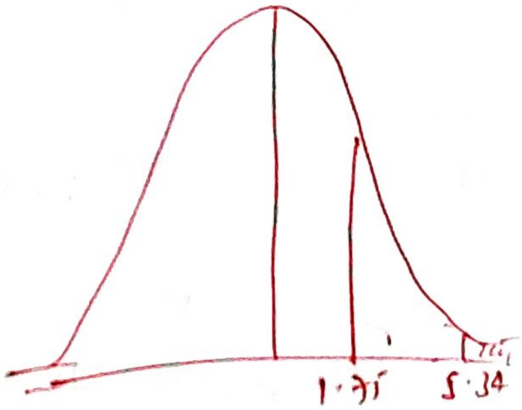
$$= \frac{12 - 10}{\frac{1.5}{\sqrt{16}}}$$

$$\boxed{t = 5.34}$$

$df = 16 - 1$
$= 15$

$\boxed{t \text{ score'q} = 1.75}$

Assume $\alpha = 0.05$



Prob - 7 -

$1 - \alpha = 0.99$

$\alpha = 0.01$

$t_{0.99} = -t_{0.01}$

$t_{0.99} = -t_{0.01}$
$= -2.602$

$df = n - 1$

$df = 16 - 1$
$= 15$

Prob - 10

$n = 25$

$\bar{x} =$

$\mu = 60$

$s = 4$

$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

$= \frac{4}{\sqrt{25}}$

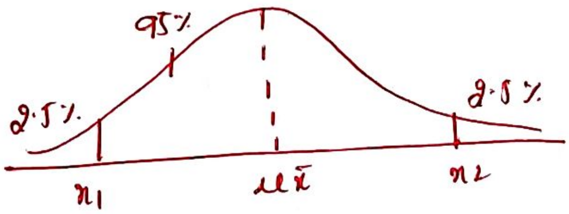
$= 0.8$

$-t_{0.05} < t < 0.10$

$df = 25-1$
$= 24$

$\cancel{P(0.05 < \bar{x} < 0.10)}$

Let middle 95% of all sample means lies b/w x_1 and x_2



t score are

$t_1 = t_{0.025,\,24}$

$= -2.064$

$t_1 = \frac{x_1 - \mu_{\bar{x}}}{s/\sqrt{n}}$

$\Rightarrow -2.064 = \frac{x_1 - 60}{4/\sqrt{25}}$

$x_1 - 60 = -2.064 \times 4/5$

$x = 60 - 1.65$

$\boxed{x_1 = 58.35}$

$t_2 = t_{0.025,\,24} = |-2.064| = 2.064$

$x_2 = 60 + 2.064 \times 4/5$

$= 61.65$

The 95% middle range is

$\boxed{58.35 \text{ to } 61.65}$

$P(-0.05 < t < 0.10)$

$= P(t < 0.10) - P(t < -0.05)$

$= 0.5394 - 0.4803$

$\boxed{= 0.0591}$

Prob – 11

$n_1 = 1200$

$\bar{x}_1 = 452$

$\sigma_1 = 212$

$n_2 = 800$

$\bar{x}_2 = 523$

$\sigma_2 = 185$

$$S.E = \sqrt{\left(\frac{(\sigma_1)^2}{n_1}\right) + \left(\frac{\sigma_2^2}{n_1}\right)}$$

$$S.E = \sqrt{\frac{(212)^2}{1200} + \frac{(185)^2}{800}}$$

$$\boxed{S.E = 8.96}$$

$$z\,test = \frac{(\bar{x}_1 - \bar{x}_2)}{S.E}$$

$$z\,test = \frac{(452-523)}{8.96}$$

$$= -7.926$$

$\alpha = 0.05$

$\alpha/2 = 0.025$

$Z_{0.025} = 2.81$

$z\,test < Z_{0.025}$

$\therefore$ Ho will be rejected

Prob. 12

H_0 : Different people using Different battery

H_1: Same people using different battery

$n_1 = 100$

$\bar{x}_1 = 308$

$\sigma = 84$

$n_2 = 100$

$\bar{x}_2 = 254$

$\sigma_2 = 67$

$$S.E = \sqrt{\left(\frac{\sigma_1^2}{n_1}\right) + \left(\frac{\sigma_2^2}{n_2}\right)}$$

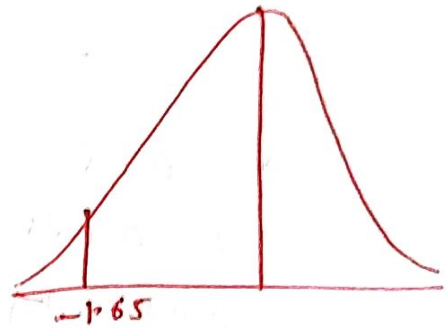
$$S.E = \sqrt{\frac{(84)^2}{100} + \frac{(67)^2}{100}}$$

$$= 10.74$$

$$Z_{test} = \frac{(\bar{x}_1 - \bar{x}_2)}{S.E}$$

$$= \frac{308 - 254}{10.74} = 5.025$$

$\alpha_{0.025} = -1.65$



H_0 will be rejected because 2 tail test doesn't fall under $Z_{\alpha/2}$

Prob - 13

$X_1 = 0.317$ $\qquad$ $H_0: \mu_1 = \mu_2$

$S_1 = 0.12$ $\qquad$ $H_1: \mu_1 \neq \mu_2$

$n_1 = 14$

$n_2 = 9$ $\qquad$ Pooled Std $= \sqrt{\dfrac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}}$

$X_2 = 0.21$

$S_2 = 0.11$ $\qquad$ $= \sqrt{\dfrac{13 \times 0.317^2 + 0.21^2}{14+9-2}}$

$$\boxed{PS = 0.1162}$$

$$t = \frac{0.317 - 0.21}{0.1162 \times \sqrt{1/14 + 1/9}}$$

$$\boxed{t_{cal} = 1.552}$$

pvalue $=$ $P(t_{n_1+n_2-2} > |t_{cal}|)$

$= P(t_{21} > |2.1552|)$

$= \underline{0.031}$

As pvalue < 0.05 we may reject H_0

Problem - 14

$n_1 = 15$

$\bar{x}_1 = 6598$

$S_1 = 844$

$n_2 = 12$

$\bar{x}_2 = 6870$

$S_2 = 669$

Ho = Small price reduction is enough to increase Sales

H1: Small price reduction is not enough to increase Sales

$$S_{12} = \sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}}$$

$$= \sqrt{\frac{(15-1)(844)^2 + (12-1)(669)^2}{15+12-2}}$$

$$\boxed{S_{12} = 771.91}$$

S.E =

$S.E = S_{12} * (\sqrt{(1/n_a) + (1/n_b)})$

$$\boxed{Se = 289.96}$$

$$t\text{-stats} = \frac{|(\bar{x}_1 - \bar{x}_2)|}{SE}$$

$$t\text{-stats} = \frac{(|6598 - 6870|)}{289.96}$$

$$\boxed{t\text{ stats} = 0.91}$$

By making calculation Easy we will taking reference of 95%.

$t_{0.05}$ at df = 25 will be = 1.708

t experimental < $t_{0.05}$ (Ho will be Accepted)

Prob - 15

$n_1 = 1000$ Population 1 : 1980

$x_1 = 53$ $P_1 = 0.53$

$P_1 = 0.53$ $n_1 = 100$ and not 1000

$n_2 = 100$

$x_2 = 43$ Population 2 : 1985

$P_2 = 0.53$ $n_2 = 100$ So favourable are $= 43$

$\therefore P_2 = 0.43$ le not 0.53

$\alpha = 0.05$

$H_0 : P_1 = P_2$

$Z_{0.05} = 1.96$

$H_1 : P_1 \neq P_2$

it's 2 tail Z test

Rejection region of 2 tail test is $R = \{Z : |Z| > 1.96\}$

$$\hat{P}_1 = \frac{X_1}{N_1} = \frac{53}{100} = 0.53$$

$$\hat{P}_2 = \frac{X_2}{N_2} = 43/100 = 0.43$$

$$\bar{P} = \frac{X_1 + X_2}{N_1 + N_2}$$

$$\boxed{\bar{P} = \frac{53+43}{100+100} = 0.48}$$

$$Z = \frac{\hat{P}_1 - \hat{P}_2}{\sqrt{\bar{P}(1-\bar{P})(1/n_1 + 1/n_2)}}$$

$$= \frac{0.53 - 0.43}{\sqrt{0.48(1-0.48)(1/100 + 1/100)}}$$

$$\boxed{Z = 1.415}$$

$\therefore$ Since it observed that $|Z| = 1.415 \leq Z_c = 1.96$ it is then Accept the H_0

16)

Population 1

$n_1 = 300$

$x_1 = 120$

$\hat{P}_1 = 0.40$

Population 2

$n_2 = 700$

$x_2 = 140$

$\hat{P}_2 = 0.20$

$H_0 : P_1 - P_2 \leq 0.10$

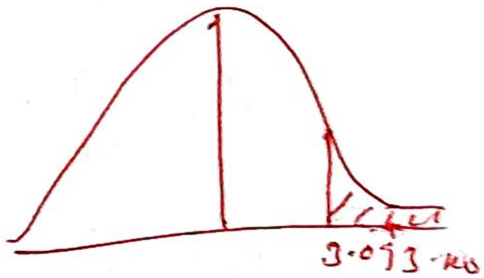
$H_1 : P_1 - P_2 > 0.10$

$$Z = \frac{(\hat{P}_1 - \hat{P}_2) - D}{\sqrt{\frac{\hat{P}_1(1-\hat{P}_1)}{n_1} + \frac{\hat{P}_2(1-\hat{P}_2)}{n_2}}}$$

$$= \frac{(0.40 - 0.20) - 0.10}{\sqrt{\left(\frac{(0.40)(0.60)}{300} + \frac{0.20(0.80)}{700}\right)}}$$

$$= \frac{0.10}{0.03207}$$

$$\boxed{Z = 3.118}$$



$Z_{0.01} = 3.09$

$\therefore H_0$ may be rejected

Prob - 17

Observed frequency (O)	Excepted frequency (E)	$(O-E)^2$
15	22	49
20	22	4
25	22	9
15	22	49
29	22	49
28	22	36
		196

B =>

Step 1 Ho : die is unbiased

H1 : The die is not unbiased

Step 2 : on The hypothesis that the die is unbiased we should Except the frequency of Each no to be $132/6 = 22$

$$\therefore \chi_{cal}^2 = \sum \frac{(O-E)^2}{E}$$

$$= 198/22$$

$$= 8.91$$

Step 3 : $L.O.S(\alpha) = 0.05$

$Df = 6-1$

$= 5$

Step 4 $(\chi_\alpha)^2 = 11.0705$

Step 5 $\chi_{cal}^2 < (\chi_\alpha)^2$

$\therefore$ Ho is accepted

$\therefore$ Die is unbiased

Prob - 18

Ho: Gender is independent of voting
H1: Gender and voting are dependent

	Men	Women		
voted	2792	3591	=	6386
Didn't vote	1486	2131	=	3617
	4278	5722		10,000

Expected value (men who voted) =

$$\frac{\text{Number (all who voted)} * \text{Number (all men)}}{\text{Number (total no)}}$$

$$\frac{6386 * 4278}{10,000}$$

$= 2731$

Expected value (women who voted) =

$$\frac{\text{Number (all who voted)} * \text{Number (all women)}}{\text{Number (total number)}}$$

$$= \frac{6386 * 5722}{10,000}$$

$= 3652$

Excepted value (men who didn't vote) =

$$\frac{\text{Number (all who did't vote)} \times \text{Number (all men)}}{\text{Number (total number)}}$$

$$= \frac{3617 \times 4278}{10,000}$$

$= 1547$

Prob- 18

Contin...

Expected value (women who did't vote):

$$\frac{\text{Number (all who didn't vote)} \times \text{Number (all women)}}{\text{Number (total number)}}$$

$$= \frac{3617 \times 5722}{10,000}$$

$$= 2070$$

Expected table	men	women
voted	2731	3652
did't vote	1547	2070

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$$=$$

$$\chi^2 = \frac{(2792-2731)^2}{2731} + \frac{(3591-3652)^2}{3652} + \frac{(1486-1547)^2}{1547} +$$

$$\frac{(2131-2070)^2}{2070}.$$

$$\chi^2 = 1.4 + 1.0 + 2.4 + 1.8$$

$$\chi^2 = 6.6$$

Degree of freedom = $1 \times 1 = 1$

Since the chi-square goodness of fit value (6.6) exceedes the critical χ^2 (3.84) we will reject the null hypothesis.

19)

Ho: All candidates are equally popular

H1: All candidates are not equally popular

$\alpha = 0.05$

$$\text{chisquare} = \sum \frac{(O-E)^2}{E}$$

N= 4

df = 4-1
= 3

$\alpha = 0.05$

Critical value = 7.814

	O	E	$\frac{(O-E)^2}{E}$
Higgins	41	25	10.24
Reardon	19	25	1.44
White	24	25	0.04
Charlton	16	25	3.24
total	100	100	14.96

$$\text{Chi Square} = \sum \frac{(O-E)^2}{E} = 14.96$$

P-value = 0.0018

P-value < α = 0.05

∴ Reject the null hypothesis

Prob - 20

Observed age of child	Data	A	B	C	Total
	5-6 y	18	22	20	60
	7-8 y	2	28	40	70
	9-10 y	20	10	40	70
	Total	40	60	100	

Excepted age of child	Data	A	B	C
	5-6 y	12	18	30
	7-8 y	14	21	35
	9-10 y	14	21	35

$$\text{Excepted value} = \frac{(\text{row total})(\text{column total})}{(\text{total value})}$$

$$\chi^2 = \frac{(18-12)^2}{12} + \frac{(12-14)^2}{14} + \frac{(20-14)^2}{14} + \frac{(22-18)^2}{18} + \frac{(28-21)^2}{21} +$$

$$\frac{(10-21)^2}{21} + \frac{(20-30)^2}{30} + \frac{(40-35)^2}{35} + \frac{(40-35)^2}{35}$$

$= 29.60$

degree of freedom $= (3-1)(3-1) = 2 \cdot 2$

$= 4$

at $\hat{p} < 0.05 \; n = 0.001$

$\chi^2_{0.001}$ at $df = 4$ will be 18.47

$\chi^2_{test} > \chi^2_{0.01}$

$\therefore$ Reject the null hypothesis

Prob- 21

Observed frequency

	Support	No support	total
Conform	18	40	58
Not Conform	32	10	42
total	50	50	100

Excepted frequency

$$EF = \frac{\text{Row total} \times \text{column total}}{\text{grand total}}$$

	Support	No support
conform	29	29
not conform	21	21

Ho: There is no relationship b/w the support & no support condition in the frequency with which individuals are likely to conform

H1: There is no relationship b/w Confirm & no Confirm condition in the frequency with which induviduals are likely to conform.

$$\chi^2 = \Sigma\left(\frac{(O-E)^2}{E}\right)$$

$\chi^2 = 19.87$

Also given that p-value < 0.05 (α = 0.05 level of Significance

Continue ... 21

If p value > α - level of significance then we accept H_0 otherwise reject H_0

Here p-value $\alpha = 0.05$

$\therefore$ we reject H_0 at 5% level of significance

Prob - 22

Table calculation for chi-square test χ^2

Leadership	Height				Total
	Short		Tall		
	Observed (O)	Extended (E)	observed (O)	Expected E	
Leader	12	19.92	32	24.08	49 (P_1)
follower	22	16.29	14	19.71	36 (P_2)
unclassified	9	6.79	6	8.21	15 (P_3)
Total	43 (C_1)	43	52 (C_2)	52	95 (T)

W.K.T $\chi^2 = \frac{\Sigma (O-E)^2}{E}$

$$= \frac{(12-19.92)^2}{19.92} + \frac{(22-16.29)^2}{16.29} + \frac{(9-6.79)^2}{6.79} +$$

$$\frac{(32-24.08)^2}{24.08} + \frac{(14-19.71)^2}{19.71} + \frac{(6-8.21)^2}{8.21}$$

$$= 3.15 + 2.00 + 0.72 + 2.60 + 1.65 + 0.59$$

$$= 10.71$$

$\chi^2 = 10.71$

$df = (3-1)\times(2-1) = 2$

$\therefore$ H_0 is rejected

$\therefore$ There is relationship b/w Height and leadership.

Continue --- 21

If p value $> \alpha$ - level of Significance then we accept Ho otherwise reject Ho

Here p - value $\alpha = 0.05$

$\therefore$ we reject Ho at 5% level of Significance

Prob - 23

H_0: The Distribution of labour force is same for different marital status

H_1: The distribution of labour force is not same for different marital status

(O)	married	windowed, divorced or separated	Never married	total
Employed	679	103	114	896
unemployed	63	10	20	93
not in labourforce	42	18	25	85
total	784	131	159	1074

calculate Expected frequency by

$$E = \frac{\text{Row total} \times \text{Column total}}{\text{grand total}}$$

E	Col 1	Col 2	Col 3
Row 1	654.06	109.28	132.6
Row 2	67.88	11.34	13.76
Row 3	62.04	10.36	12.58

$$\chi^2 = \frac{(O-E)^2}{E}$$

Observed count (O)	Expected count (E)	$\frac{(O-E)^2}{E}$
679	654.06	0.9509
101	109.28	0.3608
114	132.64	2.6194
63	67.88	0.3508
10	11.34	0.1583
20	13.76	2.8297
42	62.04	6.4732
18	10.36	5.6311
25	12.08	12.262.

$$\chi^2 = \Sigma \frac{(O-E)^2}{E}$$

$$\boxed{\chi^2 = 31.6392}$$

Significance level = 0.05

$Df = (r-1)(c-1)$

$= (3-1) \times (3-1)$

$\boxed{df = 4}$

Critical value $\chi^2_{0.05} = 9.488$

$\Rightarrow \chi^2_{0.05}$ has area of 0.05 to it's right

$\Rightarrow$ to find $\chi^2_{0.05}$ of any chi-square

df: v=4 le down from column 0.05

le get 9.488

Contin prob.-21

⇒ to get p-value

Chi square. dist RT [31.6592, 4]

The p value is = 0.0007

⇒ The result is significant at $p < 0.05$

∴ The test statistics is greater than critical value we Reject null hypothesis

⇒ At 5% level there is sufficient Evidence that the distribution are significantly different.