Part - B

(1) a) Two mean → population mean
Sample mean

Sample size ($n \geq 30$) → z test

Variance (or) standard deviation

⇒ Formula = $z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$

$\bar{x}$ ⇒ sample mean

μ ⇒ population mean

Soln:

$n = 56 \quad (n \geq 30)$

$\bar{x} = 147$

$\sigma = SD = 16$

$\mu = 140$

$H_0 : \bar{x} = \mu$

$H_1 : \bar{x} > \mu$ (Right tailed test)

LOS = 5%

$Z_\alpha = 1.645$ (from table)

$z = \dfrac{147 - 140}{16/\sqrt{56}} = \dfrac{7}{16/\sqrt{56}} = 3.27$

$|z| = 3.27$

$|z| > Z_\alpha$ Ho is rejected & H_1 is accepted

∴ The advertisement is not effective

b)

$\bar{X} \rightarrow$ sample mean

$\mu \rightarrow$ population mean

$\sigma \rightarrow$ standard deviation

$(n < 30) \Rightarrow$ small sample

$n \rightarrow$ sample size

$\Rightarrow$ t-test

$$t = \frac{\bar{X} - \mu}{\sigma / \sqrt{n-1}} \qquad N(\mu, \sigma)$$

Degree of freedom $= (\gamma = n-1)$

Soln:

$n = 17 \quad (n < 30)$

$\bar{X} = 155$

$\mu = 145$

$\sigma = 16$

$H_0 : \bar{x} = \mu$

$H_1 : \bar{x} > \mu$ Right (~~Also~~ tailed) (or) (one tailed)

$$t = \frac{155 - 145}{16 / \sqrt{17-1}} = \frac{155 - 145}{16 / \sqrt{16}}$$

$t = 2.5$

Degree of freedom : $\gamma = n-1$

$\gamma = 17 - 1$

$\boxed{\gamma = 16}$

LOS $= 5\% \Rightarrow 0.05$

t Table value $= 1.746 \Rightarrow t_{0.05}$

$t > t_{0.05}$

calculated value > table value

$\therefore$ Ho is rejected & H_1 is accepted

$\therefore$ The advertising campaign is not successful.

2) a) formula (same 1) a))

soln:

$n = 86 \quad (n \geq 30)$

$\bar{X} = 1.7$

$\mu = 1.5$

$\sigma = 0.5$

$H_0 : \bar{x} = \mu$

$H_1 = \bar{x} > \mu$ (Right tailed)

LOS = 5%, Table value = 1.645 ⇒ Z_α

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{1.7 - 1.5}{0.5/\sqrt{86}}$$

$Z = 3.709$

$|Z| = 3.709$

$|Z| > 1.645$ i.e, $|Z| > Z_\alpha$

∴ Ho is rejected & H_1 is accepted

i.e, the mean household order is greater than 1.5 litres

b)

$\mu = 30$

$n = 8 \quad (n < 30)$

$$\bar{x} = \frac{\Sigma x}{n} = \frac{31.1 + 30.7 + 24.3 + 28.1 + 27.9 + 32.2 + 25.4 + 29.1}{8}$$

$$\bar{x} = \frac{228.8}{8} = 28.6$$

$$s^2 = \frac{\Sigma x^2}{n} - \left(\frac{\Sigma x}{n}\right)^2$$

$$= \frac{6597.02}{8} - 817.96$$

$$= 824.6275 - 817.96$$

$$s^2 = 6.6675$$

$$\boxed{s = 2.58}$$

$H_0 : \bar{x} = \mu$

$H_1 : \bar{x} < \mu$ (one tailed)

LOS = 5%

$t_{0.05} = 1.895$ (table value)

$\nu = n-1$

$\nu = 8-1 = 7$

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n-1}} = \frac{28.6 - 30}{2.58/\sqrt{7}}$$

$$t = -1.435$$

$$|t| = 1.435$$

$t < t_{0.05}$

$1.435 < 1.895$

$\therefore$ H_0 is accepted & H_1 is rejected.

i.e, The avg rainfall during the past eight yrs is less than the normal rainfall.

3) a) $n_1 = 250$ $(n \geq 30)$

$n_2 = 320$ $(n \geq 30)$

$P_1 = \frac{142}{250} = 0.568$

$P_2 = \frac{150}{320} = 0.468$

formulas:

$P = \frac{n_1 P_1 + n_2 P_2}{n_1 + n_2}$

$H_0 : P_1 = P_2$

$Q = 1 - P$

$H_1 : P_1 > P_2$ (Right tailed)

main formulas:

LOS = 5%

$Z = \frac{P_1 - P_2}{\sqrt{PQ\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$

$Z_\alpha = 1.645$

$P = \frac{(250 \times 0.568) + (320 \times 0.468)}{250 + 320}$

$P = 0.5118$

$Q = 1 - 0.5118$

$Q = 0.4882$

$Z = \frac{0.568 - 0.468}{\sqrt{(0.5118)(0.4882)\left(\frac{1}{250} + \frac{1}{320}\right)}}$

$Z = 2.370$

$|Z| > Z_{0.05}$

Ho is rejected & H1 is accepted

∴ The new homes that have storm windows is larger than the proportion of older homes that have storm windows.

3)(b)

$n = 10$

$\mu = 7 cm$

$\bar{x} = \frac{\Sigma x}{n} = \frac{69.8}{10} = 6.98$

$s^2 = \frac{\Sigma x^2}{n} - (\bar{x})^2$

$s^2 = \frac{487.74}{10} - 48.7204$

$s^2 = 0.0536$

$s = 0.2315$

$H_0 : \bar{x} = \mu$

$H_1 : \bar{x} \neq \mu$ (two tailed)

$LOS = 5\%$ $\quad \gamma = n-1 = 10-1 = 9$

$t_{0.05} = 2.262$

$t = \frac{\bar{x} - \mu}{s/\sqrt{n-1}} = \frac{6.98 - 7}{0.2315/\sqrt{9}}$

$t = -0.259$

$|t| = 0.259$

$\cancel{Since}$ $t < t_{0.05}$

$0.259 < 2.262$

$\therefore$ H_0 is accepted & H_1 is rejected

i.e, The machine is reliable.

(4) a)

$n_1 = 74 + 83 = 157$ (Delhi) $(n \geq 30)$

$n_2 = 65 + 107 = 172$ (New Delhi) $(n \geq 30)$

$$P_1 = \frac{74}{157} = 0.471$$

$$P_2 = \frac{65}{172} = 0.377$$

LOS = 5%

$H_0 : P_1 = P_2$

$Z_\alpha = 1.96$

$H_1 : P_1 \neq P_2$ (two tailed)

$$P = \frac{n_1 P_1 + n_2 P_2}{n_1 + n_2} = 0.42$$

$$Q = 1 - P = 1 - 0.42$$

$$\boxed{Q = 0.57}$$

$$Z = \frac{P_1 - P_2}{\sqrt{PQ\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$= \frac{0.47 - 0.37}{\sqrt{(0.42)(0.57)\left(\frac{1}{157} + \frac{1}{172}\right)}}$$

$$\boxed{Z = 1.8}$$

$$|Z| < Z_\alpha$$

$$1.8 < 1.96$$

Ho is accepted & H_1 is rejected

∴ There is no significant diff b/w the arrival of time.

(4) b) in book (Eg 4 → Pg 299)

(5) a)

$n_1 = 250$ items $(n \geq 30)$

$n_2 = 400$ $(n \geq 30)$

$\bar{x}_1 = 120$

$\bar{x}_2 = 124$

formula ⇒ $\dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$

$s_1^2 = 12$

$s_2^2 = 14$

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

$H_1 : \bar{x}_1 \neq \bar{x}_2$ (two tailed)

LOS = 1%

$Z_\alpha = 2.58$

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}} = \frac{120 - 124}{\sqrt{\dfrac{12}{250} + \dfrac{14}{400}}}$$

$$z = -15.74$$

$$\boxed{|z| = 15.74}$$

$$|z| > z_\alpha$$

$$15.74 > 2.58$$

$\therefore$ H_0 is rejected & H_1 is accepted

i.e, There is no significant diff b/w the avg of two samples at 1% level of significance.

5 b) formula: $t = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\dfrac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}\right)\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}}$

$n_1 = 16$

$n_2 = 12$

$\bar{x}_1 = 107$

$\bar{x}_2 = 111$

$s_1 = 9 \Rightarrow s_1^2 = 81$

$s_2 = 10 \Rightarrow s_2^2 = 100$

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

H_1: $\bar{x}_1 > \bar{x}_2$ (one tailed)

los = 5%

$$\boxed{t_{0.05} = 1.706}$$

degree of freedom $\Rightarrow \gamma = n_1 + n_2 - 2$

$= 16 + 12 - 2$

$\boxed{\gamma = 26}$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$= \frac{107 - 111}{\sqrt{\left(\frac{(16 \times 81) + (12 \times 100)}{26}\right)\left(\frac{1}{16} + \frac{1}{12}\right)}}$$

$$= \frac{-4}{\sqrt{\left(\frac{1296 + 1200}{26}\right)(0.1458)}}$$

$$= \frac{-4}{\sqrt{(96)(0.1458)}}$$

$$= \frac{-4}{1.4285}$$

$t = -2.80$

$\boxed{|t| = 2.80}$

$|t| > t_{0.05}$

$2.80 > 1.706$

$\therefore$ Ho is rejected & H_1 is accepted

i.e, the production rate of workers in the latter factory is not more than that in the former factory.

(6) a) $n = 30$ $(n \geq 30)$

$\bar{x} = 2.4$ kg

$\mu = 3.1$ kg

$\sigma = 1.1$ kg

$H_0: \bar{x} = \mu$

$H_1: \bar{x} \neq \mu$ (two tailed)

LOS = 10%

$Z_\alpha = 1.645$

$$Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} = \frac{2.4 - 3.1}{1.1 / \sqrt{30}}$$

$Z = -3.485$

$|Z| = 3.485$

$|Z| > Z_\alpha$

$3.485 > 1.645$

i.e., H_0 is rejected & H_1 is accepted

∴ This is the sufficient evidence to indicate that the mean weight of fish differ from 3.1 kg.

(8) b) in book (Eg 6 → Pg - 301)

(7) a) $n = 40$ $(n \geq 30)$

$P = 2/5 = 0.4$

$p = \frac{23}{40} = 0.575$

$Q = 1 - P = 0.6$

$H_0 : p = P$

$H_1 : p > P$ (Right tailed)

LOS = 5%

$\boxed{Z_\alpha = 1.645}$

$$Z = \frac{p - P}{\sqrt{\frac{PQ}{n}}}$$

$$= \frac{0.575 - 0.4}{\sqrt{\frac{(0.4)(0.6)}{40}}} = \frac{0.175}{\sqrt{\frac{0.24}{40}}} = \frac{0.175}{0.0774}$$

$$\boxed{Z = \cancel{}\ 2.2609}$$

$|Z| = 2.2609$

$|Z| > Z_\alpha$

H_0 is rejected & H_1 is accepted

i.e. The new technique is effective at 5% level of significance.

(7) b)

$n_1 = 5$ $\quad\quad$ $\gamma_1 = n_1 - 1 = 5 - 1 = 4$

$n_2 = 7$ $\quad\quad$ $\gamma_2 = n_2 - 1 = 7 - 1 = 6$

H_0: Increased in weight

H_1: Not increased in weight

A	$U = (A - 3.6)100$	U^2	B	$V = (B - 3.6)100$	V^2
3.6	0	0	4.5	9	81
5.5	19	361	3.6	0	0
5.9	23	529	5.5	19	361
4.1	5	25	6.8	32	1024
1.4	-22	484	2.7	-9	81
Total	25	1399	3.6	0	0
			5.0	14	196
			Total:	65	1743

$$s_1^2 = \frac{1}{n_1 - 1}\left[\Sigma U^2 - \frac{\Sigma(U)^2}{n_1}\right]$$

$$= \frac{1}{4}\left[1399 - \frac{(25)^2}{5}\right]$$

$$s_1^2 = \frac{1}{4}[1274] = 318.5$$

$$S_2^2 = \frac{1}{6}\left[1743 - \frac{(65)^2}{7}\right]$$

$$= \frac{1}{6}\left[1743 - \frac{4225}{7}\right]$$

$$S_2^2 = 189.905$$

$$F = \frac{S_1^2}{S_2^2} = \frac{318.5}{189.91}$$

$$\boxed{F = 1.677}$$

~~Df for~~ (4,6) in 5% = 4.53 (table value)

cal value < Tab. value

$1.677 < 4.53$

$\therefore$ H_0 is accepted & H_1 is rejected

$\therefore$ It is increased in weight.