Statistical Inference:-

The process of drawing result about the characteristics of population using sample information taken from the population is known as statistical inference.

1:- Estimation:-

The method for finding unknown value of population parameter using sample information taken from the population at some level of confidence is known as estimation.

(Branches)

2:- Testing of Hypothesis

The procedure of accepting or rejecting, about the population parameter using sample information
any statement

at some level of significance is known as testing of Hypothesis.

1:- Point of estimation:-

The estimation in which population parameters these is estimated in the form of single value is known as point estimation.

2:- Interval estimation:-

The estimation in which unknown population parameter is estimated in the form of range of values (a, b) is known as interval estimation.

imp Differentiate b/w

Estimator	Estimate
The formula rule of method used for finding the unknown value of population parameter	The value obtained after applying and estimator is known as Estimate
Example:- $\frac{\Sigma x}{n}$ is an estimator of population mean.	**Example:-** $\bar{X} = 20$ is the estimate

Level of confidence $(1-\alpha)\%$:-

The probabilit of range(a,b) for containing true value of population parameters is known as level of confidence It is also known as coficient of confidence

It may be 95% 99% e.t.c

Level of significance:- 'α'%

The probability of rang (a,b) for not containing true value of population parameter is known as level of significance.

9%, 5%, 1% etc.

(Differences about mean)

Confidence interval for population mean 'μ':-

Case I :-

The $100(1-\alpha)\%$ C.I for 'μ' is

$$\bar{X} \pm Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}}$$ Where σ^2 is Known

Case II :-

The $100(1-\alpha)\%$ C.I for μ is

$$\bar{X} \pm Z_{\alpha/2}\sqrt{\frac{S^2}{n}}$$ (Where σ^2 is unknown and $n \geq 30$)

μ = population mean
σ^2 = population ~~varriab~~ variance
σ = population standard deviation
$\bar{x}$ = Sample mean
s^2 = Sample variance
s = Population standard deviation
n = sample size.

	α		
Z	0.10	0.05	0.01
$Z_{\alpha/2}$	1.645	1.96	2.58
Z_{α}	1.28	1.645	2.33

Null Hypothesis:-

The hypothesis which is tested for possible rejections under the assumption that it is true is known as Null hypothesis.

Q 15.20

$n = 20$, $\sigma^2 = 80$, $\bar{x} = 81.2$,

$100(1-\alpha)\% = 95\%$

The $100(1-\alpha)\%$ C.I for μ is

$$\bar{x} \pm Z_{\alpha/2} \sqrt{\frac{\sigma^2}{n}}$$

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The 95% C.I for μ is

$$81.2 \pm 1.96\sqrt{\frac{80}{20}}$$

$$81.2 \pm 1.96\sqrt{4}$$

$$8.12 \pm 1.96(2)$$

$$81.2 \pm 3.92 \Rightarrow (81.2) - 3.92)(81.2 + 3.92)$$

$$\boxed{77.28,\ 85.12}$$

15.21

$n = 25$, $\bar{X} = 67.53$ $\sigma = 10$

$$100(1-\alpha)\% = 95\%$$

The $100(1-\alpha)\%$ C.I for μ is

$$\bar{X} \pm Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}}$$

$$67.53 \pm 1.96\sqrt{\frac{(10)^2}{25}}$$

$$67.53 \pm 1.96\sqrt{\frac{100}{25}}$$

$$67.53 \pm 1.96(2)$$

$$67.53 \pm 3.92$$

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$$= (67.53 - 3.92)\ (67.53 + 3.92)$$

$$= \boxed{63.6\ ,\ 71.44}$$

15.22

$n = 25\ ,\ \bar{x} = 100 \quad \sigma^2 = 15$

$$\bar{x} \pm Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}}$$

$$100 \pm 1.645\sqrt{\frac{(15)^2}{25}}$$

$$100 \pm 1.645\sqrt{\frac{225}{25}}$$

$$100 \pm 1.645\sqrt{9}$$

$$100 \pm 1.645 \times 3$$

$$100 \pm 4.935$$

$$(100 - 4.935)\ (100 + 4.935)$$

$$\boxed{95.065\ ,\ 104.935}$$

15.23 b)

$X = 2.3, -0.2, -0.4, -0.9$

Darse Notes

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$$\bar{X} = \frac{\Sigma x}{n} = \frac{0.8}{4} \boxed{= 0.2}$$

$$\sigma = 3$$

$$100(1-\alpha)\% = 90\%$$

$$= 0.2 \pm 1.645 \sqrt{\frac{9}{4}}$$

$$= 0.2 \pm 1.645 (1.5)$$

$$0.2 \pm \cancel{1.645}\ 2.4675$$

$$= (0.2 - 2.4675)\ (0.2 + 2.4675)$$

$$= \boxed{-2.2675}, \boxed{2.6675}$$

Q 5.25

$$n = 50 \quad \bar{X} = 190 \quad S^2 = 800$$

Find 95% confidence for μ

$$\bar{X} \pm Z_{\alpha/2} \sqrt{\frac{S^2}{n}}$$

$$190 \pm 1.96 \sqrt{\frac{800}{50}}$$

$$190 \pm 1.96 \sqrt{16}$$

$$190 \pm 1.96 (4)$$

$$190 \pm 7.84$$

$$(190 - 7.84)\ (190 + 7.84)$$

$$= \boxed{182.16} \quad \boxed{197.84}$$

25.26

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95% $\sigma = 13.77$ $\bar{X} = 35.00$

$n = 36$

The 100(1-α)% C.I for μ is

$\bar{X} \pm Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}}$ $35 \pm 1.96\sqrt{\frac{(13.77)^2}{36}}$

$35 \pm 1.96\sqrt{5.267}$

$35 \pm 1.96\,(2.295)$

35 ± 4.4982

$35 - 4.4982$ $35 + 4.4982$

$\boxed{30.5018}$ $\boxed{39.4982}$

The confidence interval (C.I for $\mu_1 - \mu_2$) is

Case I:—

The 100(1-α)% C.I for $\mu_1 - \mu_2$ is

$(\bar{X}_1 - \bar{X}_2) \pm Z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

where σ_1^2 and σ_2^2 are Known

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Case II :-

The $100(1-\alpha)\%$ C.I for $\mu_1 - \mu_2$ is

$$(\bar{X}_1 - \bar{X}_2) \pm Z_{\alpha/2} \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

Where σ_1^2 and σ_2^2 are unknown but $n_1 \geq 30$, $n_2 \geq 30$

15.29 b $n_1 = 100$, $n_2 = 100$, $\bar{X} = 4.8$

$\bar{Y} = 5.6$, $S_1^2 = 8.64$, $S_2^2 = 7.88$

$100(1-\alpha)\% = 95\%$

The $100(1-\alpha)\%$ C.I for $(\mu_1 - \mu_2)$ is

$$(\bar{X}_1 - \bar{X}_2) \pm Z_{\alpha/2} \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

The 95% C.I for $(\mu_1 - \mu_2)$ is

$$(4.8 - 5.6) \pm 1.96 \sqrt{\frac{8.64}{100} + \frac{7.88}{100}}$$

$$-0.8 \pm 1.96(0.406)$$

$$-0.8 \pm 0.796$$

$$(-0.8 - 0.796) \quad (-0.8 + 0.796)$$

$$\boxed{-1.596} \quad \boxed{-0.004}$$

Darsi Notes

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15.31 (b)

$n_1 = 64 \quad n_2 = 44 \quad \bar{x}_1 = 100$

$\bar{x}_2 = 90 \quad \sigma_1^2 = 256 \quad \sigma_2^2 = 196$

$$(\bar{x}_1 - \bar{x}_2) \pm Z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$(100 - 90) \pm 1.96 \sqrt{\frac{256}{64} - \frac{196}{49}}$$

$$(10) \pm 1.96 \sqrt{4+4}$$

$$10 \pm 1.96\sqrt{8} \Rightarrow 10 \pm 1.96(2.828)$$

$$10 \pm 5.543$$

$$10 - 5.543 \quad , \quad 10 + 5.543$$

$$\boxed{4.437} \qquad \boxed{15.543}$$

15.32

$n_1 = 1720 \quad n_2 = 1230$

$\bar{X}_1 = 33.93 \quad \bar{X}_2 = 27.44$

$S_1^2 = 14.20 \quad S_2^2 = 10.74$

Darsi Notes

a) the mean age of all male operatives

$$\bar{X}_1 \pm Z_{a/2}\sqrt{\frac{S_1^2}{n_1}}$$

$$\cancel{\bar{x}_1} = 33.93 \pm 1.96\sqrt{\frac{14.20}{1720}}$$

$$= 33.93 \pm 1.96\sqrt{(0.0082590)}$$

$$= 33.93 \pm 0.00429$$

$$= 33.93 - 0.0042924 \,,\; 33.93 + 0.0042924$$

$$\boxed{33.92} \qquad \boxed{33.93}$$

b) the mean age of all female operatives

$$\bar{X}_2 \pm Z_{a/2}\sqrt{\frac{S_2^2}{n_2}}$$

$$27.44 \pm 1.96\sqrt{\frac{10.79}{1230}}$$

$$27.44 \pm 1.96\,(0.002670)$$

$$27.44 \pm 0.005233$$

$$27.44 - 0.005233 \,,\; 27.44 + 0.005233$$

$$\boxed{27.43} \qquad \boxed{27.44}$$

Case III :-

The confidence Interval (C.I) for population mean when σ is unknown and $n < 30$

The $100(1-\alpha)\%$ C.I for 'μ' is

$$\bar{X} \pm t_{\alpha/2}(n-1) \sqrt{\frac{s^2}{n}}$$ (Sigma is unknown and $n<30$)

$$s^2 = \frac{\Sigma(x-\bar{x})^2}{n-1}$$

$$s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$$

18.7

$n = 16$, $\bar{X} = 14.5$, $s = 5$, $100(1-\alpha)\% = 90\%$

The $100(1-\alpha)\%$ C.I for μ is

$$\bar{X} \pm t_{\alpha/2(n-1)} \sqrt{\frac{s^2}{n}}$$

The 90% C.I for 'μ' is

$$14.5 \pm t_{0.05(15)} \sqrt{\frac{(5)^2}{16}}$$

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$14.5 \pm (1.753)(1.118)$

14.5 ± 1.96

$14.5 - 1.96 \quad , \quad 14.5 + 1.96$

$\boxed{12.54} \quad \boxed{16.46}$

18.5

b/

X	X^2
578	334084
570	324900
568	322624
572	327,184
570	324900
570	324900
572	327184
596	355,216
584	341056
572	327184

$\Sigma x = \cancel{4602}$ 5752 $\quad \Sigma x^2 = 3309232$

$\bar{X} = \frac{\Sigma x}{n} \quad \frac{5752}{10} = \boxed{575.2}$

$$S^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1} \Rightarrow \frac{3309232 - \frac{(5752)^2}{10}}{10-1}$$

Darsi Notes

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$$= \frac{3309232 - 3308550.4}{9}$$

$$= \frac{681.6}{9}$$

$$\boxed{s^2 = 75.733}$$

$$\bar{X} \mp t_{\alpha/2(n-1)} \sqrt{\frac{75.73}{10}}$$

$575.2 + t_{0.05(9)} (2.75190)$

$575.2 + 1.833 (2.75)$

575.2 ± 5.04075

$575.2 - 5.04075$ $575.2 + 5.04075$

$\boxed{570.15925}$ $\boxed{580.24075}$

18.6 a)

$X = 9, 14, 10, 12, 7, 13, 11, 12$ $\Sigma x = 88$

$X^2 = 81 + 196 + 100 + 144 + 49 + 169 + 121 + 144$

$\Sigma x^2 = 1004$

Darsi Notes

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$\sigma = 2$

$100(1-\alpha)\% = 90\%$

$\bar{X} \pm Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}} \Rightarrow$

$11 \pm 1.645\sqrt{\frac{(2)^2}{8}} \Rightarrow 11 \pm 1.645\sqrt{\frac{4}{8}}$

$11 \pm 1.645\,(0.25)$

11 ± 0.41125

$11 - 0.41125 \qquad 11 + 0.41125$

$\boxed{10.58875} \qquad \boxed{11.41125}$

(ii) If σ were unknown

$\bar{X} = \frac{\Sigma x}{n} \Rightarrow \frac{88}{8} \quad \boxed{\bar{X} = 11}$

$s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1} \Rightarrow \frac{1004 - \frac{(88)^2}{8}}{8-1}$

$\Rightarrow \frac{1{,}004 - \frac{7744}{8}}{7} \Rightarrow \frac{1004 - 968}{7}$

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$s^2 = \frac{36}{7}$ $\boxed{s^2 = 5.1428}$

$\bar{X} \pm t_{\alpha/2(n-1)} \sqrt{\frac{s^2}{n}}$ $100(1-\alpha)\% = 90°$

$11 \pm t_{0.10(8-1)} \sqrt{\frac{s^2}{n}}$

$11 \pm t_{0.10}(7) \sqrt{\frac{5.1428}{8}}$

$11 \pm 1.415 \sqrt{0.64285} \Rightarrow 11 \pm 1.415(0.8017)$

11 ± 1.1344055

$11 - 1.1344055$ $11 + 1.1344055$

$\boxed{9.8655}$ $\boxed{12.1344}$

Date:

Pairing Data / Matched Data / Dependent Data

If the measurement has been done on the same unit more than once the required data is know as pairing Data / matched data / Dependent data

Here words come after and before

Case IV

The $100(1-\alpha)\%$ C.I for 'μ_D' is

$$\bar{d} \pm t_{\alpha/2(n-1)} \sqrt{\frac{S_d^2}{n}}$$

where d is $= x_1 - x_2$

$$S_d^2 = \frac{\sum(d-\bar{d})^2}{n-1} = \frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}$$

n = pair of observation

18.7

X_1	X_2	$d = X_1 - X_2$	d^2
148	154	-6	36
176	176	0	0
153	151	2	4
116	121	-5	25
		$\sum d = -9$	$\sum d^2 = 65$

Date:

$\bar{d} = \frac{\Sigma d}{n}$

$s^2 d = \frac{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}{n-1}$

$\bar{d} = \frac{-9}{4}$

$s^2 d = \frac{65 - (-9)^2/4}{4-1}$

$\boxed{\bar{d} = -2.25}$

$s^2 d = \frac{65 - 20.25}{3}$

$\boxed{s^2 d = 14.42}$

The $100(1-\alpha)\%$ C-I for 'μ_D' is

$\bar{d} \pm t_{\alpha/2}(n-1) \sqrt{\frac{s^2 d}{n}}$

The 95% C.I for 'μ_D' is

$-2.25 \pm t_{0.025(3)} \sqrt{\frac{14.42}{4}}$

$-2.25 \pm (3.182)(1.93)$

-2.25 ± 6.14

$(-2.25 - 6.14) \ ; \ (-2.25 + 6.14)$

$-8.39 \ , \quad 3.89$

Q 10.29

b) $X_1 = 44, 53, 51, 52, 47, 50, 52, 53$

$X_2 = 52, 55, 52, 53, 50, 54, 54, 53$

Date:

$d = x_1 - x_2$ | d^2

d	d^2
-3	9
-2	4
-1	1
-1	1
-3	9
-4	16
-2	4
0	0

$\Sigma d = -16$ $\quad \Sigma d^2 = \cancel{29}\ 44$

$$\bar{d} = \frac{\Sigma d}{n}$$

$$\bar{d} = \frac{-16}{8}$$

$$\boxed{\bar{d} = -2}$$

$$S^2_d = \frac{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}{n-1}$$

$$S^2_d = \frac{\cancel{29}\ 44 - \frac{(-16)^2}{8}}{8-1}$$

$$S^2_d = \frac{\cancel{256}\ \cancel{29}\ 44 - 32}{7}$$

$$\boxed{S^2_d = 1.7142}$$

The $100(1-\alpha)\%$ C.I for 'μ'

$$\bar{d} \pm t_{\alpha/2(n-1)} \sqrt{\frac{S^2_d}{n}}$$

The 95% C.I for 'μ_D' is

$$-2 \pm t_{0.025(7)} \sqrt{\frac{1.7142}{8}}$$

$$-2 \pm (2.365)(0.4628)$$

$$-2 \pm 1.0945$$

$$(-2 - 1.0945), (-2 + 1.0945)$$

$$\boxed{-3.0945}, \boxed{-0.9055}$$

Date:

Alternative hypothesis 'H_1' :-

"The hypothesis which is accepted after rejection of null hypothesis is known as alternative hypothesis also known as researcher hypothesis."

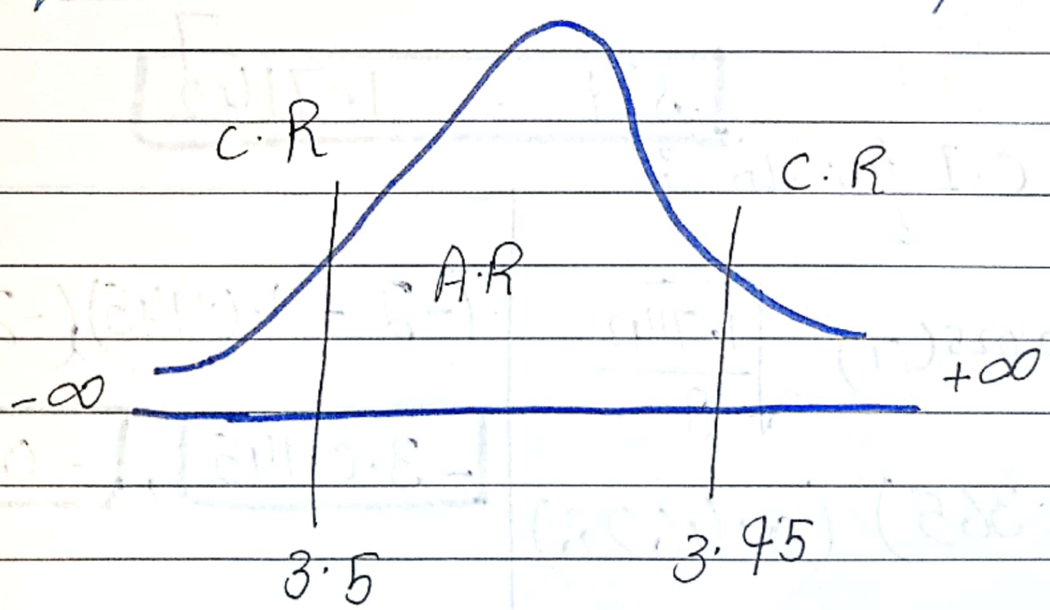
level of significance 'α':

The probability of rejecting true null hypothesis is known as level of significance

10% 5% 1% etc

Acceptance region :-

The area sampling distribution where Ho is accepted is known as acceptance region



Date:

The area of sampling region where Ho is rejected is known as rejection region or critical region

General procedure for testing of Attribute

(i) H_0: The attributes are independent
H_1: The attributes are associated

2): $\alpha = 0.05$

Test statistics

3): $\chi^2 = \Sigma \left[\frac{(fo-fe)^2}{fe}\right]$ fo = observed frequency
fe = Expected frequency

Khi square

4): Computation :- $fe = \frac{\text{total of 'A'} \times \text{total of 'B'}}{n}$

5) C.R. Reject Ho if

$\chi^2_c > \chi^2_{\alpha(r-1)(c-1)}$

row

column

6) Conclusion

Date:

The sum of squares of standardrize normal variates is know as chi square $\chi^2_{(n)}$.

$$z_1^2 + z_2^2 + \cdots + z_n^2 = \sum_{i=1}^{n} z_i^2 = \chi^2_{(n)}$$

$\hookrightarrow$ degrees of freedom

Degree of freedom (d.f)

"The total number of observation minum ~~to be a~~ Parameters to be estimated is Known as degree of freedom."

$$V = n - K$$

new

Attribute:-

The variabels which changes in quality of data. It indicates presence of and absence of quality characteristics

Eg: intellegience, religion, gender, beauty et.c

Date:

Association:—

"The interdependence between the attributes is know as association"

→ If the attributes are co-rellated these are known as associated or dependent

→ If these are un-corelated, these are called interdependent or unassociated

Testing of Hypothesis:— (H_0)

The procedure of accepting or rejecting any statement about the population parameter is known as testing of hypothesis.

Null Hypothesis:— (H_1)

The hypothesis which is tested for possible rejection under the ~~example~~ assumptions that it is true is known as null hypothesis.

Q 17.41 (b)

1. H_0: The attributes are independent
   H_1: " " " associated
2. $\alpha = 0.05$
3. Test statistic

Date:

$$\chi^2 = \Sigma \left[\frac{(f_o - f_e)^2}{f_e} \right]$$

④ Computation

f_o	A_1	A_2	Total
B_1	605	135	740
B_2	145	65	260
total	800	200	1000 = n

f_e	A_1	A_2
B_1	$\frac{740 \times 800}{1000} = 592$	$\frac{740 \times 200}{1000} = 148$
B_2	208	52

f_o	f_e	$(f_o - f_e)^2/f_e$
605	592	0.29
135	148	1.14
145	208	0.8125
65	52	3.25

$$\chi^2_c = 5.49$$

⑥ Conclusion:-

Reject H_o

⑤ C.R

$\chi_{(\alpha)(c-1)(r-1)}$ $(2-1)(2-1)$ (1)

Reject H_o if

$\chi^2_c \geq \chi^2_{0.05(1)} \Rightarrow (5.44 \geq 3.84)$

Date:

17.42 (b)

i) H_0 = The atribute are independent
H_1 = The atribute are associated

(ii) $\alpha = 0.05$

3) Test statistic $\chi^2 = \Sigma\left[\frac{(fo - fe)^2}{fe}\right]$

4) Computation :

fo	A_1	A_2	Total
B_1	528	25	553
B_2	719	75	965
total	1318	200	1518 = n

fe	A_1	A_2
B_1	$\frac{553 \times 1318}{1518}$ 480.14	$\frac{553 \times 200}{1518}$ 72.85
B_2	$\frac{965 \times 1318}{1518}$ 837.85	$\frac{965 \times 200}{1518}$ 127.14

fo	fe	$(fo - fe)^2/fe$
528	480.14	4.770
25	72.85	31.42
719	837.85	16.85
75	127.14	21.38

$\chi^2_c = 71.09$

5) C.R

Reject H_0 if $\chi^2_c \geq \chi^2_{0.05(1)}$

$(71.09 \geq 3.84)$

6) Conclusion

Reject H_0

Date:

Q 17.43

i) The attributes are independent

ii) The attributes are associated

2) $\alpha = 0.05$

3) Test statistic

4) Computation $\chi^2 = \sum\left[\frac{(f_o - f_e)^2}{f_e}\right]$

f_o	A_1	A_2	A_3	Total
B_1	215	325	60	600
B_2	135	175	90	400
Total	350	500	150	1000=n

f_e	A_1	A_2	A_3
B_1	$\frac{600 \times 350}{1000} = 210$	$\frac{600 \times 500}{1000} = 300$	$\frac{600 \times 150}{1000} = 90$
B_2	$\frac{400 \times 350}{1000} = 140$	$\frac{400 \times 500}{1000} = 200$	$\frac{400 \times 150}{1000} = 60$

5) C.R

Reject H_o if

$\chi_c^2 \geq \chi^2_{0.05(2)}$

$(30.505 \geq 5.99$

6) Rejected H_o

Date:

f_o	f_e	$(f_o-f_e)^2/f_e$
215	210	0.119
325	300	2.083
60	90	10
135	140	0.178
175	200	3.125
90	60	15
		$\chi^2_c = 30.505$

Testing Procedure for the population mean 'μ'

1. $H_0: \mu = \mu_0 \,,\; \mu \leq \mu_0 \,,\; \mu \geq \mu_0$
   $H_1: \mu \neq \mu_0 \,,\; \mu > \mu_0 \,,\; \mu < \mu_0$

2. $\alpha = 0.05$

3. Test statistics

$$Z = \frac{\bar{X} - \mu_0}{\sqrt{\sigma^2/n}}$$ (if σ^2 is known)

OR

$$Z = \frac{\bar{X} - \mu_0}{\sqrt{S^2/n}}$$ (if σ^2 is unknown and $n \geq 30$)

Date:

(4) computation

(5) C.R (see H_1)

Reject H_0 if

(i) $|Z_c| \geq Z_{\alpha/2}$

(ii) $Z_c \geq Z_\alpha$.

(iii) $Z_c \leq Z_\alpha$.

Conclusion:-

Accept or reject H_0

(i) Population

(ii) Past experience

(iii) From a Big total

(iv) From a company / institution

(v) From a lod

16.14 a

(1) $H_0 : \mu = 67.39$

$H_1 : \mu > 67.34$

(2) $\alpha = 0.05$

Date:

(3) Statics Test

$$Z = \frac{\bar{X} - \mu_0}{\sqrt{\sigma^2/n}}$$

(4) Computation

$$Z = \frac{67.47 - 67.39}{\sqrt{(1.30)^2/400}}$$

$$Z = \frac{0.08}{0.065}$$

$$Z_c = 1.2307$$

(5) C.R Reject H_0 if

$Z_c \geq Z_\alpha$

$Z_c \geq Z_{0.05}$

$1.23 \geq 1.645$

(6) Conclusion

Accept H_0

16.14

(b) (i) H_0 $H_1: \mu < \mu_0$

(2) $\alpha = 0.05$

(3) Test Statistic

$$Z = \frac{\bar{X} - \mu_0}{\sqrt{S^2/n}}$$

$\mu = 123$

$\bar{X} = 120.67$

$S = 8.44$

$$Z = \frac{120.67 - 123}{\sqrt{(8.44)^2/49}} \Rightarrow \frac{-2.33}{1.2057}$$

Date:

5) $Z_c = -1.43$

C.R

Reject H_0 if

$Z_c \leq -Z_{0.05}$

$= -1.43 \leq -1.645$ (Rejected)

16.15(a)

① $H_0 = \mu = 72$ ② $\alpha = \overset{(0.01)}{2.5}$

$H_1 = \mu \neq 72$ ③ Test statistics

④ $Z = \dfrac{\bar{X} - \mu_0}{\sqrt{S^2/n}}$ (if σ^2 were unknow and $n \geq 30$)

$\bar{X} = 71$, $S^2 = 200$, $\mu_0 = 72$, $n = 40$

$Z = \dfrac{71 - 72}{\sqrt{200/40}} \Rightarrow \dfrac{-1}{2.236}$

$Z_c = -0.44$

⑤ C.R

Rejected H_0 if

$\left[\begin{array}{l} \cancel{x} Z_c \leq -Z_{\cancel{0}.01} \\ -0.\cancel{44} \leq \cancel{x} 2.5 \end{array}\right]$

Date:

$|Z_c| \geq Z_{\alpha/2}$

$-0.44 \geq$

Testing hypothesis about 'μ'

Where σ is unknown and $n < 30$

① $H_0: \mu = \mu_0$, $\mu \leq \mu_0$, $\mu \geq \mu_0$

$H_1: \mu \neq \mu_0$, $\mu > \mu_0$, $\mu < \mu_0$

② $\alpha = 0.05$

Test statistic

$$t = \frac{\bar{X} - \mu_0}{\sqrt{s^2/n}}$$

④ **Computation :-**

$$s^2 = \frac{\sum(x-\bar{x})^2}{n-1}$$

$$s^2 = \frac{1}{n-1}\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]$$

⑥ **Reject H_0 if**

(i) $|t_c| \geq t_{\alpha/2}(n-1)$

(ii) $t_c \geq t_{\alpha}(n-1)$

(iii) $t_c \leq -t_{\alpha}(n-1)$

⑥ **Conclusion :-**

Accept or reject H_0

Date:

Q 18.13 (b) $\bar{X}$ 12 $n = 9$ $S^2 = 36$

(i) $H_0 : \mu = 10$

$H_1 : \mu > 10$

(2) $\alpha = 0.05$

(3) Test statistic

$$t = \frac{\bar{X} - \mu_0}{\sqrt{s^2/n}}$$

(4) Computation :-

$$t = \frac{12 - 10}{\sqrt{(36)^2/9}}$$

$$t = \frac{2}{\sqrt{\cancel{8}4\cancel{8}}} \Rightarrow t = \frac{\cancel{2}}{\cancel{2}} = 1$$

(5) C.R

Reject H_0 if

$t_c \geq t_{\alpha(n-1)}$

$1 \geq t_{0.05(9-1)}$

$1 \geq t_{0.05(8)} \Rightarrow 1 \geq 1.860$

(b) $H_0 : \mu = 10$

$H_1 : \mu \neq 10$

(2) $\alpha = 0.05$

(3) Test statistic

$$t = \frac{\bar{X} - \mu_0}{\sqrt{s^2/n}}$$

(4) Computation : $t = \frac{13-10}{\sqrt{64-16}}$

$t = 3/2$

$t_c = 1.5$

(5) Reject H_0 if

$|t_c| \geq t_{0.025(16-1)}$

$|t_c| \geq t_{0.025(15)}$

$1.5 \geq t_{\cancel{0.025}}\ 2.131$

(6) Conclusion:-

Accept H_0

Conclusion : Accept

Date:

c) $H_0 : \mu \leq 10$ $n = 16$

$H_1 : \mu > 10$ $\bar{X} = 11$

$s^2 = 81$

② $\alpha = 0.01$

③ Test statistic

$$t = \frac{\bar{X} - \mu_0}{\sqrt{s^2/n}}$$

$$t = \frac{11 - 10}{\sqrt{81/16}}$$

$$t = \frac{1}{2.25}$$

$$t_c = 0.44$$

C.R

rejected if H_0

$$|t_c| \geq t_{0.01(16-1)}$$

$$|t_c| \geq t(2.602)$$

$$0.44 \geq 2.602$$

Conclusion:-

Accept H_0

(d)

$\mu \geq 10 : H_0$

$\mu < 10 : H_1$

$n = 25$

$\bar{X} = 8$

$S^2 = 64$

$\alpha = 0.01$

Test statistic

$$t = \frac{\bar{X} - \mu_0}{\sqrt{s^2/n}}$$

$$t = \frac{8 - 10}{\sqrt{64/25}}$$

$$t_c = \frac{-2}{1.6} \Rightarrow -1.25$$

C.R

rejected H_0 if

$$|t_c| \geq t_{0.01(25-1)}$$

$$|t_c| \geq t(2.492)$$

$$-1.25 \geq 2.492$$

Conclusion:-

Date:

d) $H_0 : \mu = 10$

$H_1 \quad \mu \neq 10$

$n = 25$

$\bar{X} = 9$

$S^2 = 49$

$\alpha = 0.02$

Test Statistic

$$t = \frac{\bar{X} - \mu_0}{\sqrt{S^2/n}}$$

$$t = \frac{9 - 10}{\sqrt{49/25}}$$

$$t = \frac{-1}{1.4}$$

$t_c = -0.71$

C.R

Rejected H_0 if

$|t_c| \geq t_{0.02}(25-1$

$|t_c| \geq t$

Test Statistic

Test Statistic

Test Statistics

Test Statistics

Date:

not equal to 8

due to ungrouped data

18.14 $n = 12$ $\alpha = 0.05$

X	X^2
8.2	67.24
8.0	64
7.6	57.76
7.6	57.76
7.7	59.29
7.5	56.25
7.3	53.29
7.4	54.76
7.5	56.25
8.0	64
7.4	54.76
7.5	56.25
$\Sigma x = 91.7$	$\Sigma x^2 = 701.61$

$$S^2 = \frac{1}{n-1}\left[\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right]$$

$$\frac{1}{12-1}\left[701.61 - \frac{(91.7)^2}{12}\right]$$

$$\frac{1}{11}\left[701.61 - 700.74\right]$$

$$S^2 = \frac{1}{11}[0.87]$$

$$\boxed{S^2 = 0.08}$$

$$t = \frac{\bar{X} - \mu_0}{\sqrt{S^2/n}} \Rightarrow \frac{91.7-8}{\sqrt{0.08/12}}$$

$$t = \frac{83.7}{0.1} = \boxed{8.37}$$

Reject C.R

$$|t_c| \geq t_{\alpha/2}(n-1)$$

$$8.37 \geq 2.201$$

Conclusion :-

Reject

Date:

Testing about the differences b/w mean "$\mu_1 - \mu_2$"

① $H_0: \mu_1 = \mu_2$, $\mu_1 \le \mu_2$, $\mu_1 \ge \mu_2$

$H_1: \mu_1 \ne \mu_2$, $\mu_1 > \mu_2$, $\mu_1 < \mu_2$

② $\alpha = 0.05$

③ Test Statistics (Test statistic)

Case I:-

$$Z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

(Where σ_1^2 and σ_2^2 are known)

Case II:-

$$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

(Where σ_1^2 and σ_2^2 are unknown and $n_1 \ge 30$, $n_2 \ge 30$)

④ Computation:-

⑤ C.R Reject Ho if

(i) $|Z_c| \ge Z_{\alpha/2}$ (iii) $Z_c \le -Z_\alpha$

(ii) $Z_c \ge Z_\alpha$

CamScanner

Date:

Conclusion:-

Accept or Reject H_0

16.19(a):-

$H_0: \mu_1 - \mu_2 = 0$

$H_1: \mu_1 - \mu_2 \neq 0$

② $\alpha = 0.05$

③ Test statistics:-

$$Z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n} + \frac{\sigma_2^2}{n}}}$$

④ Computation:-

$$Z = \frac{(15-13) - (0)}{\sqrt{\frac{24}{6} + \frac{80}{8}}} \Rightarrow Z = \frac{2}{3.74} = 0.53$$

$Z_c = 0.53$

⑤ C.R Reject H_0 if

$|Z_c| \geq Z_{\alpha/2}$

⑥ Conclusion:- $0.53 \geq 1.96$

Accept H_0

Date:

(b) $H_1: \mu_1 \neq \mu_2$

(1) $H_0: \mu_1 = \mu_2$

$\alpha = 0.05$ $\boxed{a = 1.88}$

$$Z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$Z = \frac{(81-76) - (0)}{\sqrt{\frac{(5.2)^2}{25} + \frac{(3.4)^2}{36}}} = \frac{5}{\sqrt{1.0816 + 0.3211}}$$

$$= \frac{5}{\sqrt{1.402}} = \frac{5}{1.184} = 4.22$$

C.R

Reject H_0 if

(6) $|Z_c| \geq 1.88$

Conclusion Reject

16.20

X_1 : 16, 18, 23, 26, 19, 24, 25, 23, 21, 22

X_2 : 20 21 23; 25, 25, 27, 24, 26, 24, 28

$$\bar{X}_1 = \frac{\Sigma x_1}{n_1} = \frac{217}{10} \quad \boxed{21.7}$$

Date:

$$\bar{X}_2 = \frac{\sum X_2}{n} = \frac{243}{10} = 24.3$$

$$\alpha = 0.05$$

Testing hypothesis about difference b/w means for paired data

① $H_0 : \mu_D = 0 \quad \mu_D \leq 0 \quad , \mu_D \geq 0$

$H_1 : \mu_D \neq 0 \quad , \mu_D > 0 \quad , \mu_D < 0$

② $\alpha = 0.05$

③ Test statistic

$$t = \frac{\bar{d} - \mu_D}{\sqrt{\frac{S^2 d}{n}}}$$

④ Computation

$$\bar{d} = \frac{\sum d}{n} \; ; \; d = x_1 - x_2$$

$$S^2 d = \frac{\sum (d - \bar{d})^2}{n-1}$$

$$S^2 d = \frac{1}{n-1}\left[\sum d^2 - \frac{(\sum d)^2}{n}\right]$$

⑤ C.R

Reject H_0 if

i) $|t_c| \geq t_{\alpha/2}(n-1)$

$t_c \geq t_\alpha (n-1)$

$t_c \leq -t_\alpha (n-1)$

⑥ Conclusion

Accept or Reject H_0

Date:

18.27 (b)

① $H_0 : \mu_D = 0$

$H_1 : \mu_D \neq 0$

② $\alpha = 0.05$

③ Test statistics

$$t = \frac{\bar{d} - \mu_D}{\sqrt{s^2_d / n}}$$

Computation :-

X_1	X_2	$d = X_1 - X_2$	d^2
148	154	-6	36
176	176	0	0
153	151	2	4
116	121	-5	25
		$\Sigma d = -9$	$\Sigma d^2 = 65$

$$\bar{d} = \frac{\Sigma d}{n} = -\frac{9}{4} \qquad \boxed{\bar{d} = -1.25}$$

$$s^2_d = \frac{1}{3}\left[65 - \frac{(-9)^2}{4}\right]$$

$$s^2_d = \frac{1}{3}\left[65 - 20.25\right] \Rightarrow \boxed{s^2_d = 14.91}$$

$$t = \frac{-1.25 - 0}{\sqrt{14.91/4}} \Rightarrow \frac{-1.25}{1.93}$$

Date:

$t_c = -0.65$

(5) C.R Reject H_0 if

$|t_c| \geq t_{0.025(3)}$

$0.65 \geq 3.182$

(6) Conclusion

Accept H_0

18.28 (a) $H_0 = \mu_D = 0$

$H_1 = \mu_D \neq 0$

$\alpha = 0.05$

(3) Test statistic =

$$t = \frac{\bar{d} - \mu_D}{\sqrt{s^2 d/n}}$$

Computation :-

X_1	X_2	$d = X_1 - X_2$	d^2
44	53	-9	81
40	38	2	4
61	69	-8	64
52	57	-5	10
32	46	-14	196
44	39	5	25
70	73	-3	9
41	48	-7	49

Date: X_1

X_1	X_2	$d = X_1 - X_2$	d^2
67	73	-6	36
72	74	-2	4
53	60	-7	49
72	78	-6	36
		-60	578

$$\bar{d} = \frac{-60}{12} = -5$$

$$S^2_d = \frac{1}{11}\left[578 - \frac{(60)^2}{4}\right]$$

$$= \frac{1}{11}\left[578 - \frac{3600}{4}\right]$$

$$S^2_d = \frac{1}{11}\left[578 - 900\right] = \frac{-322}{11} = \boxed{-29.27}$$

⑤ $$t = \frac{\bar{d} - \mu_D}{\sqrt{S^2_d / n}} =$$