$\therefore n_1, n_2 \geq 10$.

① Mann Whitney U test :

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

$$Z = \frac{U - n_1 n_2/2}{\sqrt{n_1 n_2 (n_1+n_2+1)/12}}$$

σ_u

Large samples use $Z = \frac{U - \mu_u}{\sigma_u}$
$n_1, n_2 \geq 10$.

$U = \text{Min}(U_1, U_2)$

$n_1 n_2$ = Size of samples
$R_1 R_2$ = Rank Sums.

① from the following table use mann whitney U test to determine whether there is a difference in the course of the 2 groups. Use 0.05 LOS (large).

Grp A	Grp B
7	8
11	9
9	13
4	14
8	11
6	10
12	12
11	14
9	13
10	9
11	10
	8

Sol: H_0 — There is no diff b/w 2 grps
H_1 :- There is diff b/w 2 grps

GA	GB	GA Arrange small – big	GB Arrange s – b	Ranks	Common Rank
		4	—	1	1
		6	—	2	2
		7	—	3	3
		8	8, 8	4, 5, 6	$\left(\frac{4+5+6}{3}\right) = 5$
		9, 9	9, 9	7, 8, 9, 10	$\left(\frac{7+8+9+10}{4}\right) = 8.5$
		10	10, 10	11, 12, 13	12
		11, 11, 11	11	14, 15, 16, 17	15.5
		12	12	18, 19	18.5
		—	13, 13	20, 21	20.5
		—	14, 14	22, 23	22.5
	RANKS	$n_1 = 11$	$n_2 = 12$.		

Grp (A) common Rank × Digits	Grp. (B) common Rank × Digit
$1 \times 1 = 1$	—
$2 \times 1 = 2$	—
$3 \times 1 = 3$	—
$5 \times 1 = 5$	$5 \times 2 = 10$
$8.5 \times 2 = 17$	$8.5 \times 2 = 17$
$12 \times 1 = 12$	$12 \times 2 = 24$
$15.5 \times 3 = 46.5$	$15.5 \times 1 = 15.5$
$18.5 \times 1 = 18.5$	$18.5 \times 1 = 18.5$
—	$20.5 \times 2 = 41$
—	$22.5 \times 2 = 45$
$R_1 = 105$	$R_2 = 171$

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$= 11 \times 12 + \frac{11(11+1)}{2} - 105$$

$$= 93$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

$$= 11 \times 12 + \frac{12(12+1)}{2} - 171$$

$$= 39$$

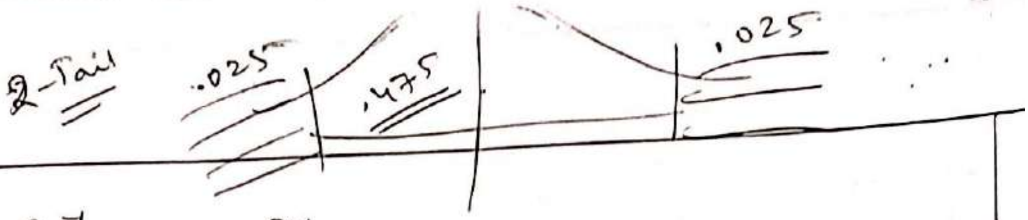
$$U = \min(U_1, U_2)$$

$$= \operatorname{Min}(93, 39)$$

$$U = \underline{\underline{39}}$$

$$Z_{cal} = \frac{U - n_1 n_2 / 2}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}}$$

$$= \frac{39 - \frac{11 \times 12}{2}}{\sqrt{\frac{11 \times 12 (11 + 12 + 1)}{12}}} = \frac{39 - 66}{\sqrt{\frac{132(24)}{12}}}$$



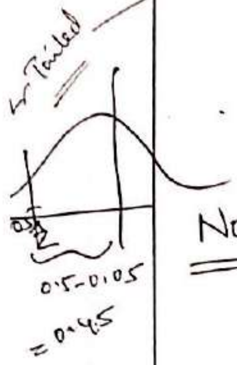
$$\frac{27}{\sqrt{\frac{3168}{12}}} = \frac{27}{\sqrt{264}} = \frac{27}{16.248} = -1.48$$

Table Value = at 5% LOS = 1.96

∴ Calcultd Value $-1.48 <$ Table value Accept H_0.

∴ There is no diff b/w 2 types.

[∵ $1.9 + 0.06$, Table value = 1.96]



Note

When $n_1 n_2 \geq 8$ We need to perform Z-test

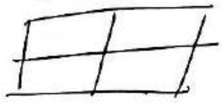
$n_1 n_2 < 8$ Use Wilcoxon Table.

Mc. Nemar Test

$$\chi^2 = \frac{(|A-D|-1)^2}{A+D}.$$

Degree of freedom = $(r-1)(c-1)$

Terms used in Qsn ⇒ Before, After



Rules If Cal < Table (Accept H_0)

Cal > Table (Reject H_0)

ⓧ In a certain before & after experiment the responses obtained from 100 respondents when classified gave the following information

Before treatment		After treatment: Unfavourable Response	After treatment: Favourable Response
	Favourable Response	100 (A)	200 (B)
	Unfavourable Response	300 (C)	50 (D)

Test @ 5% LOS whether there has been a significant diffce in ppl's attitude before & after concerning experiment.

<u>Sol</u> :-

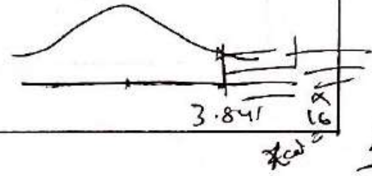
H_0 — There is no diff b/w peoples attitude.

H_1 :- There is diff b/w ppl's attitude.

$$\chi^2 = \frac{(|A-D|-1)^2}{A+D} = \frac{(|100-50|-1)^2}{100+50} = 16$$

$$D.O.F = (r-1)(c-1) = (2-1)(2-1) = 1$$

$\chi^2_{Table} = 3.841$ at L.OS .05



As the Chisquare calcultd value (16) is Greater than Chisquare table value (3.841) at 5% LOS. ∴ Reject H_0 & Accept H_1.

There is a significant diff in ppl's attitude b4 & aftr trtmt.

⊗ In a certain Before & After experiment the responses obtained from 2000 respondents are classified. Test @ 5% LOS whether there has been any change in the salesmen b4 & after training.

After training.

Before Training		Farbl Responses	Unfavbl Response
	Fav Res	200(A)	800(B)
	Unfav Res	600 (c)	900 (D)

Sol

H_0 – There is no diff b/w B, A Exp

H_1 – " " diff b/w " "

$$\chi^2_{(cal)} = \frac{(|A-D|-1)^2}{A+D} = \frac{(|200-4001|-1)^2}{200+400} = 66$$

DOF = $(r-1)(c-1) = (2-1)(2-1) = 1$

$\chi^2_{Tabl} = 3.841$ @ 5% LOS

Con – Reject Ho. As $\chi^2_{cal} > \chi^2_{tabl}$.

∴ There is signifcnt diff b/w b4 & after traing of salesmen.

Kruskal Wallis Test

K-H Test (H test)

3 or more samples

$$H = \left[\frac{12}{N(N+1)}\left[\frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \cdots \frac{R_n^2}{n_i}\right] - 3(N+1)\right]$$

(*) Using H-test find whether the 3 methods are equally effctv.

Method A – 80, 83, 79, 85, 90, 68 $n_1 = 6$

B – 82, 84, 60, 72, 86, 67, 91 $n_2 = 7$

C – 93, 65, 77, 78, 88 $n_3 = 5$.

Sol :- H_0 – There is no diff b/w 3 methods

H_1 – " " diff " "

Sol :-

Step 1 –

Arrange all numbers in ascendg order.

60	65	67	68	72	77	78	79	80
B	C	B	A	B	C	C	A	A
1	2	3	4	5	6	7	8	9

82	83	84	85	86	88	90	91
B	A	B	A	B	C	A	B
10	11	12	13	14	15	16	17

93
C
18

$R_1 \Rightarrow$ Ranks of A $= 4+8+9+11+13+16 = 61$

$R_2 \Rightarrow$ Ranks of B $= 1+3+5+10+12+14+17 = 62$

$R_3 \Rightarrow$ Ranks of C $= 2+6+7+15+18 = 48$.

$n_1 =$ No. of observations (A) $= 6$

$n_2 =$ " (B) $= 7$

$n_3 =$ " (C) $= 5$

$N = n_1 + n_2 + n_3 = 6+7+5$

$= 18$.

5.

$$H = \left[\frac{12}{N(N+1)}\left[\frac{R_1^2}{n_1}+\frac{R_2^2}{n_2}+\frac{R_3^2}{n_3}\right] - 3(N+1)\right]$$

$$= \frac{12}{18(18+1)}\left[\frac{(61)^2}{6}+\frac{(62)^2}{7}+\frac{(48)^2}{5}\right] - 3(18+1)\Big]$$

$$= \left[\frac{12}{342}\left[620.17+549.14+460.8\right] - 3(19)\right]$$

$$= \left[0.035(1630.11 - 3(19)\right]$$

$$= 57.054 - 57$$

$$= 0.0535$$

Degree of Freedom $\Rightarrow$ $K-1$ =

K = No. of samples

$= 3-1$

$= 2$

Chi-Sq Tbl Val @ 5% LOS at 2 D.O.F

is $\underline{\underline{5.991}}$

<u>Col</u> As H_{cal} (0.0535) < H_{tab} (5.991)

Accpt H_0 $\Rightarrow$ There is no sigficnt Diff b/w 3 methods.

⊛ A training was conducted for salesmen the method of training used is different from each group. find is there any diffc in training methods.

A	75	83	68	85	90	61	$n_1=6$
B	62	70	67	82	80	87	64 $n_2=7$
C	65	71	74	63	89	$n_3=5$	

Sol :- H_0 - There is no diff in traing methods
H_1 - " " diff.

Step 1 Arrnge in AO.

61	62	63	64	65	67	68	70	71
A	B	C	B	C	B	A	B	C
1	2	3	4	5	6	7	8	9
74	75	80	82	83	85	87	89	90
C	A	B	B	A	A	B	C	A
10	11	12	13	14	15	16	17	18.

6

<u>Step2</u> : Sum of Ranks.

$R_1 \overset{\text{Rank of}}{(A)} = 1+7+11+14+15+18 = 66.$

$R_2 \; (B) = 2+4+6+8+12+13+16 = 61$

$R_3 \; (C) = 3+5+9+10+17 = 49$

$N = n_1 + n_2 + n_3 = 6+7+5 = 18.$

$$H = \left[\frac{12}{N(N+1)}\left[\frac{R_1^2}{n_1}+\frac{R_2^2}{n_2}+\frac{R_3^2}{n_3}\right] - 3(N+1)\right]$$

$$= \left[\frac{12}{18(18+1)}\left[\frac{(66)^2}{6}+\frac{(61)^2}{7}+\frac{(44)^2}{5}\right] - 3(18+1)\right]$$

$$= \left(\frac{12}{342}\left[726 + 531.57 + 387.2\right] - 3(19)\right]$$

$= 0.56.$

χ table 5% $(K-1) = (3-1)$ $\nu = 2 \Rightarrow 5.991$ (Tabl Val)

$\chi_{cal\,va}(0.56) < \chi_{Tab\,v}(5.991)$

Accept H_0 ⇒ There is no diff in the training methods.

SIGN TEST

CASE 1

$n < 20.$

$$k = \frac{(n-1)}{2} - 0.98\sqrt{n}$$

n = sample size

Compare k value with S

S = No. of Negative signs

$S > k$ (Accept H_0).

$S \leq k$ [Reject H_0].

CASE 2

$n > 20$

$$z = \frac{x - np_0}{\sqrt{np_0(1-P_0)}}$$

$P_0 = 0.5$

n = sample size

x = No. of +ve signs

Compare with z-table.

⊗ Use the sign test to see if there is any difference b/w no. of days until the collection of an A/c's Rcvbl b4 & after a new collection policy Use 5% LOS

Before	30	28	34	35	40	42			
After	32 −	29 −	33 +	32 +	37 +	43 −			
B4	33	38	34	45	28	27	25	41	36
Aftr	40 −	41 −	37 −	44 +	27 +	33 −	30 −	38 +	36 0

H_0 - There nt any diff b/w A & B
H_1 - There is

$n = 12$

$k = \frac{(n-1)}{2} - 0.98\sqrt{n}$

$= \frac{12-1}{2} - 0.98\sqrt{12}$

$= 5.5 - 0.98(3.46)$

$= 5.5 - 3.3908$

$= 2.11$

S = No. of -ve signs

$= 2$

$\underset{(2.11)}{K} > \underset{(2)}{S}$

Accept H_1
reject H_0.

$\therefore$ There is diff b/w 2 brands.

(x) Find is there any difference b/w 2 methods by using the sign test.

Method A	Method B	
58	32	+
60	48	+
42	50	−
62	41	+
65	45	+
59	40	+
60	43	+
52	43	+
50	70	−
75	60	+
59	80	−
52	45	+

H_0 - There is no significant difference between the A/c's Recvbl

H_1 :- There is diffrce.

$n = 15$

$n = 15-1 = 14$ (bcoz 1 value is 0 36-36 = 0)

$K = \frac{(n-1)}{2} - 0.98\sqrt{n}$

$= \frac{14-1}{2} - 0.98\sqrt{14}$

$= 6.5 - 3.67$

$= 2.83.$

S = -ve signs No.

= 8

K < S So Accept

(2.83 < 8)

H_0 .

Con: There is ~~no~~ diff b/w the A/c's Rcvbl.

⊛ Find is there any difference b/w the two brands A & B by using the sign test.

BRAND A	26	30	94	23	18	50	16	25
Brand B.	22	27	39	7	11	56	19	18
	+	+	+	+	+	−	+	+

49	37	20
51	33	16
−	+	+

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57	36	+
30	56	−
46	40	+
66	70	−
40	50	−
78	53	+
55	50	+
52	30	+
58	42	+
44	45	−

$+ = 15$

$- = 7$

$X = Min(15, 7)$
$= 7.$

X Tab, $n = 22$
$\alpha = 0.05$
$X_{Tab} = 5$
$X_{cal} > X_{Tab}$ Accept H_0

H_0 - There is no diff b/w 2 methods
H_1 - " " diff "

x = no. of + signs

<u>Case 2</u> -

$n > 20.$

$$Z = \frac{x - np_0}{\sqrt{np_0(1-p_0)}} = \frac{15 - 22(0.5)}{\sqrt{22(0.5)[1-0.5]}}$$

$$= \frac{4}{\sqrt{5.5}} = \frac{4}{2.345} = 1.706.$$

Z_{tabl} @ 5% LOS = $[-1.96$ to $+1.96]$

$\therefore Z_{cal} < Z_{tab}$ Reject H_0.

There is no diff b/w 2 methods.

SIGN TEST FOR 1 SAMPLE

We are required to test the hypothesis Let the mean value = 20 against alterntv hypothesis $\mu \neq 20$. 15 observations are taken & the following results r obtained. Use 5% LOS.

SAMPLE ~~(15-sample~~	SIGN (20-sample)
18	−
19	−
25	+
21	+
16	−
15	−
19	−
22	+
24	+
21	+
18	−
17	−
15	−
26	+
24	+
$n = 15$	$X =$ no. of + signs $= 7$.

$$Z = \frac{x - np_0}{\sqrt{np_0(1-p_0)}} = \frac{7 - 15(0.5)}{\sqrt{15(0.5)(1-0.5)}} = \frac{-0.5}{1.936}$$

$$= -0.26$$

$Z_{\text{Table value}} = [-1.96 \text{ to } +1.96]$

As Cal. value is falling in the region

So Accept H_0.

RUN TEST

step 1 — Find the runs

step 2 — $\mu_r = \left[\frac{2n_1n_2}{n_1+n_2}\right] + 1$

step 3 — $\sigma_r = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1+n_2)^2(n_1+n_2-1)}}$

step 4 - $Z_{cal} = \frac{U - \mu_r}{\sigma_r}$ [Compare cal. value with Z value & give Conclusion]

(x) consider the following arrangements of patient male & female who have visited an OPD in an hospital during the first few hrs on a working day.

The order is as follows:- { *MM UD TQ Run Test → cont. series }

$$\underbrace{MMM}_{1}\quad \underbrace{FF}_{2}\quad \underbrace{MMMM}_{3}\quad \underbrace{FFF}_{4}\quad \underbrace{MMM}_{5}\quad \underbrace{FFFFF}_{6}\quad \underbrace{MM}_{7}$$

U = Runs = 7

$n_1 = 12$ (M) - Male

$n_2 = 10$ (F) - Female

H_0 - Male & female patients hv come in random

H_1 - " " " not "

Run Table $n_1 = 12, n_2 = 10$

$G_1 = 7$, $G_2 = 18$

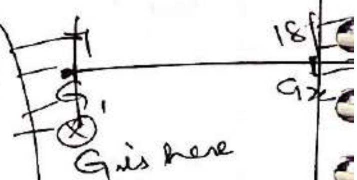
$$\mu_r = \left[\frac{2 n_1 n_2}{n_1 n_2}\right] + 1$$

$$= \frac{2(12)(10)}{12} + 1 = 11.9$$

$G = 7$

$(G_1, G_2) = (7, 18)$

$$\sigma_r = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1+n_2)^2(n_1+n_2-1)}} = 2.27$$



$$Z = \frac{U - \mu_r}{\sigma_r} \Rightarrow \frac{7 - 11.9}{2.27} = (-2.16)$$

Conclsn: Accpt H_1

$G = 7$ lies in d critical region

Reject H_0.

x) The foll arrangement shows the rise (U) & fall (d) in the price of equity shares on 40 consecutive days on which its price did not remain the same.

$\underset{1}{UU}$ $\underset{2}{DD}$ $\underset{3}{UUU}$ $\underset{4}{D}$ $\underset{5}{UUU}$ $\underset{6}{DD}$ $\underset{7}{U}$ $\underset{8}{DDD}$ $\underset{9}{U}$ $\underset{10}{DD}$

$\underset{11}{U}$ $\underset{12}{DD}$ $\underset{13}{UUUU}$ $\underset{14}{DDDD}$ $\underset{15}{UU}$ $\underset{16}{D}$ $\underset{17}{UU}$ $\underset{18}{DDD}$ $\underset{19}{U}$

H_0 - Let there be no diff b/w price rise & fall (random)

H_1 - Let " " diff " ... (2-Tailed)

$U = 19$, $n_1 = 20$ (U) $n_2 = 20$ (D)

$$\mu_r = \left[\frac{2n_1n_2}{n_1+n_2}\right] + 1 = 21.$$

$$\sigma_r = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1+n_2)^2(n_1+n_2-1)}} = 3.12$$

$$Z = \frac{\mu - \mu_r}{\sigma_r} = -0.64.$$

Z_{table} at 0.05 LOS $= \pm 1.96$.

$Z_{cal} = -0.64$.

$|Z_{cal}| < Z_{Table}$,

$0.64 < 1.96$ - Accept H_0.

Wilcoxon Matched Pair Test.

$n < 25$ (Wilcoxon table)

*) 2 models of machines are under consideratn for purchase & the org. has 1 of each for a trail period & the team of 19 operators for each machine for a fix length of time. Find using WMPT is there any diff b/w 2 M/c's.

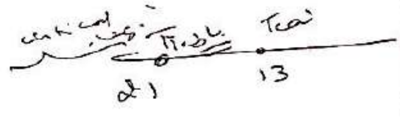
operations	M/c I	M/c II	d_i Diff	$\lvert d_i \rvert$ Ranks	Ranks with +	Ranks with −
A	78	60	18	11	11	
B	75	58	17	10	10	
C	53	46	7	7	7	
D	68	71	−3	−3	—	−3
E	82	80	2	2	2	
F	64	59	5	5	5	
G	95	73	22	13	13	
H	86	78	8	8	8	
I	64	37	27	14	14	
J	71	75	−4	−4	—	−4
K	54	60	−6	−6	—	−6
L	80	79	1	1	1	
M	51	38	13	9	9	
N	70	51	19	12	12	
				Small - Big	92	−13

$N = 14$

Minimum Value (absolute) (13) $T_{cal} = 13$

$T_{tab} = n = 14 =$ Table value $= 21$

Calc Table Accept H_0.



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For wilcoxon test if Tcalculated value is less than or equal to Table value [~~accept H0~~] reject Ho.

[∴ Test statistic T is smaller of T^+ & T^- critical region is in left hand Tail]

If $T_{cal} \le T_{table}$ [Reject H_0] ✓

$T_{cal} > T_{tab}$ Accept H_0

$T_{cal} < T_{tab}$ Reject H_0

coln: As $T_{cal} < T_{tab}$ reject null hyp.

(x) A manufg electric toys has been taken over by another co. workers were appr to ascertain their satisfctn level. The same wrkrs were again apprch to know their satisfctn after d takeover of d co. find usg wilcoxn matchd pair test whether there is an impvmt in d satisfctn of wrkrs after d takeover of d co.

H_0: There is no signt diff in d satisfctn of wrkrs after d Takeover of d co.

H_1: There is diffce.

B4	After.	Diff	Ranks	Ranks vth +	Ranks vth −
69	65	4	6.5	6.5	—
73	75	−2	4	—	−4
58	63	−5	9	—	−9
76	75	1	1.5	1.5	—
82	82	0	—	—	—
65	68	−3	8	—	−8
75	71	4	6.5	6.5	—
64	65	−1	1.5	—	−1.5
87	85	2	4	4	—
70	68	2	4	4	—
				22.5	−19.5

Min Value $T_{cal} = 19.5$

$n = 10 - 1 = 9$

$T_{tab} = 6$

$T_{cal} > T_{tab}$ val

20.5 > 6
Accept H_0

(x) Find is there any signficnt diff b/w 2 brands by usg WMPT

Brand A	Brnd B	Diff	Ranks	Ranks v/h +	Ranks v/h −
26	22	4	5.5	5.5	
30	27	3	3	3	
44	39	5	8	8	
23	7	16	11	11	
18	11	7	9.5	9.5	
50	56	−41	−12	−	−12
34	30	4	5.5	5.5	
16	14	2	1.5	1.5	
25	18	−1	9.5	9.5	
49	51	−2	−1.5	−	−1.5
37	33	4	5.5	5.5	
20	16	4	5.5	5.5	
				64.5	−13.5

Min Value(T_{cal}) = $|-13.5| = 13.5$

T_{tab} $n = 12$
Value = 14
$T_{cal} < T_{tab}$
$13.5 < 14$
∴ Reject H_0.

K-S Test ~~K~~olmogrov Smirnov Test

1 sample Test

1 samp → 2 sample → 1-Tail, 2-Tail

The table below provide info pertaing to observs freq list of daily visits of customers to the showroom list with this freq distn follows prisson disbtn or not LOS – 5%.

$\lambda = 4$

1 No. of visits	2 No. of Days	3 Com. freq	4 Relativ com freq	5 Expctd freq	6 com Expctd freq	7 = 4 – 6 Rfo – Rfe
0	5	5	$5/100 = 0.05$	0.018	0.018	0.03
1	25	30	$\frac{30}{100} = 0.30$	0.072	0.09	0.21
2	19	49	$\frac{49}{100} = 0.49$	0.144	0.234	0.256
3	29	78	$\frac{78}{100} = 0.78$	0.192	0.426	0.354
4	3	81	$\frac{81}{100} = 0.81$	0.192	0.618	0.192
5	10	91	$\frac{91}{100} = 0.91$	0.154	0.772	0.138
6	9	100	$\frac{100}{100} = 1$	0.102	0.874	0.128
7	100					

Highes value of D is

D value = 0.354

$D_{calculted} = 0.354$

~~H_0: does not follows P.D.~~

~~H_1: follows P.D~~

H_0 :→ Given freqncy follows P.D

H_1 → does not follw P.D.

Poisson Distribution

$$\frac{e^{-\lambda} \cdot \lambda^x}{x!} \qquad \lambda = 4$$

Expectd freq -

$$P(x=0) = \frac{e^{-4} \cdot 4^0}{0!} = 0.018$$

$$P(x=1) = \frac{e^{-4} \cdot 4^1}{1!} = 0.018 \times 4 = 0.072$$

$$P(x=2) = \frac{e^{-4} \cdot 4^2}{2!} = \frac{0.018 \times 16}{2} = 0.144$$

$$P(x=3) = \frac{e^{-4} \cdot 4^3}{3!} = \frac{0.018 \times 4^3}{3 \times 2 \times 1} = 0.192$$

$$P(x=4) = \frac{e^{-4} \cdot 4^4}{4!} = \frac{4.608}{24} = 0.192 \qquad \frac{0.018 \times 4^4}{4 \times 3 \times 2 \times 1}$$

$$P(x=5) = \frac{18.432}{120} = 0.154$$

$$P(x=6) = \frac{73.728}{720} = 0.102$$

$D_{cal} = 0.354$

$D_{tab} = 0.136$

$N < 35$ use (K-S table)

$N > 100$	
5%	1%
$\frac{1.36}{\sqrt{N}}$	$\frac{1.63}{\sqrt{N}}$

- In d word binomial & poisson is not mentiond then use rule of homogenity to calculte expctd freqcy

$\because$ $D_{cal} > D_{Table}$ Reject H_0 & Accept H_1

Given freqncy distsibtn does not follow a Poisson distribution

K- S Test

1 Smp — Poism

2 Smp. — Binml

$\leftarrow$ or $\begin{cases} \mu \\ KH \\ hill \end{cases}$

→ Rule of Homogenity.

x) A research is conducted by taking sample of 250 respondents to find the pref of customers towards its taste.

H_0. let there be no signt. diff in d cstmrs pref towrd taste

H_1 : let there be

	Freq	① Cum freq	② Rfo Reltv Cum freq (60 ÷ 250)	③ $\frac{250}{5} = 50$ Expctd freq.	④ Cum Exp freq.
1	60	60	0.24	50	50
2	70	130	0.52	50	100
3	30	160	0.64	50	150
4	50	210	0.84	50	200
5	40	250	1.0	50	250.
	250				

⑤ Rfe Reltv Exp Com freq	⑥ = ② − ⑤ Rfo − Rfe
0.2 = 50 ÷ 250	0.04
0.4 (100/250)	0.12
0.6 (150/250)	0.04
0.8 (200/250)	0.04
1.0 (250/250)	0

Dcal value = is the highest table value i.e 0.12

N > 35 ⇒ D-table

K-S Table 1% LOS = $\frac{1.63}{\sqrt{N}}$

$\frac{1.36}{\sqrt{N}}$ LOS 5%.

$= \frac{1.36}{\sqrt{250}} = 0.086$

$D_{vc} = 0.12$
$D_t = 0.086$

conlsn:

D_{cal} val (0.12) is more than D table value 0.086.
so Reject H_0 ie there is a diff in d cust.
pref towards tastes.

Bcoz 1,2,3 is not gvn dirctly scores - gvn so do
in form ↓

⑩ Use K-S test @ 5% LOS to test whether the distribtn is uniform.

don't consider -ve sign.

SCORES	O_i Freq	Cum Freq	A_i Relativ freq	$\lvert A_i - O_i \rvert$
41	2	2	2÷25 = 0.08	1.92 · 0.08 − 2
42	3	5	0.2	2.8
43	1	6	0.24	0.76
44	4	10	0.4	3.6
45	2	12	0.48	1.52
46	2	14	0.56	1.44
47	4	18	0.72	3.28
48	2	20	0.8	1.2
49	4	24	0.96	3.04
50	1	25	1	0
	25			

see highest value that ve be
D_{cal} val = 3.6

FS
2.5 2.5
2.5 5
7.5
10
12.5
15

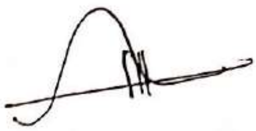
H_0: Is uniform
H_1: Is not uniform

$$D_{table}\ 5\% = \frac{1.36}{\sqrt{n}} = \frac{1.36}{\sqrt{10}} = 0.43$$

$\overset{3.6}{\text{Calval}} > \overset{0.43}{\text{Tab}}$ Reject H_0.

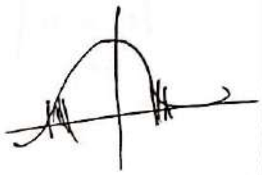
Q) K.S
2 Sample Test - one Tailed

$$\chi^2_{cal} \Rightarrow 4D^2 \left| \frac{n_1 n_2}{n_1 + n_2} \right|$$



K.S Two Sample Test - Two Tailed Test

$$\chi^2_{cal} = \frac{1.36\sqrt{n_1 + n_2}}{n_1 n_2}$$



⇒ 2- Tail test

Use K-S test @ 5% LOS to test whether there is diff in scores of two departments 2 sample

Scores	Dep A	Dep B
30-35	5	6
35-40	4	16
40-45	6	2
45-50	7	8
50-55	2	10
55-60	2	15
60-65	4	13

H_0 - Let there be no sig. diff b/w the scores of 2 deptmts.
H_1 - " obe a "

Scores	Dep A	Cum freq	Rfo Rel cf	Dep B	Cum freq	Rfc Rel cf	Rfo - Rfc
						6÷70 = 0.086	0.081
30-35	5	5	5÷30 = 0.167	6	6	0.31	-0.01
35-40	4	9	0.3	16	22	0.34	0.16
40-45	6	15	0.5	2	24	0.46	0.27 - D
45-50	7	22	0.73	8	32	0.6	
50-55	2	24	0.8	10	42	0.8	0.2
55-60	2	26	0.87	15	57	1.0	0.07
60-65	4	30	1.0	13	70		0
	$n_1 = 30$			$n_2 = 70$			

One tail test

$M_0 - M_A > M_B$

M_1 -

$M_0 - M_A = M_B$
$H_1 - M_A \neq M_B$.

KS Two sample Test - Two Tailed test

$$\chi^2_{cal} = \frac{1.36\sqrt{n_1+n_2}}{n_1 n_2} = \frac{1.36\sqrt{30+70}}{30 \times 70} = 0.07$$

$D_{cal} = 0.27 > D_{tab} = 0.07$ Acept H_1

15

(*) Test @5% LOS whether the scores of dep A is higher than the scores of dep B
case - k-s one-tail

Marks	SecA	SecB
30 - 40	3	4
40 - 50	12	13
50 - 60	12	13
60 - 70	4	3
70 - 80	2	1
80 - 90	5	5
90 - 100	2	1

H_0 - Let there be no signficant diff b/w the ~~scores~~ obtained by 2 Dep.

H_1 => let scores of Dep A > Dep B.

Test whether the 2 samples have come from the same population or not by applying Mann whitn

SAMPLE1	SAMPLE2
57	61
39	52
60	41
78	40
74	32
53	72
73	53
38	44
69	72
46	67
39	44
48	70
12	12

S_1	S_2	RANK	C.R	S1 CR x DIGIT	S2 CR x DIGIT
—	32	1	1	—	1x1= 1
38	—	2	2	2x1=2	—
39, 39	—	3, 4	3,5	3.5x2=7	—
—	40	5	5	—	5x1=5
—	41	6	6	—	6x1= 6
	44,44	7, 8	7.5	—	7.5x2=15
46	—	9	9	9 x 1=9	—
48	—	10	10	10x1= 10	—
	52	11	11	—	11x1=11
53	53	12, 13	12.5	12.5x1=12.5	12.5x1= 12.5
57	—	14	14	14x1=14	—
60	—	15	15	15x1=15	—
—	61	16	16		16 x 1= 16
—	67	17	17	—	
—	—	18	18	18x1= 18	—
69	70	19	19	—	19x1=19
—	72, 72	20, 21	20.5	—	20.5 x2=41
—		22	22	22x1=22	—
73	—	23	23	23x1= 23	—
74	—	24	24	24x1= 24	—
78	—			R_1= 156.5	R_2=143.5

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$= 12\times12 + \frac{12(12+1)}{2} - 156.5$$

$$= 222 - 156.5 = 65.5$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

$$= 12\times12 + \frac{12(12+1)}{2} - 143.5 = 222 - 143.5 = 78.5$$

$$U = \min(U_1, U_2) = \underline{65.5}$$
$(65.5, 78.5)$

$$Z = \frac{U - n_1 n_2/2}{\sqrt{n_1 n_2(n_1+n_2+1)/12}}$$

$$= \frac{65.5 - 12\times12/2}{\sqrt{12\times12(12+12+1)/12}} = \frac{6.5}{300} = -0.02.$$

i.e $(-0.02) < 1.96$ (5% LOS)

Conclsn Accpt H_0

H_0: ~~There is no signifcnt diff b/w the Alc's Rcvble~~

H_1: ~~There is signfcnt diff~~

~~$n = 15$~~

~~$n = 15 - 1$ bcoz 1 value in 0 i.e $36-36=0$)~~

~~$n = 14$~~

~~$K = \frac{n-1}{2} - 0.98\sqrt{n}$~~

~~$= \frac{14-1}{2} - 0.98\sqrt{14}$~~

~~$= 6.5 - 3.67$~~

~~$= 2.83$~~

~~$\therefore H_0 = $ Accpt i.e $K < 8(s)$~~

~~Concn : There is a diff b/w the Alc's Rcvbl~~

Krus.

Mathendu

M → ~~72~~, ~~80~~, ~~83~~, ~~75~~

S → ~~81~~, ~~74~~, ~~77~~

Eng → 88, ~~82~~, 90, ~~87~~, ~~80~~

Econ → 90, ~~71~~, ~~77~~, ~~70~~.

as.

1	2	3	4	5	6.5	6.5
70	71	72	74	75	77	77
Ec	Ec	M	S	M	S	Eco

8.5	8.5	10	11	12	13	14
80	80	81	82	83	87	88
M	Eng	S	Eng	M	Eng	

15.5	15.5
90	90
Eng	Econ

$R_1 \rightarrow 3 + 8.5 + 12 + 5 = 28.5$

$R_2 \rightarrow 10 + 4 + 6.5 = 20.5$

$R_3 \rightarrow 14 + 11 + 15.5 + 13 + 8.5 = 61$

$R_4 \rightarrow 15.5 + 2 + 6.5 + 1 = 25$

$n_1 = 4$

$n_2 = 3$

$n_3 = 5$

$n_4 = 4$

$N = 16$

$$H = \left[\frac{12}{16 \times 17}\left[\frac{(28.5)^2}{4} + \frac{(20.5)^2}{3} + \frac{(61)^2}{5} + \frac{(25)^2}{4}\right] - 3(17)\right]$$

$$= \frac{12}{} $$

$$= 0.442 \left[\frac{812.25}{4} + \frac{420.25}{3} + \frac{3721}{5} + \frac{625}{4} - 51\right]$$

$$= 27.15 \left[(203.063 + 140.084 + 744.2 + 156.25 - 51\right]$$

$$= 27.15 \left[1243.597 - 51\right]$$

$$= 32379$$

$$D.O.F = 4 - 1 = 3$$