8. Kolmogorov - Smirnov test

Run Test for Two Sample.

1. Set of the Customers entering a restaurant is noted as follows:
MMFM FFFMMMM FFF MM FFF MMMMM FF MMM FFFM FFFFFM M FFFFF. where M denotes male and F denotes female. Assuming 5% L.O.S and test the randomness of the sequence.

H_0: The sequence is random

MM|F|M | FFF|MMMMM | FFF | MM |FFF| MMMMM| FF| MMM| FFF|M |FFFFF|M M| FFFFF.

r = no. of runs = 16

m = no. of Sample 1 = 20

n = no. of Sample 2 = 25

$$E(r) = \frac{2mn}{m+n} + 1$$

$$= \frac{2(20)(25)}{20+25} + 1 = \frac{1000}{45} + 1 = \frac{1045}{45}$$

$$= 23.2222$$

$$V(r) = \frac{2mn(2mn-m-n)}{(m+n)^2(m+n-1)}$$

$$= \frac{2(20)(25)(2(20)(25)-20-25)}{(20+25)^2(20+25-1)}$$

$$= \frac{(1000)(1000-20-25)}{2025(44)}$$

$$= \frac{(1000)(955)}{89100} = \frac{955000}{89100}$$

$$= 10.7183$$

$$|Z| = \left| \frac{r - E(r)}{\sqrt{V(r)}} \right|$$

$$= \left| \frac{16 - 23.2222}{\sqrt{(10.7183)}} \right|$$

$$Z = \left| \frac{-7.2222}{3.2739} \right|$$

$$|Z| = 2.2060.$$

The table Value at 5% level of significance is 1.96. The Calculated

∴ The Calculated Value is greater than table Value.

$\therefore H_0$ is rejected.

i.e. The sequence is not random.

2. Using the run test, testing the randomness of the sample B|G|BB|GG|B|G|B|G|GG|BB|GGG|BB|G|B|G|B|GGG|B|GG|B|G|BBB|GGG|BB|GG|BBB|GG

H_0: The ~~Sample~~ Sequence is random

B|G BB GG B G|B G|B GG BB GGG BB G|B G|B GGG B GG|B G BBB GGG BB GG BBB GG.

r = No. of runs = 28

m_1 = no. of Sample 1 = 22

n = no. of Sample 2 = 25

$$E(r) = \frac{2mn}{m+n} + 1$$

$$= \frac{2(22)(25)}{22+25} + 1$$

$$= \frac{1100}{47} + 1 = \frac{1147}{47}$$

$$= 24.4043.$$

$$V(r) = \frac{2mn(2mn-m-n)}{(m+n)^2-(m+n-1)}$$

$$= \frac{2(22 \times 24)\{2(22)(24) - 22 - 24\}}{(22+24)^2 (22+24-1)}$$

$$= \frac{(1100)(1100 - 22 - 24)}{(2209)(46)}$$

$$= \frac{(1100)(1053)}{101614}$$

$$= \frac{1158300}{101614}$$

$$= 11.3990.$$

$$|Z| = \left| \frac{r - E(r)}{\sqrt{V(r)}} \right|$$

$$= \left| \frac{28 - 24.4043}{\sqrt{11.3990}} \right|$$

$$= \left| \frac{3.5957}{\sqrt{3.3762}} \right| = 1.0650.$$

The tab Value at 5% level of Significance is 1.96.

∴ The Calculated Value is less than table Value

∴ H_0 is accepted.

∴ The Sample is not a random sequence.

3. The following is an arrangement of 20 healthy [H] and 10 diseased [D] mango trees along a Certain road. Test this Sample for randomness at 1%. l.o.s.

HH DD HHHHH DDD HHHH DDDDD HHH HHH HHH.

4. A researcher Conducts a Survey to find Out whether the inhabitants of a metro town are in favour of Capital punishment [F] or against it [A]. The Sequence of responses to the question asked is given below. Use the run test at $\alpha = 0.05$ to test whether the response are random.

FF AFFF AAAAA FF AAA FFAAAAAA FF AAAAAA FFF AAA FA FFFF AAAA FFF AAA FF

5. Using the run test to test the randomness of the Sample

X: 15 18 16 26 21 22 19 10 9 8 11 14 28 30 31 32 36 29 25 24 40 41 48 49 44

Y: 22 24 25 28 36 33 31 32 12 14 15 17 18 16 5 4 3 2.

H_0: The randomness of the Sample is good.

Combine the samples X and Y and arrange value in ascending order

2	3	4	5	8	9	10	11	11	12	14	14	15	15
Y	Y	Y	Y	X	X	X	X	Y	Y	X	Y	X	Y

16	16	17	18	18	19	21	22	22	24	24
X	Y	Y	X	Y	X	X	X	Y	X	Y

25	25	26	26	28	28	29	30	31	31
X	Y	X	Y	X	Y	X	X	X	Y

32	32	33	36	36	40	41	44	48	49
X	Y	Y	X	Y	X	X	X	X	X

YYYY | XXXX | YY | X | Y | X | Y | X | Y | Y | X | Y | X | X | X | Y | X | Y | X | Y | X | Y | X | X | X | Y | X | Y | Y | X | Y | X | X | X | X |

$n_1 = 28$

$m = 25$

$n = 20$

$$E(r) = \frac{2mn}{m+n} + 1$$

$$= \frac{2(25)(20)}{25+20} + 1$$

$$= \frac{1000}{45} + 1$$

$$= 23.2222$$

$$V(r) = \frac{2mn(2mn - m - n)}{(m+n)^2 (m+n-1)}$$

$$= \frac{2(25)(20)(2(25)(20) - 25 - 20)}{(25+20)^2 (25+20-1)}$$

$$= \frac{(1000)(1000 - 25 - 20)}{(2025)(44)}$$

$$= \frac{(1000)(955)}{89100} = \frac{955000}{89100}$$

$$= 10.7183$$

$$|Z| = \left| \frac{r - E(r)}{\sqrt{V(r)}} \right|$$

$$= \left| \frac{28 - 23.2222}{\sqrt{10.7183}} \right| = \left| \frac{4.7778}{3.2739} \right|$$

$$= 1.4594$$

The table value at 5% level of Significance is 1.96.

∴ The Calculated Value is less than table Value.

∴ H_0 is accepted.

8. Solution:-

H_0: The randomness of the sample is

HH/ DD/ HHHHH/ DDD/ HHHH/ DDDDD/ HHH HHH HHH/

r = no. of runs = 7

m = no. of sample1 = 20

n = no. of sample2 = 10

$$E(r) = \frac{2mn}{m+n} + 1$$

$$= \frac{2(20)(10)}{20+10} + 1$$

$$= \frac{400}{30} + 1$$

$$= \frac{430}{30} = 14.3333$$

$$V(r) = \frac{2mn(2mn-m-n)}{(m+n)^2(m+n-1)}$$

$$= \frac{2(20)(10)(2(20)(10)-20-10)}{(20+10)^2(20+10-1)}$$

$$= \frac{(400)(400-20-10)}{(900)(29)}$$

$$= \frac{(400)(370)}{26100}$$

$$= \frac{148000}{26100}$$

$$= 5.6705$$

$$|Z| = \left| \frac{\bar{x} - E(\bar{x})}{\sqrt{V(\bar{x})}} \right|$$

$$= \left| \frac{7 - 14.3333}{\sqrt{5.6705}} \right|$$

$$= \left| \frac{-7.3333}{2.3813} \right|$$

$$= 3.0795$$

The Value at 1% level of Significance is 2.58

∴ The Calculated Value is greater than table Value.

∴ H_0 is rejected.

4. **Solution:**

H_0:

FF/A/FFF/AAAAA/FF/AAA/FF/AAAAAA/FF AAAAAA/FFF/AAA/F/A/FFFF/AAAA/FFF/AAA FF

Q3

r = no. of runs = 19

m = no. of Sample 1 = 24

n = no. of Sample 2 = 32

$$E(r) = \frac{2mn}{m+n} + 1$$

$$= \frac{2(24)(32)}{24+32} + 1$$

$$= \frac{1536}{56} + 1$$

$$= 28.4286$$

$$V(r) = \frac{2mn(2mn-m-n)}{(m+n)^2(m+n-1)}$$

$$= \frac{2(24)(32)[2(24)(32)-24-32)}{(24+32)^2(24+32-1)}$$

$$= \frac{(1536)(1536-24-32)}{(3136)(55)}$$

$$= \frac{(1536)(1480)}{172480}$$

$$= \frac{2273280}{172480}$$

$$= 13.1800$$

$$Z = \left| \frac{r - E(r)}{\sqrt{V(r)}} \right|$$

$$= \left| \frac{19 - 18.1286}{\sqrt{13.1800}} \right|$$

$$= \left| \frac{-9.4286}{3.6304} \right| = 2.5971$$

The Value at 0.05 level of Significance is 1.96

∴ The Calculated Value is greater table Value.

∴ H_0 is rejected

1. The following is an arrangement of men M and Women W lined up to purchase tickets for on rock Concert

M/W/MW/MM/M/W/M/W/MMM/WW/MMMM/WW/M W/MMM/W/MMM/ WWW/M/W/M MM/W/M/ W/M MMM/W W/M

Test for randomness of arrangement at the 0.05 level of Significance.

r = no. of runs = 27

m = no. of Sample 1 = 30

n = no. of Sample 2 = 18

$$F(r) = \frac{2mn}{m+n} + 1$$

$$\frac{2(30)(18)}{30+18} + 1$$

$$\frac{1080}{48} + 1$$

$$= \frac{1128}{48}$$

$$= 23.5$$

$$V(r) = \frac{2mn(2m-m-n)}{(m+n)^2(m+n-1)}$$

$$= \frac{2(30)(18)(2(30)(18)-30-18)}{(30+18)^2(30+18-1)}$$

$$= \frac{(1080)(1080-30-18)}{(2304)(47)}$$

$$= \frac{(1080)(1032)}{108288}$$

$$= \frac{1114560}{108288}$$

$$= 10.2926$$

$$|z| = \left| \frac{\bar{x} - E(\bar{x})}{\sqrt{V(\bar{x})}} \right|$$

$$= \left| \frac{27 - (23.5)}{\sqrt{10.2926}} \right|$$

$$= \left| \frac{3.5}{3.2082} \right|$$

$$= 1.0910.$$

The Value at 5% level of Significance is 1.96.

∴ The Calculated Value is less than table Value.

∴ H_0 is accepted.

Run test

At the beginning of the year the first class was randomly divided by 2 groups, one group was reading Uniform method. where also students progressed from on stage to next at the same time. Following the teacher direction to the second group was used to individual method for reading. Each student progressed at his more risk according to progressed work. Look Under Supermission of the teacher.