<u>Practical No. 5</u> : Run test

A quality-control person randomly selects 50 of the parts produced by the machine today and examines them one at a time in the order that they were made. The result is 40 parts with no flaws and 10 parts with flaws. The sequence of no flaws (denoted by *N*) and flaws (denoted by *F)* is shown below. Use an alpha of .05.

Enter this data in MS Excel and generate the following report:

NNN F NNNNNNN F NN FF NNNNNN F NNNN F NNNNNNFFFF NNNNNNNNNNN

Question :

Determine whether the machine is producing randomly (the flaws are occurring randomly).

Solution :

Step 1 : Type your data into the cells of a worksheet. Make sure you put your data into columns. Use column header for “Quality of parts” and “No. of runs”. Type the “Quality of parts” data into column A, count the runs manually and write them down in the “No. of runs” column B.

Step 2 : To perform run t test, we must first find out the frequency of data. For the calculation of the frequency of flawed and non-flawed parts, we have used the predefined formula in excel. The raw data column is selected, and the corresponding formula is used,

For non-flaws,
= COUNTIF($A$2:$A$51,D9)
= 40

For flaws,
= COUNTIF($A$2:$A$51,D10)
= 10

Step 3 : For the calculation of the sample size, we have used the basic formula in excel.

= SUM(F12:F13) i.e., no. of non-flaws + flaws
= 50

Step 4 : From column B, the no. of runs (r) is 13. For the calculation of the mean no. of runs, we have used the basic formula in excel.

= ((2*F12*F13)/F14)+1
= 17

Here, i.e., $\frac{2n_1n_2}{n} + 1$

F12 : No. of non-flaws (n_1)
F13 : No. of flaws (n_2)
F14 : Sample size (n)

Step 5 : For the calculation of the standard deviation of runs, we have used the basic formula in excel.

= SQRT(((2*F12*F13)*(2*F12*F13-F14))/((F14^2)*(F14-1))) i.e., $\sqrt{\frac{(2n_1n_2)(2n_1n_2-n)}{n^2(n-1)}}$

= 2.2131

Here,

F12 : No. of non-flaws

F13 : No. of flaws

F14 : Sample size

Hypothesis :

Null hypothesis	H_0 : the sequence of flaw part and non-flaw parts is in random order
Alternative hypothesis	H_1 : the sequence of flaw part and non-flaw parts is not in random order

Test :

Here, we have used large sample case. For the calculation of the Z value, we have used the basic formula in excel.

= (F16-F18)/F20 i.e., $\frac{r-u_r}{\sigma_r}$

= -1.80739

Here,

F16 : No. of runs (r)

F18 : Mean no. of runs (u_r)

F20 : S.D. of runs (σ_r)

For the calculation of the critical Z value, we have used the basic formula in excel.

= NORM.S.INV(0.975)

= 1.959964

Conclusion :

Since Cal Z lies in the acceptance region i.e., 1.96 < Z < 1.96 or |Cal Z| = 1.81 < Crit Z = 1.96, we accept our null hypothesis at 5% level of significance i.e., the machine is producing parts randomly i.e. flaws and non-flaws are produced in random order.

Worksheet :

	A	B	C	D	E	F	G	H
1	Quality of parts	No. of runs						
2	N	1		H0: the sequence of flaw part and non-flaw parts is in random order				
3	N			H1: the sequence of flaw part and non-flaw parts is not in random order				
4	N							
5	F	2						
6	N	3						
7	N							
8	N			Category	Frequency			
9	N			N	40			
10	N			F	10			
11	N							
12	N			n1	no. of non-flaws	40		
13	F	4		n2	no. of flaws	10		
14	N	5		n	sample size	50		
15	N							
16	F	6		r	no. of runs	13		
17	F							
18	N	7		μr	mean no. of runs	17		
19	N							
20	N			σr	S.D. of runs	2.213133		
21	N							
22	N			Zr		-1.80739		
23	N							
24	F	8		|Zr|		1.807392		
25	N	9						
26	N			Critical Z		1.959964		
27	N							
28	N			Statistical Decision:				
29	F	10		Since |Cal Z| = 1.81 < Crit Z = 1.96,we do not reject H0.				
30	N	11						
31	N							
32	N							
33	N			Conclusion:				
34	N			Hence the machine is producing parts randomly i.e. flaws and non-flaws are produced in random order.				
35	N							
36	F	12						
37	F							
38	F							
39	F							
40	N	13						
41	N							
42	N							
43	N							
44	N							
45	N							
46	N							
47	N							
48	N							
49	N							
50	N							
51	N							
52								