Manufactures	:	1	2	3	4	5	6	7	8	9
Panel rating	:	6	9	2	8	5	1	7	4	3
Suggested price	:	480	395	575	550	510	545	400	465	420

Is there a significant relationship between the quality and the price of a microwave oven? Use $\alpha = 0.05$.

Solution

Let us take panel rating rank $= R_1$, and suggested price rank $= R_2$.

X	R_1	Y	R_2	$d = R_1 - R_2$	d^2
6	6	480	5	1	1
9	9	395	1	8	64
2	2	575	9	-7	49
8	8	550	8	0	0
5	5	510	6	-1	1
1	1	545	7	-6	36
7	7	400	2	5	25
4	4	465	4	0	0
3	3	420	5	0	0

$$\sum d^2 = 176$$

Here $n = 9, \sum d^2 = 176$

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

$$= 1 - \frac{6 \times 176}{9(9^2 - 1)}$$

$$= 1 - \frac{1056}{720}$$

$$= -0.4667$$

$$\therefore \quad |r_s| = 0.4667$$

$$H_0 \quad : \quad \rho_s = 0$$
$$\text{Now,} \quad H_1 \quad : \quad \rho_s \neq 0$$
$$\alpha \quad = \quad 0.05$$

The expected value at $\alpha = 0.05$ with $n = 9$ d.f is 0.6833

Conclusion

Since $|r_s| < 0.6833$, we accept H_0 and we may conclude that there is no significant relationship between the quality and the price of a microwave oven.

Solved Problem 4.42   *Anna Univ MBA: Apr/May 2005*

The following are ratings of aggressiveness (X) and amount of sales (Y) in the last year for eight salespeople. Is there a significant rank correlation between the two measures? Use the 0.10 significance level.

$$X : \quad 30 \quad 17 \quad 35 \quad 28 \quad 42 \quad 25 \quad 19 \quad 29$$
$$Y : \quad 35 \quad 31 \quad 43 \quad 46 \quad 50 \quad 32 \quad 33 \quad 42$$

Solution

X	R_1	Y	R_2	$d = R_1 - R_2$	d^2
30	6	35	4	2	4
17	1	31	1	0	0
35	7	43	6	1	1
28	4	46	7	-3	9
42	8	50	8	0	0
25	3	32	2	1	1
19	2	33	3	-1	1
29	5	42	5	0	0

$$\sum d^2 = 16$$

Here $n = 8, \sum d^2 = 16$

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$
$$= 1 - \frac{6 \times 16}{8(8^2 - 1)}$$
$$= 1 - 0.1905$$
$$\therefore \quad r_s = 0.8095$$

Now,
$H_0 : \quad \rho_s = 0$
$H_1 : \quad \rho_s \neq 0$ (two tailed test)
$\alpha \quad = \quad 0.10$

The table value of r at $\alpha = 0.10$ with $n = 8$ is 0.619.

Conclusion

Since $|r_s| > 0.619$, we reject our null hypothesis and conclude that there is no significant rank correlation between the two measures.

Solved Problem 4.43

Most people belive that managerial produces better interpersonal relationships between a manager and her employees. The quill corporation has the following data matching years of experience on the part of the manager with the number of grievances filed last year by the employees reporting to that manager. At the 0.05 level of significance, does the rank correlation between these two suggest that experience improves relationships?

Age of manager	:	32	43	42	29	56	62	45	39	40	35
No of grievances	:	5	2	4	4	3	2	4	5	4	6

Solution

Let X = Age of manager

Y = Number of grievances

X	R_1	Y	R_2	$d = R_1 - R_2$	d^2
32	2	5	8.5	−6.5	42.25
43	7	2	1.5	5.5	30.25
42	6	4	5.5	0.5	0.25
29	1	4	5.5	−4.5	20.25
56	9	3	3	6	36
62	10	2	1.5	8.5	72.25
45	8	4	5.5	2.5	6.25
39	4	5	8.5	−4.5	20.25
40	5	4	5.5	−0.5	0.25
35	3	6	10	−7	49

$$\sum d^2 = 277$$

Here $n = 10, \sum d^2 = 277$

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

$$= 1 - \frac{6 \times 277}{10(10^2 - 1)}$$

$$= 1 - \frac{1662}{990}$$

$$r_s = -0.6788$$

$$\therefore \quad |r_s| = 0.6788$$

Now,

$$H_0 \quad : \quad \rho_s = 0$$
$$H_1 \quad : \quad \rho_s \neq 0$$
$$\alpha \quad = \quad 0.05$$

The table value of r at $\alpha = 0.05$ with $n = 10$ is 0.6364.

Conclusion

Since $|r_s| > 0.6364$, we reject our null hypothesis H_0 and conclude that the rank correlation between these two not improving the relationships.

Exercise

Part - A

1. How do the non-parametric methods differ from parametric methods?

2. Name any three Non-parametric tests.

3. What is sign test?

4. Define rank sum test?

5. Define the statistic used in the U-test and give its mean.

6. Write a short note on "Kruskal-Wallis" test.

7. When is Mann-Whiteney 'U' test used?

8. Define 'H' test.

9. Name three non-parametric tests that are used for examining hypothesis about location in the case of two independent samples.

10. The following data represent the number of hours that a rechargeable hedge trimmer operates before a recharge is required.

$$1.5, 2.2, 0.9, 1.3, 2.0, 1.6, 1.8, 1.5, 2.0, 1.2 \text{ and } 1.7$$

Use the sign test to test the hypothesis of the 0.05 level of significance that this particular trimmer operates with a median of 1.8 hours before requiring a recharge.

11. Write a note on non-parametric tests.