ICCPP-STATISTICS

- Mann-Whitney U Test

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Henry Berthold Mann (1905-2000)

Mann-Whitney U Test

Donald Ransom Whitney (1915-2007)

Mann-Whitney U Test

Definition

- The Mann-Whitney U test is a non-parametric test that can be used to analyze data from a two-group independent groups design when measurement is at least ordinal.
- It is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed.

Null Hypothesis for the Test

- The test compares two populations. The null hypothesis for the test is that the probability is 50% that a randomly drawn member of the first population will exceed a member of the second population.
- Another option for the null hypothesis is that the two samples come from the same population (i.e. that they both have the same median).

Mann-Whitney U Test Formula

- $U = N1\ N2 + [N1(N1+ 1) / 2] - \Sigma\ R1$

  and

- $U' = N1\ N2 + [\ N2(N2+ 1) / 2\ ] - \Sigma\ R2$

Assumptions

1.

The dependent variable should be measured on an ordinal scale or a continuous scale.

Assumptions

2.

The independent variable should be two independent, categorical groups.

Assumptions

3.

Observations should be independent. In other words, there should be no relationship between the two groups or within each group.

Assumptions

4.

Observations are not normally distributed. However, they should follow the same shape (i.e. both are bell-shaped and skewed left).

Example

Assessment Center Rating By Two Teams: Officers Randomly Assigned to Teams

Team A		Team B	
Score	Rank (R_1)	Score	Rank (R_2)
72	13	97	25
67	10	76	16
87	21	83	19
46	2	69	12
58	6	56	5
63	8	68	11
84	20	92	24
53	3	88	22
62	7	74	15
77	17	73	14
82	18	65	9
89	23	54	4
		43	1
	$\sum R1 = 148$		$\sum R2 = 177$

Solution Step Wise

Step 1

Rank the ratings from lowest to highest regardless of assessment team.

Step 2

Sum the ranks in either group

$$\Sigma\ (R1) = 148$$

$$\Sigma\ (R2) = 177$$

Solution Step Wise

Step 3

Calculate U

$$U = N1\ N2 + [N1(N1 + 1) / 2] - \Sigma\ R1$$

$$U = (12)\ (13) + [12\ (12 + 1) / 2] - 148$$

$$U = 156 + 78 - 148 = 86$$

Solution Step Wise

And Calculate U'

$$U' = N1\ N2 + [N2(N2+ 1) / 2] - \Sigma\ R2$$

$$U' = (12)\ (13) + [13(13 + 1) / 2] - 177$$

$$U' = 156 + 91 - 175 = 70$$

Solution Step Wise

Step 4
Determine the significance of U

Decide whether you are making a one- or a two-tailed decision

Compare the smaller value of U to the appropriate critical table value for N1 and N2

If the observed U is smaller than the table value, the result is significant.

Solution Step Wise

Step 5

The critical value of U for N1 = 12 and N2 = 13,

two-tailed α = 0.05, is 41.

Solution Step Wise

Since the smaller obtained value of U ($U' = 70$) is larger than the table value, the null hypothesis is accepted.

And we conclude that there is no significant difference in the ratings given by the two assessment teams.

References

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