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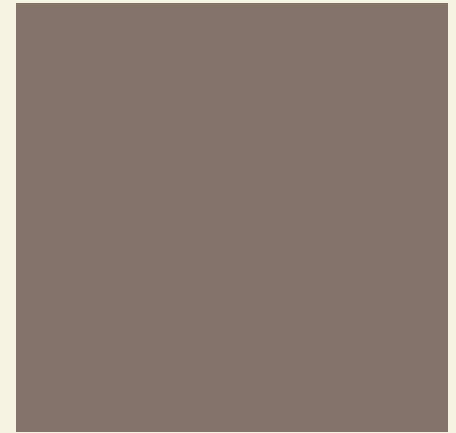
ICCPP-STATISTICS

- Mann-Whitney U Test

Vishal Lohchab

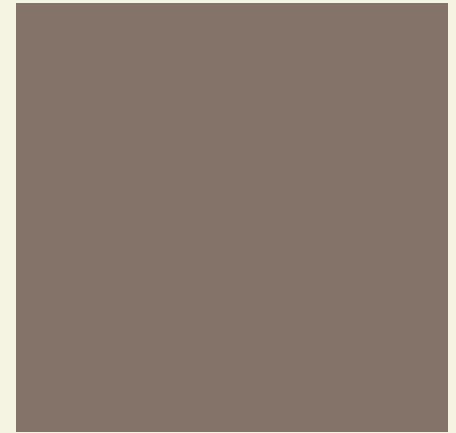
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Prof. Dr. Hans-Werner Gessmann
Director ICCPP International*





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).

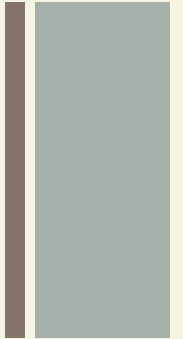
+ Mann-Whitney U Test Formula

- $U = N_1 N_2 + [N_1(N_1 + 1) / 2] - \sum R_1$

and

- $U' = N_1 N_2 + [N_2(N_2 + 1) / 2] - \sum R_2$

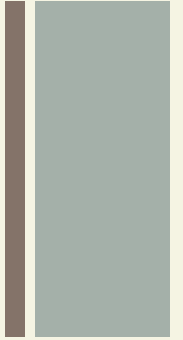
+ Assumptions



1.

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

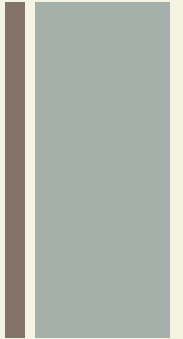
+ Assumptions



2.

The independent variable should be two independent, categorical groups.

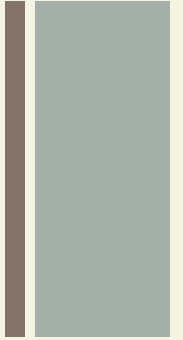
+ Assumptions



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).

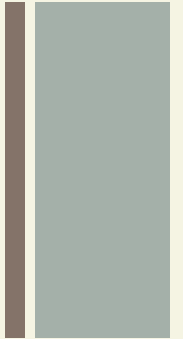
+ Example

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
	$\Sigma R_1 = 148$		$\Sigma R_2 = 177$



Solution Step Wise



Step 1

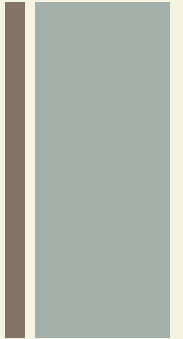
Rank the ratings from lowest to highest regardless of assessment team.

Step 2

Sum the ranks in either group

$$\Sigma (R1) = 148$$

$$\Sigma (R2) = 177$$



Solution Step Wise

Step 3

Calculate U

$$U = N_1 N_2 + [N_1(N_1 + 1) / 2] - \sum R_1$$

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

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



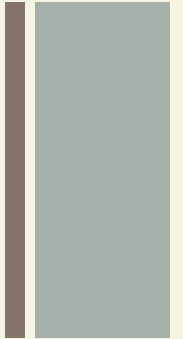
Solution Step Wise

And Calculate U'

$$U' = N_1 N_2 + [N_2(N_2 + 1) / 2] - \sum R_2$$

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

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



Solution Step Wise

Step 4

Determine the significance of U

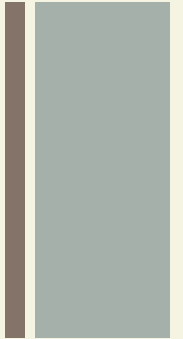
Decide whether you are making a one- or a two-tailed decision

Compare the smaller value of U to the appropriate critical table value for N_1 and N_2

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 $N_1 = 12$ and $N_2 = 13$, two-tailed $\alpha = 0.05$, is 41.



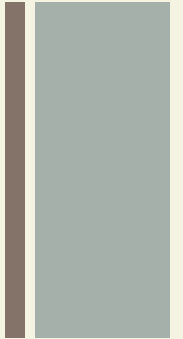
Solution Step Wise

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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Calderwood J, Bal G, Reid D G (2021). Trial and error: Tactical changes in fishing behaviour can help reduce discards and exposure to chokes, but scientific trials can fail to spot this, Marine Policy, 10.1016/j.marpol.2020.104365, 124, (104365).

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