## Median Test

Tests whether two or more independent samples are drawn from populations with the same median using the chi-square statistic. It can be used when the assumptions of similarity of distributions for the Mann-Whitney U and Kruskal-Wallis tests are not met.

H0: There is no difference in medians amongst the groups being studied.

HA: There is at least one difference in medians amongst the groups being studied.

The assumptions of the Median test are:

1. The dependent variable is at least at the ordinal level of measurement. The data are from 2 or more groups.
2. The groups are independent and a subject can only be in one of the groups.
3. The assumptions of the chi-square test apply to the second half of the test.

### If these assumptions are met then the test can be carried out in the following way:

1. Construct the null and alternative hypotheses and decide on , the level of significance for the test.
2. Treat the data as a single sample and calculate the overall median.
3. Separate the data into the various groups and classify the observations in each group as either above, below or equal to the overall median. Calculate the number above and below or equal to the median, in each group.
4. Arrange these values into a 2xc contingency table, where the two rows are: > or ≤ to the overall median. The c columns are the groups.
5. Calculate the chi-square statistic for the table, if the assumptions hold.
6. Compare the value of the chi-square statistic with the value in the tables on (c-1) degrees of freedom (where c is the number of groups) at the pre-specified level of .
7. Reject the null hypothesis of equal medians if *X*2 exceeds the critical value of the χ2 distributions.
8. If the null hypothesis is rejected, it is then possible to do post-hoc testing on the individual groups to see which ones are significantly different. This again will be using the median test, but applied to pairs of groups.

**Example**

There are three groups with different types of dementia (data from Sanjana Nyatsanza, Fulbourn hospital). Below are the patients’ scores on a mini mental state examination (MMSE). The median test will be used to see if there is a significant difference between the groups.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group | MMSE Score | | | | | | | | | | |
| 1 | 19 | 7 | 17 | 28 | 21 | 6 | 21 | 19 | 27 | 8 | 25 |
| 2 | 16 | 22 | 30 | 24 | 22 | 23 | 22 | 28 | 29 | 29 | 0 |
| 3 | 4 | 9 | 30 | 29 | 25 | 22 | 25 | 26 | 27 | 18 | 10 |

1. There is no difference in medians between the groups.

HA: There is a difference in medians between the groups.

 = 0.05.

1. The overall median (i.e. the one in the middle when ranked in order) is 22.
2. Classify the values in each group as above or below 22.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group | MMSE Score | | | | | | | | | | |
| 1 | 19 | 7 | 17 | 28 | 21 | 6 | 21 | 19 | 27 | 8 | 25 |
|  | − | − | − | + | − | − | − | − | + | − | + |
| 2 | 16 | 22 | 30 | 24 | 22 | 23 | 22 | 28 | 29 | 29 | 0 |
|  | − | = | + | + | = | + | = | + | + | + | − |
| 3 | 4 | 9 | 30 | 29 | 25 | 22 | 25 | 26 | 27 | 18 | 10 |
|  | − | − | + | + | + | = | + | + | + | − | − |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group | 1 | 2 | 3 | Total |
| ≤ 22 | 8 | 5 | 5 | 18 |
| >22 | 3 | 6 | 6 | 15 |
| Total | 11 | 11 | 11 | 33 |

1. Find the expected values for each of the cells:

|  |  |  |
| --- | --- | --- |
| 6 | 6 | 6 |
| 5 | 5 | 5 |

Calculate the chi-square statistic:



1. The chi-square statistic for =0.05 on 2df is 5.99.
2. *X*2 =2.20<5.99, there is insufficient evidence to reject the null hypothesis that the medians are the same for all three groups, p=0.33.
3. As this result is not significant, post-hoc testing could not be carried out as there are no significant differences between the groups.

The Median test has is very straightforward and easy to apply and is particularly useful when the exact values of the scores (especially those at the extremes) are unknown. The test only considers two states for the scores, above and below (or equal to) the median and does not take the size of the differences into account. Therefore, the Median test is less powerful than the Mann-Whitney U and Kruskal-Wallis tests.