**Kruskal Wallis H Test**

The Kruskal Wallis test is the non parametric alternative to the One Way [ANOVA](https://www.statisticshowto.com/probability-and-statistics/hypothesis-testing/anova/). Non parametric means that the test doesn’t assume your data comes from a particular distribution. The H test is used when the assumptions for ANOVA aren’t met (like the [assumption of normality](https://www.statisticshowto.com/assumption-of-normality-test/)). It is sometimes called the one-way ANOVA on ranks, as the ranks of the data values are used in the test rather than the actual data points.

The test determines whether the [medians](https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/mean-median-mode/#median) of two or more groups are different. Like most statistical tests, you calculate a test statistic and compare it to a distribution cut-off point. The test statistic used in this test is called the **H statistic.**

**The hypotheses for the test are:**

* H0: population medians are equal.
* H1: population medians are not equal.

The Kruskal Wallis test will tell you if there is a [significant difference](https://www.statisticshowto.com/what-is-statistical-significance/) between groups. However, it won’t tell you which groups are different. For that, you’ll need to run a [Post Hoc](https://www.statisticshowto.com/post-hoc/) test.

## **Examples**

1. You want to find out how test anxiety affects actual test scores. The independent variable “test anxiety” has three levels: no anxiety, low-medium anxiety and high anxiety. The dependent variable is the exam score, rated from 0 to 100%.
2. You want to find out how socioeconomic status affects attitude towards sales tax increases. Your independent variable is “socioeconomic status” with three levels: working class, middle class and wealthy. The dependent variable is measured on a 5-point [Likert scale](https://www.statisticshowto.com/likert-scale-definition-and-examples/) from strongly agree to strongly disagree.

**Assumptions for the Kruskal Wallis Test**

Your variables should have:

* One [independent variable](https://www.statisticshowto.com/independent-variable-definition/) with two or more levels (independent groups). The test is more commonly used when you have three or more levels. For two levels, consider using the [Mann Whitney U Test](https://www.statisticshowto.com/mann-whitney-u-test/) instead.
* [Ordinal scale](https://www.statisticshowto.com/nominal-ordinal-interval-ratio/), [Ratio Scale](https://www.statisticshowto.com/ratio-scale) or [Interval scale](https://www.statisticshowto.com/nominal-ordinal-interval-ratio/#interval) [dependent variables](https://www.statisticshowto.com/dependent-variable-definition/).
* Your observations should be independent. In other words, there should be no relationship between the members in each group or between groups.
* All groups should have the same shape distributions.

**Running the H Test**

**Sample question:**A shoe company wants to know if three groups of workers have different salaries:
Women: 23K, 41K, 54K, 66K, 78K.
Men: 45K, 55K, 60K, 70K, 72K
Minorities: 18K, 30K, 34K, 40K, 44K.

**Joint ranking of three samples from smallest to largest**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Women** | **Ranks** | **Men** | **Ranks** | **Minorities** | **Ranks** |
| 23 | 2 | 45 | 8 | 18 | 1 |
| 41 | 6 | 55 | 10 | 30 | 3 |
| 54 | 9 | 60 | 11 | 34 | 4 |
| 66 | 12 | 70 | 13 | 40 | 5 |
| 78 | 15 | 72 | 14 | 44 | 7 |

**Add up the different ranks for each samples**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Women** | **Ranks** | **Men** | **Ranks** | **Minorities** | **Ranks** |
| 23 | 2 | 45 | 8 | 18 | 1 |
| 41 | 6 | 55 | 10 | 30 | 3 |
| 54 | 9 | 60 | 11 | 34 | 4 |
| 66 | 12 | 70 | 13 | 40 | 5 |
| 78 | 15 | 72 | 14 | 44 | 7 |
| **Total** | 44 | **Sum** | 56 | **Sum** | 20 |

**Calculate the H Statistic**

Where:

* n = sum of sample sizes for all samples,
* c = number of samples,
* Tj = sum of ranks in the jth sample,
* nj = size of the jth sample.



**H = 6.72**

Step 5: Find the [critical chi-square value](https://www.statisticshowto.com/how-to-find-a-critical-chi-square-value/), with c-1 [degrees of freedom](https://www.statisticshowto.com/degrees-of-freedom/). For 3 – 1 degrees of freedom and an alpha level of .05, the critical chi square value is 5.9915.

Step 6: Compare the H value from Step 4 to the [critical chi-square value](https://www.statisticshowto.com/how-to-find-a-critical-chi-square-value/) from Step 5.

If the critical chi-square value is less than the H statistic, [reject the null hypothesis](https://www.statisticshowto.com/support-or-reject-null-hypothesis/) that the medians are equal.

If the chi-square value is not less than the H statistic, there is not enough evidence to suggest that the medians are unequal.

In this case, 5.9915 is less than 6.72, so you can reject the null hypothesis.