Tutorials and worked examples for simulation, curve fitting, statistical analysis, and plotting.
https://simfit.org.uk
https://simfit.silverfrost.com

The Wilcoxon signed rank test is a sort of nonparametric equivalent of the paired t test that is used to examine the differences between matched observations in two data sets, say X and Y, just assuming a symmetrical, but unspecified, distribution for the paired differences.

To be precise, the user has two samples (i.e. vectors X with median X_{med}, and Y with median Y_{med}) with n observations, and specifies a hypothetical median for the paired differences, say D_{med}, that generates a vector of signed differences $d_i = x_i - y_i$ defined by

$$X = (x_1, x_2, \ldots, x_n)$$
$$Y = (y_1, y_2, \ldots, y_n)$$
$$D = (d_1, d_2, \ldots, d_n).$$

Users have to decide whether to include or discard zero differences, and whether to change the default median difference of $D_{med} = 0$ to $D_{med} = k$ for some hypothetical k, then analysis of the signed differences is performed to test if it is reasonable to conclude that either

- both samples have the same population median,
- the population median for sample X is smaller than that for sample Y, or
- the population median for sample X is larger than that for sample Y.

The test is weak unless large samples are used, and is further weakened by ties within the data, that is, multiple observations with the same value.

From the main SimFIT menu select `[A/Z]`, choose to open the SimFIT statistics program **simstat**, then the standard tests option to analyze the test files provided. Choosing a specified zero median and opting to suppress zero differences yields the following results.

Wilcoxon paired-sample signed-rank test

Zero differences suppressed, median test value = 0
X-data: test file `g08agf.tf1`
Y-data: test file `g08agf.tf2`
Size of data = 8, Number of values suppressed = 0
W 32.00
Z 1.890
H_0: X median = Y median
as null hypothesis against the alternatives:-
H_1: Medians differ
p 0.0547
H_2: X median < Y median
p 0.9805
H_3: X median > Y median
p 0.0273 Reject H_0 at 5% significance level

In this example there were no zero differences to reject, and here W is the signed ranks test statistic, while Z is an approximate normal test statistic. Using SimFIT program **normal**, we find that $P(Z \geq 1.89) = 0.0294$. In order to make the interpretation of this test as clear as possible, especially the effect of the value chosen for D_{med}, the results from sequential analysis of data in SimFIT test files `wilcoxon.tf1` and `wilcoxon.tf2` using two different values of $D_{med} = 0$ then $D_{med} = -2$ are displayed next.

Wilcoxon paired-sample signed-rank test 1 and test 2

Median test value = 0
X-data: test file `wilcoxon.tf1`
Y-data: test file `wilcoxon.tf2`
Size of data = 50, Number of values suppressed = 0
W 306.0
Z -3.195
H_0: X median = Y median
H_1: Medians differ
p 0.0011 Reject H_0 at 1% significance level
H_2: X median < Y median
p 0.0005 Reject H_0 at 1% significance level
H_3: X median > Y median
p 0.9995

Median test value = -2
W 783.0
Z 1.400
H_0: X median = Y median
H_1: Medians differ
p 0.1629
H_2: X median < Y median
p 0.9200
H_3: X median > Y median
p 0.0815

The following graph shows that, although X and Y do appear to be matched, the difference is mostly around -2, which explains why $D_{med} = 0$ is rejected, but $D_{med} = -2$ is not rejected, emphasizing the importance of choosing D_{med} sensibly on the outcome of this test.