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

When the 2-way ANOVA assumptions are not justified, the Friedman nonparametric 2-way analysis of variance by ranks is often used. This investigates the score differences between k matched sets of size n. If $k = 2$ then the sign test, or else the Wilcoxon signed rank test, should be used.

From the main SIMFIT menu choose [Statistics], [ANOVA], then the Friedman test, and read in data from the default test file `anova2.tf1`. This has data for matched samples of eighteen rats under three different patterns of enforcement as follows.

1.00	3.00	2.00
2.00	3.00	1.00
1.00	3.00	2.00
1.00	2.00	3.00
3.00	1.00	2.00
2.00	3.00	1.00
3.00	2.00	1.00
1.00	3.00	2.00
3.00	1.00	2.00
3.00	1.00	2.00
2.00	3.00	1.00
2.00	3.00	1.00
3.00	2.00	1.00
2.00	3.00	1.00
2.50	2.50	1.00
3.00	2.00	1.00
3.00	2.00	1.00
2.00	3.00	1.00

Analysis then leads to the results below.

Friedman Nonparametric 2-way ANOVA	
Test Statistic (FR)	8.583
Number of degrees of freedom	2
Significance (i.e., p-value)	0.0137

As the data matrix represents scores rather than normally distributed variables with identical variances, the matrix was analyzed as a two way table using the nonparametric Friedman 2-way ANOVA procedure to test

H_0 : all medians are equal, against the alternative,

H_1 : they come from different populations.

For this analysis SIMFIT first rearranges these data into a $k = 3$ by $n = 18$ matrix, then ranks column scores for this transposed matrix as r_{ij} for row i and column j, assigning average ranks for ties, works out rank sums as $t_i = \sum_{j=1}^{l} r_{ij}$, then calculates FR given by

$$FR = \frac{12}{nk(k+1)} \sum_{i=1}^{k} (t_i - n(k+1)/2)^2 .$$

For small samples, exact significance levels are calculated, while for large samples it is assumed that FR follows a χ^2_{k-1} distribution.