

# Nonparametric order–restricted inference for factorial and temporal data <sup>\*</sup>

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## Abstract

Often in medical studies, the detection of biological trend underlying different treatments or varying time points are of primary interest to biologists. To assess the significance of the underlying trend, a researcher may restrict attention to an ordered alternative and thus increase the power of his test. As the crucial normality assumptions for parametric inferences are often untenable in practice, we propose a nonparametric procedure to test for completely ordered alternatives with monotone, non–monotone, or cyclical orderings. The approach consists of forming a statistic which measures the correlation between the empirical ranking of the treatments based on the data and the criterion ranking induced by the alternatives. By considering a vector of Spearman correlations on multiple subsets of treatment effects, the proposed method is extended to test for incompletely ordered alternatives with multiple sub–orderings. Using the projection technique, the variance–covariance structure associated with the test statistic is derived and consistently estimated under unbalanced factorial designs and repeated measures designs. The limiting distribution and asymptotic relative efficiency of the proposed test under Pitman alternatives are established. The application of the proposed test to assess biological trends is demonstrated through the analysis on real data sets.

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