NPC TEST: A NEW STATISTICAL SOFTWARE FOR MULTIVARIATE PERMUTATION TESTS

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The paper deals with permutation tests for multivariate data, named NPC methods. Observational studies have raised increasing popularity in recent years for several reasons (e.g. low costs, availability of large datasets, etc.), but they differ from an experiment since there is no control of the assignment of treatments to subjects. In observational studies, usually the main experimenters interest is to find out an association among variables of interest possibly indicating for one or more causal effects. Recently, in the New England Journal of Medicine, Benson and Hartz (Benson K., Hartz A.J. A comparison of observational studies and randomized, controlled trials, 2000; 342 (25): 1878-1886) found little evidence that estimates of treatment effects in observational studies reported after 1984 are either consistently larger than or qualitatively different from those obtained in randomized, controlled trials. In the context of observational studies the robustness of the methodology against departures from Normality is much more relevant than in controlled clinical trials. Hence in this context, the NPC method is particularly suitable. Moreover, as the nonparametric combination method is conditional on a set of sufficient statistics it shows good general power behaviour and Fisher, Liptak or direct combining functions often have power functions which are quite close to the best parametric counterparts, when the latter are applicable, even for moderate sample sizes. Thus NPC tests are relatively efficient and much less demanding in terms of underlying assumptions with respect to parametric competitors and to standard distribution-free methods based on ranks, which are generally not conditional on sufficient statistics and almost never present better unconditional power behaviour. One major feature of the nonparametric combination of dependent tests, provided that the permutation principle applies, is that one must pay attention to a set of partial tests each appropriate for the related sub hypotheses because the underlying dependence relation structure is nonparametrically and implicitly captured by the combining procedure. In particular the researcher is not explicitly required to specify the dependence structure of response variables. This aspect is of great importance especially for non normal or categorical variables in which dependence relations are generally too difficult to define and even when well defined are hard to cope with. Further, in the presence of a stratification variable the nonparametric combination through a multi phase procedure allows for quite flexible solutions. For instance we may first combine partial tests with respect to variables within each stratum and then combine the combined tests with respect to strata. Alternatively, we may first combine partial tests related to each variable with respect to strata and then combine the combined tests with respect to variables. In this respect for instance the nonparametric component-wise analysis based on rank tests as suggested, for example, by Rosenbaum (Rosenbaum P.R. Observational Studies, Springer, 2nd edition, 2002) can only permit the overall solution and nothing is possible to say as regards the stratified analyses. In this sense, the NPC methodology can provide an efficient and robust tool to be used in the analysis of both experimental and observational studies. A new software and some real case studies are presented.