A LEGO SYSTEM FOR CONDITIONAL INFERENCE

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Conditioning on the observed data is an important and flexible design principle for statistical test procedures. Although generally applicable, permutation tests currently in use are limited to the treatment of special cases, such as contingency tables or K-sample problems. A new theoretical framework for permutation tests (Strasser & Weber, 1999, Mathematical Methods of Statistics 8, 220–250) opens up the way to a unified and generalized view.
This framework provides us with a conceptual Lego system for the construction of permutation tests consisting of Lego bricks for linear statistics suitable for different inference problems (contingency tables, multivariate problems, etc.), different forms of test statistics and several ways to compute or approximate the conditional null distribution. The classical procedures, such as a permutation t test, are part of this framework and new test procedures can be embedded into the same theory.
We argue that the transfer of such a theory to practical data analysis has important implications in many applications and requires tools that enable the data analyst to compute on the theoretical concepts as closely as possible. We re-analyze data on smoking and Alzheimer's disease, photococarcinogenicity experiments, genetic components of alcoholism and contaminated fish consumption by adapting the general conceptual framework to these non-standard inference problems and utilizing the `coin` add-on package in the R system for statistical computing to show what one can gain from going beyond the 'classical' test procedures.