

Markov basis and Gröbner basis of Segre–Veronese configuration for testing independence in group-wise selections

Satoshi Aoki · Takayuki Hibi · Hidefumi Ohsugi ·
Akimichi Takemura

Received: 17 May 2007 / Revised: 24 January 2008 / Published online: 30 April 2008
© The Institute of Statistical Mathematics, Tokyo 2008

Abstract We consider testing independence in group-wise selections with some restrictions on combinations of choices. We present models for frequency data of selections for which it is easy to perform conditional tests by Markov chain Monte Carlo (MCMC) methods. When the restrictions on the combinations can be described in terms of a Segre–Veronese configuration, an explicit form of a Gröbner basis consisting of binomials of degree two is readily available for performing a Markov chain. We illustrate our setting with the National Center Test for university entrance examinations in Japan. We also apply our method to testing independence hypotheses involving genotypes at more than one locus or haplotypes of alleles on the same chromosome.

Keywords Contingency table · Diplotype · Exact tests · Haplotype · Hardy–Weinberg model · Markov chain Monte Carlo · National Center Test · Structural zero