A family of near-exact approximations based on truncations of the exact distribution for the generalized Wilks Lambda statistic[1]

Luís M. Grilo[1] **and Carlos A. Coelho**[2]

[1]*Polytechnic Institute of Tomar, Portugal*
[2]*New University of Lisbon, Portugal*

Abstract

In multivariate analysis the generalized Wilks Lambda statistic is used to test the independence among m sets of random variables, under the normality assumption. For the case where at least two sets, among the m sets, have an odd number of variables, we do not have the exact distribution in a manageable form, adequate for further manipulation. Thus, we expressed the exact characteristic function of this well known statistic under the form of the characteristic function of an infinite mixture of Generalized Integer Gamma distributions and, based on truncations of this exact characteristic function, we obtained a family of near-exact approximations, as finite mixtures of Generalized Integer Gamma distributions and Generalized Near-Integer Gamma distributions, which by construction match the first two exact moments. The members of the family of near-exact approximations developed this way display an asymptotic behaviour for increasing number of variables. The corresponding near-exact cumulative distribution functions are obtained in a concise and manageable form, relatively easy to implement computationally, allowing for the computation of virtually exact moments and quantiles. We undertake a comparative study for small sample sizes, using two proximity measures based on the Berry-Esseen bounds, to assess the performance of the near-exact approximations, for different numbers of sets and different numbers of variables in each set, and also to compare them with a near-exact approximation based on factorizations of the exact characteristic function.

Keywords

Independent random variables, Characteristic function, Sum of Gamma, Mixtures, Proximity measures, Small sample sizes.

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