An overview of the generalized multivariate beta type II distribution and its extensions

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The construction of the random variables (i.e. individual components) and the derivation of the probability density function of the generalized multivariate beta type II distribution and two extensions thereof viz. (i) the noncentral generalized multivariate beta type II distribution and (ii) the extended bimatrix variate beta type II distribution, are studied. We show the relationship with other well-known distributions and study the statistical properties of these distributions. These distributions arise when one derives closed form expressions for the exact run-length distribution (i.e. the waiting time until the first signal) when monitoring the location and/or scale parameters of a particular distribution using a Shewhart-type Q-chart. More specifically, the first distribution arises when monitoring the unknown spread parameter when the observations from each random sample are independent and identically distributed normal random variables. The proposed distribution is constructed from a sequence of dependent random variables which consists of independent chi-squared ratios. The two extensions of the aforementioned problem arise when: (i) monitoring the unknown variance when the known mean also encountered a permanent upward or downward step shift and (ii) when monitoring the process covariance structure of p attributes where the samples are being collected from a multivariate normal distribution with known mean and unknown covariance matrix.

Keywords: bimatrix variate, chi-squared ratios, noncentral