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Impact of different conditions on accuracy of five rules for principal components retention

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Polemics about criteria for nontrivial principal components are still present in the literature. Finding of a lot of papers, is that the most frequently used Guttman Kaiser's criterion has very poor performance. In the last three years some new criteria were proposed. In this Monte Carlo experiment we aimed to investigate the impact that sample size, number of analyzed variables, number of supposed factors and proportion of error variance have on the accuracy of analyzed criteria for principal components retention. We compared the following criteria: Bartlett's χ^2 test, Horn's Parallel Analysis, Guttman-Kaiser's eigenvalue over one, Velicer's MAP and CHull originally proposed by Ceulemans & Kiers. Factors were systematically combined resulting in 690 different combinations. A total of 138,000 simulations were performed. Novelty in this research is systematic variation of the error variance. Performed simulations showed that, in favorable research conditions, all analyzed criteria work properly. Bartlett's and Horns criterion expressed the robustness in most of analyzed situations. Velicer's MAP had the best accuracy in situations with small number of subjects and high number of variables. Results confirm earlier findings of Guttman-Kaiser's criterion having the worse performance.

Key words: *Principal component analysis, Criterion for extraction, Factor retention*

Exploratory factor analysis (EFA) is *de facto* psychological method, not just because of its origin, but because it is among the most popular methods in psychology. The idea of identification of the structures underlying measured variables is very close to everyday psychological problems in which phenomena of interest cannot be measured directly, but have to be derived from the direct measures of behavior. Principal components analysis (PCA), in a broader sense one of EFA techniques for factor extraction, is the mostly used one. Reviews of its usage in psychological journals (Conway & Huffcutt, 2003; Fabrigar, Wegener, MacCallum, & Strahan, 1999; Ford, MacCallum, & Tait, 1986) show that the popularity of EFA and PCA, in particular, still holds. After the misconceptions that exploratory is subordinated to confirmatory analysis have been rejected (for example Tukey, 1980; Velicer & Jackson, 1990), the main critique is formed around insufficient preciseness and objectiveness as results

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