Package for Deciding the Number of Factors in Exploratory Factor Analysis

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Exploratory factor analysis is one of the most widely used methods in psychology. The most crucial procedure in this technique is determining the number of factors to retain. A numbers of rules have been proposed. Among them, Kaiser's lower bound (eigenvalue-greater-than-one, Kaiser, 1960) is most widely used. Horn (1965) proposed parallel analysis to modify Kaiser's rule in taking variation of eigenvalues duo to sampling. Eigenvalues of real data are compared with eigenvalues from simulated normal random variables in ordinary parallel analysis. However, the normality assumption might be improper. Permutation analysis (Buja & Eyuboglu, 1992) which compares data with identical marginal distribution seems more proper for non-normal data. In addition, Lambert, Wildt and Durand (1991) suggested using nonparametric bootstrapping to decide the number of factors. Alternatively, Velicer (1976) proposed that a minimum average partial test which employs a matrix of partial correlations be considered. Procedures above consider different aspects in deciding factor number, so.Gorsuch (1983) had suggested using more than one way to decide the number of factors.

However, popular statistical software packages do not have all the procedures described above. Moreover, there are even no any code of permutation analysis and nonparametric bootstrapping in literatures, so I would like to present a package which implements all procedures. With the impressive graphic ability of R, the package shows the plot of eigenvalues of data, lower bound, parallel analysis, and permutation analysis and the plot of the confidence intervals of eigenvalues. Besides, the package would suggest the number of factors according different rules. Users would only need to read the raw data or correlation matrix into the package, number of factors and plots of eigenvalues through 5 different ways will be obtained easily and comprehensively at the same time.

References

Buja, A. & Eyuboglu, N. (1992). Remarks on parallel analysis. *Multivariate behavioral research*, 27, 509-540.
Gorsuch, R. L. (1983). *Factor analysis*, Philadelphia, PA, Laerence Erlbaum Associates.
Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrica*, 30, 179-185.
Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and psychological measurement*, 20, 141-151.
Lambert, Z. V., Wildt, A. R. & Durand, R. M. (1991). Approximating confidence intervals for factor loading. Multivariate behavioral research, 26, 421-434.
Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, 41, 321-327