Journal of Educational and Behavioral Statistics
Summer 2002, Vol. 27, No. 2, pp. 105–145

Constrained Principal Component Analysis: Various Applications

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Constrained Principal Component Analysis (CPCA) is a method for structural analysis of multivariate data. It combines regression analysis and principal component analysis into a unified framework. This article provides example applications of CPCA that illustrate the method in a variety of contexts common to psychological research. We begin with a straightforward situation in which the structure of a set of criterion variables is explored using a set of predictor variables as row (subjects) constraints. We then illustrate the use of CPCA using constraints on the columns of a set of dependent variables. Two new analyses, decompositions into finer components and fitting higher order structures, are presented next, followed by an illustration of CPCA on contingency tables, and CPCA of residuals that includes assessing reliability using the bootstrap method.

Keywords: *correspondence analysis (CA), principal component analysis (PCA) projection, singular value decomposition (SVD)*

Accompanying the increased use of multivariate designs in behavioral research has been a corresponding growth in the development of new methods of multivariate data analysis. Of particular interest to researchers in clinical, social, and developmental psychology are methods that investigate the underlying structure (e.g., factor structure) of sets of variables and simultaneously the interrelationships among those underlying structures. Adding to traditional methods for addressing these issues (e.g., canonical correlation analysis) are techniques such as Structural Equation Modeling (SEM) (Joreskog, 1970), and if the data are categorical, Correspondence Analysis (CA) (Greenacre, 1984; Nishisato, 1980). A recently developed multivariate technique is constrained principal component analysis (CPCA) (Takane & Shibayama, 1991; Takane & Hunter, 2001). CPCA is a very general method that combines regression analysis and Principal Component Analysis (PCA) into a unified framework that can be used with data measured on

This research was supported by grant A6394 from the Natural Sciences and Engineering Research Council of Canada and by grant 410-89-1498 from the Social Sciences and Humanities Research Council of Canada to the second author. The authors thank Joe Rodgers and Forrest Young for providing data for the analysis.