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Resistant Multidimensional Scaling

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Abstract

Multidimensional scaling is a multivariate technique for constructing a configuration of n points in Euclidean space using information about the distances between the objects. This can be done by the singular value decomposition of the data matrix. But it is known that the singular value decomposition is not resistant. In this study, we provide a resistant version of the multidimensional scaling.

Keywords: Singular value decomposition, Multidimensional scaling, Resistant.

1. Introduction

Multivariate techniques such as principal component analysis, factor analysis, multidimensional scaling, etc. are tools to analyze the multivariate data. Recent trend in multivariate analysis views these multivariate techniques as exploratory rather than inferential in that they seek to formulate hypotheses more than to test hypotheses. In this regard, the underlying theme of these techniques is to find a simple geometric structure among the points would either reduce the dimensionality or suggest a possible internal relationships among units or variables. The singular value decomposition is tool which is used to find a linear structure of reduced dimension and to give interpretation of the lower dimensional structure. Moreover, the singular value decomposition of the data matrix is computationally far more efficient than the spectral decomposition of the sample covariance matrix when the number of

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variables(or objects) is large.(Shin, 1982) But the singular value decomposition of the data matrix is not resistant, i.e., it is very sensitive to small changes in the input data. If there exist outliers in data matrix, multivariate techniques using the singular value decomposition does not give the desirable results. And, they developed the resistant singular value decomposition. Choi and Byun(1996) provided a resistant version of the principal factor analysis based on the resistant singular value decomposition. Multidimensional scaling is a multivariate technique for describing the interrelationship among many objects. Therefore, in multidimensional scaling, it is important to find a simple geometric structure among objects which would reduce the dimensionality. This can be done by the spectral decomposition or singular value decomposition. The singular value decomposition of the data matrix is more efficient than the spectral decomposition of the sample covariance matrix as the number of unit gets large. But, if there exist notable variables in data matrix, the multidimensional scaling using the singular value decomposition does not give the good results. In this study, we provide the way the resistant singular value decomposition is used in the multidimensional scaling from the geometric(and algebraic) point of view.

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