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Hossein Moradi Rekabdarkolaee, Edward Boone, Qin Wang

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Robust Estimation and Variable Selection in Sufficient Dimension Reduction

Hossein Moradi Rekabdarkolaee, Edward Boone, Qin Wang*

Department of Statistical Sciences and Operations Research, Virginia Commonwealth University, Richmond, Virginia 23284, U.S.A.

Abstract

Dimension reduction and variable selection play important roles in high dimensional data analysis. Minimum Average Variance Estimation (MAVE) is an efficient approach among many others. However, because of the use of least squares criterion, MAVE is not robust to outliers in the dependent variable or errors with heavy tailed distributions. A robust extension of MAVE through modal regression is proposed. This new approach can adapt to different error distributions and thus brings robustness to the contamination in the response variable. The estimator is shown to have the same convergence rate as the original MAVE. Furthermore, the proposed method is combined with adaptive LASSO to select informative variables. The efficacy of this new solution is illustrated through simulation studies and a data analysis on Hong Kong air quality.

Keywords: Robust estimation, shrinkage estimation, sufficient dimension reduction, variable selection.

1. Introduction

Regression analysis is a standard tool for studying the relationship between the response $y \in R$ and the predictor vector $\mathbf{X} \in R^p$. Two important goals

*Corresponding author
Email addresses: moradirekabh@vcu.edu (Hossein Moradi Rekabdarkolaee), elboone@vcu.edu (Edward Boone), qwang3@vcu.edu (Qin Wang)