Statistica Sinica: Preprint
doi:10.5705/ss.202016.0117

In recent years several sparse linear discriminant analysis methods have been proposed for high-dimensional classification and variable selection. However, most of these proposals focus on binary classification and they are not directly applicable to multiclass classification problems. Some sparse discriminant analysis methods that can handle multiclass classification problems, but their theoretical justifications remain unknown. In this paper, we propose a new multiclass sparse discriminant analysis method that estimates all discriminant directions simultaneously. We show that when applied to the binary case our proposal yields a classification direction that is equivalent to those by two successful binary sparse linear discriminant analysis methods in the literature. Thus, our proposal offers a neat unification of these seemingly unrelated proposals for binary sparse discriminant analysis. Our method can be solved by an efficient algorithm which is implemented in an open R package msda available from CRAN. We offer theoretical justification of our method by establishing a variable selection consistency result and rates of convergence under the ultrahigh dimensionality setting. We further demonstrate the empirical performance of our method on simulated and real data.