A Unified Classification Model Based on Robust Optimization

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Abstract

In machine learning, statistical classification is the problem of identifying the class to which new observations belong, where the identity of the class is unknown, on the basis of a training set of data containing observations whose class is known. An example of classification problems would be assigning a given email into "spam" or "non-spam" classes or assigning a diagnosis to a patient depending on observed characteristics of the patient such as gender, blood pressure, presence or absence of certain symptoms, etc.

For binary classification, there exists a wide variety of machine learning algorithms such as support vector machine (SVM), minimax probability machine (MPM), Fisher discriminant analysis (FDA), and so on. The purpose of this work is to provide a unified optimization problem for those classifiers using a robust optimization approach. There are several benefits obtained from the unified model. One of the benefits is that clarified relationship between SVM and MPM leads to a new maximum margin classifier based on MPM. To obtain the new maximum margin classifier, we need to solve a nonconvex optimization problem. We show a new algorithm to solve the problem and present some of the promising numerical results.