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A Simulation Study Comparing Ridge Logistic Regression and Crammer–Singer Support Vector Machine for Multiclass Classification

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Abstract

This work compares ridge multinomial logistic regression and the Crammer–Singer support vector machine, two standard methods for multiclass classification. While the two are derived from quite different arguments, the first part of this work shows that they nonetheless lead to optimisation problems of the same form, the difference being mainly in the loss function used. Here we compare the two empirically on simulated multiclass problems for which the Bayes-optimal classifier is known and linear, spanning 300 conditions varying the number of classes, dimension, sample size, class separation and correlation. The two methods turned out to perform very similarly. The mean paired difference in test accuracy never exceeded 5.3 percentage points in magnitude, and stayed below one percentage point in the large majority of conditions. The one difference regarded as reliable within the present design is a small advantage for the Crammer–Singer support vector machine at strong correlation between variables. The overall conclusion made here is that for data of this kind, the choice between the logistic and the hinge loss matters little for classification accuracy.

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