

# Weighted multiple-quantile classifiers for functional data with application in multiple sclerosis screening

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**Abstract:** Multiple sclerosis (MS) is the most prevalent chronic neurological disease. It can be diagnosed by functional data generated from diffusion tensor imaging. Early recognition and treatment of MS are crucial in the treatment and management of MS patients. Existing functional classifiers seem to suffer from high false negative rates or high false positive rates or both. To develop a classifier with low false negative and false positive rates, we define a generalized distance measure for the functional data. Using this generalized distance, we show that the existing classifiers can be derived by choosing appropriate loss functions. Furthermore, when we consider the quantile loss function, we are able to develop a weighted multiple-quantile (weMulQ) classifier that is robust, accurate, and computationally fast. We showed that it is asymptotically consistent and enjoys the near perfection optimality. Numerically, we demonstrate that it outperforms the other methods when the data are from a generalized Gaussian noise process with mixed populations. Finally, we apply weMulQ to classify MS patients using a DTI data set collected from the Johns Hopkins University and the Kennedy-Krieger Institute. Our classifier indeed has much lower false negative and false positive rates than the existing methods.