New Algorithms for Least Quartile Difference Regression

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Summary. Least quartile difference (LQD) regression is a highly robust method which possesses a breakdown point of 50%, i.e. it can resist up to almost 50% largely deviant data values without becoming extremely biased. Additionally, the Gaussian efficiency of the LQD estimator is 67.1% which is much higher than for most other robust regression estimators such as e.g. least median of squares (LMS) regression. However, the LQD is not widely used yet due to the high computational effort needed when using common algorithms, e.g. the subset algorithm of Rousseeuw and Leroy.

We show that it is possible to compute the LQD estimator for n bivariate data points in expected running time $\mathcal{O}(n^2 \log n)$ and deterministic running time $\mathcal{O}(n^2 \log^2 n)$. Additionally, we present two easy to implement algorithms with slightly inferior time bounds. All of these algorithms are also applicable to least quantile of squares and least median of squares regression through the origin, improving the known time bounds to expected time $\mathcal{O}(n \log n)$ and deterministic time $\mathcal{O}(n \log^2 n)$. The proposed algorithms improve on known results of existing LQD algorithms and hence increase the practical relevance of this method.

Furthermore, we present an application of the LQD estimator for robust real-time filtering of time series and compare its performance with filters based on LMS and repeated median (RM) regression.

References

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