R. Clifton Bailey Statistics Seminar Series

Stein Discrepancy Methods for Robust Estimation and Regression

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Abstract: All statistical procedures highly depend on the modeling assumptions and how close these assumptions are to reality. This dependence is critical: Even the slightest deviation from assumptions can cause major instabilities during statistical estimation.

In order to mitigate issues arising from model mismatch, numerous methods have been developed in the area of robust statistics. However, these approaches are aimed at specific problems, such as heavy tailed or correlated errors. The lack of a holistic framework in robust regression results in a major problem for the data practitioner. That is, in order to build a robust statistical model, possible issues in the data have to be found and understood

before conducting the analysis. In addition, the practitioner needs to have an understanding of which robust models can be applied in which situations.

In this talk, we propose a new framework for robust parameter estimation to address these issues. The new method relies on the Stein Discrepancy Measure, and the estimate is given as the empirical minimizer of a second order U-statistic. The approach provides a "silver bullet" that can be used in a range of problems. When estimating parameters in the exponential family, the estimate can be obtained by solving a quadratic convex problem. For parameter estimation, our approach significantly improves upon MLE when outliers are present, or when the model is misspecified. Furthermore, we show how the new estimator can be used for robust high dimensional covariance estimation. Extensions of the method for regression problems and its efficient computation by subsampling are also discussed.