A Robust Empirical Bayesian Model for Weighted Linear Regression: Application to Cryo-EM Analysis

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Abstract

Cryo-electron microscopy (cryo-EM) has become a powerful technique for determining the three-dimensional structures of biological macromolecules at high resolution. In this work, we propose a robust empirical Bayesian model for parameter estimation using a weighted linear regression approach. Our model employs weights derived from minimum power divergence to achieve robustness in parameter estimation. Furthermore, we apply our approach to cryo-EM analysis, where it provides a flexible framework for estimating parameters for various atoms in constructing a cryo-EM density map given its atomic model. We demonstrate the effectiveness of our proposed approach with both simulation and real data analysis. Our proposed model has broad applicability beyond cryo-EM analysis and can be used for parameter estimation in other fields. This is a joint work with Shu-Cheng Zheng, Po-Chun Lin, Yu-Hsiang Lien, Ting-Li Chen, and Wei-Hau Chang.