Estimation after parameter selection: Estimation methods, performance analysis, and adaptive sampling

Abstract:

In many practical parameter estimation problems, such as medical experiments and cognitive radio communications, parameter selection is performed prior to estimation. The selection process has a major impact on subsequent estimation by introducing a selection bias and creating coupling between decoupled parameters. As a result, classical estimation theory may be inappropriate and inaccurate and a new methodology is needed. In this study, the problem of estimating a preselected unknown deterministic parameter, chosen from a parameter set based on a predetermined data-based selection rule, \( \psi \), is considered. In this talk, I present a general non-Bayesian estimation theory for estimation after parameter selection, includes estimation methods, performance analysis, and adaptive sampling strategies. First, I use the post-selection mean-square-error (PSMSE) criterion as a performance measure instead of the commonly used mean-square-error (MSE). The corresponding Cramér-Rao-type bound on the PSMSE of any \( \psi \)-unbiased estimator is derived, where the \( \psi \)-unbiasedness is in the Lehmann-unbiasedness sense. The post-selection maximum-likelihood (PSML) estimator is presented and its \( \psi \)-efficiency properties are demonstrated. Practical implementations of the PSML estimator are proposed as well. Finally, I discuss the concept of adaptive sampling in a two-sampling stages scheme of selection and estimation.