Nonparametric Combination of Multiple Inferences Using Data depth, Bootstrap and Confidence distribution

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We apply the concepts of confidence distribution and data depth together with bootstrap to develop a new nonparametric approach for combining inferences from multiple studies for a common hypothesis. A confidence distribution (CD) is a sample-dependent distribution function that can be used to estimate parameters of interest. It can be viewed as a "distribution estimator" of the parameter of interest. Examples of CDs include Efron's bootstrap distribution and Fraser's significance function (also referred to as p-value function). CDs have shown high potential to be effective tools in statistical inference. We discuss a new approach to combining the test results from several independent studies for a common multivariate nonparametric hypothesis. Specifically, in each study we apply data depth and bootstraps to obtain a p-value function for the common hypothesis. The p-value functions are then combined under the framework of combining confidence distributions. This approach has several advantages. First, it allows us to resample directly from the empirical distribution, rather than from the estimated population distribution satisfying the null constraints. Second, it enables us to obtain test results directly without having to construct an explicit test statistic and then establish or approximate its sampling distribution. The proposed method provides a valid inference approach for a broad class of testing problems involving multiple studies where the parameters of interest can be either finite or infinite dimensional. The method will be illustrated using simulations and flight data from the Federal Aviation Administration (FAA).

Key Words: Bootstrap, combined inference, confidence distribution, data depth, p-value function, significance function