Meta-Analysis for Diagnostic Test Data: a Bayesian Approach

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Abstract

Clinical investigations based on systematic reviews for diagnostic test data present substantial differences with respect to traditional randomized controlled trials (RCT). Main differences derived from data quality issues, different sources of bias and statistical techniques used to combine results and to explore variability. Moreover, new diagnostic technologies deliver very high sensitivity and specificity results, where Gaussian approximations of meta-analysis models are less adequate.

In this work a full Bayesian approach to perform meta-analysis for diagnostic test data is presented. This model is based on a bi-variate random effect model, where test results are modeled as multinomial random variables and study effect as a bi-variate continuous random variable. The advantage of making meta-analysis in a single model framework is illustrated by deriving the classical summary ROC curve (Moses et al. 1993) and making inference on complex functional parameters like the area under the SROC curve (AUC). Statistical computations are performed with Markov chain Monte Carlo (MCMC) methods based on a Gibbs sampler implemented in WinBUGS 1.4.1 software.

The data of a new systematic review, which investigates the potential diagnostic benefits of computer tomography (CT) scans in the diagnostic of appendicitis (Ohmann et. al. 2005), is used to illustrate this Bayesian approach.

References

Moses L. E., Shapiro, D. and Littenberg B. (1993) Combining independent studies of a diagnostic test into a summary ROC curve: data-analytic approaches and some additional considerations. Statistics in Medicine, 12, 1293-1316.

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