A LIKELIHOOD APPROACH TO ESTIMATING SENSITIVITY & SPECIFICITY WITH BINOCULAR DIAGNOSTIC DATA: APPLICATION IN OPHTHALMOLOGY

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Binocular data typically arise in ophthalmology, where pairs of eyes are screened, through some diagnostic procedure, for the presence of certain diseases or pathologies. Treating the eyes as independent and adopting the usual approach in estimating the sensitivity and specificity of a diagnostic test ignores the correlation between the eyes, and may consequently yield incorrect estimates, especially of the standard errors.

We propose a likelihood-based method of accounting for the correlations between eyes and estimating sensitivity and specificity using a model for binocular or paired binary outcomes. Estimation of model parameters via maximum likelihood is outlined and approximate tests are provided. The efficiency of the model is assessed both theoretically and by a simulation study. An extension of the methodology to the case of several diagnostic tests, or the same test measured on several occasions, which arises in multi-reader studies, is given. A further extension to the case of multiple diseases is outlined as well. Data from a study on diabetic retinopathy are analyzed to illustrate the methodology.