Likelihood Ratio Tests with Three-Way Tables

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Abstract

Likelihood ratio (LR) tests for association and for interaction are examined for three-way contingency tables, in particular, the widely used $2x2xK$ table. Mutual information identities are used to characterize the information decomposition and the logical relationship between the omnibus LR test for conditional independence across K strata and its two independent components, the LR tests for homogeneity and for no association. The latter two tests are logically connected to formulating a natural two-step test for conditional independence. It is suggested to use the proposed two-step test with reduced nominal levels in contrast to the Breslow-Day test and the Cochran-Mantel-Haenszel test. This yields efficient interval estimation for both the interaction parameter and the common odds ratio, compared to using the Mantel-Haenszel estimate. This allows the development of power analysis for testing general hypotheses of varied interactions, using an invariant Pythagorean law of relative entropy.

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