

RECEIVER OPERATING CHARACTERISTIC CURVE FOR COMPLEX SURVEY DATA

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Abstract: The receiver operating characteristic (ROC) curve is frequently used to evaluate the accuracy of medical diagnostic tests. Currently, analysis based on the ROC curve has been performed in large public-use data arising from complex survey samples by ignoring the sampling scheme. This paper proposes a nonparametric estimator for the ROC curve that accounts for complex survey sampling. The asymptotic properties of the estimator are developed using empirical process arguments. Simulation studies showed that our proposed estimator performed well in the practical situations we considered, with better performance for larger sample size and disease proportions. The estimator was illustrated in the National Health and Nutrition Examination Survey (NHANES) to evaluate the discrimination of a traditional risk calculator of undiagnosed diabetes.

Key words and phrases: Complex survey data, empirical processes, Horvitz–Thompson estimator, ROC curve.

1. Introduction

Diagnostic medicine is the process of identifying the disease or condition that a patient has, and ruling out conditions that the patient does not have, through assessment of the patient's signs, symptoms, and results of various diagnostic tests (Zhou, McClish and Obuchowski, 2009). It has evolved over the years as the advances in technology allowed the development of new diagnostic tests for detecting diseases. Examples of diagnostic tests include biochemical serum markers, such as prostate specific antigen (PSA) for prostate cancer, CA-125 for ovarian cancer, creatinine for kidney dysfunction, and cholesterol and blood pressure for cardiovascular disease. Given the importance of diagnostic medicine to population's overall health, and understanding of disease mechanism, statistical methods that assess the accuracy of diagnostic tests in a reliable way are crucial.

The receiver operating characteristic (ROC) curve is the most popular method to assess the performance of a continuous diagnostic test. The curve is defined as the plot of the false positive rate (1-specificity) versus the true-positive rate (sensitivity) across all possible cutoffs of the diagnostic test. The false-positive rate (FPR) is the proportion of non-diseased individuals that test

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