

Using Dual-Frame Estimation for Telephone Surveys: A Simulation Study Based on the US NHIS Dataset

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Abstract

Telephone surveys increasingly rely on dual-frame sampling designs because neither landline nor mobile phone frames alone adequately cover the target population. Appropriate estimation methods are therefore required to account for overlapping sampling frames while reducing coverage bias and improving estimation efficiency. Although several dual-frame estimators have been proposed, practical comparisons using realistic population data remain limited.

This study uses the US NHIS 2000 public-use dataset as a finite population to evaluate the performance of several dual-frame estimators. Two telephone sampling frames, landline and cellular phones, are constructed from the NHIS data to represent overlapping survey frames. Independent simple random samples are repeatedly selected from each frame through Monte Carlo simulation.

Five representative dual-frame estimators are compared, including the Hartley estimator, Fuller–Burmeister estimator, Bankier–Kalton–Anderson estimator, Pseudo Maximum Likelihood estimator, and Calibration estimator. Their performance is evaluated using empirical bias, relative bias, root mean squared error (RMSE), variance, confidence interval coverage probability, and average confidence interval width.

The results are expected to provide practical guidance for selecting appropriate dual-frame estimation methods in modern telephone surveys and official statistics. The proposed simulation framework also demonstrates how publicly available health survey data can be used to evaluate complex survey estimation procedures in an accessible and reproducible manner.