



Estimation of population proportion and sensitivity level of a qualitative character using unrelated question randomized response model

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ABSTRACT

In survey sampling, it is still a great challenge to estimate the proportion of a sensitive characteristic in a population with the assurance of protecting respondent anonymity. Efficiency and privacy protection are key challenges in classical randomized response methods, particularly when applied to sensitive traits. In a bid to overcome this challenge, we propose a more enhanced randomized response model that enhances respondent privacy protection as well as the accuracy of the estimates. Utilizing stratified random sample methods, our model generalizes the use of the pioneering work. Apart from providing unbiased estimators for the sensitive proportion, the proposed model introduces a better sensitivity measure. We demonstrate via theoretical proofs and numerical simulations that our scheme is more efficient and secure compared to existing methods. Our proposed estimator, in specific, has a notably higher percentage relative efficiency (PRE) compared to existing models for both simple and stratified random sampling for certain parameter values, with significant respondent privacy protection and estimating accuracy gains. It is found that, compared to existing methods, the proposed models offer respondents greater efficiency and better privacy protection. Due to these advancements, our approach is particularly beneficial for social and behavioral research where privacy protection is important.

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1. Introduction

Warner (1965) was the first to develop an ingenious method to estimate the proportion of stigmatizing character, such as drug abuse, induced abortion, tax evasion, homosexual activities, etc. His design consists of two related questions each of which divides the sample/population into two mutually exclusive and complementary classes. Simmons et al. (1967) perceived that the confidence of the respondent provided by randomized response RR technique might be further enhanced if one of the two questions is referred to a non stigmatized attribute, say y , which is unrelated to the sensitive trait. Their model is known as unrelated question RR