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A sprightly mathematical model in the presence of scrambled responses

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Abstract

The crux of this paper is to develop a new "Partial" randomized response model. Its properties are studied both theoretically as well as empirically. The proposed model is proved to be more efficient than the randomized response models studied by Eichhorn and Hayre [3] and the "Partial" randomized response model.

Keywords: Randomized response sampling, Estimation of proportion, sensitive quantitative variable, Bogus pipeline
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1 Introduction

Social desirability response bias (SDB)is a major problem in survey research involving sensitive questions [2]. Warner [13] was the first to suggest an ingenious method to estimate the proportion of a sensitive character like induced abortion, drug used, etc., through a randomization device such as deck of cards, spinners etc. such that respondent's privacy would be protected. Randomized response technique is one of several methods to partially overcome SDB. Other methods involve use of bogus pipeline (BPL) [7] and a SBD scale [1]. A rich growth of literature on randomized response techniques can be found in Fox and Tracy [4], Zaizai et al. [14], Singh and Tarry [11], Singh et al. [9] and Singh and Singh [10]. Gupta and Thornton [6] have presented a comparison of BPL and RRT methods using survey data. They have shown that a "Partial" RRT is at least as effective in circumventing SDB as BPL, while being more friendly and portable. Below we give the "Full" RRT model due to Eichhorn and Hayre [3] and the "Partial" RRT model of Mangat and Singh [8].

2 The "Full" and "Partial" RRT Models

Eichhorn and Hayre [3] proposed a multiplicative model to gather information on quantitative sensitive variables like income, tax evasion, amount of drug used etc. In the "Full" RRT model of [3], each subject provides a scrambled response. This model works as follows. Let X be a sensitive quantitative variable of interest with an unknown mean of μ_x and an unknown variance of σ_s^2. Let there be a deck of flash cards that follows a probability distribution S, independent of X, with a known mean of $\mu_s(=\theta)$ and a known variance of σ_s^2.The respondent is asked to draw a card

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