An alternative to stratified Kim and Warde's randomized response model using optimal (Neyman) allocation

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Abstract. This paper addresses the problem of estimating the population proportion π_S possessing the sensitive attribute using stratified random sampling. Two alternatives to Kim and Warde [12] stratified randomized response model have been proposed. The proposed models are based on extending Singh [28] models to the case of stratified random sampling. It has been shown that the proposed models are more efficient than Kim and Warde [12] stratified randomized response technique under some realistic conditions in both the cases of completely truthful reporting and that of not completely truthful reporting by the respondents. A practical problem with the use of optimum (Neyman) allocation has been pointed out. Thus, in practice, the use of either proportional allocation or equal allocation has been suggested while estimating proportion of a sensitive attribute using stratified randomized response sampling. Numerical illustrations and graphs are also given in support of the present study.

Keywords: Randomized response technique, stratified random sampling, dichotomous population, sensitive attribute, estimation of proportion, bias, mean square error

1. Introduction

The Randomized response (RR) technique was first introduced by Warner [30] mainly to cut down the possibility of (i) reduced response rate and (ii) inflated response bias experienced in direct or open survey relating to sensitive issues. Warner himself pointed out how one may get a biased estimate in an open survey when a population consists of individuals bearing a stigmatizing character A or its complement A^c , which may or may not also be stigmatizing. It requires the interviewee to give a "Yes" or "No" answer either to the sensitive question or to its negative depending on the outcome of a randomized device not reported to the interviewer.

Greenberg et al. [4] derived results for Warner's model in the case of less than completely truthful reporting. Mangat and Singh [17] proposed a two – stage RR model in a variation of the Warner model. Singh and Mangat [25] have given the applicability of this model. Mangat [16] proposed another RR model which has the benefit of simplicity over that of Mangat and Singh [17]. Later several modifications in RR technique have been developed by various authors, see, Fox and Tracy [3], Chaudhuri and Mukerjee [1], Tracy and Mangat [29], Ryu et al. [22], Hong [7], Javed and Grewal [8], Grewal et al. [5], Sidhu et al. [23], Perri [20], Zaizai et al. [31], Singh [26] and Singh and Tarray [24].

Stratified random sampling is generally obtained by dividing the population into non-overlapping groups called strata and selecting a simple random sample from each stratum. An RR technique using stratified random sampling provides the group characteristics related to each stratum estimator. Also, stratified sample, protect a researcher from the possibility of obtaining a poor sample, see Kim and Warde [12].

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