Alternative ”optimal” calibration weights using a modified distance measure

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1. Introduction

When dealing with nonresponse in survey sampling calibration has proved to be a useful technique for dealing with bias for estimators of population totals using auxiliary information. The setup is that we take a random sample from a finite population, but due to nonresponse we only observe study variable values in the response set, which is a subset of the sample. The auxiliary information can be known either at the sample level or the population level, or both.

Linear calibration as suggested in (1) and (2) is now widely used in National Offices for Statistics throughout the world. This type of calibration is akin to GREG estimation and has proved to be efficient especially in combination with simple random sampling.

The distance function (measure) to be minimized corresponding to the resulting calibration weights under full response is of a simple chi-square type. It turns out that under nonresponse a similar function generates the weights which are presented in (1). This is shown in detail in (3), where it is also pointed out that a problem with the function which we want to minimize the value of, given our observation in the response set, is that we are still comparing the calibration weights with the original design weights. The latter weights should not be used under nonresponse.

However, as is also shown in (3), there is an invariance property involved for many important cases for this type of calibration. Specifically, this means here that if we e.g. multiply the design weights with a constant larger than one, to compensate for the fact that we have nonresponse, the resulting weights will be the same. Furthermore, we will get the same effect if we try to group the observations where we in each group allow for a unique multiplicative constant.

2. Methods And Results

So, could we work with another distance function where this invariance property does not hold in general (or at least not for important cases)? The answer is yes and one alternative is provided by the ”optimal” calibration technique. These weights are obtained by transferring the optimal calibration weights (see e.g. (4)) under full response to the nonresponse case. (We put optimal within quotes since optimality is not clearly defined when the nonresponse mechanism is not fully known.)

Previous results from simulations show that the ”optimal” weights work well when applied to the situation of estimating a population total using e.g. Poisson sampling. Under simple random sampling the GREG type calibration weights and the ”optimal” weights coincide for cases involving an intercept in the underlying assisting model for the former type of weights. But, even for the closely related stratified simple random sampling design, the two different sets of weights are in general not identical. The Poisson design is of great interest since it incorporates auxiliary information in the design weights.

The final question is whether the ”optimal” weights in general also possess the aforementioned invariance property. The answer is no and this gives us an opportunity to use a multiplicative constant larger than one in the distance measure the better to compensate for the nonresponse effect. (If we had access to a reliable model for nonresponse propensities, estimated propensities can be used in a simliar way, but here we will not assume any such model.)
The next question which arises is how the values of the constant should be derived. A natural candidate is an estimator of the average response propensity (probability). This can be accomplished by a ratio of sums of design weights over the response set and the sample,respectively.

Preliminary results show that he resulting alternative (modified) ”optimal” distance measure indeed works well in combination with e.g. Poisson sampling to reduce the bias of the calibration estimator of a population total. A natural refinement to be tested is when we can divide the sample in such a way that estimates of average propensities can be obtained in each group. This should further reduce the bias.

The population sampled from in the simulations is called KYBOK and consists of some financial variables for 832 clerical municipalities in Sweden in 1992. An advantage of using this population is that it is also used in (1) for simulation purposes, which means that we can compare results for various combinations of estimators, designs and available auxiliary information. Furthermore, it is worth pointing out that the population consists of r*eal* data.

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