Sample Design for Impact Evaluation of Welfare Programs: The Yemen Case

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Abstract

Survey samples for impact evaluation of welfare programs aim to provide comparative assessment between population subgroups of program beneficiaries and non-beneficiaries. In this paper we discuss the sample design aspects of the Yemeni National Social Protection and Monitoring Survey (NSPMS), carried out by Unicef-Yemen with the International Policy Centre for Inclusive Growth methodological support. The NSPMS has the Yemeni resident population (excluding non-household communities such as refugees, nomads and internally displaced persons, hotels, dormitories, prisons and hospitals) as its target population. Expected to last for 12 consecutive months, the NSPMS is a longitudinal household survey that aims to provide parameters estimates quarterly, and to accommodate the Social Welfare Fund program impact assessment.

Keywords: conflict affected population surveys; probabilistic sampling; repeated surveys; rotating panels.

1. Introduction

Designing samples to assess welfare programs require survey statisticians to focus on the estimation of parameters related to comparative studies. In this paper, we describe some of the major aspects of the sample design for the Yemeni National Social Protection and Monitoring Survey (NSPMS), a large-scale longitudinal survey aiming to provide data to comparative demographic and economic research related to welfare program impact evaluation.

Yemen has an estimated population of 19.72 million and is divided in 21 governorates (see Map 1) and 333 districts. Districts are divided in sub-districts and further, in villages. In each district, enumeration areas (EAs), defined for the 2004 Census.

The NSPMS is a twelve months long survey carried-out by Unicef-Yemen with methodological support from the International Policy Centre for Inclusive Growth, from the United Nations Development Program (IPC-IG / UNDP). The target population is the Yemen resident population, excluding non-household communities such as refugees, nomads and internally displaced persons, hotels, dormitories, prisons and hospitals. The survey was designed to provide parameter estimates every quarter.

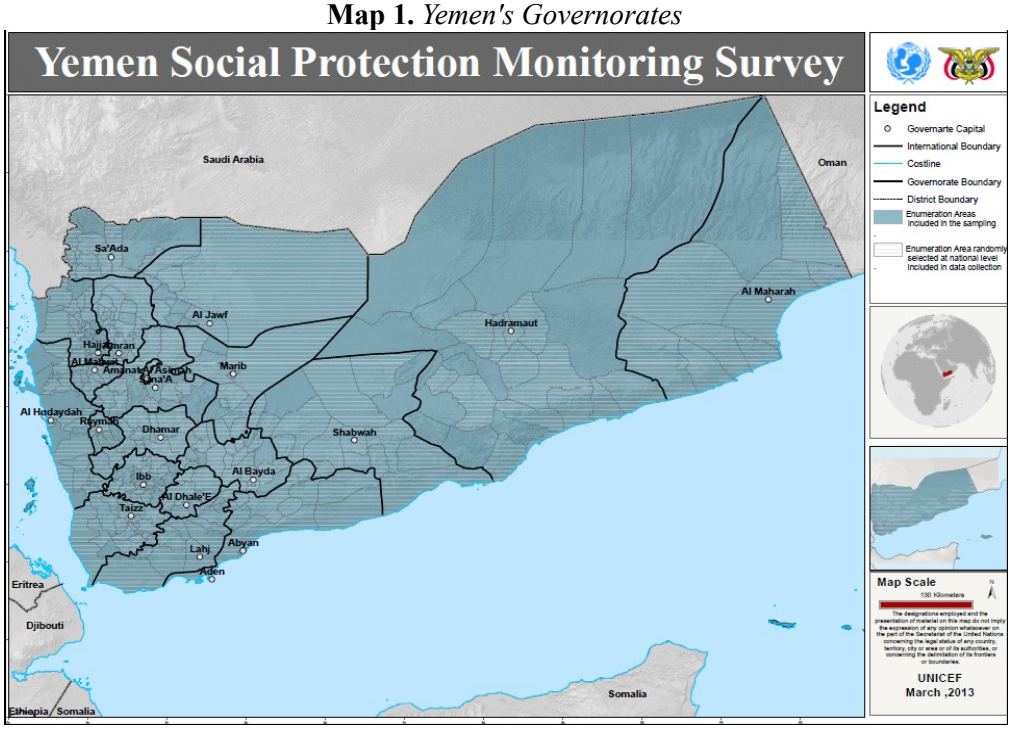
The sample was selected according to a stratified two phase sampling design. In phase one, the country was stratified by governorate, and enumeration areas were selected in each governorate by a probability proportional to size sample scheme. In phase two, households were selected, from each selected EAs, using a stratified simple random sampling procedure where strata were defined according to the social program beneficiary status of the household.

Budget constraints limit the total survey sample size to approximately 7560 households. In each governorate, 30 EAs were selected, and in each sampled EA, 12 households were selected. Sample size allocation to strata followed post-survey analysis needs, focusing on providing higher probabilities of finding counterfactual

matches for the treatment cases in the impact analysis that shall be performed.

In addition to this introduction, this paper is divided in three further sections. The cross-sectional and longitudinal aspects of the sample design are discussed in Section 2. A brief description on how the sampling weights were calculated is introduced in Section 3, and concluding remarks are presented in Section 4.

Map 1. *Yemen's Governorates*



2. The NSPMS Sample design

In the first phase of the NSPMS sample design, the EAs were geographically stratified by governorate and the sample selection was performed using a sequential Poisson sampling procedure (Ohlsson, 1998), with the average number of poor people per EA as a size variable. Such a poverty measure was calculated utilizing the Yemen Multipurpose Household Budget Survey (MHBS) 2005/2006 district level data.

Let π_{hi} and y_{hi} be the first-phase selection probability and the size variable for the EA i within governorate h, respectively. Also let m_h be the number of EAs selected in governorate h, with m_h=30. Then,

$$\pi_{hi} = m_h \frac{y_{hi}}{\sum_{i \in U_h} y_{hi}},$$

where U_h denotes the frame set of enumeration areas listed in governorate h.

Phase one strata sample size allocation was done uniformly, aiming at producing comparison estimates for each stratum with similar levels of precision. By the time the first phase sample was designed, estimation of a contrast between sub-populations of beneficiary (b) and non-beneficiary (nb) households was the main goal. Following Cochran (1977, sec 5A.13), ignoring finite population correction factors, optimum

allocation rules for simple random samples in each stratum can be derived by minimizing

$$Var(\bar{y}_b - \bar{y}_{nb}) = \frac{\sigma_b^2}{n_b} + \frac{\sigma_{nb}^2}{n_{nb}}$$

subject to cost constraints such as

$$C = c_0 + c_b n_b + c_{nb} n_{nb} .$$

The results indicate that

$$n_b = n \frac{\sigma_b / c_b}{\sqrt{\sigma_b^2 / c_b + \sigma_{nb}^2 / c_{nb}}} \quad \text{and} \quad n_{nb} = n \frac{\sigma_{nb} / c_{nb}}{\sqrt{\sigma_b^2 / c_b + \sigma_{nb}^2 / c_{nb}}} .$$

With no further information on variances and approximately equal costs, allocation assuming equal variances ($\sigma_b^2 = \sigma_{nb}^2$) and costs ($c_b = c_{nb}$) can be done uniformly through the sub-populations of interest.

The second phase of the NSPMS sample was designed based on a household listing operation conducted at each selected EA. The listing procedure aimed to identify and classify every household by its beneficiary status. Phase two sample design was stratified by the household classification into three groups: (i) treatment stratum: households with at least one beneficiary of the welfare program (with at least one payment already received); (ii) counter-factual 1 stratum: households with at least one resident either selected or registered for the welfare program, but without any beneficiaries; and, (iii) counter-factual 2 stratum: households with all their residents without support and not registered for the welfare program. A simple random sample of households was selected in each stratum, which characterizes a stratified simple random sampling design in the second phase. Twelve households selected from each EA were allocated to the second phase strata as indicated by Table 1.

Table 1. *Second phase sample allocation to classification strata*

Stratum	Description	Sample allocation
i)	Treatment	5
ii)	Counter-factual 1	5
iii)	Counter-factual 2	2

The NSPMS longitudinal data collection process follows a multiple panel rotation scheme, as illustrated in Figure 1.

Figure 1. *Multiple panel rotation scheme*

Panels	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Panel 1	1			2			3			4		
Panel 2		1			2			3			4	
Panel 3			1			2			3			4

According to Figure 1, the selected EAs located at Panel 1 should be visited for the first time at the first month of the survey; for the second time, at the fourth month of the survey, and so on, totaling four visits. Each panel is composed by 10 randomly allocated EA in each of the 21 Yemeni governorates. Therefore, in each month, 10 from the 30 sampled EAs, at each governorate, are visited. Such longitudinal design allows for releasing national estimates monthly, at reduced precision levels, and quarterly with higher precision. Estimates at the governorate level, however, should be released only quarterly.

3. Sample weights

By the time we write this paper, only cross-sectional sampling weigths were calculated. These weights reflect not only the NSPMS sampling design but also adjustment terms for dealing with unit nonresponses found at the first quarter data collection process. The following notation is useful to describe the weights building process:

- π_{hi} is the inclusion probability of EA i within governorate h;
- $\pi_{j\,g|hi}$ is the conditional inclusion probability of household j within group g given the selected EA i within governorate h;
- $\pi_{hi\,jg}=\pi_{hi}\pi_{j\,g|hi}$ is the inclusion probability of household j within group g, at EA i of governorate h;
- $d_{hijg}=1/\pi_{hi\,jg}$ is the basic design-weight for household j within group g, at EA i of governorate h;

Unit nonresponse cases were considered generated by a missing at random mechanism, depending on the variables governorate and second phase stratum (group), that define the stratification in the sampling design. A weighting adjustment procedure was adopted to correct the basic design-weight for nonresponses. Let

$$\tilde{w}_{hi\,jg}=\frac{d_{hi\,jg}}{\hat{\phi}_{hg}}$$

be the sample weight adjusted for unit nonresponse at governorate h and group g, where

$$\hat{\phi}_{hg} = \frac{\sum_{hg} d_{hijg} a_{hg}}{\sum_{hg} d_{hijg}},$$

and a_{hg} is an indicator variable that unit nonresponse cases are found at governorate h and group g. Further investigation revealed no need for further adjustments on $\tilde{w}_{hijg}$ to diminish the impact of extreme weights.

4. Concluding remarks

Detailed information on the NSPMS sample design and weights can be found at Vieira and Ferraz (2012) and Ferraz and Vieira (2012). Further work shall involve the calculation of longitudinal survey weights, which shall account for non-response at each wave of the survey and attrition. Moreover, results on subsequent policy impact analysis shall be shortly released on a Baseline report by IPC-IG/UNDP.

5. Acknowledgements

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