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SOME REMARKS ON PADAM SINGH'S SAMPLING METHOD

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SUMMARY

Some new results pertaining to Padam Singh's Sampling Method have been derived. Explicit expression of second order inclusion probabilities are derived and some relationships established.

Keywords : Finite population, Inclusion probabilities.

Introduction

In the beginning Padam Singh's sampling method (P. S. Method), is described in brief. Let $U = (U_1, U_2, \ldots, U_N)$ be a finite population of N units and p be a non negative vector $(p_1, p_2, \ldots, p_N)$ such that $\Sigma p_i = 1$. In the sequel for $r > N$ U_r and p_r will mean U_{r-N} and p_{r-N}. P. S. Method is as follows :

(*A*) Select one unit according to probability vector P. Let the selected unit be U_i, S_i be the subject of U as

S_i $(U_i, U_{i+1}, U_{i+3}, \ldots, U_{i+2n'-3})$

where $n' =$ (integral part of $N/2$) + 1

(*B*) From S_i select a sample of size n by simple random sampling without replacement (we assume that $n < n'$).

Properties

Here we obtain the first and second order inclusion probabilities namely π_i, π_{ij} and establish a few relations, Let $\delta_i = 1$ if i is even

$= 0$ if i is odd.

We shall discuss two cases, when N is even and when N is odd separately.

Case No. I (When N is even)

It can be easily seen that

$$\pi_i = [\delta_i(1-\alpha) + \alpha(1-\delta_i) + p_i](n/n')$$

Where $\alpha = \sum_i \delta_i p_i$

$$\pi_{ij} = [a_{ij} + b_{ij}][n(n-1)/n'(n'-1)]$$

Where $a_{ij} = \delta_i\delta_j(1-\alpha) + (1-\delta_i)(1-\delta_j)\alpha$

$$b_{ij} = [\delta_i(1-\delta_j) + \delta_j(1-\delta_i)](p_i + p_j)$$

Noting that $\delta_i + 1 = 1 - \delta_i$ and $\delta_{i+2} = \delta_i$

we get the following relationships

$$\begin{aligned} \pi_i + \pi_{i+1} &= n(1 + p_i + p_{i+1})/n' \\ \pi_{i+2} - \pi_i &= n(p_{i+2} - p_i)/n' \end{aligned} \quad \text{(A)}$$

Case No. II (When N is odd)

It can be easily seen that

$$\pi_i = n\left(\sum_{r=0}^{N} \delta_r p_{i+r}\right)/n'$$

and for $j > i$

$$\pi_{ij} = \frac{n(n-1)}{n'(n'-1)}\left[\delta_{j-i}\left(\sum_{r=0}^{a} p_{j+2r}\right) + (1-\delta_{j-i})\sum_{r=0}^{b} p_{i+2r}\right]$$

where $a = [(N-1-j+i)/2]$, $b = [(j-i-1)/2]$, and

$[x] =$ integral part of x.

We note the following relationships.

$$\begin{aligned} \pi_i + \pi_{i+1} &= n(1 + p_i)/n' \\ \pi_{i+2} - \pi_i &= n(p_{i+1} - p_i)/n' \end{aligned} \quad \text{(B)}$$

It is interesting to compare (A) and (B).

The use of P. S. Method for inclusion probability proportional to size sampling is discussed by Singh [2] and Deshpande [1].

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[2] Singh, Padam (1978) : A Sampling scheme with inclusion probability proportional to size, *Sankhya C*, **40** : 122-128.