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Sampling Procedure with Unequal Probabilities of Selection an Generalization for Fixed Sample Size

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Research Article

Abstract: This new scheme possesses many interesting and desirable properties. for n=2 and identical first order inclusion probabilities, we note that Brewer's procedure (1963), Durbin's method (1967) and many other have identical π_{ij},Other procedure like Narayan's (1951) are non exact here we give exact sampling procedures for n=2 with different π_{ij}'s, the new procedure depends on four vectors .In this paper we are presented a new sampling procedure with unequal probabilities of selection for sample size two and one special case is discussed.

Key Words: IPPS Sampling.

Introduction

For n=2 and identical first order inclusion probabilities, we note that Brewer's procedure (1963), Durbin's method (1967) and many other have identical π_{ij},Other procedure like Narayan's (1951) are non exact here we give exact sampling procedures for n=2 with different π_{ij}'s, the new procedure depends on four vectors, In this paper a new sampling procedure is suggested and few properties are derived.

Research Methodology (New Scheme)

1) Let there be four vectors $\tilde{P}$, $\tilde{Q}$, $\tilde{R}$, $\tilde{S}$,
$\tilde{P}$, $\tilde{Q}$, $\tilde{R}$, $\tilde{S}$ $\in$ to SN. (N>1)

$\tilde{P}$= (p1 ,p2 ,p3 ,…….pN) and $\tilde{Q}$ =(q1 ,q 2,q3 ,………qN)

$\tilde{R}$ = (r1,r2,r3 ,………r N) , $\tilde{S}$ =(s1 ,s2 , s3,……….sN)

2) Select one unit from the population according to vector $\tilde{R}$,i.e probability of selecting U_i from the whole population is r_i.

3) Select second unit from the whole population according to vector $\tilde{S}$,i.e. probability of selecting U_j from the population s_i.

If units are different then retain them as sample. And If units are same then ,

4) Select one unit from the population according to vector $\tilde{P}$ and second unit with probabilities proportional to q_i , from remaining (N-1) units.

Results and Discussion (Properties of New Scheme)

The scheme results into a f.s.s.=2. The sample space consists of $\binom{N}{2}$ samples. Probability measures on sample space let s be the sample , such that

s = (Ui, Uj) $i \neq j$ then

$$p(s) = ri\ sj + rj,\ si + (\textstyle\sum_{i=1}^{N} r_i s_i) \left[p_i \frac{q_j}{1-q_j} + p_j \frac{q_i}{1-q_j}\right] \quad (1)$$

we have $\sum_{s \in S} p(s) = 1$

First order inclusion Probability.

For the unit U_i the first order inclusion probability is given by .

$\pi_i = \sum_{s \ni Ui} p(s)$

therefore , π_i = ri (1-si) + si (1-ri)+ $(\sum_{i=1}^{N} ri\ si) \left[pi\ qi \sum_{i=1 \neq j}^{N} \frac{pj}{1-qj}\right]$

$$= ri + si - 2ri\ si + (\textstyle\sum_{i=1\neq j}^{N} (ri\ si) \left[pi + \sum_{j=1 \neq i}^{N} \frac{pjqi}{1-qj}\right] \quad (2)$$

Second Order Inclusion Probability.

For units U_i , U_j the second order inclusion probability is $p(s)$.

Where

$S = (U_i , U_j)$

Therefore,

π_{ij} = ri sj + rj si + $(\sum_{i=1}^{N} ri\ si)\left[\frac{piqj}{1-qi} + \frac{pjqi}{1-qj}\right]$

Special Case

Next question is how to select the vectors $\tilde{P}$, $\tilde{Q}$, $\tilde{R}$, $\tilde{S}$, so that the resulting design satisfies the desirable first order inclusion probabilities. $\tilde{P}$

Let πi 's be the desirable inclusion probabilities we have to solve the equation

πi = ri + si – 2ri si + ($\sum_{i=1}^{N}(ri\ si)\left[pi + \sum_{j=1\neq i}^{N}\frac{pjqi}{1-qj}\right]$

Here we will fix elements of two vectors $\tilde{R}$ and $\tilde{S}$ out of four and find elements of vectors $\tilde{P}$ and $\tilde{Q}$ in terms of πi 's , ri 's si 's.

denoting $\frac{\pi i - ri - si + 2risi}{\sum_{i=1}^{N} risi}$ by A(i)

We have , pi + $\sum_{i=1}^{N}\frac{pj\ qi}{1-qj}$ = A (i) (3)

We note that, $\sum_{i=1}^{N} A(i)$ = 2

and A(i)'s depend on πi , ri , si solutions of (3)are obtained using ,Brewer's(1963) method, as following

$qi = \frac{A(i)}{2}$ and $pi = \frac{A(i)(2-A(i))}{(1-A(i))}$) (4)

(i = 1,2,3,………..k)

Where

$$k = \sum \frac{A(i)(2-A(i))}{(1-A(i)}$$

These choices of $p_i's\ and\ q_i's$ are feasible if they are non negative. In the section $ri's\ and\ si's$ are chosen ands in different ways and condition of feasibilities are obtained.

$$\pi_{ij} = r_i s_j + r_j s_i + (\sum_{i=1}^{N} r_i s_i)\left[\frac{A(i)A(j)}{k}\left(\frac{1}{(1-A(i))} + \frac{1}{(1-A(j))}\right)\right] \quad (1.3.5)$$

Thus in the beginning we have found out elements of vectors P and Q in terms of π_i's and r_i's and s_i's .

By choosing r_i's and s_i's in different ways various special cases are derived as follows also the π_{ij}'s are obtained.

Conclusion & Suggestion

Here for fixed size 2 this sampling method gives solution of $\pi_{ij}'s$. Many more special cases can be derived. main advantage is that we get different joint inclusion probabilities here we are not touching the estimation part this is our limitation and it should be an open problem for the researcher.

References

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