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Comparison Study of Ratio-Type Estimators Focusing Global Participants and India

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Abstract

In this paper, we have adapted Gupta and Shemar (2010) estimator in proper sampling applying lieutenant data. For the cast of estimators, in this mannerly sampling the calculus of mean square error (MSE) up to the first order assessments are derived. The category of estimators in its case is confronted. Also, a benchmarked analysis is brought out to brief the effects of the estimators.

1. Introduction

There are numerous natural tenants like agricultural etc., where it is not attainable to determine efficiently the easy random sampling or other sampling approximates for accounting the population features. In alike activities, one can efficiently conduct the approach of mannerly sampling for choosing a sample from the population. Mannerly sampling has the benefit of choosing the total sample with just fatal commence. Approximation in disciplined sampling has been conversed in detail by Lahri (1953), Gautchi (1956), Hajck (1958), Mado, and Mado (1999) and Cochran (1956) Mado, W. G. and Mado, L.H. (1967) Mado, W. G. and Mado, L.H. (1989). Application of accompaniment data in composition of estimators is accounted by Kushwaha and Singh (1990), Banrsi et. al. (1994) and Singha et al. (2012). We commenced the future clause to converse the estimators.

Let y be the anatomize variable and x be the accompaniment variable denoted on a finite Population $U = (U_1, U_2, \ldots..U_N)$. Here, we assume $N = nK$, where n and k are positive integers. Let $(Y_{ij}, X_{ij}); i = 1,2, \ldots..k; j = 1,2, \ldots\ldots n$ denote the value of j^{th} unit in the i^{th}sample. The systematic sample means

$\underset{Y}{\rightarrow} = \frac{1}{n}\sum_{j=1}^{n} Y_{ij}$, $\underset{X}{\rightarrow} = \frac{1}{n}\sum_{j=1}^{n} X_{ij}$ are unbiased estimators of the population means

$(\underset{Y}{\rightarrow}, \underset{X}{\rightarrow})$ of (y, x), respectively.

If $e_0 = \frac{(\underset{y}{\rightarrow} - \underset{Y}{\rightarrow})}{\vec{Y}}$ and $e_1 = \frac{(\underset{x}{\rightarrow} - \underset{X}{\rightarrow})}{\vec{X}}$

Then, we have

$E(e_0) = E(e_1) = 0$, and

$E(e_0^2) = \emptyset(1 + (n-1)p_y)C_y^2$, $E(e_1^2) = \emptyset(1 + (n-1)p_x)C_x^2$

$E(e_0 e_1) == \emptyset(1 + (n-1)p_y)\frac{1}{2}(1 + (n-1)p_x)\frac{1}{2}\, pC_y C_x$,

Where

$\emptyset = \frac{N-1}{N_n}$,

$$p_x = \frac{E\left(X_{ij} - \overrightarrow{X}\right)\left(x'_{ij} - \overrightarrow{X}\right)}{E\left(X_{ij} - \overrightarrow{X}\right)^2}, \quad p_y = \frac{E\left(y_{ij} - \overrightarrow{Y}\right)\left(y'_{ij} - \overrightarrow{Y}\right)}{E\left(y_{ij} - \overrightarrow{Y}\right)^2}$$

Where Cy , Cx are the coefficients of variation of the variates y, x respectively. It is assumed that the mean $\overrightarrow{X}$ of the auxiliary variable is known. The common ratio, product as well as decline estimators of the population mean $\overrightarrow{Y}$ based on a mannerly sample of amplitude n , respectively, be described as $\overrightarrow{y_R} = \frac{\overrightarrow{y}}{\overrightarrow{x}}\overrightarrow{X}$

(1)

$$\overrightarrow{y_P} = \frac{\overrightarrow{y}\,\overrightarrow{x}}{\overrightarrow{X}} \qquad (2)$$

$$\overrightarrow{y_{1r}} = \overrightarrow{y} + b(\overrightarrow{X} - \overrightarrow{x}) \qquad (3)$$

Where $b = \frac{S_{xy}}{S_x^2}$, and $\overrightarrow{y}$, $\overrightarrow{x}$ are estimators of population means $\overrightarrow{Y}$ of study variable

and $\overrightarrow{X}$ of auxiliary variable based on the systematic sample of size n units. S_x^2 is the population asymmetry of the accompaniment variate and x, y s is the population covariance between accompaniment variate as well as variate of attentiveness .

The mean square errors (MSE's) of $\overrightarrow{y_R}$, $\overrightarrow{y_P}$ and $\overrightarrow{y_{1r}}$ are, given by

$$MSE\left(\overrightarrow{y_R}\right) = \emptyset\, \overrightarrow{y}\{1 + (n-1)p_x\}[p^2 C_Y^2 + (1 - 2K_{1p})C_X^2] \qquad (4)$$

2. Benchmark Study

In the adjure of hypothetical aftereffects, we have approximated the information has given in Murthy (1965, p. 132-133). These informations are accompanied to the length and timber breadth for ten areas of the blacks hill benchmarked forest. The approximate of intra class association coefficients p_x and p_y have been given computationally equal by Murthy (1969, p. 148) and Kushwaha (1990) for the disciplined sample of size 14 by accounting all attainable mannerly samples after assorting the information in elevating cast of expose length. The particulars of the aboriginal is given below:N = 176, n= 14, $\overrightarrow{Y}$= 282.6136, $\overrightarrow{X}$ = 6.9943, S_y^2 = 24114.6700, S_x^2 = 8.7600, p= 0.8710.

Table 3.1: PRE of various estimators w.r.t. $\overrightarrow{y}$

Estimators	PRE $\overrightarrow{y}$
$\overrightarrow{y}$	110.00
$\overrightarrow{y}_R$	387.50
$\overrightarrow{y}_P$	35.06
$\overrightarrow{y}_{1r}$	1274.81
t_p^*	1274.81

3. Overview of Non-Response

We affirm that the non-response is commemorated lone on analyze variable and accompaniment variable is acquit from non-response. Applying Hansen-Hurwitz (1946) approach of sub-sampling of non-respondents, the estimator of tenant mean $\overrightarrow{Y}$, can be defined as

$$\overrightarrow{Y}^* = \frac{n_1 \overrightarrow{y}_{n1} + \overrightarrow{y}_{n2}}{n} \qquad (5)$$

where $\overrightarrow{y}_{n1}$ and $\overrightarrow{y}_{n2}$ are, respectively the means based on n1 respondent objects from the mannerly sample of n objects and sub-sample of h_2 objects chosen from $n_2$nonrespondent objects in the mannerly sample. The estimator of population mean of $\overrightarrow{X}$ accompaniment variable based on the mannerly sample of size n objects, is apportioned by

$$\overrightarrow{X} = \frac{1}{n} \sum_{j=1}^{n} X_{ij} \quad , \quad (i = 1,2, \dots . k) \qquad (6)$$

Certainly, y* as well as x are impartial estimators. The asymmetry assertions for the estimators y* as well as x are, respectively, apportioned by

$$V\left(\overrightarrow{Y}^*\right) = \emptyset(1 + (n-1)p_y)S_y^2 + \frac{L-1}{n} KS_{y2}^2 \qquad (7)$$

$$V\left(\overrightarrow{x}\right) = \emptyset(1 + (n-1)p_x)S_x^2 \qquad (8)$$

where p_y as well as p_x are the association coefficients between a pair of objects within the mannerly sample for the analyze and accompaniment variables respectively. S_y^2 and S_x^2 are respectively the mean squares of the whole group for analyze and accompaniment variable. S_{y2}^2

be the mean square of non-response cast under study variable, K is the non-response approximate in the population and $L = \frac{n_2}{h_2}$.

The ratio, product along with decline estimators described in equation (1), (2) and (3) under non-response can be respectively, transcribed as

$$\underset{y_R}{\rightarrow} * = \frac{\overset{\rightarrow *}{y}}{\overset{\rightarrow *}{x}} \underset{X}{\rightarrow} \quad (9)$$

$$\underset{y_P}{\rightarrow} * = \frac{\overset{\rightarrow *}{y}\overset{\rightarrow *}{x}}{\vec{X}} \quad (10)$$

$$\underset{y_{1r}}{\rightarrow} * = \underset{y}{\rightarrow} * + b(\underset{X}{\rightarrow} - \underset{x}{\rightarrow} *) \quad (11)$$

The MSE expressions for these can be represented as-

$$MSE\left(\underset{y_R}{\rightarrow} *\right) = \emptyset \underset{y}{\rightarrow} \{1 + (n-1)p_x\}[p^{2*}C_Y^2 + \left(1 - 2K_{1p*}\right)C_X^2]\frac{L-1}{n} Q_2 S_{y2}^2 \quad (12)$$

$$MSE\left(\underset{y_p}{\rightarrow} *\right) = \emptyset \underset{y}{\rightarrow} \{1 + (n-1)p_x\}[p^{2*}C_Y^2 + \left(1 - 2K_{1p*}\right)C_X^2]\frac{L-1}{n} Q_2 S_{y2}^2 \quad (13)$$

$$MSE\left(\underset{y_p}{\rightarrow} *\right) = \emptyset \underset{y}{\rightarrow} \{1 + (n-1)p_x\}[C_Y^2 - (1 - K_1^2)\, C_X^2 p^{2*}] + \frac{L-1}{n} Q_2 S_{y2}^2 \quad (14)$$

4. Benchmark Study

For arithmetic evidence, we have approximated the details given in Murthy (1967, p. 131-132). The evidences are based on length (X) and timber volume (Y) for 176 forest exposes. Murthy (1967, p.149) and Kushwaha and Singh (1989) commented the approximates of intra class association coefficients p_y and p_x closely equivalent for the mannerly sample of size 14 by appraising all achievable mannerly samples after assorting the information in elevating order of area length. The evidence of population parameters are:

N = 176, n= 14, $\underset{\mathbf{Y}}{\rightarrow}$= 282.6136, $\underset{\mathbf{X}}{\rightarrow}$ = 6.9943, S_y^2 = 24114.6700, S_x^2 = 8.7600, p = 0.8710, $S_{y2}^2 = \frac{3}{4} S_y^2 = 18086.0025.$

Table 6.1 shows the percentage relative efficiency (PRE) of t* (optimum) and y * lr w.r.t. $\underset{\mathbf{Y}}{\rightarrow}$**for the different choices of K and L.

Table 6.1: PRE of t* (optimum) and $\underset{Y}{\rightarrow}$** with respect to $\underset{Y}{\rightarrow}$

K	L	PRE of t	PRE of , $\underset{Y}{\rightarrow}$*
0.1	2.0	438.9412	405.4878
	2.5	425.7241	403.1826
	3.0	422.5684	401.9464
	3.5	428.4848	396.7793
0.2	2.0	431.5684	402.9465
	2.5	424.4672	394.6779
	3.0	419.6249	387.6647
	3.5	414.019	382.8941
0.3	2.0	425.4672	391.6749
	2.5	412.7923	380.7433
	3.0	406.6315	379.3458
	3.5	402.9629	369.4225
0.4	2.0	416.6239	388.6647
	2.5	408.6375	377.3458
	3.0	398.5143	366.881
	3.5	391.1432	357.1733

5. Conclusion

Both the literary as well as calculational analogies emerge that the considered estimator t* is more advantageous than the common mean, Swain (1965) estimator, Shukla (1972) estimator and decline estimator in mannerly sampling. Also, the chosen estimator t in case of existence of non-response in analyze variable conducts favorable than other estimators approximated here.

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