

## **Annexure-I: Note on Estimation Procedure of Annual Survey on Unincorporated Sector Enterprises (ASUSE), 2022-23**

### **Estimation Procedure**

#### **1 Notations:**

s = subscript for s-th stratum

t = subscript for t-th sub-stratum

i = subscript for i-th FSU [village/ block]

d = subscript for a segment (d = 1, 2, 9) [sometimes, 'd' is not mentioned in the formulae, instead value of d, i.e., '1', '2' or '9' is mentioned in the formulae]

j = subscript for j-th second stage stratum in an FSU/ segment (i.e., j=1, 2, 3 ..... , 18)

k = subscript for k-th sample establishment under a particular second stage stratum within an FSU/ segment

D = total number of hg's/ sb's formed in the sample FSU

D\* = 0 if D = 1

= (D - 1)/2 for FSUs with D > 1

N = total number of FSUs in any rural/urban sub-stratum

n = number of sample FSUs surveyed including 'uninhabited' and 'zero cases' but excluding casualty for a particular sub-stratum

E = total number of establishments listed in a second-stage stratum of an FSU / segment of sample FSU

e = number of establishments surveyed in a second-stage stratum of an FSU / segment of sample FSU (excluding casualty establishments)

x, y = observed value of characteristics x, y under estimation

$\hat{X}$  ,  $\hat{Y}$  = estimate of population total X, Y for the characteristics x, y

Under the above symbols,

$Y_{stidjk}$  = observed value of the characteristic y for the k-th establishment in the j-th second stage stratum of the d-th segment (d = 1, 2, 9) of the i-th FSU belonging to the t-th sub-stratum of s-th stratum.

However, for ease of understanding, a few symbols have been suppressed in following paragraphs where they are obvious.

## 2 Formulae for Estimation of Aggregates for a particular stratum × sub-stratum:

### 2.1 Schedule LSU:

#### 2.1.1 Rural/Urban:

(i) For estimating the number of establishments in a stratum × sub-stratum possessing a characteristic:

$$\hat{Y} = \frac{N}{n} \sum_{i=1}^n \left[ y_{i9} + y_{i1} + D_i^* \times y_{i2} \right]$$

where  $y_{i9}$ ,  $y_{i1}$ ,  $y_{i2}$  were the total number of establishments possessing the characteristic  $y$  in segments 9, 1 & 2 of the  $i$ -th FSU respectively.

### 2.2 Schedule ESU:

#### 2.2.1 Rural/Urban:

Estimation formula for a sub-stratum of a State/UT:

(i) For establishments selected in  $j^{\text{th}}$  second stage stratum in the  $i^{\text{th}}$  FSU belonging to  $t^{\text{th}}$  substratum under  $s^{\text{th}}$  stratum:

$$\hat{Y}_{ij} = \frac{N_{st}}{n_{st}} \sum_{i=1}^{n_j} \left[ \frac{E_{i9j}}{e_{i9j}} \sum_{k=1}^{e_{i9j}} y_{i9jk} + \frac{E_{i1j}}{e_{i1j}} \sum_{k=1}^{e_{i1j}} y_{i1jk} + D_i^* \times \frac{E_{i2j}}{e_{i2j}} \sum_{k=1}^{e_{i2j}} y_{i2jk} \right]$$

(ii) For all selected establishments, the estimate of characteristic  $y$  for  $t^{\text{th}}$  substratum under  $s^{\text{th}}$  stratum is:

$$\hat{Y} = \sum_i \sum_j \hat{Y}_{ij}.$$

This  $\hat{Y}$  may be viewed as  $\hat{Y}_{st}$ .

## 3 Overall Estimate for Aggregates for a stratum:

Overall estimate for a stratum ( $\hat{Y}_s$ ) will be obtained as

$$\hat{Y}_s = \sum_t \hat{Y}_{st}$$

#### 4 Overall Estimate of Aggregates at State/UT/all-India level:

The overall estimate  $\hat{Y}$  at the State/ UT/ all-India level is obtained by summing the stratum estimates  $\hat{Y}_s$  over all strata belonging to the State/ UT/ all-India.

#### 5 Estimates of Ratios:

Let  $\hat{Y}$  and  $\hat{X}$  be the overall estimates of the aggregates Y and X for two characteristics y and x respectively at the State/ UT/ all-India level.

Then the combined ratio estimate ( $\hat{R}$ ) of the ratio ( $R = \frac{Y}{X}$ ) will be obtained as  $\hat{R} = \frac{\hat{Y}}{\hat{X}}$ .

#### 6 Estimation of Errors:

##### 6.1 Formula for estimated variance (for Rural/Urban):

6.1.1 The sampling scheme in the current round is SRSWOR. However, if the sampling fraction is small, then the difference between variance estimates using the SRSWR and SRSWOR becomes negligible. In such case, samples can be treated as drawn with SRSWR and variance estimates become simpler in form and easy to calculate. It has been observed that overall sampling fraction is quite low in the current situation and hence there is not much loss in accuracy of variance estimates if SRSWR is assumed.

With this view, formulae for estimates of variances are given below based on SRSWR scheme.

##### (a) Formula for aggregate $\hat{Y}$ (for Rural/Urban):

$$\begin{aligned} \hat{V}ar(\hat{Y}) &= \sum_s \hat{V}ar(\hat{Y}_s) = \sum_s \sum_t \hat{V}ar(\hat{Y}_{st}) \\ \hat{V}ar(\hat{Y}_{st}) &= \frac{1}{n_{st}(n_{st}-1)} \sum_{i=1}^{n_{st}} (N_{st} \hat{Y}_{sti} - \hat{Y}_{st})^2 \end{aligned}$$

(b) **Formula for ratio  $\hat{R}$  (for Rural/Urban):**

$$M\hat{S}E(\hat{R}) = \frac{1}{\hat{X}^2} \sum_s \sum_t M\hat{S}E_{st}(\hat{R})$$

$$M\hat{S}E_{st}(\hat{R}) = \frac{1}{n_{st}(n_{st}-1)} \sum_{i=1}^{n_{st}} \left[ N_{st} (\hat{Y}_{sti} - \hat{R}\hat{X}_{sti}) - (\hat{Y}_{st} - \hat{R}\hat{X}_{st}) \right]^2,$$

where  $N_{st}\hat{Y}_{sti} = \sum_j \sum_k y_{stijk} \times n_{st} \times multiplier,$

$$N_{st}\hat{X}_{sti} = \sum_j \sum_k x_{stijk} \times n_{st} \times multiplier$$

in the formula in (a) and (b) above.

Multiplier is as given in the table in para 7.

## 6.2 Estimates of Relative Standard

**Error (RSE):**

$$R\hat{S}E(\hat{Y}) = \frac{\sqrt{Var(\hat{Y})}}{\hat{Y}} \times 100$$

$$R\hat{S}E(\hat{R}) = \frac{\sqrt{M\hat{S}E(\hat{R})}}{\hat{R}} \times 100$$

## 7. Multipliers:

The formulae for multipliers at stratum/sub-stratum/second-stage stratum level for a schedule type were given below:

sch type	sector	formula for multipliers		
		segment 9	segment 1	segment 2
LSU	rural/urban	$\frac{N_{st}}{n_{st}}$	$\frac{N_{st}}{n_{st}}$	$\frac{N_{st}}{n_{st}} \times D_{sti}^*$
ESU		$\frac{N_{st}}{n_{stj}} \times \frac{E_{sti9j}}{e_{sti9j}}$	$\frac{N_{st}}{n_{stj}} \times \frac{E_{sti1j}}{e_{sti1j}}$	$\frac{N_{st}}{n_{stj}} \times D_{sti}^* \times \frac{E_{sti2j}}{e_{sti2j}}$
j = 1,2,3, ....., 18				

**Note:**

- (i) For estimating any characteristic for any domain not specifically considered in sample design, indicator variable may be used.
- (ii) Multipliers had to be computed on the basis of information available in the listing schedule irrespective of any misclassification observed between the listing schedule and detailed enquiry schedule.
- (iii) In case, sub-round-wise estimates are required, then the number of FSUs actually surveyed during the months pertaining to the respective sub-round will be considered in the denominator ( $n_{st}$ ) while computing the sub-round-wise multiplier.

**7.1 Adjustment of multipliers due to status of the establishment as ‘out of coverage’**

Let

E = total number of establishment for a Second Stage Stratum (SSS)

e = total number of surveyed sample establishment for an SSS

m = total number of sample surveyed establishment out of coverage for an SSS

Then

(i) Proportion of sample establishment out of coverage =  $m/e$  in an SSS

(ii) Estimated number of establishment out of coverage =  $E*m/e$  in an SSS

Adjustments may be done in the following manner:

(i) Adjusted number of establishment within the coverage =  $(E - E*m/e)$  in an SSS

(ii) Adjusted number of sample establishment within the coverage =  $(e-m)$

Thus, in such situation, **E** in the multiplier in para 5 above will be replaced by **E \* (1 – m/e)** and **e** will be replaced by **(e – m)**.

**8. Treatment for zero cases, casualty cases etc.:**

8.1 While counting the number of FSUs surveyed ( $n_{st}$ ) in a stratum/sub-stratum, all the FSUs with survey codes 1 to 6 in schedule LSU will be considered.

8.2 However, establishments are available in the frame of the FSU but none of these could be surveyed then that FSU has to be treated as casualty.

8.3 *Casualty cases*: FSUs with survey code 7 as per schedule LSU are treated as casualties.

8.4 *All the FSUs with survey codes 1 to 6 as per schedule LSU minus the number of casualties as identified in 8.3 will be taken as the number of surveyed FSUs ( $n_{st}$ ) for that (stratum/sub-stratum).*

**9. Treatment in cases of void second-stage strata/sub-strata /strata**

9.1 A stratum/sub-stratum may be void because of the casualty of all the FSUs belonging to the stratum/sub-stratum.

9.2 When a stratum/sub-stratum is void, the following procedure is recommended:

*Case (I): Stratum/Sub-stratum void cases at FSU levels (i.e. all FSUs having survey code 7):*

- (i) If a rural/urban sub-stratum is void then it may be merged with the other similar sub-stratum of the same stratum.
- (ii) If a complete rural/urban stratum is void due to all FSUs being casualty, it may be excluded from the coverage of the survey. The state level estimates will be based on the estimates of regions for which estimates are available and remarks to that effect may be added in appropriate places.

*Case (II): Void case at second stage stratum level:*

If due to some reason no establishment could be surveyed (i.e., all ssu's are casualties in a second stage stratum of an FSU, i.e.,  $e_{jk}=0$ ) even though there were establishments listed (i.e.  $E_{jk}>0$ ), which is known as 'void' second stage stratum. Then that second stage stratum may be merged with another non-void second stage stratum. Initially, it is to be checked whether the same void SSS is available in other segment (1 or 2) of the same FSU and will be merged. Now, in case void SSS is observed even after considering both segments 1 and 2 of that FSU, then that void SSS to be merged with another non-void SSS of that same FSU; and the principle and order of "second stage stratum merging" will be as follows:

SSS found void	Merging order of SSS
1	2, 3
2	1, 3
3	1, 2
4	5, 6, 7, 13
5	4, 6, 7, 13
6	4, 5, 7, 13
7	4, 5, 6, 13
8	14
9	10, 11, 12, 15, 16, 17, 18
10	9, 11, 12, 16, 15, 17, 18
11	9, 10, 12, 17, 15, 16, 18
12	9, 10, 11, 18, 15, 16, 17
13	Maximum of (SSSs 4, 5, 6, 7)
14	8
15	16, 17, 18
16	15, 17, 18
17	15, 16, 18
18	15, 16, 17

Similarly, for segment 9, any void SSS to be merged with another non-void SSS in that segment 9 of that same FSU following the above SSS merging procedure.