Note on Estimation Procedure of Annual Survey on Unincorporated Sector Enterprises (ASUSE 2021-22)

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)

j = subscript for j-th second stage stratum in an FSU/ segment (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.

1

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-th second stage stratum:

$$\hat{Y_j} = \frac{N}{n_j} \sum_{i=1}^{n_j} \left[\sum_{k=1}^{e_{i9j}} y_{i9jk} + \frac{E_{i1j}}{e_{i1j}} \sum_{k=1}^{e_{i1j}} y_{i1jk} + D_i^* \times \frac{E_{i2j}}{e_{i2j}} \sum_{k=1}^{e_{i2j}} y_{i2jk} \right]$$

(ii) For all selected establishments:

$$\hat{Y} = \sum_{j} \hat{Y}_j$$

Note: For segment 9, an adjustment may be necessary if E ≠ e for a second-stage stratum due to casualty at the detailed enquiry stage. In that case, contribution of segment 9 (i.e. $\sum_{k=1}^{e_{i9j}} y_{i9jk}$) in

the above formulae may be replaced by $\dfrac{E_{i9j}}{e_{i9j}} \sum_{k=1}^{e_{i9j}} y_{i9jk}$, where E_{i9j} = (number of establishments in the frame of of segment 9 for j-th SSS of i-th FSU as per column (4) of Block 6a of Schedule LSU) and e_{i9j} = (number of establishments actually surveyed for segment 9 of j-th SSS of i-th FSU as per column (6) of Block 6a of Schedule LSU)

$E_{i9j} = e_{i9j}$, if there was no casualty.

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 $(R = \dfrac{Y}{X})$ 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 sheme 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 neglible. In such case, samples can be treated as drawn with SRSWR and variance estimates becomes 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)**:

$$V\hat{a}r(\hat{Y}) = \sum_s V\hat{a}r(\hat{Y}_s) = \sum_s \sum_t V\hat{a}r(\hat{Y}_{st})$$

$$V\hat{a}r(\hat{Y}_{st}) = \frac{1}{n_{st}(n_{st}-1)} \sum_{i=1}^{n_{st}} (N_{st}\hat{Y}_{sti} - \hat{Y}_{st})^2$$

Note on Estimation Procedure: ASUSE

(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 $\quad N_{st}\hat{Y}_{sti} = \sum_{j} \sum_{k} y_{stijk} \times n_{st} \times multiplier \quad ,$

$$N_{st}\hat{X}_{sti} = \sum_{j} \sum_{k} x_{stijk} \times n_{st} \times multiplier$$

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):

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

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

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		$\dfrac{N_{st}}{n_{st}}$	$\dfrac{N_{st}}{n_{st}}$	$\dfrac{N_{st}}{n_{st}} \times D_{sti}^{*}$
ESU	rural/urban	$\dfrac{N_{st}}{n_{stj}} \times \dfrac{E_{sti9j}}{e_{sti9j}}$	$\dfrac{N_{st}}{n_{stj}} \times \dfrac{E_{sti1j}}{e_{sti1j}}$	$\dfrac{N_{st}}{n_{stj}} \times D_{sti}^{*} \times \dfrac{E_{sti2j}}{e_{sti2j}}$
		$j = 1,2,3, ..., 18$		

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.

4

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 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} or n_{stj}) 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 and it will not be treated as surveyed in respect.

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

8.3.1 FSUs with survey codes 1 or 4 as per schedule LSU having number of establishments in the frame of j-th second stage stratum greater than 0 (i.e. E > 0) but number of establishments surveyed according to data file as nil (e =0), will be taken as casualties for j-th second stage stratum.

8.4 *All the FSUs with survey codes 1 to 6 as per schedule LSU minus the number of casualties as identified in 6.3 and 6.3.1 will be taken as the number of surveyed FSUs (n_{stj}) for that (stratum/sub-stratum) ×(second stage 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 sub-stratum of the same Group of the stratum.

(ii) If a rural/urban stratum (district) 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 districts for which estimates are available and remarks to that effect may be added in appropriate places.

Case (II): Stratum/Sub-stratum void case at second stage stratum level (i.e. all the FSUs were casualties for a particular second stage stratum):

An FSU may be a casualty for a particular *second stage stratum* although survey code is not 7. If all the FSUs of a stratum/sub-stratum become casualties in this manner for a particular *second stage stratum*, the stratum/sub-stratum will become void.

9.3 If a complete rural/urban NSS Region 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.

Note on Estimation Procedure: ASUSE

Special Note (for removal of sub-round restriction in ASUSE-2021-22):

In view of removal of sub-round restriction in ASUSE- 2021-22, the following may be implemented for estimation of ASUSE-2021-22:

Let, n_1, n_2, n_3, and n_4 be the original sub-round wise allocations of selected FSUs in a sub-stratum, which are normally equal and N is the size of the sub-stratum.

Suppose, n_1^*, n_2^*, n_3^*, and n_4^* are the actual no. of FSUs surveyed from that sub-stratum in the rth sub-round, r=1, 2, 3 and 4

Further, r and i denotes respectively a sub-round and a FSU for a sub-stratum;

$\hat{Y}_{stri}$ denotes the annual estimates obtained from the enterprises surveyed in the ith FSU belonging to the tth sub-stratum of sth stratum in the rth sub-round; and

Under the design adopted for the survey (SRSWOR),

Estimate of the tth sub-stratum of sth stratum from r^{th} sub-round is,

$$\hat{Y}_{str} = \frac{N}{n_r^*} \sum_{i=1}^{n_r^*} \hat{Y}_{stri} \quad , r=1, 2, 3 \text{ and } 4$$

1 Overall Estimate for Aggregates for a sub-stratum:

The overall estimates $\hat{Y}_{st}$, of a sub-stratum, will be taken as the simple average of the sub-round wise estimates of that sub-stratum, i.e.,

$$\hat{Y}_{st} = \frac{1}{4} \sum_{r=1}^{4} \hat{Y}_{str}$$

Special Cases:

$\hat{Y}_{st} = \frac{1}{3} \sum_{r=1}^{3} \hat{Y}_{str}$, if estimate is available of the tth sub-stratum of sth stratum from 3 sub-rounds only.

$\hat{Y}_{st} = \frac{1}{2} \sum_{r=1}^{2} \hat{Y}_{str}$, if estimate is available of the tth sub-stratum of sth stratum from 2 sub-rounds only.

$\hat{Y}_{st} = \hat{Y}_{str}$, if estimate is available of the tth sub-stratum of sth stratum from r^{th} sub-round (r=1 or 2 or 3 or 4) only.

2 Overall Estimate for Aggregates for a stratum:

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

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

Note on Estimation Procedure: ASUSE

3 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 $\hat{Y}_s$ (s stands for stratum) over all strata belonging to State/UT/all-India.

4 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 ($R = \dfrac{Y}{X}$) will be obtained as $\hat{R} = \dfrac{\hat{Y}}{\hat{X}}$.

Note: The treatment required to handle void stratum, sub-stratum etc. and the estimation procedure of RSE/MSE for ASUSE 2021-22 will be carried out following the usual practice.

Note on Estimation Procedure: ASUSE