

**3.12 Formation of second stage strata and allocation of households:**

3.12.1 A cut-off point ‘A’ (in ₹) has been determined from NSS 68<sup>th</sup> round data for urban areas of each NSS region in such a way that top 40% of the population have Monthly Per Capita Expenditure (MPCE) more than ‘A’.

The following is the plan of second stage stratification for Schedule 21.1

**Schedule 21.1: Domestic Tourism Expenditure**

SSS	composition of SSS	number of households to be surveyed		
		FSU without hg/sb formation	FSU with hg/sb formation (for each hg/sb)	
<b>Rural</b>				
1	households having at least one member who performed overnight trip during last 365 days for medical/ holidaying/ shopping purpose	with strong dwelling structure	2	1
2		without strong dwelling structure	2	1
3	from the remaining, households having at least one member who performed any other overnight trip during last 30 days	with strong dwelling structure	2	1
4		without strong dwelling structure	2	1
5	other households		2	1
<b>Urban</b>				
1	households having at least one member who performed overnight trip during last 365 days for medical/ holidaying/ shopping purpose	with MPCE > A	2	1
2		with MPCE ≤ A	2	1
3	from the remaining, households having at least one member who performed any other overnight trip during last 30 days	with MPCE > A	2	1
4		with MPCE ≤ A	2	1
5	other households		2	1

**3.13 Selection of households:** From each SSS the sample households for each of the schedules are selected by SRSWOR. Only one schedule is to be canvassed in any household. So, under no circumstances, any household can be selected for more than one schedule.

## 4. Estimation Procedure

### 4.1 Notations:

s = subscript for s-th stratum

t = subscript for t-th sub-stratum

m = subscript for sub-sample (m = 1, 2)

i = subscript for i-th FSU [village (panchayat ward)/ block]

d = subscript for a hamlet-group/ sub-block (d = 1, 2)

j = subscript for j-th second stage stratum in an FSU/ hg/sb

k = subscript for k-th sample household under a particular second stage stratum within an FSU/ hg/sb

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

$D^* = 0$  if  $D = 1$

= (D - 1) for FSUs with  $D > 1$

Z = total size of a rural/urban sub-stratum (= sum of sizes of all villages/blocks of a sub-stratum)

z = size of sample village/UFS block used for selection.

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

H = total number of households listed in a second-stage stratum of an FSU / hamlet-group or sub-block of sample FSU

h = number of households surveyed in a second-stage stratum of an FSU / hamlet-group or sub-block of sample FSU

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,

$y_{stmidjk}$  = observed value of the characteristic y for the k-th household in the j-th second stage stratum of the d-th hg/ sb (d = 1, 2) of the i-th FSU belonging to the m-th sub-sample for 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.

**4.2 Formulae for Estimation of Aggregates for a particular sub-sample and stratum × sub-stratum:**

**4.2.1 Schedule 0.0:**

**4.2.1.1 Rural/Urban:**

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

$$\hat{Y} = \frac{Z}{n} \sum_{i=1}^n \frac{1}{z_i} [y_{i1} + D_i^* \times y_{i2}]$$

where  $y_{i1}$ ,  $y_{i2}$  are the total number of households possessing the characteristic  $y$  in hg's 1 & 2 of the  $i$ -th FSU respectively.

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

$$\hat{Y} = \frac{Z}{n} \sum_{i=1}^n \frac{1}{z_i} y_i$$

where  $y_i$  is taken as 1 for sample villages possessing the characteristic and 0 otherwise.

**4.2.2 Schedules 21.1**

**4.2.2.1 Rural/ Urban:**

(i) For  $j$ -th second-stage stratum of a stratum × sub-stratum:

$$\hat{Y}_j = \frac{Z}{n_j} \sum_{i=1}^{n_j} \frac{1}{z_i} \left[ \frac{H_{i1j}}{h_{i1j}} \sum_{k=1}^{h_{i1j}} y_{i1jk} + D_i^* \times \frac{H_{i2j}}{h_{i2j}} \sum_{k=1}^{h_{i2j}} y_{i2jk} \right]$$

(ii) For all second-stage strata combined:

$$\hat{Y} = \sum_j \hat{Y}_j$$

**4.3 Overall Estimate for Aggregates for a sub-stratum:**

Overall estimate for aggregates for a sub-stratum ( $\hat{Y}_{st}$ ) based on two sub-samples in a sub-stratum is obtained as:

$$\hat{Y}_{st} = \frac{1}{2} \sum_{m=1}^2 \hat{Y}_{stm}$$

**4.4 Overall Estimate for Aggregates for a stratum:**

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

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

**4.5 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.

**4.6 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  $\hat{R} = \frac{\hat{Y}}{\hat{X}}$ .

**4.7 Estimates of Error:** The estimated variances of the above estimates will be as follows:

**4.7.1 For aggregate  $\hat{Y}$ :**

$$V\hat{a}r(\hat{Y}) = \sum_s V\hat{a}r(\hat{Y}_s) = \sum_s \sum_t V\hat{a}r(\hat{Y}_{st}) \text{ where } V\hat{a}r(\hat{Y}_{st}) \text{ is given by}$$

$V\hat{a}r(\hat{Y}_{st}) = \frac{1}{4} (\hat{Y}_{st1} - \hat{Y}_{st2})^2$ , where  $\hat{Y}_{st1}$  and  $\hat{Y}_{st2}$  are the estimates for sub-sample 1 and sub-sample 2 respectively for stratum ‘s’ and sub-stratum ‘t’.

**4.7.2 For ratio  $\hat{R}$ :**

$$M\hat{S}E(\hat{R}) = \frac{1}{4\hat{X}^2} \sum_s \sum_t \left[ (\hat{Y}_{st1} - \hat{Y}_{st2})^2 + \hat{R}^2 (\hat{X}_{st1} - \hat{X}_{st2})^2 - 2\hat{R} (\hat{Y}_{st1} - \hat{Y}_{st2}) (\hat{X}_{st1} - \hat{X}_{st2}) \right]$$

4.7.3 Estimates of Relative Standard Error (RSE):

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

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

5. Multipliers:

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

sch type	sector	formula for multipliers	
		hg / sb 1	hg / sb 2
0.0	rural/urban	$\frac{Z_{st}}{n_{stm}} \times \frac{1}{z_{stmi}}$	$\frac{Z_{st}}{n_{stm}} \times \frac{1}{z_{stmi}} \times D_{stmi}^*$
21.1	rural/urban	$\frac{Z_{stmj}}{n_{stmj}} \times \frac{1}{z_{stmi}} \times \frac{H_{stmi1j}}{h_{stmi1j}}$	$\frac{Z_{stmj}}{n_{stmj}} \times \frac{1}{z_{stmi}} \times D_{stmi}^* \times \frac{H_{stmi2j}}{h_{stmi2j}}$
	j = 1, 2, 3, 4, 5 for Sch. 21.1		

Note:

- (i) For estimating any characteristic for any domain not specifically considered in sample design, indicator variable may be used.
- (ii) Multipliers have 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) For estimating number of villages possessing a characteristic, take  $D_{stmi}^* = 0$  in the relevant multipliers and there will be only one multiplier for the village.

6. Treatment for zero cases, casualty cases etc.:

6.1 While counting the number of FSUs surveyed ( $n_{sm}$  or  $n_{stm}$ ) in a stratum/sub-stratum, all the FSUs with survey codes 1 to 6 in schedule 0.0 will be considered. In addition, if no SSU is available in the frame then also that FSU will be treated as surveyed. However, if the SSUs of a particular schedule type 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 of that schedule.

6.2 *Casualty cases*: FSUs with survey code 7 as per schedule 0.0 are treated as casualties. In addition to this, an FSU, although surveyed, may have to be treated as casualty for a particular schedule type and a particular *second stage stratum* as given in the following para:

6.2.1 FSUs with survey codes 1 or 4 as per schedule 0.0 having number of households in the frame of j-th second stage stratum greater than 0 but number of households surveyed according to data file, considering both hg/sb together, as nil (i.e.  $H_{i1j} + H_{i2j} > 0$  but  $h_{i1j} + h_{i2j} = 0$ ) will be taken as casualties for j-th second stage stratum.

*All the FSUs with survey codes 1 to 6 as per schedule 0.0 minus the number of casualties as identified above will be taken as the number of surveyed FSUs ( $n_{stmj}$ ) for that (stratum/sub-stratum)  $\times$  (second stage stratum).*

When casualty for j-th second stage stratum occurs for a particular hg/sb but not for the other hg/sb, the FSU will not be treated as casualty but some adjustments in the value of H for the other hg/sb will be done as follows:

- (i) Suppose for hg/sb 1,  $H_{i1j} > 0$  but  $h_{i1j} = 0$  while for hg/sb 2,  $H_{i2j} > 0$  and  $h_{i2j} > 0$ . In that case  $D_i^* \times H_{i2j}$  will be replaced by  $(H_{i1j} + D_i^* \times H_{i2j})$  in the formula for multiplier of hg/sb 2.
- (ii) Suppose for hg/sb 1,  $H_{i1j} > 0$  and  $h_{i1j} > 0$  while for hg/sb 2,  $H_{i2j} > 0$  but  $h_{i2j} = 0$ . In that case  $H_{i1j}$  will be replaced by  $(H_{i1j} + D_i^* \times H_{i2j})$  in the formula for multiplier of hg/sb 1.

It may be noted that  $n_{smj}$  or  $n_{stmj}$  would be same for hg/sb 1 & 2 of an FSU.

## 7. Treatment in cases of void second-stage strata/sub-strata /strata at FSU or household level

7.1 A stratum/sub-stratum may be void because of the casualty of all the FSUs belonging to the stratum/sub-stratum. This may occur in one sub-sample or in both the sub-samples. If it relates to only one sub-sample, then estimate for the void stratum/sub-stratum may be replaced with the estimate as obtained from the other sub-sample for the same stratum/sub-stratum.

7.2 When a stratum/sub-stratum is void in both the sub-samples, 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 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.

6.2 *Casualty cases*: FSUs with survey code 7 as per schedule 0.0 are treated as casualties. In addition to this, an FSU, although surveyed, may have to be treated as casualty for a particular schedule type and a particular *second stage stratum* as given in the following para:

6.2.1 FSUs with survey codes 1 or 4 as per schedule 0.0 having number of households in the frame of j-th second stage stratum greater than 0 but number of households surveyed according to data file, considering both hg/sb together, as nil (i.e.  $H_{i1j} + H_{i2j} > 0$  but  $h_{i1j} + h_{i2j} = 0$ ) will be taken as casualties for j-th second stage stratum.

*All the FSUs with survey codes 1 to 6 as per schedule 0.0 minus the number of casualties as identified above will be taken as the number of surveyed FSUs ( $n_{stmj}$ ) for that (stratum/sub-stratum)  $\times$  (second stage stratum).*

When casualty for j-th second stage stratum occurs for a particular hg/sb but not for the other hg/sb, the FSU will not be treated as casualty but some adjustments in the value of H for the other hg/sb will be done as follows:

- (i) Suppose for hg/sb 1,  $H_{i1j} > 0$  but  $h_{i1j} = 0$  while for hg/sb 2,  $H_{i2j} > 0$  and  $h_{i2j} > 0$ . In that case  $D_i^* \times H_{i2j}$  will be replaced by  $(H_{i1j} + D_i^* \times H_{i2j})$  in the formula for multiplier of hg/sb 2.
- (ii) Suppose for hg/sb 1,  $H_{i1j} > 0$  and  $h_{i1j} > 0$  while for hg/sb 2,  $H_{i2j} > 0$  but  $h_{i2j} = 0$ . In that case  $H_{i1j}$  will be replaced by  $(H_{i1j} + D_i^* \times H_{i2j})$  in the formula for multiplier of hg/sb 1.

It may be noted that  $n_{smj}$  or  $n_{stmj}$  would be same for hg/sb 1 & 2 of an FSU.

## 7. Treatment in cases of void second-stage strata/sub-strata /strata at FSU or household level

7.1 A stratum/sub-stratum may be void because of the casualty of all the FSUs belonging to the stratum/sub-stratum. This may occur in one sub-sample or in both the sub-samples. If it relates to only one sub-sample, then estimate for the void stratum/sub-stratum may be replaced with the estimate as obtained from the other sub-sample for the same stratum/sub-stratum.

7.2 When a stratum/sub-stratum is void in both the sub-samples, 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 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 are 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. In such cases, sub-strata will be merged with other sub-strata for all the second stage strata as in *Case (I) above*.

However, if whole district/stratum becomes void in this manner for a particular second stage stratum, adjustment for this type of stratum void case may be done according to the following guidelines.

The adjustment will be made involving other strata/sub-strata of the State/U.T. Suppose A, B, C and D are the four strata in the State/UT and stratum C is void for j-th *second stage stratum*. If  $\hat{Y}_{aj}$ ,  $\hat{Y}_{bj}$  and  $\hat{Y}_{dj}$  are the aggregate estimates for the strata/sub-strata A, B and D respectively, then the estimate  $\hat{Y}_{cj}$  for stratum/sub-stratum C may be obtained as  $\left( \frac{\hat{Y}_{aj} + \hat{Y}_{bj} + \hat{Y}_{dj}}{Z_a + Z_b + Z_d} \times Z_c \right)$  where  $Z_a$ ,  $Z_b$ ,  $Z_c$  and  $Z_d$  are the sizes of strata A, B, C and D respectively.

**8. Reference to the values of  $Z_{st}$ ,  $n_{st}$ ,  $n_s$ ,  $z_{sti}$ ,  $D_{sti}$ ,  $D^*_{sti}$ ,  $D_{si}$ ,  $D^*_{si}$ ,  $H_{sti1j}$ ,  $h_{sti1j}$ ,  $H_{sti2j}$ ,  $h_{sti2j}$ :**

- (a) Values of  $Z_{st}$  and number of FSUs allotted for the whole round are given in Appendix Table 2 for rural sector and in Appendix Table 3 for urban sector.
- (b) Surveyed number of FSUs ( $n_{st}$ ) should not be taken from the tables. The value of  $n_{stm}$  for each sub-sample is to be obtained following the guidelines given in para 6 above. It includes uninhibited and zero cases but excludes casualty cases.
- (c) The value of  $z_{sti}$  for the samples selected by PPS is to be taken from the column of sample list under the heading ‘frame population’ for rural samples and ‘block size’ i.e. total number of households in each UFS block for urban samples.
- (d) Value of  $D_{sti}$  is to be taken from item 16 of block 1, sch 0.0.  $D^*_{sti}$  is to be calculated from the value of  $D_{sti}$ .
- (e) Values of  $H_{sti1j}$ ,  $H_{sti2j}$  are to be taken from column (5), block 6 of sch 0.0 for respective hg/sb and second-stage stratum.
- (f) The value of  $h_{sti1j}$  and  $h_{sti2j}$  should not be taken from col (9), block 6 of sch.0.0. The figures should be obtained by counting the number of households available in the data file excluding the casualty households.

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