Design & Estimation Procedure of 55th Round

1.1 Introduction: The 55th round of NSS is an integrated survey on household consumer expenditure, employment-unemployment and *informal* non-agricultural enterprises (other than those covered by the Annual Survey of Industries and other industrial categories of 'mining & quarrying' & 'electricity, gas and water supply'). The survey on household consumer expenditure and employment-unemployment is the sixth quinquennial survey in the series, the last one being conducted in the 50th round (1993-94) of NSS.

1.1.1 Salient feature: One salient feature of the 55th round is the *rotation sampling scheme* which is adopted for the first time in the NSS (**central sample only**) for the purpose of collection of **employment-unemployment data**. Under this scheme, 1 sub-sample of the sampled first stage units (FSU's) of each sub-round is revisited in the subsequent sub-round. From each such FSU, sample households visited in the previous sub-round for collecting data on employment-unemployment are revisited in the subsequent sub-round for collecting employment-unemployment details. In addition, for the purpose of collecting employment-unemployment data, a thin sample of 2 households is selected during the revisit from the frame of newly formed households in the FSU. [Note that the above scheme of *rotation sampling* for collecting employment-unemployment data is followed only for the FSU's belonging to the central sample. For state samples, the FSU's are visited only once as they appear in the sample list for canvassing various schedules in the selected households/ enterprises.]

1.1.2 Geographical coverage: The survey covers the whole of the Indian Union excepting (i) Ladakh & Kargil districts of Jammu & Kashmir, (ii) interior villages of Nagaland situated beyond 5 kms. of a bus route & (iii) villages of Andaman & Nicobar Islands remaining inaccessible throughout the year. All the villages of the country, uninhabited according to 1991 census, are also left out of the survey coverage of the NSS 55th round [as done in the earlier Rounds].

1.1.3 Period of Survey and Work Programme: The **fieldwork** of 55th round of NSS is from 1st July, 1999 to 30th June, 2000. As usual, the survey period of this round is divided into four sub-rounds, each with a duration of three months. The 1st sub-round period is from July to September 1999, 2nd sub-round period is from October to December 1999 and so on. Equal number of sample FSU's is allotted for survey in each of these four sub-rounds. Each FSU is surveyed during the sub-round period to which it is allotted. Within a particular sub-round, the fieldwork is spread out **uniformly** over different weeks/ months to the extent possible. As discussed in paragraph 1.1.1, 1 sub-sample of the sampled FSU's of each sub-round is revisited again (only for the central sample) in the subsequent sub-round for collecting employment-unemployment details from the sample households who were visited during the previous sub-round.

1.1.4 Schedules of enquiry: The following table gives the list of schedules of enquiry for the 55th round.

Table 1: Schedules canvassed in the NSS 55th round.

sl. no.	schedule no.	description	sector
(1)	(2)	(3)	(4)
1.	0.1	list of households and non-agricultural enterprises	rural
2.	0.2	list of households and non-agricultural enterprises	urban
3.	1.0	household consumer expenditure	rural & urban
4.	10	household schedule: employment & unemployment	-do-
5.	10.1*	household (revisit) schedule: employment & unemployment	-do-
6.	2.0	informal non-agricultural enterprises	-do-

* canvassed in the sample households revisited in the subsequent sub-round (central sample only)

1.1.5 Linking of sub-rounds x sub-samples x schedules of enquiry: Sample FSU's from each *first stage stratum* are drawn in the form of a number of independent sub-samples. There is a one-to-one correspondence between sub-round number x sub-sample number of the FSU x schedules canvassed in the FSU. The same is clarified below in a tabular form.

Sub-round	Sub-sample	Schedules canvassed in the FSU
1	1, 2	1.0, 10, 2.0
2	1	10.1 (in households revisited), 10 (in newly formed households and also in a few cases where the households surveyed in the previous visit have been substituted)
	3, 4	1.0, 10, 2.0
3	3	10.1 (in households revisited), 10 (in newly formed households and also in a few cases where the households surveyed in the previous visit have been substituted)
	5, 6	1.0, 10, 2.0
4	5	10.1 (in households revisited), 10 (in newly formed households and also in a few cases where the households surveyed in the previous visit have been substituted)
	7, 8	1.0, 10, 2.0

1.2 An outline of sampling design

A stratified sampling design has been adopted for selection of the sample first-stage units (FSU's). The FSU's are villages (panchayat wards for Kerala) for rural areas and Urban Frame Survey (UFS) blocks for urban areas. The Ultimate stage units (USU's) are enterprises for schedule 2.0 and households for schedule 1.0/ 10/ 10.1, which are selected by the method of circular systematic sampling from the corresponding frame in the FSU. Large FSU's are subdivided into hamlet groups (rural)/ sub-blocks (urban), that are grouped into two segments, and USU's are selected independently from each of these segments.

1.2.1 Identification and Selection of first stage units (FSU's)

1.2.2 Sampling Frame: List of villages (panchayat wards for Kerala) as per 1991 Census and latest lists of UFS blocks are respectively used for selection of rural and urban sample FSU's. For selection of sample villages from the State of Jammu & Kashmir, list of villages as per 1981 Census has been used as the sampling frame. It may be mentioned that all the uninhabited villages of the country as per 1991 Census, interior villages of Nagaland situated beyond 5 kms. of a bus route and inaccessible villages of Andaman & Nicobar Islands are left out of the survey coverage of the NSS 55th round.

1.2.3 Sample size (FSU's): A total number of 10,384 FSU's is selected for survey in the *central sample* at all-India level (rural & urban combined) in the 55th round. For *state samples*, there is a matching sample size as per the usual matching pattern being followed over the last few rounds. Sample size for the whole round for each State/UT x Sector (i.e. rural/ urban) are allocated equally among the 4 sub-rounds. Sample FSU's for each sub-round are selected afresh in the form of 2 independent sub-samples.

1.2.4 Formation of Stratum of FSU's

(a) **Rural**:

Two special strata are formed at the **State/ UT level,** viz.

Stratum 1: all FSU's with population between 1 to 100, and
Stratum 2: FSU's with population more than 15,000.

[Note: The above two strata are spread across a given state and are not confined to any particular administrative division within the state.]

Above strata of either type are formed if at least 50 such FSU's are there in the respective frames. Otherwise, they are merged with the general strata.

While forming general strata (consisting of FSU's other than those covered under strata 1 & 2), efforts have been made to treat each district as a separate stratum. If limitation of sample size does not allow forming so many strata, smaller districts within a

particular NSS region are merged to form a stratum. Each district with rural population of 2 millions or more as per 1991 Census (1.8 millions or more as per 1981 Census in case of Jammu & Kashmir) is as usual split into a number of strata.

(b) **Urban**:

Strata are formed within NSS Regions as follows:

Stratum number	Composition of strata by considering population of various towns as per the 1991 Census
1, 3, 5 *	'hospital area' (HA) / 'industrial area' (IA) / 'bazaar area' (BA) blocks taken together of each single city with a population of 10 lakhs or more (there could be a maximum of 3 such cities within an NSS Region)
2, 4, 6 *	Other blocks of each single city with a population of 10 lakhs or more
7	HA or IA or BA blocks of all towns with population between 50,000 to less than 10 lakhs
8	Other blocks of all towns with population between 50,000 to less than 10 lakhs
9	HA or IA or BA blocks of all towns with population less than 50,000
10	Other blocks of all towns with population less than 50,000

* Stratum numbers 3, 4, 5 & 6 remain void if there is only one city in an NSS region with a population of 10 lakhs or more.

If limitation of sample size does not allow forming so many strata, all blocks of stratum 7 are merged with those of stratum 8 and all blocks of stratum 9 are merged with those of stratum 10.

1.2.5 Allocation of FSU's Among Strata: State/ UT level rural sample size is allocated among the rural strata in proportion to population. State/ UT level urban sample size is first allocated among the three classes of towns (i.e. 10 lakh +, 50000 to less than 10 lakhs and less than 50,000) in proportion to population. Then sample allocation for each of the three classes of towns, within an NSS region, is further allocated between two strata types consisting of - (i) HA/ IA/ BA blocks, and (ii) the rest in proportion to total number of FSU's in the respective frames with double weightage given to the first category of blocks. Stratum level allocations for both rural and urban areas of a sub-round are made in even numbers in order to facilitate selection of FSU's in the form of 2 independent sub-samples. Sub-sample numbers are 1 & 2 for sub-round 1; 3 & 4 for sub-round 2; 5 & 6 for sub-round 3 and 7 & 8 for sub-round 4.

1.2.6 Selection of FSU's: For each sub-round, sample FSU's from each stratum are selected in the form of **2 independent sub-samples** by following circular systematic sampling with **(a) probability proportional to population for all rural strata other than stratum 1, and (b) equal probability for rural stratum 1 as well as all urban strata.**

1.3 Identification and Selection of Ultimate Stage Unit within FSU

1.3.1 Formation of hamlet-group/ sub-block Depending upon the values of approximate present population (P) and approximate total number of non-agricultural enterprises (E), decision is taken to divide the FSU into a fixed number of hamlet-groups (hg's - the term applicable for rural samples) / sub-blocks (sb's - the term applicable for urban samples) as per the rules given below:

Value of P	No. of hg's/ sb's formed in the FSU as per population criterion	value of E	no. of hg's/ sb's formed in the FSU as per enterprise criterion
(1)	(2)	(3)	(4)
Less than 1200	1 @	Less than 100	1 @
1200 – 1999	5	100 – 249	5
2000 – 2399	6	250 – 299	6
2400 – 2799	7	300 – 349	7
2800 – 3199	8	350 – 399	8
(and so on)		(and so on)	

@ no. of hb's/ sb's = '1' means the whole FSU is considered for listing.

[For rural areas of Himachal Pradesh, Sikkim and Poonch, Rajouri, Udhampur and Doda districts of Jammu & Kashmir, number of hg's formed in the village as per population criterion is : 1 for P < 600, 5 for P = 600 to 999, 6 for P = 1000 to 1199, 7 for P = 1200 to 1399, 8 for P = 1400 to 1599, and so on (procedure remains unchanged as per enterprise criterion)]

1.3.2 The number (D) of hamlet-groups (hg)/ sub-blocks (sb) formed in the FSU is such that the **higher** of the two values as per population and enterprise criteria is chosen. If value of P is less than 1200 (600 for certain hilly areas specified above) as well as value of E is less than 100 for an FSU, hg/ sb formation is not resorted to and the whole FSU is considered for listing.

1.3.3 In case hg's/ sb's are formed in the sample FSU, the same is done by more or less **equalizing** population.

1.3.4 Formation of Segments within FSU

The hg/ sb having **maximum** concentration of non-agricultural enterprises is selected with certainty for listing of households/ enterprises. This hg/ sb is referred to as **segment 1**. From the remaining (D-1) hg's/ sb's of the FSU, 2 more hg's/ sb's are selected circular systematically and these 2 selected hg's/ sb's together is referred to as

segment 2 for doing a combined listing of households/ enterprises. Thus listing of households/ enterprises is done only in segments 1 and 2 of the FSU. The FSU not requiring hg/ sb formation is to be treated as **segment 1** for the purpose of data collection and estimation.

1.3.5 Sampling frame of households/ enterprises

Having determined the area(s) considered for listing, all the households (including those found temporarily locked) and non-agricultural enterprises are listed in the next step. Although all non-agricultural enterprises are listed, only the 'informal non-agricultural enterprises' (other than ASI and mining & quarrying and electricity, gas & water supply) which operated at least 30 days (15 days for seasonal enterprises) during the last year **qualify** for survey. Such enterprises are referred to as '**eligible enterprises**'. Listing of households as well as eligible enterprises for the purpose of sample selection is independent for segments 1 & 2.

1.3.6 Stratification of households

All the households listed in a segment (both rural & urban) are stratified into two second stage strata, viz. '**affluent households**' (forming second stage stratum 1) and **the rest** (forming second stage stratum 2). In **rural** sector, a household is classified as 'affluent' if the household owns certain items like motor car/ jeep, colour TV, telephone, etc. or owns land / livestock in excess of certain limits. In **urban** sector, the households having MPCE (monthly per capita consumer expenditure) greater than certain limit for a given town/city are treated as 'affluent' households for the present survey and are included in the frame of second stage stratum 1, and rest of the urban households are included in the frame of second stage stratum 2.

1.3.7 Stratification of enterprises

All the eligible enterprises in a segment (both rural & urban) are stratified into **12 strata** by jointly considering their *broad industry group* and *enterprise class*. Eligible enterprises could belong to any of the 6 broad industry groups, viz. manufacturing - 1, construction - 2, trade & repair services - 3, hotels & restaurants - 4, transport, storage & communication - 5 and other service sector - 6. The enterprises are classified into 2 enterprise classes. Enterprise class of an enterprise is '1' if the entrepreneurial activity was pursued with no hired worker during the major part of the period of operation in the last year (in other words, enterprise class is '1' for Own Account Enterprises). Otherwise enterprise class is '2' (i.e. for Establishments). Thus there are 12 possible strata of various combinations of broad industry groups and enterprise classes.

1.3.8 Number of households/ enterprises selected for survey

The **number** of households/ enterprises selected for survey from each FSU in general is given below:-

seg-ment	Household allotment * (sch. 1.0/10 each)			enterprise allotment (sch. 2.0)												
	SSS			broad industry group												
	1	2	total	1		2		3		4		5		6		total
				Ent. class		ent. class		ent. Class		ent. class		ent. class		ent. class		
				1	2	1	2	1	2	1	2	1	2	1	2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
FSU with hg/ sb formation:																
1	1	3	**4**	1	1	1	1	1	1	1	1	1	1	1	1	**12**
2	1	7	**8**	1	1	1	1	1	1	1	1	1	1	1	1	**12**
FSU with no hg/ sb formation:																
1	2	10	**12**	2	2	2	2	2	2	2	2	2	2	2	2	**24**

('SSS' means 2nd stage stratum and 'ent. class' means enterprise class)

* If the FSU is **revisited** in the next sub-round (this is applicable to **central sample** only), a sample of 2 additional households (one each from the 2 segments) is surveyed from out of all new households that may have come up during the last three months, forming 2nd stage strata 9. Thus, a total of 14 households are, generally, surveyed from the FSU at the time of revisit.

1.3.9 In the **Central sample**, if the **FSU is revisited** in the next quarter/ sub-round for collecting employment-unemployment data, all the households surveyed under schedule 10 in visit 1 are **revisited** for collection of employment-unemployment data afresh during visit 2. In addition, a **thin sample** of 2 households (1 each from segments 1 & 2 for the FSU's requiring hg/ sb formation) is selected for survey in visit 2 from the newly formed households (2nd stage strata 9) for collection of employment-unemployment data. It is **important** to note that when the same sample household is revisited, schedule 10.1 is canvassed during the revisit. But if it is either a newly formed household or a substitute of the earlier household surveyed in the previous sub-round (substitute necessitated due to difficulties in collecting information at the time of revisit) or casualty in visit 1 but could be surveyed in revisit, schedule 10 is canvassed.

1.3.10 General procedure of selection of households/ enterprises

Sample **households/ enterprises are selected from the respective frames by circular systematic sampling with equal probability**. For the purpose of systematic sampling, households in the frame of 2nd stage stratum 2 are arranged by means of livelihood x land possessed classes for rural samples and by means of livelihood x MPCE classes for urban samples. Enterprises under each stratum (i.e. segment x broad industry group x enterprise class) are arranged in the ascending order of NIC 2-digit codes (3-digit codes for hotels & restaurants) before sampling.

2. ESTIMATION PROCEDURE FOR 55th ROUND

2.0.1 Approach: This estimation procedure fulfils the twin objectives of providing (a) estimates on quarterly/ sub-round basis, and (b) the estimate of error from the sub-sample replicates. Tabulated estimate for a quarter/ sub-round is obtained by combining the estimates of the corresponding sub-sample replicates. Similarly, a tabulated estimate of the Round is obtained by combining the four sub-round-wise/ quarterly estimates.

2.0.2 The following notations are being used in this section:

a = subscript for the a-th stratum
r= subscript for the r-th sub-sample replicate (r=1,2,…,8)
q= subscript for the q-th sub-round / quarter (q=1,2,3 & 4)
f= subscript for the f-th sampled village/ block as First Stage Unit (FSU)
v= subscript for the v-th visit of sampled village/ block (v=1 & 2)
s= subscript for the s-th segment of sampled village/ block (s= 1 & 2)
c= subscript for the c-th 2nd stage stratum of households in the sampled village/ block (c= 1,2); for new hhs during revisit, c= 9.
g= subscript for the g-th broad group of industry (g=1,2,3,..,6)
t= subscript for the t-th enterprise class (t= 1 & 2)
j= subscript for the j-th sampled household
k= subscript for the k-th sampled enterprise
p= subscript for pooled estimate
z= size used for selection of an FSU from the sampling frame
Z= total of sizes in the sampling frame for the stratum
[Note: For urban sector, z=1 and Z=N which is the total number of UFS blocks (FSU's) in the frame.]
n= number of sampled FSU surveyed within a stratum and a sub-sample replicate (including zero cases but excluding casualty and not reported cases) and used for tabulation
L= number of sub-sample replicates surveyed and used for tabulation
D= number of hamlet-groups/ sub-blocks formed in rural/ urban sampled FSU
H= total number of households listed in the appropriate frame
h= number of sampled households surveyed and used for tabulation from the frame
E= total number of enterprises listed in the appropriate frame
e= number of sampled enterprises surveyed and used for tabulation from the frame
y, x= value of characteristic y, x obtained in the sample
$\hat{Y}, \hat{X}$ = estimated value of characteristic y, x obtained from the sample.

[Also, see sections 2.4 and 2.5.]

2.1 ESTIMATES OF AGGREGATES

In the formulae given in this section, $\hat{Y}$ is the estimate of aggregate of any characteristic y for a given stratum (**a**), and for a particular sub-round (**q**) and sub-sample replicate (**r**). These formulae [except (5) and (6)] are provided for the general case of FSU's having 2 segments 1 & 2. For the FSU's requiring no hg/ sb formation, the formula is identical to that given for segment 1 while the contribution from segment 2 is taken as zero.

Schedule 0.1/ 0.2

For estimating the number of households of 2nd stage stratum (c) from selection stage:

Rural

$$\hat{Y}_c = \frac{Z}{n}\sum_{f=1}^{n}\frac{1}{z_f}\sum_{s=1}^{2}B_{fsc} \qquad \ldots(1)$$

Here $B_{fsc} = H_{fsc}$, for segment 1 (s=1) and $B_{fsc} = \frac{D_f - 1}{2} \times H_{fsc}$, for segment 2 (s=2).

Urban

$$\hat{Y}_c = \frac{Z}{n}\sum_{f=1}^{n}\sum_{s=1}^{2}B_{fsc} \qquad \ldots(2)$$

Here $B_{fsc} = H_{fsc}$, for segment 1 (s=1) and $B_{fsc} = \frac{D_f - 1}{2} \times H_{fsc}$, for segment 2 (s=2).

For estimating the number of enterprises by broad group of industry (g) x enterprise class (t) from selection stage within a stratum and sub-sample replicate,

Rural

$$\hat{Y}_{gt} = \frac{Z}{n}\sum_{f=1}^{n}\frac{1}{z_f}\sum_{s=1}^{2}B_{fsgt} \qquad \ldots(3)$$

Here $B_{fsgt} = E_{fsgt}$, for segment 1 (s=1) and $B_{fsgt} = \frac{D_f - 1}{2} \times E_{fsgt}$, for segment 2 (s=2).

Urban

$$\hat{Y}_{gt} = \frac{Z}{n}\sum_{f=1}^{n}\sum_{s=1}^{2}B_{fsgt} \qquad \ldots(4)$$

Here $B_{fsgt} = E_{fsgt}$, for segment 1 (s=1) and $B_{fsgt} = \frac{D_f - 1}{2} \times E_{fsgt}$, for segment 2 (s=2).

For estimating the number of villages/ blocks possessing a characteristic,

Rural

$$\hat{Y} = \frac{Z}{n} \sum_{f=1}^{n} \frac{y_f}{z_f} \qquad \ldots(5)$$

Urban

$$\hat{Y} = \frac{Z}{n} \sum_{f=1}^{n} y_f \qquad \ldots(6)$$

Here, y=1 if the sampled village/ block possesses the characteristic, and y=0 otherwise.

Schedule 2.0

For estimating a characteristic of enterprises for a stratum of a sub-sample replicate from the selection frame based on a broad group of industry (g) x enterprise class (t):

Rural

$$\hat{Y}_{gt} = \frac{Z}{n} \sum_{f=1}^{n} \frac{1}{z_f} \sum_{s=1}^{2} B_{fsgt} \sum_{k=1}^{e_{fsgt}} y_{fsgtk} \qquad \ldots(7)$$

Here $B_{fsgt} = \frac{E_{fsgt}}{e_{fsgt}}$, for segment 1 (s=1) and $B_{fsgt} = \frac{D_f - 1}{2} \times \frac{E_{fsgt}}{e_{fsgt}}$, for segment 2 (s=2).

Urban

$$\hat{Y}_{gt} = \frac{Z}{n} \sum_{f=1}^{n} \sum_{s=1}^{2} B_{fsgt} \sum_{k=1}^{e_{fsgt}} y_{fsgtk} \qquad \ldots(8)$$

Here $B_{fsgt} = \frac{E_{fsgt}}{e_{fsgt}}$, for segment 1 (s=1) and $B_{fsgt} = \frac{D_f - 1}{2} \times \frac{E_{fsgt}}{e_{fsgt}}$, for segment 2 (s=2).

Note: For tabulating any characteristic from this detailed schedule, $\hat{Y} = \sum_{g} \sum_{t} \hat{Y}_{gt}$ is to be used.

Schedule 1.0/ 10

For estimating a characteristic of household from a given 2nd stage stratum (c) in the selection frame

Rural

$$\hat{Y}_c = \frac{Z}{n}\sum_{f=1}^{n}\frac{1}{z_f}\sum_{s=1}^{2}B_{fsc}\sum_{j=1}^{h_{fsc}}y_{fscj} \qquad \ldots(9)$$

Here $B_{fsc} = \frac{H_{fsc}}{h_{fsc}}$, for segment 1 (s=1) and $B_{fsc} = \frac{D_f - 1}{2} \times \frac{H_{fsc}}{h_{fsc}}$, for segment 2 (s=2).

Urban

$$\hat{Y}_c = \frac{Z}{n}\sum_{f=1}^{n}\sum_{s=1}^{2}B_{fsc}\sum_{j=1}^{h_{fsc}}y_{fscj} \qquad \ldots(10)$$

Here $B_{fsc} = \frac{H_{fsc}}{h_{fsc}}$, for segment 1 (s=1) and $B_{fsc} = \frac{D_f - 1}{2} \times \frac{H_{fsc}}{h_{fsc}}$, for segment 2 (s=2).

Note: For tabulating any characteristic from this detailed schedule, $\hat{Y} = \sum_c \hat{Y}_c$ is to be used.

Schedule 10.1 (Revisit)

Here, the formula for estimating any characteristic from sch. 10.1 is the same as that given for sch. 1.0/ 10.

Note: In Central sample, the estimate from re-visited FSU's is used as follows.

> Estimate from re-visited FSU's within a stratum is treated as an estimate from a sub-sample replicate for that stratum. The estimates of **common** characteristics from both **the schedules 10 & 10.1** are combined over different sub-sample replicates (i.e. with & without re-visited FSU's) to obtain the final estimate.

2.2.1 COMBINED ESTIMATE FROM SUB-SAMPLES

In the previous section, the estimate of a characteristic $\hat{Y}$ as obtained for a stratum (a), for a particular sub-round (q) and a sub-sample replicate (r), actually represent $\hat{Y}_{aqr}$. The combined /pooled estimate for a particular stratum and a particular sub-round is computed as the average of sub-sample replicate estimates and is given below:

$$\hat{Y}_{aq} = \frac{1}{L}\sum_{r=1}^{L}\hat{Y}_{aqr} \qquad \ldots(11)$$

2.2.2 ESTIMATE OF AGGREGATES FOR A SUB-ROUND AT STATE/ UT/ REGION LEVEL

If $\hat{Y}_{qr}$ be the State/ UT/ Region level aggregate from the r-th sub-sample replicate and q-th sub-round, and $\hat{Y}_{qp}$, the combined/ pooled estimate of the aggregate based on the whole sample, for a given sub-round/ quarter q, then

$$\hat{Y}_{qr} = \sum_{a}\hat{Y}_{aqr} \qquad \ldots(12)$$ based on sub-sample replicate group r,

and

$$\hat{Y}_{qp} = \frac{1}{L}\sum_{r=1}^{L}\hat{Y}_{qr} \qquad \ldots(13)$$ based on all sub-sample replicates.

2.2.3 ESTIMATES OF AGGREGATES FOR THE ROUND (i.e. all the 4 sub-rounds/ quarters together) AT STATE/ UT/ REGION LEVEL

The estimates of aggregates for the whole round are computed as the simple average of the sub-round estimates derived in section 2.2.2, and are given below:

$$\hat{Y}_{r} = \frac{1}{4}\sum_{q=1}^{4}\hat{Y}_{qr} \qquad \ldots(14)$$ based on sub-sample replicate1 and 2*,

and

$$\hat{Y}_{p} = \frac{1}{4}\sum_{q=1}^{4}\hat{Y}_{qp} \qquad \ldots(15)$$ based on whole sample.

***Note:** In the Round, sub-samples 1, 3, 5 & 7 (in sub-rounds 1 to 4) are combined together to form sub-sample replicate1 (annual) while sub-samples 2, 4, 6 & 8 (in sub-rounds 1 to 4) combine together to form sub-sample replicate 2 (annual). This is being followed in the remaining sections also.

Stratum level estimate for the Round is obtained similarly.

2.2.4 ESTIMATES OF RATIO

If $\hat{X}$ & $\hat{Y}$ be the State/ UT/ Region level aggregate estimate corresponding to variables x and y, then the estimate of ratio is given below:

$$\hat{R}_r = \frac{\hat{Y}_r}{\hat{X}_r} \qquad \ldots(16)$$ based on sub-sample group r,

and

$$\hat{R}_p = \frac{\hat{Y}_p}{\hat{X}_p} \qquad \ldots(17)$$ based on the whole sample.

(The formulae for $\hat{X}$ are obtained similarly by replacing $\hat{Y}$ by $\hat{X}$ and y by x in the above formulae stated in previous sections.)

Note: Estimates for the sub-round (/quarter) $\hat{R}_{qr}$ and $\hat{R}_{qp}$ may also be obtained by replacing $\hat{Y}_r$ and $\hat{Y}_p$ by $\hat{Y}_{qr}$ and $\hat{Y}_{qp}$, respectively and $\hat{X}_r$ and $\hat{X}_p$ by $\hat{X}_{qr}$ and $\hat{X}_{qp}$, respectively.

2.2.5 ERROR ESTIMATE

The estimated variances of pooled estimates* (as computed above) are calculated on the basis of sub-sample replicate estimates of strata over State/ UT/ Region and obtained as follows:

$$\hat{Var}(\hat{Y}_p) = \frac{1}{L(L-1)} \sum_{a} \sum_{r=1}^{L} (\hat{Y}_{ar} - \hat{Y}_{ap})^2 \qquad \ldots(18)$$

$$\hat{MSE}(\hat{R}_p) = \frac{1}{L(L-1)\hat{X}_p^{\,2}} \sum_{a} \sum_{r=1}^{L} [(\hat{Y}_{ar} - \hat{Y}_{ap})^2 + \hat{R}_p^{\,2}(\hat{X}_{ar} - \hat{X}_{ap})^2 - 2\hat{R}_p(\hat{Y}_{ar} - \hat{Y}_{ap})(\hat{X}_{ar} - \hat{X}_{ap})]$$

(approx.) ...(19)

Note: Such estimates for the quarter may also be obtained by suitable replacement as stated in **2.2.4**.

For the combined estimates of schedules 10 and 10.1 in the Central sample, following may be noted:

As the sample design is circular systematic in the first stage selection and without replication into sub-samples in the re-visited sampled units, an estimate of the variance (upper bound) for estimate of a common characteristic, obtained by combining estimates from both the **schedules 10 & 10.1 in the Central sample,** is computed by using estimates of sub-sample replicates from schedule 10 only for the Round as a whole.

2.3 TREATMENT FOR CASUALTY

2.3.1 SCHEDULE 2.0

I) If E_{fsgt} >0 but e_{fsgt}=0 for a particular frame of enterprises (i.e. for a broad industry group x enterprise class) in a FSU with no hamlet-group/ sub-block formation (i.e. D_f =1), it is a case of casualty and the value of n will be reduced by 1.

II) If D_f > 1 and $E_{fs'gt}$ >0 but $e_{fs'gt}$=0 for s=1 (say, s′) and if it is not a case for the entire FSU, here n will not be reduced by 1 and in this case $[(D_f-1)/2]x\ E_{fsgt}$ will be replaced by $\{ E_{fs'gt} + [(D_f-1)/2]x\ E_{fsgt} \}$ in the formula for s=2.

III) If D_f > 1 and $E_{fs'gt}$ >0 but $e_{fs'gt}$=0 for s=2 (say, s′) and if it is not a case for the entire FSU, here n will not be reduced by 1 and in this case E_{fsgt} will be replaced by $\{ E_{fsgt} + [(D_f-1)/2]x\ E_{fs'gt} \}$ in the formula for s=1.

IV) If E_{fsgt} >0 but e_{fsgt}=0 in a particular frame of enterprises (i.e. for a broad industry group x enterprise class) for both the segments (s = 1 & 2) in an FSU, it is a case of casualty and the value of n will be reduced by 1.

2.3.2 SCHEDULE 1.0/ 10/ 10.1

I) If H_{fsc} >0 but h_{rfsc}=0 for a particular 2nd stage stratum of households in a FSU with no hamlet-group/ sub-block formation (ie. D_f =1), it is a case of casualty and the value of n will be reduced by 1.

II) If D_f > 1 and $H_{fs'c}$ >0 but $h_{fs'c}$=0 for s=1 (say, s′) and if it is not a case for the entire FSU, here n will not be reduced by 1 and in this case $[(D_f-1)/2]\ x\ H_{fsc}$ will be replaced by $\{H_{fs'c} + [(D_f-1)/2]\ x\ H_{fsc}\}$ in the formula for s=2.

III) If D_f > 1 and $H_{fs'c}$ >0 but $h_{fs'c}$=0 for s=2 (say, s′) and if it is not a case for the entire FSU, here n will not be reduced by 1 and in this case, H_{fsc} will be replaced by $\{H_{fsc} + [(D_f-1)/2]\ x\ H_{fs'c}\}$ in the formula for s=1.

IV) If H_{fsc} >0 but h_{fsc}=0 for a particular 2nd stage stratum of households in both the segments (s = 1 & 2) in an FSU, it is a case of casualty and the value of n will be reduced by 1.

Cases with n = 0 at stratum level, if any, may be referred to SDRD for suggesting measures before tabulation.

2.4 REFERENCES TO VALUES OF Z, n, D_f, E_{fsgt}, H_{fsc} ,e_{fsgt}, h_{fsc}

a) The values of Z (i.e. total size of villages/ no. of urban blocks in the frame of a-th stratum) is given in the appendix for rural and urban sectors .

b) The value of D_f is the entry in item-17/block-1 in schedule 0.1/0.2.

c) The block-6, 6A & 7 of schedule 0.1/0.2 provides for the value of H_{fsc} & $E_{fsgt.}$

d) The values of n for each type of schedule are to be obtained by counting the number of sampled FSU's (i.e. villages/ blocks) within a given stratum and a sub-sample replicate for which schedules for the given selection are available for tabulation {including uninhabited village/ block (if sampled) and zero cases for which schedules may not be available} after adjusting for casualty as given in the section 2.3 .

2.5 Some comments on subscripts and factors used in this round

It may be noted that this sample design does not strictly correspond to the earlier surveys but some similarities exist. Those familiar with estimation procedure of the earlier rounds may note the following correspondence:

Old	New
$\mathbf{N_s}$	**n** (restricted to stratum, sub-sample, sub-round for a given formula)
$\mathbf{D_{si}}$	$\mathbf{D_f}$(restricted to stratum, sub-sample, sub-round for a given formula)
I	**f** (i.e. subscript for FSU)
S	**a** (i.e. subscript for stratum)

These modifications were adopted to (i) avoid confusion over **s** related to stratum/ sub-round/ sub-sample/ 2nd stage-stratum and (ii) to make subscripts mnemonic as far as possible.

Mathematical expression for the multiplier at FSU (f) level in differing cases for a given first stage stratum, sub-round and sub-sample

Formula Group- I

Sl.	Schedule	Sector	Broad industry group (g)**	Enterprise class (t)**	segment –I s=1	Segment –II s=2	Stratum weight (common to FSU)	Sub-sample replicate weight for combining together	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	2.0	R	g	t	E_{fsgt}/e_{fsgt}	$[(D_f-1)/2] \times E_{fsgt}/e_{fsgt}$	$Z/(z_f \times n)$	½*	
2.		U	g	t	E_{fsgt}/e_{fsgt}	$[(D_f-1)/2] \times E_{fsgt}/e_{fsgt}$	Z/n	½*	

Formula Group- II

Sl.	Schedule	Sector	2^{nd} stage stratum (c)	segment -I s=1	Segment –II s=2	Stratum weight (common to fsu)	Sub-sample replicate weight for combining together	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
3.	1.0	R	c=1 & 2	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	$Z/(z_f \times n)$	½*	
4.		U	c=1 & 2	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	Z/n	½*	

* Here the number of sub-sample replicates is 2, i.e. L = 2, for the State/ Central sample processed separately.

** As per selection frame.

<u>Note</u>: Multiplier is to be modified for treatment of casualty as per rules stated in section 2.3.

Mathematical expression for the multiplier at FSU (f) level in differing cases for a given first stage stratum, sub-round and sub-sample

Formula Group - III

Sl. no.	Schedule	sector	Visit (v)	2nd stage stratum (c)	Segment -I s=1	Segment -II s=2	stratum weight (common to FSU)	Sub-sample replicate weight (W) for combining together	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
5.	10	R	v=1	c=1 & 2	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	$Z/(z_f \times n)$	W_r	FSU (not re-visited)
6.	10	R	v=2	c=9	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	$Z/(z_f \times n)$	W_{r1}	FSU (re-visited)
7.	& 10.1	R	v=2	c=1 & 2	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	$Z/(z_f \times n)$	W_{r1}	FSU(re-visited)
8.	10	U	v=1	c=1 & 2	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	Z/n	W_r	FSU (not re-visited)
9.	10	U	v=2	c=9	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	Z/n	W_{r1}	FSU (re-visited)
10.	& 10.1	U	v=2	c=1 & 2	H_{fsc}/h_{fsc}	$[(D_f-1)/2] \times H_{fsc}/h_{fsc}$	Z/n	W_{r1}	FSU (re-visited)

For **state sample** where there are no re-visited FSU's and there are 2 sub-sample replications, W_r =1/2 and L = 2.

For **central sample where there are re-visited FSU's** in a sub-round (i.e. sub-round 2, 3 or 4) and tabulation is done by combining estimate of variables from both 're-visited' FSU's and 'not re-visited' FSU's (i.e. sampled independently afresh) in the same sub-round, the re-visited sample FSU's will be treated as a separate sub-sample so that W_r =1/3 & W_{r1} =1/3, and L = 3, unless otherwise stated in the tabulation plan (for exclusion of estimates from 're-visited' FSU's, then L = 2 and W_r =1/2 & W_{r1} =0). If sub-round is 1, then W_r =1/2 always.

<u>Note</u>: Multiplier is to be modified for treatment of casualty as per rules stated in section 2.3.

APPENDIX