Note on Sample Design and Estimation Procedure of TUS 2024

1.0 Introduction

The National Sample Surveys (NSS) are conducted by the Government of India since 1950 to collect data on various socio-economic indicators employing scientific sampling methods. Time use survey 2024 was started from January 2024 and it will continue till December 2024.

1.1 Subject Coverage:

Time Use Survey 2024: The primary objective of Time Use Survey (TUS) is to measure participation of persons in paid and unpaid activities. The survey will be an important source of information on the time spent in unpaid caregiving activities, unpaid volunteer work, unpaid domestic service producing activities of the household members. This will also provide information on time spent on learning, socializing, leisure activities, self-care activities, etc. by the household members.

1.2 Outline of the Survey programme

1.2.1 **Geographical coverage:** The survey is covering the whole of the Indian union except the villages in Andaman and Nicobar Islands which are difficult to access.

1.2.2 **Survey Period:** The survey was started from January 2024 and continue till December 2024.

1.2.3 **Sub-rounds:** The survey period is divided into four sub-rounds of three months duration each as follows:

sub-round 1 :	January 2024 - March 2024
sub-round 2 :	April 2024 - June 2024
sub-round 3 :	July 2024 - September 2024
sub-round 4 :	October 2024 - December 2024

In each of these four sub-rounds equal number of sample First Stage Units (FSUs) is allotted for survey with a view to ensure uniform spread of sample FSUs over the entire survey period. Attempt should also be made to survey each of the FSUs during the sub-round to which it is allotted. *Because of the arduous field conditions, this restriction need not be strictly enforced in Andaman and Nicobar Islands, Lakshadweep, Leh and Kargil districts of Ladakh and rural areas of Arunachal Pradesh and Nagaland.*

1.2.4 **Schedule of enquiry:** During this round, the following Schedules of enquiry will be canvassed:

Schedule 0.0T :	List of Households
Schedule 10.6 :	Time Use

1.3 **Sample Design**

1.3.1 **Formation of sub-units (SUs)**:

1.3.1.1 **Rural areas**: A rural village is notionally divided into a number of sub-units (SU) of more or less equal population during the preparation of frame. Census 2011 population of villages are projected by applying suitable growth rates and the number of SUs to be formed in a village will be determined apriori.

1.3.1.2 The above procedure of SU formation will be implemented in the villages with population *more than or equal to 1000 as per Census 2011*. In the remaining villages, no SU is formed.

1.3.1.3 The number of SUs to be formed in the villages (with Census 2011 population 1000 or more) of the frame will be decided before selection of the samples following the criteria given below:

projected population of the village	no. of SUs to be formed
less than 1200	1
1200 to 2399	2
2400 to 3599	3
3600 to 4799	4
4800 to 5999	5
.....and so on	....

1.3.1.4 **Special case**:

For rural areas of (i) Himachal Pradesh, (ii) Sikkim, (iii) Andaman & Nicobar Islands, (iv) Uttarakhand (except four districts Dehradun, Nainital, Hardwar and Udham Singh Nagar), (v) Poonch, Rajouri, Udhampur, Reasi, Doda, Kishtwar, Ramban of Jammu and Kashmir (vi) Leh and Kargil districts of Ladakh region and (vii) Idukki district of Kerala, numbers of SUs to be formed in a village are determined in such a way that each SU contains 600 or less projected population. Further, SUs are not formed in the villages in the above-mentioned districts/States with population less than 500 as per Census 2011. In the remaining villages the number of SUs to be formed for these States/districts are as follows:

projected population of the village	no. of SUs to be formed
less than 600	1
600 to 1199	2
1200 to 1799	3
1800 to 2399	4
2400 to 2999	5
.....and so on	....

For rural parts of Kerala, similar procedure as mentioned in para 1.3.1.3 above is to be adopted with the modification that the SUs are to be formed within Panchayat Wards instead of villages.

1.3.1.5 Urban **areas**: SUs are formed in urban sector also. The procedure is similar to that adopted in rural areas except that SUs are to be formed on the basis of number of households in the UFS frame instead of population, since UFS frame does not have population. Each UFS block with number of households more than or equal to 250 is divided into a number of SUs. In the remaining UFS blocks, no SU are formed.

1.3.1.6 The number of SUs to be formed in the UFS blocks of the frame are decided before selection of the samples following the criteria given below:

number of households of the UFS block	no. of SUs to be formed
less than 250	1
250 to 499	2
500 to 749	3
750 to 999	4
1000 to 1249	5
.....and so on	....

1.3.2 **Outline of sample design**: A stratified two-stage design is adopted for the TUS 2024 survey. *The first stage units (FSU) are villages/UFS blocks/sub-units (SUs) as per the situation.* The ultimate stage units (USU) are households in both the sectors.

1.3.3 **Sampling Frame for First Stage Units (FSUs)**:

1.3.3.1 There is no SU formation in uninhabited villages and villages (Panchayat wards for Kerala) with population less than 1000 as per Census 2011 (less than 500 as per Census 2011 for the areas mentioned in para 1.4.1.4.1) and entire village is considered as one FSU. All such villages (Panchayat wards for Kerala) areconsidered as First Stage Units (FSUs).

1.3.3.2 In the remaining villages, notional sub-units (SUs) following the procedure as described in para 1.4.1.1 are formed. Such SUs are considered as First Stage Units (FSUs).

1.3.3.3 For the UFS blocks with less than 250 households, the entire UFS block are considered as one FSU. In the remaining UFS blocks, the SUs a

re considered as First Stage Units (FSUs).

1.3.3.4 List of FSUs as described above are the sampling frame for respective cases.

1.3.4 **Stratification of FSUs**:

Rural Sector:

(a) In the rural areas a special stratum is formed at all-India level before the strata are formed in each State/UT. This stratum comprised all the uninhabited villages as per Census 2011 belonging to all States.

(b) All inhabited villages within each NSS State region are constituted a rural stratum.

Urban Sector: In urban areas strata are formed within each NSS State region on the basis of size class of towns as per Census 2011. The tentative stratum numbers and their composition (within each NSS State region) are as follows:

stratum 1 :	all towns with population less than 50,000
stratum 2 :	all towns with population 50,000 or more but less than 3 lakhs
stratum 3 :	all towns with population 3 lakhs or more but less than 15 lakhs
stratum 4, 5, 6, ...	each city with population 15 lakhs or more

1.3.5 **Sub-stratification of FSUs**:

1.3.5.1 **Rural sector:** Three groups of villages are formed within each stratum (except special rural stratum at all-India level)

Group 1: all villages (Panchayat wards for Kerala) with Census 2011 population less than 250

Group 2: all villages (Panchayat wards for Kerala) with Census 2011 population more than or equal to 250 but less than 500

Group 3: remaining villages

The sample size for a rural stratum will be allocated among 3 groups in proportion to population. Let r_1, r_2 and r_3 be the allocations to Group 1, Group 2 and Group 3 respectively. The villages within each group are arranged in ascending order of number of population. For all the three groups within each strata, '$r_1/4$'>1, '$r_2/4$'>1 and '$r_3/4$'>1, are implied formation of 2 or more sub-strata in each group. Sub-strata are demarcated in Group 1, Group 2 and Group 3 respectively in such a way that each sub-stratum is comprised a group of villages (all SUs of a village considered together) of the arranged frame and have more or less equal population.

If number of FSUs in a particular Group is very small, no sub-stratum may be formed in that Group.

1.3.5.2 **Urban sector**: Let 'u' be the sample size allocated for an urban stratum. For all strata, if 'u/4' >1, implying formation of 2 or more sub-strata, all the UFS blocks within the stratum are first arranged in ascending order of total number of households in the UFS blocks as per urban frame. Then sub-strata are demarcated in such a way that each sub-stratum is comprised a group of UFS blocks (all SUs of a block considered together) having more or less equal number of households. If number of blocks in a particular stratum is very small, no sub-stratum is to be formed in the stratum.

1.3.6 **Total sample size (FSUs)**:**10024** FSUs will be surveyed at all-India level.

1.3.7 **Allocation of total sample to State/UTs**: The total number of sample FSUs are allocated to the States and UTs in proportion to population as per Census 2011 subject to a minimum sample allocation of 16 FSUs to each State/UT.

1.3.9 **Allocation of State/UT level sample to rural and urban sector**:State/UT level sample size is allocated between two sectors in proportion to population as per Census 2011 with 1.5 weightage to urban sector. A minimum of 4 FSUs, each for rural and urban sector separately, are allocated to each State/UT

1.3.9.1.Within each sector of a State/ UT, the respective sample size at stratum level is allocated to the different strata in proportion to the population as per Census 2011. Stratum level allocation is adjusted to multiples of 4 with a minimum sample size of 4

1.3.9.2. Generally, allocation is 4 for each sub-stratum in the rural/urban sector. However, allocation is adjusted in case of constraints of first stage units. Thus, allocations may be more than 4 in some cases.

4 FSUs are allocated to rural special stratum at all India level.

1.3.10 **Selection of FSUs within a stratum/sub-stratum**:

1.3.10.1 From all the sub-strata in both rural and urban sector within each stratum, required number of FSUs are selected by Simple Random Sampling without Replacement (SRSWOR) scheme.

1.3.11**Formation of sub-units and listing of households**

1.3.11.1**Procedure of formation ofSUs:** After identification of the boundaries of the village/ UFS block which contains the sample FSU, the village/ UFS block is to be divided into a number of SUs (say, D) as given in the sample list by more or less equalising the present population of the village/UFS block in which the sample FSUs are located. It is to be ensured that SUs formed are clearly identifiable in terms of physical landmarks. For villages/blocks where the number of SUs to be formed is 1 as per the sample list, no SU formation is required.

1.3.11.2**Listing of households:** All the households of the sample FSU will be listed. Temporarily locked households are also be listed after ascertaining the temporariness of locking of the households through local enquiry.

1.3.12**Formation of Sub-divisions in the selected SU**: It has been observed in the previous rounds that there happen to be some extreme cases where the population/number of households of the selected SU is very high and listing becomes very difficult. To take care of such extreme situations, such SU may be sub-divided into a number of smaller units (i.e., Sub-divisions) and one of them may be randomly selected. Listing and selection of households may be done in the selected Sub-division unit only. The procedure for formation of Sub-divisions is same as that of formation of SUs within village/blocks. The listing of hamlets will not be required but Sub-divisions will be formed such that each Sub-division has more or less equal population and is a compact area.

The criteria for determining the number of Sub-divisions (D_1) to be formed in the selected rural/urban SUs is as follows:

Approx. population of the selected SU	no. of Sub-divisions (D_1) to be formed
less than 1500	1
1500 to 2399	2
2400 to 3599	3
3600 to 4799	4
4800 to 5999	5
.....and so on	....

1.3.12.1 **Special case**:

1.3.12.1.1 For rural areas of (i) Himachal Pradesh, (ii) Sikkim, (iii) Andaman & Nicobar Islands, (iv) Uttarakhand (except four districts, i.e.,Dehradun, Nainital, Hardwar and Udham Singh Nagar), (v) Punch, Rajouri, Udhampur, Reasi, Doda, Kishtwar, Ramban of Jammu (vi) Leh and Kargil districts of Ladakh region and (vii) Idukki district of Kerala, the criterion for determining the number of sub-divisions (D_1) to be formed in rural SUs is as follows:

Approx. population of theselected SU	no. of Sub-divisions to be formed
less than 750	1
750 to 1199	2
1200 to 1799	3
1800 to 2399	4
2400 to 2999	5
.....and so on	....

1.3.13**Listing of households**: All the households of the sample FSU are listed. Temporarily locked households are also listed after ascertaining the temporariness of locking of households through local enquiry.

1.3.14**Selection of households:**A total number of 14 households are selected from each FSU and canvassed during 7 days. 2 households are canvassed on each day of the week. The sample households are selected by SRSWOR.

2. **Estimation Procedure**

2.1 **Notations:**

s = subscript for s-th stratum

t = subscript for t-th sub-stratum

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

k = subscript for k-th sample household within an FSU

D_1 = total number of sub-divisions formed in the sample FSU. D_1=1, if no Sub-division is formed in the SU

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

H = total number of households listed in a selected FSU

h = number of households surveyed in a selected 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_{stik} = observed value of the characteristic y for the k-th household of the i-th FSU 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.

2.2 **Formulae for Estimation of Aggregates for a stratum × sub-stratum:**

422.1 **Schedule 0.0 T (Rural/Urban):**

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

$$\hat{Y} = \frac{N}{n}\sum_{i=1}^{n} D_{1\times}\, y_i$$

where y_i is the total number of households possessing the characteristic *y* in i-th FSU respectively.

2.2.2 **Schedule 10.6:**

2.2.2.1For any indicator stratum× sub-stratum level aggregates:

$$\hat{Y}st = \frac{N}{n_{st}} \sum_{i=1}^{nst} \left[D1 * \frac{H_i}{h_i} \sum_{k=1}^{h_i} y_{ik} \right]$$

Where n_{st} is the number of sample FSUs surveyed including zero cases and uninhabited in a particular stratum × sub stratum.

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

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

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

2.4 **Overall Estimate of Aggregates at State/UT/all-India level**:

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

2.5 **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 $(\hat{\boldsymbol{R}})$ of the ratio $\left(\boldsymbol{R} = \frac{\boldsymbol{Y}}{\boldsymbol{X}}\right)$ will be obtained as $\hat{\boldsymbol{R}} = \frac{\hat{\boldsymbol{Y}}}{\hat{\boldsymbol{X}}}$.

2.6 **Estimation of Errors**:

2.6.1 **Formula for estimated variance (for Rural/Urban)**:

2.6.1.1 Here FSU is selected by SRSWOR method and USU (households) also selected SRSWOR method. If i^{th} FSU has been selected then $h_i$unit is selected from this particular FSU by SRSWOR method.

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

$\widehat{Y_\iota}=H_i * \overline{y_\iota} * D_{1si}$ and $\overline{y_i}= \sum_1^{h_{ij}} y_{ik} \Big/ h_i$

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

$\widehat{var}\ (\widehat{Y_{st}})= N_{st}^{\ 2}\ (\frac{1}{n_{st}} - \frac{1}{N_{st}})\ (1/(n_{st} - 1)) \sum_1^{n_{st}} (H_{sti} * D_{1sti} * \overline{y_{st\iota}} - \frac{1}{n_{st}} \sum_1^{n_{st}} H_{sti} * D_{1sti}\, \overline{y_{st\iota}})^2 +$
$\frac{N_{st}}{n_{st}} \sum_1^{n_{st}} H_{sti}^{\ 2} * D_{1sti}^{\ 2} (\frac{1}{h_{sti}} - \frac{1}{H_{sti} * D_{1si}})\ s^2_{wi}$

where $s^2_{wi} = \frac{1}{(h_{sti}-1)} \sum_{k=1}^{h_{sti}} (y_{stik} - \overline{y_{st\iota}})^2$

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

Note that MSE($\widehat{R}$) is unbiasedly estimated by V($\hat{Y}$- R$\hat{X}$) × $\frac{1}{\hat{X}^2}$

V($\hat{Y}$ -R$\hat{X}$)= v($\hat{u}$) where u_{ik}= (y_{ik} – R x_{ik}) ,

U_i = (Yi – R Xi) and U=(Y-RX)=0 at domain level (State/All India) .

$\widehat{X^2 MSE}\ (\hat{R}) = \hat{V}\ (\hat{U})$ at R= $\hat{R}$

$\widehat{Y_{st\iota}} = \frac{1}{N_{st}} * \sum_k y_{stik} * n_{st}$ * multiplier

$\widehat{X_{st\iota}} = \frac{1}{N_{st}} * \sum_k x_{stik} * n_{st}$ * multiplier

$$\hat{MSE}(\hat{R}) = \frac{1}{\hat{X}^2} \sum_s \sum_t \hat{MSE}st(\hat{R})$$

Finally;

$\widehat{MSE_{st}}(\hat{R}) = N_{st}^2 (\frac{1}{n_{st}} - \frac{1}{N_{st}}) \frac{1}{(n_{st}-1)} \sum_1^{n_{st}} (H_i\, D_{1si} \overline{u_\iota} - \frac{1}{n_{st}} \sum_1^{n_{st}} H_i\, D_{1si} \overline{u_\iota})^2$

$+\frac{N_{st}}{n_{st}} \sum_1^{n_{st}} H^2{}_i * D_{1si}^{\ 2} (\frac{1}{h_i} - \frac{1}{H_i * D_{1si}}) s_{ui}^{\ 2}$

Where $s_{ui}^{\ 2} = \frac{1}{(h_i-1)} \sum_{k=1}^{h_i} (u_{ik} - \overline{u_\iota})^2$

$\overline{u_\iota} = \overline{y_\iota} - \hat{R}\overline{x_\iota}$

Multiplier formulae are as given in Section3.

2.6.2 **Estimates of Relative Standard Error (RSE)**:

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

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

3. **Multipliers**:

3.1 The formulae for multipliers at stratum/sub-stratum stratum level for a schedule type are given below.

schedule	sector	formula for multipliers
0.0T	Rural/urban	$\frac{N_{st}}{n_{st}}$
10.6	Rural/urban	$\frac{N_{st}}{n_{st}}\times D_1 \times \frac{H_{sti}}{h_{sti}}$

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 0.0T irrespective of any misclassification observed between the listing Schedule and detailed enquiry Schedule.

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

4.1 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: 0.0T will be considered. In addition, if no household is available in the frame then also that FSU will be treated as surveyed. However, household 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.

4.2 *Casualty cases*: FSUs with survey code 7 as per Schedule: 0.0T are treated as casualties. In addition to this, an FSU, although surveyed, may have to be treated as casualty for a particular cases

4.2.1 FSUs with survey codes 1 or 4 as per Schedule: 0.0Thaving number of households in the frame greater than 0 (i.e. H > 0) but number of households surveyed according to data file as nil (h =0), will be considered as casualties for this particular FSU.

All the FSUs with survey codes 1 to 6 as per Schedule 0.0T minus the number of casualties as identified above will be taken as the number of surveyed FSUs (n_{st}) for that (stratum/sub-stratum)).

5. **Treatment in cases of void sub-strata /strata at FSU level**

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

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

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. If for a particular group only one sub-stratum is there and only one FSU is allocated and the FSU become casualty then this sub-stratum can be merged with next group sub-stratum with proper size adjustment. Merged (in which void sub-stratum is merging) sub-stratum size may be calculated as :

Merged stratum size + Merging stratum size * (per FSU size of merging sub-stratum/per FSU size of merged sub-stratum).

Here merging sub-stratum means void sub-stratum and merged sub-stratum means in which void sub-stratum is merging. Here per FSU size of a sub-stratum means average number of households per sub-unit in urban area and average population per sub-unit in rural area.

(ii) If a rural/urban stratum (NSS Region/NSS Region * Town class) 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 NSS Region for which estimates are available and remarks to that effect may be added in appropriate places.