Estimation Procedure for LFS + NCLS 2006, Mongolia

The following notations are used :

s = subscript for s-th stratum (s = 1-29)
i = subscript for i-th sample kheseg / bagh
j = subscript for j-th second-stage stratum of sample kheseg / bagh
k = subscript for k-th sample household
l = subscript for l-th person in a sample household
r = subscript for sub-sample (r = 1, 2)
p = population (size) of the sample kheseg / bagh used for selection
P = total population in a stratum as per the frame
n = number of sample kheseg / bagh (i.e. no. used for tabulation) excluding casualty
   cases.
D = number of segments formed in the kheseg / bagh
H = total number of households listed in the frame
h = number of sample households available for tabulation
x, y = observed value of characters X, Y under estimation
$\hat{X}$, $\hat{Y}$ = estimate of population total of the characters X, Y.

Then y_{srijkl} = observed value of the character Y for the l-th person of k-th sample household belonging to j-th second stage stratum of i-th kheseg/bagh (FSUs) of the r-th sub-sample of s-th stratum. Normally, y = 1 or 0.

Formulae for estimation :

Annul estimate of Y_{sr} for stratum s and sub-sample r:

$$\hat{Y}_{sr} = \frac{P_s}{n_{sr}} \sum_{i=1}^{n_{sr}} \frac{D_{sri}}{p_{sri}} \sum_{j=1}^{2} \frac{H_{srij}}{h_{srij}} \sum_{k=1}^{h_{srij}} \sum_{l} y_{srikl}$$

If Q_t is the set of FSUs selected for t-th quarter, the quarterly estimate for t-th quarter is given by:

$$\hat{Y}_{tsr} = \frac{P_s}{n_{tsr}} \sum_{i \in Q_t} \frac{D_{sri}}{p_{sri}} \sum_{j=1}^{2} \frac{H_{srij}}{h_{srij}} \sum_{k=1}^{h_{srij}} \sum_{l} y_{srikl} \quad , t=1, 2, 3, 4$$

Estimate for the aggregate :

Pooled estimate $\hat{Y}$ based on two sub-samples is obtained as

$$\hat{Y}_s = \frac{1}{2} \sum_{r=1}^{2} \hat{Y}_{sr}$$

The pooled estimate $\hat{Y}$ at country level is obtained by summing the stratum estimates $\hat{Y}_s$ over all the strata.

3.4 **Multipliers** (weights):
The formula for multipliers is given below :
Formula for multiplier for a sub-sample is

$$M_{srij} = \frac{P_s \times D_{sri} \times H_{srij}}{n_{sr} \times p_{sri} \times h_{srij}}$$ and for combined sub-samples, it is

$$M_{sij} = \frac{1}{2} \times \frac{P_s \times D_{sri} \times H_{srij}}{n_{sr} \times p_{sri} \times h_{srij}}$$ and for a quarter t, the formula is

$$M_{tsij} = \frac{1}{2} \times \frac{P_s \times D_{sri} \times H_{srij}}{n_{tsr} \times p_{sri} \times h_{srij}}$$

Value of P, p, n, D, H & h

- The values of P_s are given in Table 1.
- The values of n_{sr} are to be obtained by counting the number of sample FSUs (baghs/khesegs) in sub-sample r available for tabulation. If there is no casualty of FSUs, it will be the same as allotted number of FSUs.
- If n_{sr} is found zero in a stratum for a particular sub-sample, the estimate for this sub-sample may be taken as the same based on the other sub-sample of the same stratum. However, special action is to be taken if n_s (or n_{sr}) is zero for building up estimates for the whole stratum.
- Value of p_{si} is the entry in item 11: Frame population of ID, Section I, Listing Questionnaire.
- Value of D_{sri} is the entry in item 9: number of segments formed of Section I, ID Particulars, Listing Questionnaire.
- Value of H is given in column 2, Section V, Listing Questionnaire.
- Values of h are given column 7, Section V, Listing Questionnaire. These are obtained by counting the number of household questionnaires available for tabulation excluding casualty cases.

Ratio estimates

The estimate of the ratio R = $\frac{Y}{X}$ (X is the population total of an auxiliary variable) is given by

$$\hat{R} = \frac{\hat{Y}}{\hat{X}}$$

Error estimates

The error estimate may be obtained on the basis of sub-sample wise estimates of the stratum totals. The estimates of the variances of $\hat{Y}$ and $\hat{X}$ are given by

$$\hat{V}(\hat{Y}) = \frac{1}{4} \sum_s (\hat{Y}_{s1} - \hat{Y}_{s2})^2$$

2

$$\hat{V}(\hat{R}) = \sum_s [(\hat{Y}_{s1} - \hat{Y}_{s2})^2 - 2\hat{R}(\hat{Y}_{s1} - Y_{s2})(\hat{X}_{s1} - X_{s2}) + \hat{R}^2(\hat{X}_{s1} - X_{s2})^2] \div 4\hat{X}^2$$

where $\hat{Y}_{s1}$ and $\hat{Y}_{s2}$ are the estimates of the s-th stratum total obtained from sub-samples 1 and 2 respectively. Similarly, $\hat{X}_{s1}$ and $\hat{X}_{s2}$ are the estimates of X based on sub-samples 1 and 2 respectively.

Relative standard errors (RSEs) of $\hat{Y}$ and $\hat{R}$ are given by

$$RSE(\hat{Y}) = \frac{\sqrt{\hat{V}(\hat{Y})}}{\hat{Y}} \times 100 = \frac{\hat{Y}_1 - \hat{Y}_2}{\hat{Y}_1 + \hat{Y}_2} \times 100$$

and

$$RSE(\hat{R}) = \frac{\sqrt{\hat{V}(\hat{R})}}{\hat{R}} \times 100$$

Table 1: Values of P_s (size of s-th stratum i.e. stratum population) and n_s (no. of sample FSUs allotted for survey)

stratum number	District/ Aimag		size of the stratum (P_s)	no. of samples allotted	
	Name	code		To each sub sample(n_s)	Total
(1)	(2)		(3)	(4)	(5)
	CAPITAL CITY				
1		1	83104	20	40
2		2,8	28199	4	8
3		3	200206	40	80
4		4	24909	4	8
5		5	132956	32	64
6		6	114418	24	48
7		7	127167	28	56
8		9	202144	40	80
	AIMAGS				
9		1	91055	16	32
10		2	95758	20	40
11		3	82088	16	32
12		4	56428	12	24
13		5	63587	12	24
14		6	51582	12	24
15		7	73981	16	32
16		8	49934	12	24
17		9	78668	16	32
18		10	108235	20	40
19		11	47866	12	24
20		12	52768	12	24
21		13	90190	16	32
22		14	88491	16	32
23		15	80924	16	32
24		16	91687	16	32
25		17	123416	28	56
26		18	66762	12	24
27		19	90657	20	40
28		21	84297	16	32
29		22	12625	4	8
Total	**all**	**-**	**2494102**	**512**	**1024**