

## Sampling Practical I

1)

A random sample of  $n=2$  households what is drawn from a small colony of 5 households (hypothetical population) having monthly income (in rupees) as follows:

Household	1	2	3	4	5
Income (in rupees)	156	149	166	164	155

- a) Work out population mean, population mean Square and population variance.
- b) Enumerate all possible samples of size 2 with replacement and show, thereby, that
  - (i) Sample mean ( $\bar{y}_n$ ) is an unbiased for the population mean ( $\bar{Y}_N$ )
  - (ii) Sample mean Square ( $s^2$ ) is unbiased for the population variance ( $\sigma^2$ )
  - (iii)  $V(\bar{y}_n) = \left(\frac{1}{n} - \frac{1}{N}\right) S^2$   $V(\bar{y}_n) = \sigma^2/n$
- c) Enumerate all possible samples of size 2 without replacement and show, thereby, that
  - (i) Sample mean ( $\bar{y}_n$ ) is an unbiased for the population mean ( $\bar{Y}_N$ )
  - (ii) Sample mean Square ( $s^2$ ) is unbiased for the population variance ( $S^2$ )

2)

The table below use the stratification of all the farms in the country by farmsize and the acreage of corn (maize) in the sampled farms. Obtain the estimate of average acreage of corn per farm in the population and its variance.

Also obtain the variance of the estimate of population mean under

- a. Proportional allocation
- b. Optimum allocation; for the same total sample size of 21 farms.
- c. Hence obtain the efficiency of the given allocation with respect to the optimum allocation.

Farm size (acres)	No. of farms $N_h$	Acreage of corn in the sample farms (10 acres)	Standard deviation (10 acres) from a past survey
0-40	12	3.5, 2.7, 1.1, 1.9	5.2
41-80	24	2.4, 6.9, 3.7, 2.8, 3.4, 2.6	3.7
81-120	19	1.0, 1.3, 2.9, 1.6, 3.4	6.5
121-160	13	1.0, 0.0, 2.3, 0.5	3.4
161-200	9	5.8, 4.9	2.7

3) .

In a survey for estimating the milk production in Calcutta all the cowsheds were classified into 3 strata according to the number of milch animals housed therein. An SRSWOR of cowsheds was selected from each of the three strata. The data in the table gives the milk yield (in litres) of selected cowsheds in the summer season.

Distribution of cowsheds by the number of Milch animals and Milk yield per selected Cowshed			
Stratum Type	$N_h$	$n_h$	Total milk-yield (in liters) per selected cowshed
One milch animal	2461	19	0,27,1068,0,0,0,0,0,0,81,418,0,

per cowshed			162,397,0,0,0,0,0,
Two to six milch animals per cowshed	2385	27	960,56,0,0,0,0,513,170,843,1627,661,0,511,0,1361,232,0,981,477,906,864,2422,2055,803,0,0,655
More than six milch animals per cowshed	543	6	1835,1744,1821,2496,7974,10238

Estimate the average milk yield per cowshed in the city of Calcutta during the season. Estimate the variance of the estimate.

4)

The table below gives the summary of data for complete enumeration of 340 villages in a certain District. The villages were stratified according to their agricultural area into four strata. The population values of the strata mean for the area under wheat and those of the standard deviations for the area under wheat are given below along with the values of strata sizes.

Stratum No.	Size of		$\bar{Y}_N$	$S_h$
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	villages in bighas	$N_h$		
1	Up to 500	63	112.1	56.3
2	501-1500	199	276.7	116.4
3	1501-2500	53	558.1	186.0
4	2500- and above	25	860.1	363.1

Compute the sampling variance of the estimated mean under wheat for a 10% sample when

- (i) The villages are selected by the method of simple random sampling without stratification
- (ii) The villages have selected by the method of simple random sampling within each stratum, the sample size being allotted in each stratum in proportion to
  - a)  $N_h$
  - b)  $W_h S_h$
- (iii) Calculate the efficiency of the stratified sampling procedures in (ii) over the unstratified procedure in (i)



5).

The data shown in the table below gives the distribution of number of factories according to size class of workers and stratum mean and standard deviation of output and cost of sampling. Calculate the sampling variance of the estimated average output from a sample of 600 factories if

a) The factories are selected by SRSWOR

b) The factories are selected by SRSWOR from each stratum with

(i) Proportional allocation

(ii) Neymann's optimum allocation

Compare the three variances

If the total cost of survey is Rs. 6000 with an overhead cost of Rs. 1500, find an optimum allocation that will minimize the variance.

Compute the sample size. Find the corresponding value of the variance and compare the same with that for proportional allocation for the same sample size.

Size Class: No. of workers	No. of factories $N_h$	Average output per Factory (000Rs.)	Standard deviation (000 Rs.) $S_h$	Cost of sampling (Rs.) $C_h$
1-49	18260	100	80	6
50-99	4315	250	200	9
100-249	2233	500	600	10
250-999	1057	1760	1900	12
1000-and above	567	2250	2500	15