Cluster Sampling and Systematic Sampling

(Adapted from Cochran 1977)

Cluster Sampling

1. A cluster sample is a simple random sample in which each sampling unit is a collection, or cluster, of elements.

2. Cluster sampling is an effective sampling design for obtaining a specified amount of information at minimum cost/effort under the following conditions:

   (i) A detailed listing of the population elements is not available or is very costly to obtain, while listing the clusters is easily obtained.

   (ii) The cost/effort involved in obtaining observations increases as the distance separating the elements increases.

Systematic Sampling

1. The starting point, i.e., the selection of the first unit, determines the whole sample.

2. It is easier to draw a systematic random sample than a simple random sample or stratified random sample, and often easier to execute without mistakes.

3. Intuitively, systematic random sampling seems likely to be more precise than simple random sampling. In fact, it partitions the population into strata, which consist of the first k units, the second k units, and so on. We might therefore expect the systematic sample to be about as precise as the corresponding stratified random sample with one unit per stratum. The difference is that with the systematic sample the units occur at the same relative position in the stratum, whereas with the stratified random sample the position in the stratum is determined separately by randomization within each stratum. The systematic sample is spread more evenly over the population, and this fact has sometimes made systematic sampling considerably more precise than stratified random sampling.

EX: Systematic random sampling

Population: 0, 2, 4, 3, 1, 0, 2, 1, 3, 0, 4, 2, 1, 2, 0, 1, 3, 1, 1, 2, 3

$\tau = 36$, $\mu = \frac{36}{21} = 1.7143$, and $\sigma^2 = 1.6143$

$N = 7$

Use a single starting to obtain a systematic sample of size 3. List all possible samples.

Possible sample	$\widehat{\mu}$	S^2
0, 1, 0	$\frac{1}{3}$	$\frac{1}{3}$
2, 3, 1	2	1
4, 0, 3	$2\frac{1}{3}$	$4\frac{1}{3}$
3, 4, 1	$2\frac{2}{3}$	$2\frac{1}{3}$
1, 2, 1	$1\frac{1}{3}$	$\frac{1}{3}$
0, 1, 2	1	1
2, 2, 3	$2\frac{1}{3}$	$\frac{1}{3}$

Second ordering: 0, 0, 1, 1, 2, 3, 3, 0, 1, 1 ,2 ,2 ,3, 4, 0, 1, 1, 2, 2, 3, 4

Possible sample	$\widehat{\mu}$	S^2
0, 0, 0	0	0
0, 1, 1	$\frac{2}{3}$	$\frac{1}{3}$
1, 1, 1	1	0
1, 2, 2	$1\frac{2}{3}$	$\frac{1}{3}$
2, 2, 2	2	0
3, 3, 3	3	0
3, 4, 4	$3\frac{2}{3}$	$\frac{1}{3}$

Third ordering: 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 2, 2, 2, 2, 4, 4, 3, 3, 3, 3, 2

Possible sample	$\widehat{\mu}$	S^2
0, 1, 4	$1\frac{2}{3}$	$4\frac{1}{3}$
0, 1, 4	$1\frac{2}{3}$	$4\frac{1}{3}$
1, 1, 3	$1\frac{1}{3}$	$1\frac{1}{3}$
0, 2, 3	$1\frac{2}{3}$	$2\frac{2}{3}$
0, 2, 3	$1\frac{2}{3}$	$2\frac{2}{3}$
1, 2, 3	2	1
1, 2, 2	$1\frac{2}{3}$	$\frac{1}{3}$