

## LECTURE 6: SYSTEMATIC SAMPLING 4.1

### 4.1 Systematic Sampling

Suppose we want to draw a random sample from a population of size  $N$  and we know that elements in the sampling frame are ordered. For example, a manager of a store wants to study buying habits of his customers. The sampling frame consists of customers entering the store. Then the easiest sampling procedure to implement is called the systematic sampling. Functionally it is similar to the simple random sampling, because all population element are equally likely to be chosen for the sample. Suppose we want to draw a sample of size  $n$ . First we compute the sampling interval (or skip)  $k = N/n$ . Then we choose the starting point at random from the interval  $(0, k)$ , and thereafter sample at regular intervals of length  $k$ .

**Example** Suppose you want to sample 8 houses from a street of 120 houses. Since  $k = 120/8 = 15$ , we pick at random starting point between 1 and 15, and then sample every 15th house. If the random starting point is 3, then the houses selected are 3, 18, 33, 48, 63, 78, 93, and 108.

**Example** More frequently, the population is not evenly divisible. For example, suppose you want to sample 8 houses out of 125, so  $k = 125/8 = 15.625$ . Should we sample every 15th or every 16th house? If we take every 16th house ( $8 \cdot 16 = 128$ ), then there is a risk that the last house chosen does not exist. On the other hand, if we take every 15th house ( $8 \cdot 15 = 120$ ), then the last five houses are not in the sampling frame. To ensure that every house has equal chance of being selected for the sample, the random starting point should be chosen as a non-integer between 0 and 15.625. The sampling interval should be kept non-integer,  $k = 15.625$ , but each non-integer selected should be rounded up to the next integer. If, for instance, the random starting point is 7.8, then the houses selected are  $\lceil 7.8 \rceil = 8, \lceil 23.425 \rceil = 24, \lceil 39.05 \rceil = 40, \lceil 54.675 \rceil = 55, \lceil 70.3 \rceil = 71, \lceil 85.925 \rceil = 86, \lceil 101.55 \rceil = 102, \lceil 117.175 \rceil = 118$ .