B Sc II

Simple Random Sampling

In this sampling technique each sampling unit of population has an equal chance to include in the sample. In this method, a simple random sample is drawn unit by unit. The unit drawn is noted and may or may not be replaced back to the population. So a simple random sample may be with and without replacement.

Simple Random Sampling Without Replacement (SRSWOR)

Let us denote the population and sample size by N and n respectively. The probability of selecting any unit at Ist draw is $\frac{1}{N}$, the probability of selecting any unit from the remaining units at IInd draw is $\frac{1}{N-1}$ and so on. The sample obtained in this manner is called simple random sample without replacement and the method is known simple random sampling without replacement (SRSWOR). In this method, there are ${}^{N}C_{n}$ samples of size n and each sample has an equal chance of selection with probability $\frac{1}{{}^{N}C_{n}}$.

Simple Random Sampling With Replacement (SRSWR)

In this method of sampling, a sampling unit selected in the sample is replaced back to the population. So, a sampling unit may be selected in the sample more than one time and population size remains the same (N) at each draw of selection of sample units.

Therefore in this method, the prob. of selecting any sampling at any draw is $\frac{1}{N}$. There are N^n possible samples and each sample has an equal chance of selecting i.e. $\frac{1}{N^n}$.

Various Probabilities of selection

1. Prob that a particular sampling unit is included in the sample

= P(a particular unit is included in the sample)

= P(it is selected at Ist draw) or P(it is not selected at Ist draw but selected at IInd draw) ... or P(it is not selected in the previous (n-1) draws but sel. at nth draw)

$$= \frac{1}{N} + \left(1-\frac{1}{N}\right)\frac{1}{(N-1)} + \left(1-\frac{1}{N}\right)\left(1-\frac{1}{N-1}\right)\frac{1}{N-2} + \cdots$$

$$+ \left(1-\frac{1}{N}\right)\left(1-\frac{1}{N-1}\right)\cdots\left(1-\frac{1}{N-n+2}\right)\frac{1}{N-n+1}$$

$$= \frac{1}{N} + \frac{(N-1)}{N}\times\frac{1}{N-1} + \frac{N-1}{N}\times\frac{N-2}{N-1}\times\frac{1}{N-2} + \cdots + \frac{(N-1)}{N}\cdot\frac{(N-2)}{N-1}\cdots$$

$$\frac{(N-n+3)}{N-n+2}\times\frac{(N-n+1)}{(N-n+2)}\times\frac{1}{(N-n+1)} = \frac{n}{N}$$

2. Prob that a particular unit is selected in the sample at Ith draw

= P[a particular unit is selected in the sample at Ith draw]

= Prob that it is not selected in the previous (I-1) draw but it is selected at Ith draw ?

$$= \prod_{i=1}^{I-1} \text{Prob. that it is not selected at } i\text{th draw} \times \text{Prob that it is selected at Ith draw}$$

$$= \prod_{i=1}^{I-1}\left[1-\frac{1}{N-(i-1)}\right]\times\frac{1}{N-(I-1)}$$

$$= \left[1-\frac{1}{N}\right]\left[1-\frac{1}{N-1}\right]\left[1-\frac{1}{N-2}\right]\cdots\left[1-\frac{1}{N-I+2}\right]\times\frac{1}{N-I+1}$$

$$= \frac{(N-1)}{N}\times\frac{(N-2)}{(N-1)}\times\frac{(N-3)}{N-2}\cdots\frac{(N-I+1)}{(N-I+2)}\times\frac{1}{(N-I+1)} = \frac{1}{N}$$