Module 5:Understanding of applications of renewal theory, Stationary Process with discrete and continuous parameters

Lecture 20:New Multi-Stage Sampling Procedure

The Lecture Contains:

- Batch crawl and jump (BCJ) sequential sampling technique
- Batch jump and crawl (BJC) sequential sampling technique

Previous Next

Module 5:Understanding of applications of renewal theory, Stationary Process with discrete and continuous parameters

Lecture 20:New Multi-Stage Sampling Procedure

Batch crawl and jump (BCJ) sequential sampling technique: This proposed batch crawl and jump (BCJ) sequential sampling methodology follows from batch sequential sampling procedure and for convenience of understanding is illustrated below, Figure 5.2.

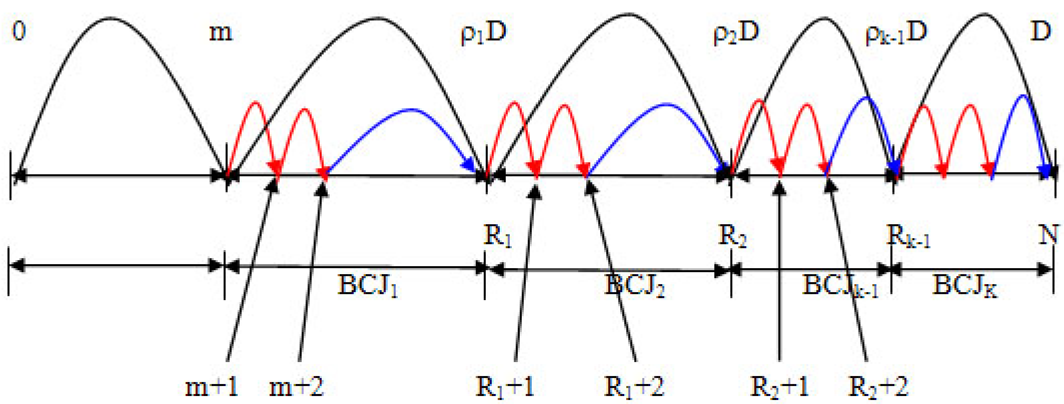

Figure 5.2: Batch crawl and jump (BCJ) sequential sampling technique

The basic notion of this procedure differs from that of batch sequential sampling procedure due to the fact, that for each individual batch we first proceed purely sequentially and then literary jump after a certain number of stages to estimate the values of $\rho_i \times D's$. In order to explain the scheme of sampling, one first needs to specify γ_i, ρ_{i-1}, and k, where i = 1, 2,....., k. Here k is the number of batches, which is fixed at the beginning of the experiment depending on the experimenter's choice of the sampling scheme. Now $0 = \rho_0 < \rho_1 < \rho_2 < \rho_3 < \text{K} < \rho_{k-1} < 1$ are the percentages of the total actual sample size, D, which is unknown and which one needs to estimate. As for the values of $\rho_{i-1}'s$, they are also specified before the experiment.

Previous Next

So if we consider BCJ$_1$ as illustrated in the diagram above, i.e., Figure 5.2, then we need to find $\rho_1 \times D$, usingits estimate R1. γ_i's , $(0 < \gamma_i < 1)$, are the corresponding values of percentage of the ith batch itself,i.e., till which stage in that ith batch we continue sampling taking one at a time observation, i.e., continue using the purely sequential sampling methodology. This effectively means we continue the purelysequential sampling methodology till the $(\gamma_i \times \rho_i \times D)^{th}$ stage in each of the i^{th} batch. After that, one jumps at one go to estimate $\rho_i \times D$. Thus the procedure works as follows. Start with a sample size of $m(\geq 2)$ and for each batch follow the crawl and jump sampling rule according to the scheme given below

$$T_1 = \inf\left\{n \geq m : n \geq \gamma_1 \times \rho_1\left(\frac{S_n^2}{w}\right)\right\}$$

$$U_1 = \left\lceil \rho_1\left(\frac{S_{T_1}^2}{w}\right)\right\rceil$$

$$R_1 = \max\{T_1, U_1\}$$

batch # 1

$$T_2 = \inf\left\{n \geq R_1 : n \geq \gamma_2 \times \rho_2\left(\frac{S_n^2}{w}\right)\right\}$$

$$U_2 = \left\lceil \rho_2\left(\frac{S_{T_2}^2}{w}\right)\right\rceil$$

$$R_2 = \max\{T_2, U_2\}$$

batch # 2

$$T_{k-1} = \inf\left\{n \geq R_{k-2} : n \geq \gamma_{k-1} \times \rho_{k-1}\left(\frac{S_n^2}{w}\right)\right\}$$

$$U_{k-1} = \left\lceil \rho_{k-1}\left(\frac{S_{T_{k-1}}^2}{w}\right)\right\rceil$$

$$R_{k-1} = \max\{T_{k-1}, U_{k-1}\}$$

batch # k-1

.

.

and

$$T_k = \inf\left\{n \geq R_{k-1} : n \geq \gamma_k\left(\frac{S_n^2}{w}\right)\right\}$$

$$U_k = \left\lceil \frac{S_{T_k}^2}{w}\right\rceil$$

$$N = \max\{T_k, U_k\}$$

batch # k

Once sampling stops, we calculate the sample estimator, $\overline{X}_N = \frac{1}{N}\sum_{i=1}^{N} X_i$. We must remember that $R_1, R_2, \ldots, R_{k-1}$ and N estimate the values of $\rho_1 \times D, \rho_2 \times D, \ldots, \rho_{k-1} \times D$ and D respectively. In choosing values of $\rho_{1,\ldots,}\rho_{k-1,}$ the basic idea about the efficiency of the sampling results versus cost of sampling is similar in line to that mentioned for Jump crawl (JC) sequential sampling technique.

Module :Understanding of applications of renewal theory, Stationary Process with discrete and continuous parameters

Lecture 20:New Multi-Stage Sampling Procedure

Batch jump and crawl (BJC) sequential sampling technique: The batch jump and crawl (BJC) sequential sampling methodology (Figure 5.3) is just a different variant of the methodology explained under Batch crawl and jump (BCJ) sequential sampling technique. Under Batch jump and crawl (BJC) sequential sampling technique we follow the jump crawl sampling scheme rather than the crawl jump procedure. The nomenclature of BJC scheme is exactly the same as for BCJ procedure. Hence we illustrate the diagram and the procedure without going into detailed explanation of the same.

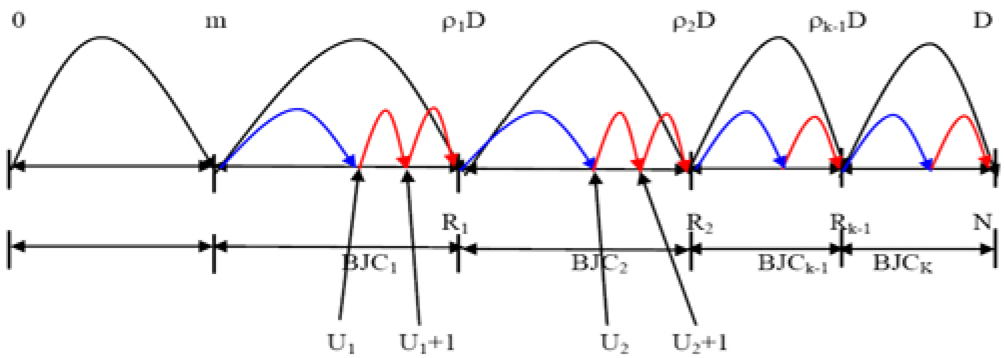

Fig 5.3: Batch jump and crawl (BJC) sequential sampling technique

Previous Next

$$T_1 = \left\lceil \gamma_1 \times \rho_1 \left(\frac{S_m^2}{w} \right) \right\rceil$$
$$U_1 = \max\{m, T_1\}$$
$$R_1 = \inf\left\{ n \geq U_1 : n \geq \rho_1 \left(\frac{S_n^2}{w} \right) \right\}$$

batch # 1

$$T_2 = \left\lceil \gamma_2 \times \rho_2 \left(\frac{S_{R_1}^2}{w} \right) \right\rceil$$
$$U_2 = \max\{R_1, T_2\}$$
$$R_2 = \inf\left\{ n \geq U_2 : n \geq \rho_2 \left(\frac{S_n^2}{w} \right) \right\}$$

batch # 2

.

.

$$T_{k-1} = \left\lceil \gamma_{k-1} \times \rho_{k-1} \left(\frac{S_{R_{k-2}}^2}{w} \right) \right\rceil$$
$$U_{k-1} = \max\{R_{k-2}, T_{k-1}\}$$
$$R_{k-1} = \inf\left\{ n \geq U_{k-1} : n \geq \rho_{k-1} \left(\frac{S_n^2}{w} \right) \right\}$$

batch # k-1

and

$$T_k = \left\lceil \gamma_k \left(\frac{S_{R_{k-1}}^2}{w} \right) \right\rceil$$
$$U_k = \max\{R_{k-1}, T_k\}$$
$$N = \inf\left\{ n \geq U_k : n \geq \left(\frac{S_n^2}{w} \right) \right\}$$

batch # k

After the sampling stops we find the estimator of μ using $\overline{X}_N = \frac{1}{N}\sum_{i=1}^{N} X_i$.

One should note that the value of ρ (for JC method) or ρ_i and γ_i (for BJC or BCJ) would depend on two important factors which are (i) expected regret, i.e., the difference between the estimated risk and its actual value (which is denoted by w) and (ii) number of sampling operations.

Previous Next