Output Analysis for Single Model

LECTURE # 33

Output Analysis for Single Model

- Output analysis is the examination of data generated by a simulation.
- Its purpose is either to predict the performance of a system or to compare the performance of two or more alternative system designs.
  - **Absolute Performance**: Estimating values of one or more system performance measures
  - **Relative Performance**: Comparison of two or more systems

Types of Simulation w.r.t Output Analysis

- **Terminating or Transient Simulation:**
  - That run for some duration of time TE, where E is specified event that stop simulation.
  - Initial condition (time 0) must be specified and stopping event must be well defined.
  - Such a simulated system "opens" at time 0 under well-specified initial conditions and "closes" at the stopping time TE.
  - A simulation is considered to be terminating depends on both of the objectives of the simulation study and the nature of the system.

Types of Simulation w.r.t Output Analysis

- Example:
  - The Shady Grove Bank opens at 8:30 A.M. (time 0) with no customers present and 8 of the 11 tellers working (initial conditions) and closes at 4:30P.M. (time TE = 480 minutes). Here. the event E is merely the fact that the bank has been open for 480 minutes. The simulation analyst is interested in modeling the interaction between customers and tellers over the entire day, including the effect of starting up and of closing down at the end of the day.

Types of Simulation w.r.t Output Analysis

- **Non-terminating System:**
  - It is a system that runs continuously or at-least over a very long period of time.
  - Examples:
    - A continuous production system of many different types
    - Telephone systems
    - Hospital emergency rooms
  - The simulation starts at Time 0, under initial conditions defined by the analyst and run for some analyst specified period of time TE.

Types of Simulation w.r.t Output Analysis

- **Steady-state Simulation:**
  - A steady-state simulation is a simulation whose objective is to study long-run, or steady-state, behavior of a nonterminating system.

Measure of Performance and their Estimations

- **Estimation:**
  - The process by which one makes inference about a population, based on information obtained from a sample.
  - Statistcian use sample statistics to estimate population parameter.
  - The purpose of the statistical analysis is either to estimate standard error or confidence interval or to figure out the number of observations required to achieve a standard error or confidence interval of a given size-or both.
  - An estimate of population parameter may be expressed in two ways
    - Point estimate
    - Interval estimate

Point Estimate

- It is a single value of a population parameter statics.
- The point estimator of θ based on the data { Y" ... , Y.J is defined by

$$\hat{\theta} = \frac{1}{n}\sum_{i=1}^{n} Y_i$$

where θ is a sample mean based on a sample of size n.

- The point estimator θ^ is said to be unbiased for θ if its expected value is θ that is, if
- In general, however, $E(\hat{\theta}) = \theta$

- If $E(\hat{\theta}) \neq \theta$ and $E(\hat{\theta}) - \theta$ is called bias in point estimator.

Interval Estimate

- It is defined by two numbers, between which a parameter is said to lie.
- The length of interval estimate is a measure of error in point estimate.

The point estimator of ϕ based on the data $\{Y(t), 0 \le t \le T_E\}$, where T_E is the simulation run length, is defined by

$$\hat{\phi} = \frac{1}{T_E}\int_0^{T_E} Y(t)dt$$

Confidence Interval Estimation

- To express degree of uncertainty associated with sample statistics.
- The usual confidence interval, which assumes the Yr are normally distributed, is

$$\bar{Y}.. \pm t_{\alpha/2,R-1} \frac{S}{\sqrt{R}}$$

- It consists of 3 parts
  - Confidence level
  - Statistics
  - Margin of error
- Example
  - 5.80 +- 3.18

Comparison of two system designs

- Using 2 statistical techniques
  - Independent Sampling
  - Correlated Sampling (CRN)