Simulation Modeling for Better Decision-Making, I: Fundamental Principles

Overview

   This three-day course is designed for operations research analysts, systems and industrial engineers, military planners, computer scientists, and technical managers who would like to use simulation to design and optimize real-world systems. The course presents definitive methods for developing a simulation model, ensuring its validity, choosing simulation software, selecting input-probability distributions, designing and analyzing simulation experiments, and project management. Unfortunately, many people who attempt a simulation study don't have the technical background required for success, because their education is limited, at best, to an undergraduate course that focusses on how to use a particular simulation-software product. This often results in a system design that does not meet stated performance requirements, excess capital expenditures, or the potential loss of life. The prerequisite for this seminar is a course on probability and statistics, or the equivalent. This course has been presented hundreds of times in countries such as Australia, Brazil, Canada, England, France, Germany, Singapore, South Africa, South Korea, and the U.S.

Outline

1. **Designing and Optimizing Systems via System Modeling**

    - New system design: ensuring that system requirements are met

    - Existing system modification: analyzing alternative configurations

    - Components and logic of a simulation model

    - 10 crucial steps in a sound simulation study

    - The importance of an initial kick-off meeting with all stakeholders present

2. **Selecting Simulation Software**

    - Important software features such as flexibility, ease of use, 3-D animation, and good statistical capabilities

    - Live demonstrations of software

3. **Review of Probability and Statistics That Are Needed for This Course**

4. **Building Valid, Credible, and Appropriately Detailed Simulation Models**

    - Determining an appropriate level of model detail

- Techniques for increasing model validity and credibility

- Management's critical role in the modeling process

5. **Modeling Randomness in Real-World Systems**

- Deciding between fitted theoretical distributions (e.g., exponential or lognormal) or empirical distributions when system data exist

- Using a triangular distribution in the absence of data

- ExpertFit distribution-fitting software

- Basics of random-number generators for the practitioner including the need for reproducibility and multiple streams

6. **Designing and Analyzing Simulation Experiments**

- Choosing experimental parameters such as the number of independent simulation runs (replications), run length, and warm-up period duration when steady-state performance measures are of interest

- Using the simple replication approach to obtain estimators for desired measures of system performance and determining their statistical precision with confidence intervals

7. **Case Study**

- Design of a manufacturing system consisting of workstations and forklift trucks

- Six different configurations of the system are successively proposed and analyzed

8. **23 Critical Pitfalls in Simulation Modeling and How to Avoid Them**

- Modeling process and validation

- Simulation software

- Modeling the randomness in a system

- Design and analysis of simulation experiments

9. **Introduction to Digital Twins and Cloud Computing**