STATISTICAL CONSIDERATION IN SIMULATION

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It is often found that a simulation model of a computer system takes much longer to construct, requires much more computer time to execute, and yet provides much less information than the model writer expected. Yet, many problems associated with design and configuration changes of computing systems are so complex that an analytical approach is often unable to characterize the real system in a form amenable to solution.

It is therefore very important to use statistical methodology that will enable one to achieve his or her desired simulation accuracy as quickly as possible. In this presentation, we discuss several statistical methods for analyzing the outputs of a simulation model: the independent replication method, the single run method, the regenerative method, etc.

The objective of probabilistic simulation can usually be translated as a mapping from a random vector to a scalar value of some performance measure. Thus, many of the variance-reducing techniques developed in the Monte Carlo method are applicable to variance reductions in stochastic system simulations. We will discuss recent progress of the control variable method in simulation of computer system models.

REFERENCES

1. Kobayashi, H. (1978). Modeling and Analysis: An Introduction to System Performance Evaluation Methodology. Addison-Wesley, Reading, Mass.

2. Iglehart, D. L. (1978). "The Regenerative Method for Simulation Analysis." In Current Trends in Programming Methodology, Vol. III: Software Modeling. K. M. Chandy and R. T. Yeh (eds.): 52-71, Prentice-Hall, Englewood Cliffs, New Jersey.

3. Lavenberg, S. S. , T. L. Moeller, and P. D. Welch (1977). "Control Variables Applied to the Simulation of Queueing Models of Computer Systems." In Proceedings of the International Symposium on Computer Performance Modeling, Measurement and Evaluation: 459-468, Yorktown Heights, New York, August 16-18, 1977.

ANALYTIC MODELS FOR COMPUTER PERFORMANCE

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In the past several years noteworthy progress has been achieved in development of various analytic techniques for computer system modeling and performance evaluation. Among a number of mathematical disciplines pertinent to analytic modeling, queueing theory plays the most important role. We view a computer system as a multiple resource system, where resources are the CPU, memory, auxiliary storage, and I/O channels and devices. A major function of the operating system is to manage the use of resources among many programs. Most performance problems are therefore related to queueing delays caused by contention for resources.

In this paper we provide an overview of recent results for queueing network models, and their applications. In particular, various extensions of Markovian queueing networks will be highlighted. We also discuss hierarchical decomposition, computational algorithms, and approximations.

REFERENCES

1. Kobayashi, H. (1978). Modeling and Analysis: An Introduction to System Performance Evaluation Methodology, Addison-Wesley, Reading, Mass.

2. Kobayashi, H. (1978). "System Design and Performance Analysis Using Analytic Models." In Current Trends In Programming Methodology, Vol. III: Software Modeling. K. M. Chandy and R. T. Yeh (eds.): 72-114, Prentice-Hall, Englewood Cliffs, New Jersey

3. Kobayashi, H. and A. G. Konheim (1977). "Queueing Models for Computer Communications System Analysis," IEEE Transactions on Communications com-75(1): 2-19.

4. Kleinrock, L. (1975). Queueing Systems, Vol. I: Theory. John Wiley, New York.

5. Kleinrock, L. (1976). Queueing Systems, Vol. II: Computer Applications. John Wiley, New York.

6. Lemoine, A. J. (1977). "Networks of Queues: A Survey of Equilibrium Analysis," Management Sciences, 24 (4):464-481.