Variance reduction of the mean number of customers in the orbit of M/M/1 retrial queues using sampling methods

Abstract :

In retrial queues, analytical results are generally difficult to obtain. In contrast, there are a great number of numerical and approximation methods. In fact, detailed analytical results exist for some special retrial queuing systems with assumptions on some characteristics such as the retrial times distribution, the number of servers, the customers homogeneity, ..., while for many others, the performance evaluation is limited to numerical algorithms, approximation methods and simulation.

In simulation, the standard sampling procedure used to represent the stochastic behavior of the input random variables is Simple Random Sampling (SRS), the so-called Monte Carlo (MC) method. This method is well known and used in an intensive way, it can solve a large variety of problems, but statistically it is not the best, because its estimates obtained through simulation vary between different runs and this variation is due to the set and sequence effect of the MC method. As a consequence, other sampling methods were proposed to reduce the variance of MC estimates. We can cite Refined Descriptive Sampling (RDS). This method was proposed as a better approach to MC simulation. Several works on sampling methods have been conducted in the field of queuing simulation.

In this paper, our attention is focused on the application of RDS on M/M/1 retrial queues for which an analytical solution exists and can therefore be used as a basis for comparison between RDS and SRS methods. This paper is concerned on the evaluation of performance measures, especially the number of customers in the orbit. A comparison of both MC methods, through the study of the mean number of customers in the orbit, is carried out practically using different efficiency statistical criteria showing that RDS outperforms SRS. To achieve such results, a simulator was designed and realized under Linux using the getRDS generator for the generation of all input RDS samples and the built in random number generator of the computing environment for the generation of all input SRS samples.