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Increasing Sampling Efficiency in Stochastic Process Based on the Erlang Sampling Procedure

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Abstract

Work sampling utilizing the sampling techniques to understand the characteristics of a process rather than the entire process has been widely used in the industrial settings to set standards, in pharmacies to describe work patterns, and in the medical education to describe house staff training. Random sampling of an alternating Poisson process (APP) over a finite period produces inter-observation times with approximate exponential distributions. Pape and Liao [4, 5] and Pape [7, 8] proposed two earlier procedures, the delayed randomization and fixed-random mixture sampling models for gaining some of the efficiency advantage of fixed sampling while retaining some degree of randomization. In this paper, the Erlang sampling procedure is developed. When making N instantaneous random observations of an alternating Poisson process, significant gains in efficiency are shown to result from selecting $2N$, $3N$, or $4N$ candidate observation times, ordering them, and making observations at every second, third or fourth time. The approximate statistical model for the inter-observation times determined by this sampling procedure is Erlang $^{(k,\delta/k)}$. Increasing k causes the sampling method to move in discrete steps from random $^{(k=1)}$ to fixed interval $^{(k=\infty)}$. Direct application of these results can be made to the field of work sampling.

Keywords: Work Sampling, Alternating Poisson Process, Delayed Randomization Model, Fixed-Random Mixture Model, Erlang Sampling Procedure.