

APPROXIMATE METHOD FOR A PRODUCTION LINE WITH ASYNCHRONOUS VACATIONS

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ABSTRACT. *This paper deals with the system of a serial production line consisting of machines and intermediate buffers with finite capacities. In some of such systems the machines will become idle, even when they are ready to work on items, because of starving and blocking. While the machines are idle, they can carry out some auxiliary jobs with economic benefits. We call the periods carrying out such auxiliary jobs as vacations. By utilizing the idle periods in this way the system will be more productive. The present paper proposes a method of evaluating performances of such production lines with vacations. We will construct a model of the systems as a stochastic process. A common difficulty in those situations is that the system of equilibrium equations will easily become huge even for practical scales of production lines if we formulate the whole system as one entity, i.e. as one system of equilibrium equations. We will first develop an exact solution method for the 2-stage system with two machines and a buffer in-between. For larger systems we will develop an approximate method decomposing the system into a set of 2-stage systems. The approximate method is an iterative one. Numerical experiments show that the proposed method is very accurate as well as efficient.*

Keywords: Asynchronous vacation, Phase distribution, Iteration algorithm, Production rate, Accuracy

1. **Introduction.** The system we will investigate in this paper is a serial production line with n machines M_1, M_2, \dots, M_n and $n-1$ finite-capacity intermediate buffers B_1, B_2, \dots, B_{n-1} as in Fig.1. In the past years, a great amount of effort has been devoted to the problem of serial production lines and many important research results have been obtained. Simulation studies and analytical methods are two major approaches. They have their raison d'être. We will employ one of the latter approaches, the queuing theory.

Most of the past researches applying the queuing analyses are rather limited in dealing with blocking and starving which make machines idle. Actually, in those studies machines remain idle without doing any jobs. When the difference of the processing times of

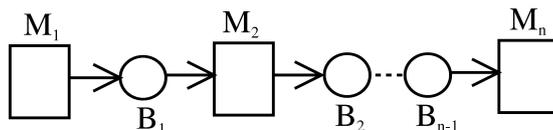


FIGURE 1. Series production line