

PREMIERE REVUE INTERNATIONALE ALGERIENNE DES TECHNOLOGIES AVANCEES

TECHNOLOGIES AVANCEES



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TECHNOLOGIES AVANCEES

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ESTIMATE OF STRONG STABILITY IN THE SYSTEM

G/M/∞ .

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Abstract : Let Π_n denote the stationary distribution of a number of demands in a G/M/m system , considered at the time of the arrival of the next demand . Let Π_∞ denote the stationary distribution of the imbedded Markov chain in a G/M/∞ system .

In this paper ,we determine an estimate of the closeness between the stationary distributions Π_n and Π_∞ . (the perturbed system has the same properties as the G/M/∞ system) .

Keys Words : Estimation ,strong stability, uniform ergodicity, G/M/m system, G/M/∞ system, perturbation .

I. INTRODUCTION

This paper is to be considered a continuation of [Aissani (87)]. We determine the conditions and estimations of the strong stability of chains describing the queue size (demands in service or waiting) in a G/M/∞ system, then, we find exact estimations to approximate characteristics of a G/M/m system by analogous characteristics of the system limit. For this, the perturbed system (the perturbation refers to the structure of the system) of type G/M/m has the same properties as the G/M/∞ system.

The proofs are based on results [Kartashov (81), Aissani (85)] of the strong stability of Markov chains. To apply these results, we introduce in the second paragraph, a special class of norm operators. In the third paragraph, we expose the results of this article .

Note that in practice parameters of queueing systems are, in general, known only approximately. The stability inequalities obtained can be used to estimate the error of definition of the characteristics we are looking for, and this, after small perturbation of the system parameters.

2 . PRELIMINARIES AND NOTATIONS

Consider a G/M/m queueing system (FIPO, ∞) with H distribution of the period between the time of arrival of the demands, and with exponential service time distributions with mean γ^{-1} .

The transition chains are defined with the arrival of new demands and let X_n denote the number of demands (in service or waiting) being in the system at the time of the arrival of the n-th demand. The sequence X_n constitutes a Markov chain with transition kernel $P_m = \parallel P_{ij}(m) \parallel_{i,j} \geq 0$. At the same time, we consider a G/M/∞ queueing system with infinite number of

servers, having the same distribution as the G/M/m system considered previously. To estimate the difference between the stationary distributions of the chains X_n in the G/M/m and G/M/∞ systems, we introduce in the space $m = \{(\mu_n, n \geq 0)\}$ of finite measures on N, a family of norms,

$$\|\mu\|_v = \sum_{n \geq 0} v^n |\mu_n| \quad \text{for any } v > 1$$

Where $\mu = (\mu_n, n \geq 0)$ and $|\mu|$ is the variation of the measure μ .

This norm induces a corresponding norm in the space of transition kernels on $(N, B(N))$

$$\|Q\|_v = \sup_{i \geq 0} v^{-i} \sum_{j \geq 0} v^j |Q_{ij}|$$

All the notions and notations not defined here, can be found in [9]. In particular, the definitions of uniform ergodicity and strong stability in the sense this research goes, are given in the first paragraph, where as the expressions of transition kernels P_m and $P_\infty = \parallel P_{ij}(\infty) \parallel_{i,j} \geq 0$ are given in paragraph two, or for instance in [1], [Kardin(68)] . Recall that we associate with each transition kernel P_{ij} the linear mapping $P_{ij}: m \rightarrow m$

acting on $\mu \in m$ as follow :

$$(\mu P_s)_k = \sum_{j \geq 0} \mu_j . P_{jk}(s)$$

Secondly, we denote by $\mu(Z)$ and $v(Z)$ respectively the generating functions of the measures μ and v . Furthermore, every integral with unspecified domain of integration is taken all over R^+ .