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Analysis of M/G/1 Queueing System with Fixed Times of Feedback

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Abstract: We consider a M/G/1 queueing system with fixed times of feedbacks. Every customer accepts total m times of services. After finishing one service, the customer feeds back to the tail of the queue to wait for another service. The customer departs immediately from the system when he finishes the mth service. The distribution function of the ith service time is $B_i(x), 1 \le i \le m$. To differentiate the ith services of a customer, we define a customer on his ith service as a class-C_i-customer. We obtain the joint probability generation function of the number of class-C_i-customers $(1 \le i \le m)$ under steady status, and provide a way to calculate the mean queue sizes of class-C_i-customers. Moreover, we also obtain the Laplace-Stieltjes Transform of the total sojourn time of a customer.
Key words: M/G/1 queue with feedback; fixed feedback; queue sizes

1. INTRODUCTION

We consider a M/G/1 queueing system with fixed times of feedbacks. A customer arrives at the queueing system according to Poisson distribution and accepts total m times of services. After finishing one service, the customer feeds back to the tail of the queue to wait for another service. The customer departs immediately from the system when he finishes the mth service. No matter the newly arriving customer or the feedback customer, they are served according to the order that they join the tail of the queue (ref. Fig. 1). The distribution of the ith service time of a customer X_i is $B_i(x)$.

The motivation that we consider such a model comes from the performance analysis of mobile intelligent network. We assume that a customer arrives with arriving rate λ, and service times are all independent regardless of different customer or different service of the same customer. Let $\overline{x_i} = E(X_i)$, $\overline{x_i^2} = E(X_i^2)$, $\rho_i = \lambda \overline{x_i}$, $\rho = \rho_1 + \rho_2 + \cdots + \rho_m$, and

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