Comparison Study between Performance Measures of Queues System without and with Priority with the Application of the National Bank of Egypt- Zagazig- Branch

Faten Mohamed Ali Suleiman

Faculty of commerce

Zagazig University

Abstract

This study investigates comparative study between performance measures of the queueing system without and with priority with application on the National Bank of Egypt- Zagazig Branch, using daily data for customer access and the rate of service performance during the period of July 2 until August 8 in 2014. The study used this phenomenon and also use the program (QM for windows).

The applied study found that the average length of the class of priority, and also the average service time are less than them in the case of priority by almost half.

Introduction

The customers have defined the queue as where they wait before being served. A queue is characterized by the maximum permissible number of customers that it can contain. Queues are called infinite or finite, according to whether this number is infinite or finite. Queueing System are often analyzed by analytical methods or simulation. The later technique is a general of wide applications able to incorporate many complexities of a model, but its main drawback is the potentially high development and computational cost to obtain accurate results [Bejan (2007)].

The use of priority-discipline models often provides a very welcome refinement over the more usual queueing models. Many real queueing systems fit these priority-discipline models much more closely than other available models. Rush jobs are taken ahead of other jobs, and important customers may be given precedence over others. Therefore,

The distinction between the two models is whether the priorities are non -preemptive or preemptive. With non-preemptive priorities**,** a customer being served cannot be ejected back into the queue (preempted) if a higher priority customer enters the queueing system. Therefore, once a server has begun serving a customer, the service must be completed without interruption [Pardo, M. and la Fuente, D. (2007)].

With preemptive priorities**,** the lowest-priority customer being served is preempted (ejected back into the queue) whenever a higher-priority customer enters the queueing system. A server is there by freed to begin serving the new arrival immediately.

The Egyptian Governmental Banks play an important role in the stability of the Egyptian economy. But recently, many leading foreign banks have been established in Egypt. To be able to compete with these leading banks, the Egyptian Governmental Banks have to improve their performance efficiency and to present a high quality service.

The customers dealing with some departments' service at Zagazig Branch of National Bank of Egypt suffer and complain from the long times they spend in the bank to acquire specific their needed service. This happens especially in specific days in each month and specific days in each week [Mohamed (2008)].This paper aims to provide suggestion that may help in decrease the time spent to get served.

The rest of the paper is organized as follows:

Section 2 presents the literature review. Section 3 discusses the methodology. Section 4 presents the data and empirical results. Finally, in section 5 summary and conclusions are presented.

1- Literature Review

Vahid Sarhangian (2011) has discussed first study for delay system with different classes of impatient customers. He analyzed the M/G1/1+M queue serving two priority classes under the static non-preemptive priority discipline. He also studied the multi–server priority queue considering two cases depending on the time to abandon distribution begin exponentially distribution or deterministic. In all models, he obtained the Laplace transforms of the virtual waiting time for each class by exploiting the level of crossing methods. He derived the steady-state system performance measure. He considered in the second part of the steady-state waiting time distributions of a two class M/G1/1 queue operating under a dynamic priority discipline. He found an accurate approximation for the steady-state waiting time distribution of low- priority customers, also he obtained bounds for the variance of the waiting time of high- priority customers. Finally, He applied some of illustrative numerical examples.

Walraevens, J., Maertens, T. and Bruneel (2013) have presented study depth analytical of a semi –preemptive priority scheduling discipline. The discipline eliminates the deficits of both the full and non-preemptive versions under the non-preemptive category. They have used probability generating functions and the supplementary variable techniques.

Hattab Guesmi , Ridha Djemal (2013) have presented a scalable architecture for a high performance IP switch based on Priority Active Queue Management (PAQM), which provides multimedia services with improved quality of service (QOS) in the communication system. A performance analysis of an optimized (PAQM) algorithm is presented using an NS-2 network simulator to evaluate the capacity of the internet protocol (IP) switch to support (QOS). The results show that this system can achieve the maximum through to put with low levels of delay. To achieve high performance, they have implemented the proposed algorithm using 0.35 μ m CMOS technology, the performance of which is subsequently analyzed.

Vahid Sarhangian, Baris Balciog˘lu (2013) have studied a first passage time problem for a class of spectrally positive levy processes. By considering the special case where the levy process is a compound Poisson process with negative drift .They obtained the Laplace–Stie1tjes transform of the steady state waiting time distribution of low priority customer in a two–class M/G/1 queue operating under a dynamic non- preemptive priority discipline.

Mohsin Iftikhar, M. , Al Elaiwi, N. and Aksoy (2014) have focused to analyze a three queues priority model for low power Wireless Body Area Network (WBAN), which enables to provide guaranteed quality of service (QOS) parameters such as queue, queueing, through put and packet loss rate . They also simulate the behavior of traffic in (WBAN) to further evaluate the proposed analytical framework.

2- Methodology and Data

One can specify many stochastic processes taking place in the described queueing systems. Some of the characteristics of these stochastic processes are of special interest and may well serve as system performance characteristics.

Let us begin with the notions of busy period and idle period (or vacation period). The busy period is the period of time during which the server is occupied either with servicing of the request or with the switching. The notion of busy period is intuitively absolutely clear. We shall call the periods of time which alternate busy periods by idle periods. It is clear that a busy period follows some idle periods and vice versa.

Let $\pi = \{ \pi^{(1)}, \pi^{(2)}, \ldots\ldots\}$ be consecutive busy periods of the system. One may consider that busy periods π are independent and identically distributed (i.i.d) random variables with some cumulative distribution function (c.d.f) π (t). The sequence π of consecutive busy periods in priority queueing system under all schemes but the "wait and see" mode of behavior of server is a sequence of (i.i.d) random variables. The busy periods in the system with "wait and see" mode of behavior of the server are independent due to Markovian property of the incoming flows [Bejan(2007)].

2-1 The First Method: Single Service M/ M/1 Model

Consider the (M/M/1) where M stands for Markoven, 1 server, the arrival and service rates are λ and μ, respectively. The service discipline is assumed to be first come first served (FCFS). Assuming that steady state, access rate is less than the rate of service ($\lambda<\mu$). Moreover, if the waiting capacity is infinite, the queueing models assume that inter-arrival and service times are exponentially distributed, then the probability density function for the time between successive arrivals would be [Bastani (2009)]

$$\boldsymbol{f}\ (\boldsymbol{t}) = \lambda \boldsymbol{e}^{-\lambda t} \qquad \mathbf{t \geq 0\ ,\ \lambda > 0} \qquad \mathbf{(2\text{-}1)}$$

Equivalently, the arrivals can be said to follow the Poisson process, a collection $\{ N\ (t)\ , t\ \geq 0 \}$ of random variable. Where N(t) is the number of customers that have occurred up to time (t) , starting from time 0 . The Poisson distribution is given by [Taha. A (2007)]

$$P_r\ \{ \mathbf{N}(t)\ \ \mathbf{t} \geq 0 \} = \frac{(\lambda \mu)^n\ e^{-\lambda t}}{n!} \qquad \mathbf{(2\text{-}2)}$$

We now proceed to compute some performance measures. The probability that the service provider is busy (the rate of use of the system)

$$\mathbf{P} = \lambda/\mu \qquad \mathbf{(2\text{-}3)}$$

The possibility of disruption of facilities or service (the probability of the absence of any unit in the system)

$$\rho_0 = 1 - \lambda/\mu \qquad \mathbf{(2\text{-}4)}$$

The probability of having one customer in the system

$$\boldsymbol{\rho_1} = (\lambda/\mu)\ \boldsymbol{\rho_0} \qquad \mathbf{(2\text{-}5)}$$

The probability of the existence of n customers in the system

$$\rho_n = (\lambda/\mu)^n\ \rho_0 \qquad (2\text{-}6)$$

The average number of customers (service recipients) in the system

$$L_s = \frac{\lambda}{\mu \lambda} \qquad (2\text{-}7)$$

The average number of customers in the queue (the average length of the waiting row)

$$\boldsymbol{L_q} = \frac{\lambda^2}{\mu(\mu - \lambda)} \qquad \mathbf{(2\text{-}8)}$$

The average elapsed time for one customer in the system

$$w_s = \frac{1}{\mu - \lambda} \qquad \textbf{(2-9)}$$

The average elapsed time for one customer in the queue

$$W_q = \frac{\lambda}{\mu(\mu - \lambda)} \qquad \textbf{(2-10)}$$

2-2 The Second Method: Priority Model

We consider a single server queueing system serving two types of customers; class-1 and class-2, each having its own respective line and the arrival process for both types is state independent. A higher priority is assigned to class-1. Suppose that the service rule within each class is FIFS and the priority system is preemptive resumed, i.e. during the service of low priority customer's service is interrupted and will be resumed again when there is no high priority customers in the system. We denote by the number of the customers of class i (i=1, 2) [Sarhangian (2011)].

Let the number of customers in the first class is restricted to a finite number L including the one being served, if any, and the number of the second class is infinite. Let also λ_1, λ_2 denote the arrival rates for the two classes and let μ_1,μ_2 denote the service rates for two classes respectively. Denote the traffic intensities by $\rho_1 = \lambda_1/\mu_1$, $\rho_2 = \lambda_2/\mu_2$ and the steady state

probability that the system is in state (i , j), where i is the number of the high priority customers and j is the number of low priority customers in the system. Clearly, the governing difference equations of the system under consideration are given by [Tarabia (2007)].

$$(\lambda_1 + \lambda_2)\, \rho_{0,0} = \mu_1 \rho_{1,0} + \mu_2 \rho_{0,1} \qquad \text{(2-11)}$$

$$(\lambda_1 + \lambda_2 + \mu_2)\, \rho_{0,j} = \lambda_2 \rho_{0,j-1} + \mu_1 \rho_{1,j} + \mu_2 \rho_{0,j+1} \quad , j \geq 1 \qquad \text{(2-12)}$$

$$(\lambda_1 + \lambda_2 + \mu_1) \rho_{i.0} = \lambda_1 \rho_{i-1.0} + \mu_1 \rho_{i+1,0} \quad , 1 \leq i \leq L-1 \qquad \text{(2-13)}$$

$$(\lambda_1 + \lambda_2 + \mu_1) \rho_{i,j} = \lambda_1 \rho_{i-1,j} + \mu_1 \rho_{i+1+j} + \lambda_2 \rho_{i,j-1}$$

$$, \ 1 \leq i \leq L-1 \quad , j \geq 1 \qquad \text{(2-14)}$$

$$(\lambda_2 + \mu_1) \rho_{L,0} = \lambda_1 \rho_{L-1,O} \qquad \text{(2-15)}$$

$$(\lambda_2 + \mu_1) \rho_{L,j} = \lambda_1 \rho_{L-1,j} + \lambda_2 \rho_{L,j-1} \quad , \quad j \geq 1 \qquad \text{(2-16)}$$

3- Empirical Result

The comparison between the obtained results concerning the performance measures in the case of without priority and with priority is performed at the National Bank of Egypt Zagazig Branch for the period time from 2 July to 4 August in 2014.It showed in Table (1)

Table 1 (service Performance Rate without and with Priority from 2 July to 4 August 2014)

		all times				priority		
	average no. of tickets per hour				average no. of tickets per hour			
	arrival rate	service rate	minutes	no. per hour	arrival rate	service rate	minutes	no. per hour
02-July	65.33	00:02:56	2.93333333	20.4545455	45	00:02:14	2.233333	26.86567
03-July	67.40	00:03:37	3.61666667	16.5898618	51.2	00:02:14	2.233333	26.86567
06--July	83.71	00:05:05	5.08333333	11.8032787	59.43	00:01:37	1.616667	37.1134
07-July	62.83	00:03:09	3.15	19.047619	44.67	00:01:55	1.916667	31.30435
08-July	60.40	00:04:02	4.03333333	14.8760331	43.2	00:02:47	2.783333	21.55689
09-July	64.60	00:03:24	3.4	17.6470588	47.6	00:02:19	2.316667	25.89928
10-July	71.40	00:03:05	3.08333333	19.4594595	55.4	00:02:27	2.45	24.4898
13-July	62.00	00:03:59	3.98333333	15.0627615	45	00:02:27	2.45	24.4898
14-July	60.20	00:03:51	3.85	15.5844156	41	00:02:25	2.416667	24.82759
15-July	40.33	00:03:29	3.48333333	17.2248804	29.17	00:02:21	2.35	25.53191
04-August	57.67	00:05:00	5	12	29	00:03:22	3.366667	17.82178

The analysis of these data yields the following results: in case of queue without priority we obtain: λ= 16.33, μ= 63.26, ρ= 0.25 , while in case of queue with priority we obtain λ= 42.39, μ= 107.26, ρ= 0.39, Let L= 20.

From the previous results, we can reach the following performance measures. It showed in Table (2).

Table 2 (Comparison between Queues without and with Priority)

Performance measure	**Without priority**	**With priority**
L_q	**2**	**5**
L_s	**7**	**13**
W_q	**19.8**	**21.6**
W_s	**55.2**	**76.8**

From this comparison, its clear that, the average number of customers in the queue (not counting the customer being served at the server's window) increases at a rate of 3 customer service expected performance borne while in the case of a priority customer, the average number of customers in the system. It is the sum of the average number of customers in the queue plus sum of the average number of customers in the system more than doubled in the event of a priority.

The average wait time in the queue without priority = 19.8 minutes in case of a priority than the waiting time 2 minutes for each customer.

4- Summary and Conclusions

1- The average number of customers in a queue = 2 and the average number of customers in the system = 7 which indicates that in case of priority, these is wasting time until the client gets the service.

2- The average number of customers in a queue without priority = 5 and the number of customers in the system with priority = 13, this means that in the presence of a priority customer bears almost twice as much time to expect in the classroom to get service.

3- The client takes around 19.8 minutes waiting to perform service while waiting 21.6 minutes in case of a priority.

4- The customers with certain priorities either preemptive or non-preemptive affect negatively on the length of the queue falls to existing customers in the queue.

In order to avoid breakdown points in the performance of the bank. To save the time of the customer and the avoid the priority discipline:

1- Addition a property to ATM allows the customer to deposit either for each money or checks.

2- Canceling surcharges when withdrawals from ATMs in agreement with other banks and re-distributed geographically and increase the number of machines.

3- Transferring system must be applied on the account number directly.

References

1- Bastani, p. (2009). A Queueing Model of Hospital Congestion, M .A Thesis , Simon Fraser University.

2- Bejan, A. (2007).Switchover time Modeling in Priority Queueing Systems, Submitted in partial fulfillment of the P.H.D degree in Mathematical Cybernetics and Operations Research.

3- Guesmi[a] , H. and Djemal, R. (2013)"Design of Priority- based active Queue management for a high- performance IP switch". Computer and Electrical Engineering, Vol.39, 246-260.

4- Iftikhar, M. , Al Elaiwi, N. and Aksoy, . M. (2014). "Performance Analysis of Priority Queueing Model for Low Power Wireless Body Area Networks (WBANS)". Procedia Computer Science, Vol. 34 , 518-525 .

5- Marīa Josē Pardo[a], David de la Fuente[b]. (2007). "Optimizing a Priority- Discipline Queueing Model using Fuzzy Set Theory". Computer and Mathematics with Applications 54, 267-281.

6- Mohamed, V.(2008). Modeling and Analyzing A Bank Queueing System (A Case Study), M.A Thesis, Cairo university.

7- Pardo, M. and la Fuente, D. (2007). "Discipline Queueing Model using Fuzzy Set Theory". Computers and Mathematics with Applications, Vol. 54 , 267-281

8- Sarhangian, V. (2011). Certain Static and Dynamic Priority Policies in Queueing Systems, M.A Thesis, University of Toronto.

9- Sarhangian, V. and Balcioğlu, B. (2013)."A First Passage Time Problem for Spectrally Positive Lĕvy Processes and its Application to A Dynamic Priority Queue". Operations Research letters, Vol. 41, 659-663.

10- Taha, A. (2007). Operation Research: An Introduction, Upper Saddle River, New Jersey.

11- Tarabia, A. (2007). "Two-Class Priority Queueing System with Restricted Number of Priority Customers". Int. J. Electron. Commun (AEÜ), Vol. 61, 538-539.

12- Walraevens, J., Maertens, T. and Bruneel, H. (2013). "A Semi-Preemptive Priority Scheduling Discipline: Performance Analysis". European Journal of Operation Research, Vol. 224, 324-332.

الملخص

يهدف هذا البحث إلى دراسه مقارنه بين مقاييس الأداء لصفوف الانتظار فى حاله عدم وجود أولويه وفى حاله وجود أولويه وذلك بالتطبيق على البنك الاهلى المصرى فرع الزقازيق ، وذلك بأستخدام بيانات يوميه عن معدل وصول العملاء ومعدل أداء الخدمه خلال الفترة من ٢ يوليو حتى ٨ اغسطس٢٠١٤م. وقد تم استخدام مقاييس الأداء لدراسة هذه الظاهرة وأيضا تم استخدام برنامج (QM)

وتتمثل نتائج الدراسه فى أنه فى حاله عدم وجود أولويه فإن متوسط طول الصف ومتوسط وقت الخدمه أقل عنها فى حاله وجود أولويه بمعدل النصف تقريبا.

تنقسم الدراسه فى هذا البحث إلى خمسة اجزاء رئيسية، تبدأ بالمقدمه، ويعرض الجزء الثانى للدراسات السابقة،ويتناول الجزء الثالث منهجيه البحث، ويستخلص الجزء الرابع عرض البيانات و نتائج الدراسة، وتنتهى الدراسة بعرض الملخص والتوصيات.