Saving Time – Limit for Waiting Line of Clinic with Queuing Theory

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Abstract

This paper implements the waiting line of clinic by using Queuing Theory to save the time-limit. The system is using the multiple queue line. One is for emergent patients, one is for old patients, another one is for new patients and another is for waiting in clinic. And the first priority will give to the emergent patients. So, emergent patients can be satisfied by saving time – limit in waiting line of clinic.

This paper implements clinic system with multiple queue line, limited server model. First, the patients enter the system with call sign in. The system will choose the queue line as appropriate. The information displays to the user as the actual service time of each patient. In this system, the patient can wait systematically in an appropriate queue line. So, patient's waiting time is covered for emergency case.

This paper will explain how to apply the real world problem in Queuing Theory. And it also can help many clinics to solve the waiting time problem for Emergency patients in this system. The system is developed to accommodate the patients to the appropriate queue line. This paper describes and implements the fundamental concepts of Queuing theory.

Keywords: Queuing Theory, Clinic, Emergency patient, Old patient, New Patient, Emergency queue line, Old queue line, New queue line, Waiting queue line.

1. Introduction

A common situation occurring in everyday life is that of ' queuing ' or waiting in a line. Queues (waiting line) from at bus stops, ticket - booths, doctor's clinics, bank counters, traffic lights and so on. Queues are also found in industry, in shops where the machines wait to be repaired; at a tool crib where the mechanics wait to receive tools, in a warehouse where parts wait to be used and in telephone exchange where incoming calls wait to be matured. [4]

In general a queue is formed when either unit requiring services commonly referred to as customers, wait for service or the service facilities, stand idle, and wait for customers. Some customers wait when the total number of customers requiring service exceeds the number of service facilities, some service facilities stand idle when the total number of service facilities exceeds the number of customers requiring service. J.K Shama [4] describes this queuing theory at Operations Research.

The system needs to ensure in arrival sequence is the space between queue lines approaching and analyze the expected and actual service time of each patient. In this system, emergent patients are given to first priority. The system will determine the patients who recurs the clinic within one month that he/she is old patient. If the patients over 70 will define that he/she is emergency patient.

Queuing Theory can apply the service facilities, their operations and customer's waiting time. In the original way of clinic or health care centre, we can see that the single queue system is familiar with the patient's waiting line. If there is an emergency patient, the original way of the single queue system is a big problem. This single queue system may have weak points such as lack of caring and treating immediately to the emergency. To solve this weak point, it needs to provide this multiple queue line system, such as Emergency queue line, Old queue line, New queue line and Waiting queue line. The patient over 70 or emergency case have to wait in Emergency queue line. The patient who came back during one month should wait in the Old queue line. New patient have to line in New queue line. If there is full in Emergency queue line or Old queue line or New queue line, the patient will wait at Waiting queue line. The service facilities would affect on the emergency patient.

By doing this, service facilities would reduce the patient's waiting time and reduce queuing up. If there is no emergency case, the new queue line and

old queue line's patients will be secured alternatively.

In every era, it is health which is very vital for all human beings. On the day, when ordinary clinic crowded with patients, not a specialist centre, ' waiting' is a big problem. That is why 'token system' is used. But this system also has its weak point: how to wait for such a long time for their turns because of its 'single queue system', especially for those patients who are in emergency or the aged. To solve this problem, this waiting line of clinic is designed using Single Server, Unlimited Queue Model of Queuing Theory.

The system can provide the emergency patient more effectively, save life and prevent the emergent patient from the serious case because the system offers the emergency patient with the first priority of the service.

This paper is done to apply in real word. The system is intended to learn the Operation Research and Queuing Theory. And it is proposed to know about the models of Queuing Theory. The system is applied by Queuing Theory very easily in clinics. The main objective of this paper is to reduce the waiting time of the emergency patients and to reduce the preparation time of clinics. The purpose of this paper is that the patients have to wait systematically according to their age or their emergency – stages. The emergency patient's waiting time is saving by the service facilities of the system.

This paper includes the following sections. Section 2 describes the Queuing Theory and explains how to solve the problem of waiting line in clinic. Section 3 represents the architecture of the system. Section 4 explains implementation of this system. In section 5, conclusion is described. And references are included.

2. Requirements of Saving time - limit for waiting line of clinic with queuing theory

2.1. Queues

We come across 'queues' in many occasions in our life. Queuing is inevitable, especially, in highly populated countries.

Few examples are:

1. Waiting to buy/ reserve bus/ train traveling tickets.
2. Waiting to use public telephone booth.
3. Waiting to consult doctor in clinic.
4. Waiting to get service at barber shops/ beauty parlors.
5. Aero planes waiting to take off.
6. Machines waiting to be repaired.
7. Documents waiting to be printed on a shared printer in a network.

The theory which deals with the study of such waiting lines is called 'Queuing Theory'.

A queuing system can be describe as the customers arriving for service, waiting for service if it is not immediate, utilizing the service and leaving the system after being served. J.K Shama [4] explains the essential features of queuing system in Operation Research.

1. Input source (or calling population)
2. Queue configuration
3. Queue discipline
4. Service mechanism (or pattern)

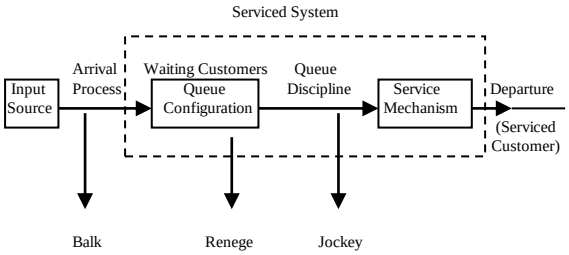

Figure 1: Queuing System

2.2. Requirements of the System

Number of servers refers to one server available for patients to use. Server can be fed from multiple lines or queues. The patients of waiting in line at the clinic have to wait systematically according to their age or their emergency - stages by grouping them into three queue lines.

The capacity refers to the limitation of the system such as waiting lines. When the appropriate waiting line is full, the next patient must accommodate to another waiting line.

The queue discipline describes the manner in which the patients are served after a queue has formed. This system is using common disciplines that are FCFS - First Come First Served and RSS - Random Selection Service, Preemptive priority.

The probability density distribution that determines the customer arrival in the system. In a clinic system, this refers to the patient arrival probability distribution.

2.3. Queuing Problem in Clinic

In this system, firstly, it must define the expected time per patient, the whole time of the system and queue line lengths.

If the expected time per patient assume will be 10 minutes, the fixed time the doctor's given assume

will be 3 hours, the clinic can accept 18 patients for 3 hours. Let the Emergency queue line length for 3 patients, New and Old queue line lengths 5 patients each according to the queue line length. When the emergency queue line is full according to the Emergency queue line length for 3, the patients will be waiting in the Waiting queue line if there is another emergency case. The system of the Old and New queue line is similarly to Emergency queue line and they also have to wait in the Waiting queue line if the patient is fixed in the line.

If there is a patient in the Emergency queue line, the doctor has to serve for first priority. So, one place will be left in Emergency queue line. And then, the system will check there is an emergency patient in the Waiting queue line. If there is an emergency patient in the Waiting queue line, the system will push to the Emergency queue line.

Moreover, the system will be served the patients in the Old queue line and New queue line alternatively if there is not the patient in the Emergency queue line. The system will check if there is a patient in the Waiting queue line equally to the Emergency queue line when the system served the Old and New queue line. If there is a patient in the Waiting queue line, the system will push to the appropriate queue line, respectively.

The system will display " The limit (Full patient)" when the served patients, the patients in service, the patients in Emergency queue line, the patients in Old queue line, the patients in New queue line and the patients in Waiting queue line are over 18 that is fixed patients for 3 hours. By this way, this system will solve the problem of the patients in the waiting line of the Clinic.

3. Architecture of this System

The architecture of the system that can be accommodated the patients using queuing theory. So, the emergent patients can be satisfied by saving waiting time. The service facilities would reduce the patient's waiting time.

First, there is need to give expected time, total time, and queue line length as inputs. And then, when the patients arrive, name, age, date and emergency case are given as inputs. If there is an old patient in this case, the patient number that used within one month is also given as input.

The patient's input is examined whether he or she is greater than 70 or not or the emergent one. Only the patient who is greater than 70 or the emergent one has to wait at emergency queue line. If he is not such kind of patient, he will be examined using the database whether he is the old one or the new one. If he is the old patient, he has to wait at the old queue line. If not, he has to wait the new queue line. Then, the first priority will be given to the patient who is in the emergency queue line. Only if there is no patient in the emergency queue line, the patients in the old and new queue line will be given services alternately. Only when the doctor's finish response is received, the service will be finished.

The patient must wait at the Waiting queue line whether Emergency queue line, Old queue line, New queue line or any queue line is not available. The number of patients in the system is limited by using expected time and total time. The system flow diagram is as follow:

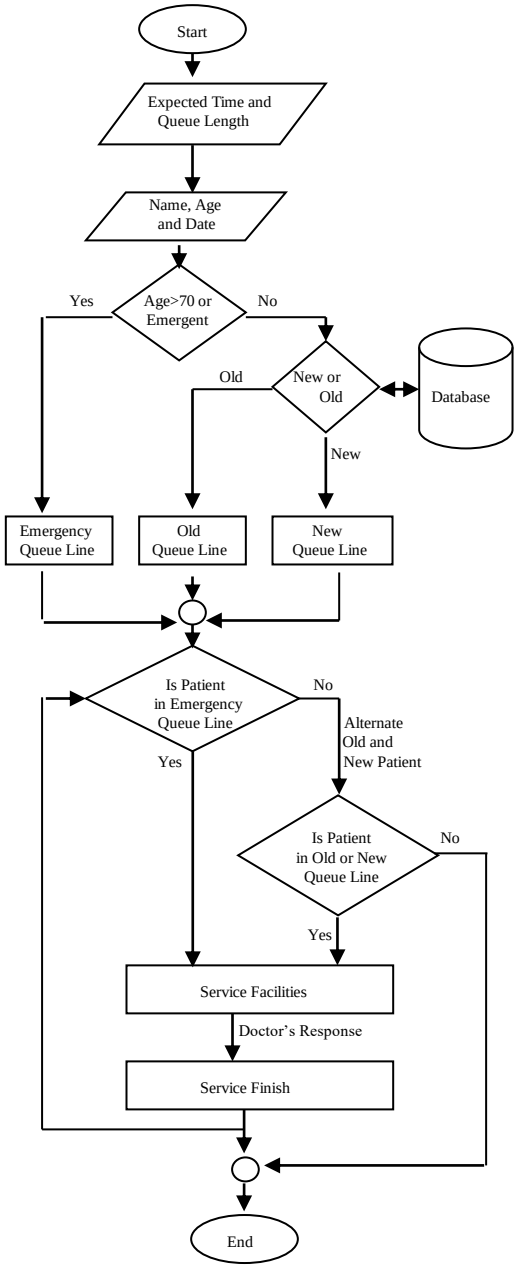

Figure 2: System Flow Diagram

4. Implementation of the System

This system is implemented to save waiting time by using multiple queue line. At first, the interface that must be given the inputs of expected time per patient, total time and queue lengths. And if the patient is new patient, he/she just need to input Name, Age and Date. If the patient is not new, he or she must also type the old patient number.

And the system will check the patient number using Database that there is patient number in Database within one month. If the patient is emergency case, he/ she check to Emergent (Accident) checkbox or age is over 70. In this case, the interface like as Figure 3 will be displayed.

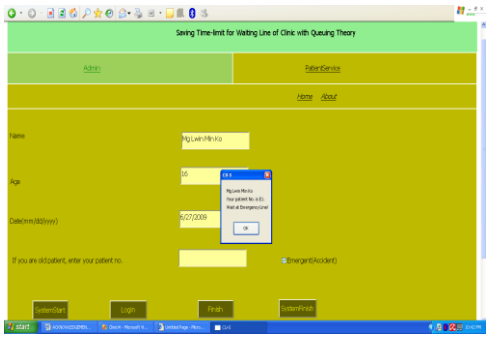

Figure 3: An Interface for Emergency patient

And the interface will be also displayed for New patient and Old patient as like as Emergency patient. If one of the queue lines is full, these message, 'Emergency Queue is full. So you should wait at Waiting Queue' will be displayed. And if Old or New Queue is full, the message will also display like as Emergency Queue.

If the number of patients given the system is limited, the message "Full patient" will display. If the doctor would like to start the servicing, the message will display that the patient who will serve. If the doctor response that servicing is finished, the message will display that another patient who will serve.

If the patient is limited according to the expected time and total time, the message, 'Total Emergency patient, Total Old patient, Total New patient, Total number of patients' will display like as Figure 4.

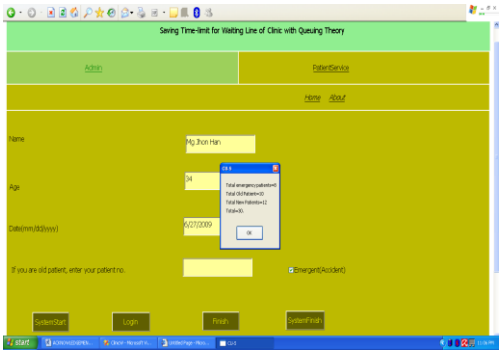

Figure 4: An interface that the system is limited

This system can help all patients according to the appropriate queue line. And the rate of customer's arrival can be known when the patient is limited over the expected time and total time.

5. Conclusion

A queuing system can be described as patients arriving for service, waiting for service if it is not immediate, utilizing the service, and leaving the system after being served. Queuing theory is the mathematical approach to the analysis of waiting lines in clinic. In this system, it is mainly used in wait line. Queuing models have several limitations, many of which are based on its assumptions. The limitations of the queuing models can be offset partially if they are used in conjunction with other decision analysis methods such as simulation and regression.

This system reduces service time, avoids human error and ensures safety of the system. The FCFS order also minimizes the service time of the clinic.

The problem of customer waiting time is solved by using queuing theory. Patient can know appropriate waiting line by using this system. And then, this system is designed to give first priority for emergent waiting line. So, emergent patients can be satisfied by saving waiting time.

And then, the patient's waiting time can be reduced by using this system. This system is managed by the multiple queue line that is computerized system. Advantages of this system keep the time for patient's service, save life in time and fulfill the patient's indeed. The doctor would know clearly what kind of patient it is and how important it is by distinguishing multiple queue line. There is no complex case by waiting their appropriate lines, respectively. It can provide to make a decision for doctor what kind of patient.

According to the queue discipline, service facilities save the emergency patients in time. And moreover, by providing by turn in old and new line, the service facilities made more satisfied the patient's requirements. This system made fulfillment of the patient's life saving.

References

[1] C. Tantau. and M, Murray, "*Same-day appointments: exploding the access paradigm"*, 2000 by Family Practice Management, 7(8), 45-50.

[2] F. Shortle John, M. Harris Carl, Donald Gross, M. Thompson James, "*Fundamentals of Queuing Theory*", August 2008.

[3] G. F. Newell, "*Applications of Queuing Theory*". 2nd ed., 1982 by Chapman & Hall, New York.

[4] J.K Sharma, "*Operations Research (Theory and Applications)*", CS -401.

[5] Lester Lipsky, "*Queuing Theory (A Linear Algebraic Approach)"*(Second Edition), Feb 2009.

[6] C. Troxler and T., Ulmer, "*The Economic Cost of Missed Appointments and the Open Access System*", working paper, 2006, University of Florida Area Health education center Program.

[7] K.Bose Sanjay, "*An Introduction to Queuing System*".

[8] Giambene, Giovanni, "*Queuing Theory and Telecommunications*"

[9] G.R. Datlatreya, "*Performance Analysis of Queueing & Computer Networks* ", June 2008.

[10] Ryan Berry, "*Queuing Theory*"

[11] Y.A., Ozcan, "*Quantitative methods in health care management; Techniques and applications*", First edition, 2006 by Jossey – Bass Publications.