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# APPLICATION OF QUENING MODEL IN HOSPITAL

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**Abstract:** *Queue theory is a branch of operational research of applied mathematics, we are dealing with the phenomenon of the queue. Mathematicalmodelling and systems analysis which corresponds to a random request. By using the appropriate probability, it will also be observed different queues and server number is included in the process. This is because there is a possibility that when the too long awaited the patient, the ability to manipulate the system becomes excessive. Data from this study, observation, interviews, through the management of a questionnaire, has been one month collected by the hospital. Using a plurality of m / m / 3 server grid model, to analyse the queue parameters and system performance measurements. This model can also determine and another policy maker is used to solve a different multiple of server problems.*

***Key word:*** *queuing theory, queuing simulation, m/m/3 queuing model*

**Introduction:**A typical situation that occurs in everyday life is a queue or queue. Queue, usually, hospitals, seen in the bank, generally a queue is formed when the demand for services exceeds supply. Time-out depends on the number of service lines on the server. In the health authorities, the effect of the queue for the patient time to access to treatment has become a source of great concern for the modern hospital.
Hospital in which the research is conducted has one general ward and in general ward there is 20 beds; one emergency ward in which there are 10 beds; and one special ward in which there are 15 beds.

**Research Method:**Data for this study were obtained from Rajkot Hospital. The method used in the data collection was a questionnaire, which is managed by direct observation and personal interviews, and investigator. Data for one month collect. For queuing system of the hospital in accordance with the tail theory, the following assumptions have been made. They are
(1) Arrivals follows a Poisson distribution at an average rate of λ customers per unit of time.
(2) Service times are distributed exponentially, with an average of μ patients per unit of time.
(3) There is no limit to the number of the queue.

**The Model:** Model adopted in this study, (M / M / S) - is a multi-server queuing model. In this queue system, it is assumed that the arrival follows the average according to a Poisson probability distribution, time unit per λ client (patient). In addition, all of the server (in this case, the doctor) assumes that receives a primary notification. Service time is distributed exponentially, the average number of clients per unit time (S) determined by the S stand number of servers. If there are n number of clients in the queuing system, you may receive the following two cases may occur
(1) If n<S,(number of customers in the system is less than the number of servers), then there will be no queue. However, (S–n) number of servers will not be busy. The combined service rate will then be$\mu_n = n\mu; n < s$;n<s
(2) If (number of customers in the system is more than or equal to the number of servers) then all servers will be busy and the maximum number of customers in the queue will be (n – s). The combined service rate will be ;$\mu_n = s\mu; n \geq s$
From the model the probability of having n customers in the system is given by (1)

$$P_0 = \left[\sum_{n=0}^{s-1} \frac{\left(\frac{\lambda}{\mu}\right)^n}{n!} + \frac{\left(\frac{\lambda}{\mu}\right)^s}{s!\,(1-\rho)}\right]^{-1}$$

When, $n \leq s, P_n = \frac{\left(\frac{\lambda}{\mu}\right)^n}{n!}$ And

$$n > s, P_n = \frac{\left(\frac{\lambda}{\mu}\right)^n}{s!.\,s^{n-s}}$$

We now proceed to compute the performance measures of the queuing system.
(2)The expected number of the customer (patients) waiting on the queue (length of line) is given as:

 

$$L_q = \frac{\left(\frac{\lambda}{\mu}\right)^s}{s!\,(1-\rho)^2} \times P_0$$

(3) Expected number of customers (patients) in the system:

$$L_s = L_q + \frac{\lambda}{\mu}$$

(4) Expected waiting time of customer (patients)in the queue:

$$W_q = \frac{L_q}{\lambda}$$

(5) Average time a customer (patient) spends in the system:

$$W_s = W_q + \frac{1}{\mu}$$

(6) Utilization factor i.e. the fraction of time servers (doctors) are busy.

$$\rho = \frac{\lambda}{s\mu}$$

Where,
$\lambda$ = the arrival rate of patients per unit time
$\mu$ = the service rate per unit time
s = the number of servers
$P_0$ = the probability that there are no customers (patients) in the system
$L_q$ = Expected number of customers in the queue
$L_s$ = Expected number of customers in the system
$W_q$ = Expected time a customer (patient) spends in the queue
$W_s$ = Expected time a customer (patient) spend in the system.

**Analysis of the data:**

**A. General department**

| Sr. No. | Day | λ | μ | $L_s$ | $L_q$ | $W_q$ | $W_s$ | ρ |
|---|---|---|---|---|---|---|---|---|
| **1** | **30** | 1.6666 | 16.7241 | 0.09965 | 0.00000367 | 0.0000022 | 0.05979 | 0.03321 |

**B. Emergency department**

| Sr. No. | Day | λ | μ | $L_s$ | $L_q$ | $W_q$ | $W_s$ | ρ |
|---|---|---|---|---|---|---|---|---|
| **1** | **30** | 1.3333 | 6.9655 | 0.1914 | 0.00007023 | 0.00005267 | 0.1436 | 0.0638 |

**C. SPECIAL ROOM DEPARMENT**

| Sr. No. | Day | λ | μ | $L_s$ | $L_q$ | $W_q$ | $W_s$ | ρ |
|---|---|---|---|---|---|---|---|---|
| **1** | **30** | 1.0666 | 10.1034 | 0.1055 | 0.00000665 | 0.00000623 | 0.09898 | 0.0351 |

**RESULT:**All three department of indoor patient are unoccupied during over research period and hospital can Accountant more patient then it is doing at present. Hence we recommend the hospital to increase more super speciality so that hospital resources are utilized optimally and the future hospital can expand more.

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