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MULTIPLE TRANSMIT FUZZY QUEUING MODEL

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Abstract

This paper proposes a single transmit and multiple transmit fuzzy queuing models with single and multiple servers. Here we consider the arrival rate to be Poisson distribution and assumed to follow pentagonal and heptagonal fuzzy numbers. Based on that we execute the characteristics of queuing model by applying the ranking technique. A numerical examples are also verified to show the methodology.

Keywords : arrival rate, service rate, heptagonal fuzzy number and pentagonal fuzzy number

1.Introduction

This chapter deals with one of the queuing models with the technique for transformation from fuzzy to crisp qualities known as the left and right positioning strategy in application to two sorts of participation capacities pentagonal and heptagonal enrolment capacities.

Queuing models have a wide application in administration associations. One of such application is zones in genuine circumstances having a strategy of one arrival and two servers administration channels.

Various sorts of lining models have been investigated. Yager R.R[5] discussed a procedure for ordering fuzzy subsets of the unit interval in information science. In this way Zadeh L.A [6] analysed the fuzzy sets as a basic for a theory of possibility in fuzzy sets and system and also Zadeh L.A[7] the information and control in fuzzy sets.

As fuzzy numbers don't frame a characteristic straight request similar to genuine number a key issue in operationalizing fuzzy set hypothesis is the number by which to look at fuzzy numbers different methodologies have been produced for positioning fuzzy numbers. One of such techniques is the positioning strategy.

Kao et al and Chan.S.P[1]analysed the parametric programming to the analysis of fuzzy queue in fuzzy sets and systems. They proposed a general method to develop the participation elements of the presentations estimates M/F/1/∞, F/M/1/∞, F/F/1/∞ and FM/FM/1/∞ lines. where F and FM signfy the fuzzy time and exponential time.

This prompt acquiring diverse execution measures as far as crisp qualities for fuzzy queuing model with one arrival and two servers of landing rates and exponential administration rates.

The primary aim of this paper is to acquire the exact crisp values from the fuzzy values and applying within the queuing performance formulas. Fuzzy models are also studied by Mueen at [4] analysed a performance measures with single channel fuzzy queues under one arrival and two servers ranking method.

2.Basic Defenition

2.1 Fuzzy set

A fuzzy set can be characteristics of $\widetilde{A}$={<x, $\mu\widetilde{A}$(x)>; xϵX} and X can be an non-void set, $\mu\widetilde{A}$ (x)e[0,1] is the membership of xϵX in $\tilde{A}$.

2.2 Infinite Framework Limit

If the arrival rate is not affected by the number of customer being served and waiting (i.e) system with large population of potential customers.

3.Fuzzy queuing model with one arrival and two server

Consider a solitary channel fuzzy queuing model with one arrival and two service FM/F (H_1,H_2)/1/FCFS without any priorities in entry rates, where FM signifies the fuzzy landing rates a poisson procedure while F(H_1,H_2) indicates the fuzzified hyper potential administration time rate with one arrival and two services in FCFS with infinite framework limit.

In this model, clients arrive in gatherings by a solitary channel spoken to $\tilde{\lambda}$, $\widetilde{\mu_1}$ and $\widetilde{\mu_2}$ seperately

Let $\widetilde{\emptyset}\ \lambda(W), \widetilde{\emptyset}\mu_1(x), \widetilde{\emptyset}\mu_2(y)$

$\tilde{\lambda}$ ={(W, $\widetilde{\emptyset}$ λ(W)/w∈W}

$\widetilde{\mu_1}$={(y, $\widetilde{\emptyset}\mu_1(y)$/y∈ Y}

$\widetilde{\mu_2}$={(z, $\widetilde{\emptyset}\mu_2(z)$/z∈ Z}

Where w,y,z are crisp universal gathering of the landing rate and administration rate, Moreover let f(w,y,z) mean the specific arrangement of interest consequently w.y.z are fuzzy numbers and allegedly f(w,y,z) are fuzzy numbers.

Let $L_q^{(i)}$ represent the current equation in the traditional single queuing model

Number of the customer in the queue

$$L_q^{(i)} = \lambda \frac{\left(\frac{\rho_1}{\mu_1}+\frac{\rho_2}{\mu_2}\right)}{1-\rho}$$

Number of waiting time in the queue

$$W_q^{(i)} = \frac{L_q^{(i)}}{\lambda}$$

Number of waiting time in the system

$$W_s^{(i)} = W_q^{(i)} + \frac{1}{\mu_i}$$

Number of customer in the system

$$L_s^{(i)} = \lambda\, W_s^{(i)}$$

4.Ranking technique

In this section the way to change over the fuzzy numbers into crisp numbers is explained two sorts of fuzzy numbers pentagonal and heptagonal fuzzy numbers are executed with the left and right ranking technique which is addressed by F(R)→R

5.Pentagonal fuzzy number

Let a convex pentagonal fuzzy number a(z)=A(a1,a2,a3,a4,a5,w), Then the left and right ranking index is portrayed

$$R(\tilde{A}) = \int_{z=0}^{w} \frac{L^{-1}(z)+R^{-1}(Z)}{2}\,dz \text{---------}\rightarrow 1$$

Where,

$$L^{-1}(z) = [W(b-a)+a] + \frac{1}{2}[W(c-b)+b]$$

R^{-1}(z)=[W(d-c)-d] + [W(e-d)+e]

from equation 1 after simplification we obtain

$$R(\widetilde{A}) = \frac{W(2a1+3a2+23+3a4+2a5)}{4}$$

6.Heptagonal fuzzy number

Let a convex pentagonal fuzzy number

$\widetilde{A}(z) = \widetilde{A}(a1, a2, a3, a4, a5, a6, a7; w)$ ***then the ranking index is portrayed by***

$$R(\widetilde{A}) = \int_{z=0}^{w} \frac{L^{-1}(z) + R^{-1}(Z)}{2} dz$$

Proceeding in the same way

$$R(\widetilde{A}) = \frac{W(2a_1 + 7a_2 + 7a_3 + 22a_4 + 7a_5 + 7a_6 + 2a_7)}{54}$$

SINGLE SERVER- PENTAGONAL FUZZY NUMBER

Assume that both arrival and services rate and administration rate are pentagonal fuzzy numbers in a first come first serve

$\widetilde{\lambda}$ **= (0.007,0.008,0.009,0.010,0.011;1)**

$\widetilde{\mu_1}$ **= (0.02,0.03,0.04,0.05,0.06;1)**

$\widetilde{\mu_2}$ **= (0.08,0.09,0.10,0.11,0.12;1)**

$R(\widetilde{A}) = 0.027$

R $(\widetilde{\mu_1})$ **= 0.12**

R $(\widetilde{\mu_2})$ **= 0.3**

The performance measures for heptagonal fuzzy number

$L_q^{(1)}$= 0.084450

$W_q^{(1)}$ =0.164814

$W_s^{(1)}$=0.49814

$L_s^{(1)}$=0.22944

SINGLE SERVER HEPTAGONAL FUZZY NUMEAR

Assume that both arrival and services rate and administration rate are heptagonal fuzzy numbers in first come first serve

$\widetilde{\lambda}$ **= (0.009,0.010,0.011,0.012,0.013,0.014,0.15;1)**

$\widetilde{\mu_1}$ **= (0.08,0.09,0.10,0.11,0.12,0.13,0.14;1)**

$\widetilde{\mu_2}$ **= (0.04,0.05,0.06,0.07,0.08,0.08,0.09,0.10;1)**

$R(\widetilde{A}) = 0.012$

R $(\widetilde{\mu_1})$ **= 0.11**

R $(\widetilde{\mu_2})$ **= 0.0**

The performance measures for heptagonal fuzzy number

$L_q^{(1)}$= 0.08365

$W_q^{(1)}$ =0.280416

$W_s^{(1)}$=0.871325

$\mathbf{L_s^{(1)}=0.34455}$

MULTIPLE SERVER PENTAGONAL FUZZY NUMBER

Assume that both arrival and services rate and administration rate are pentagonal fuzzy numbers in first come first serve

$\tilde{\lambda}$ **= (0.007,0.008,0.009,0.010,0.011;3)**

$\widetilde{\mu_1}$**= (0.02,0.03,0.04,0.05,0.06;3)**

$\widetilde{\mu_2}$**= (0.08,0.09,0.10,0.11,0.12;3)**

$R(\tilde{A}) = 0.081$

R $(\widetilde{\mu_1})$ **= 0.36**

R $(\widetilde{\mu_2})$ **= 0.9**

The performance measures for pentagonal fuzzy number

$\mathbf{L_q^{(2)}= 0.21354}$

$\mathbf{W_q^{(2)} =0.263629}$

$\mathbf{W_s^{(2)}=0.641406}$

$\mathbf{L_s^{(2)}=0.63353}$

MULTIPLE SERVER HEPTAGONAL FUZZY NUMBER

Assume that both arrival and services rate and administration rate are heptagonal fuzzy numbers in first come first serve

$\tilde{\lambda}$ **= (0.009,0.010,0.011,0.012,0.013,0.014,0.015;3)**

$\widetilde{\mu_1}$**= (0.08,0.09,0.10.0.11,0.12,0.13,0.14;3)**

$\widetilde{\mu_2}$**= (0.04,0.05,0.06,0.07,0.08,0.09,0.10;3)**

$R(\tilde{A}) = 0.036$

R $(\widetilde{\mu_1})$ **= 0.33**

R $(\widetilde{\mu_2})$ **= 0.21**

The performance measures for heptagonal fuzzy number

$\mathbf{L_q^{(2)}= 0.448356}$

$\mathbf{W_q^{(2)} =0.34322}$

$\mathbf{W_s^{(2)}=0.863523}$

$\mathbf{L_s^{(2)}=0.97344}$

7. Nomenclatures

$F(H_1,H_2)$= Fuzzy administration rate with 2 classes (classes/second)

FM= Fuzzy landing rate (second)

LS = Average number of customers in the system (customers/ second)

Lq = Average number of customers in the queue (customers/ second)

Ws = Average waiting time of customers in system (second) Wq = Average waiting time of customers in queue (second)

X = Set of inter arrival time

Y,Z = Set of inter Service time

Greek symbols

$\mu\tilde{A}(x)\tilde{A}(x)$ = membership of X

λ = Average arrival rate (seconds)

μ= Average service rate (seconds)

ρ = stability steady state

Abbreviation

FCFS = First Come First serve

TABLE 1

PENTAGONAL AND HEPTAGONAL SINGLE SERVER

Membership Function	$L_q^{(2)}$	$L_s^{(2)}$	$W_q^{(2)}$	$W_s^{(2)}$
Pentagonal	0.04450	0.22944	0.164814	0.49814
Heptagonal	0.8365	0.34455	0.280416	0.871325

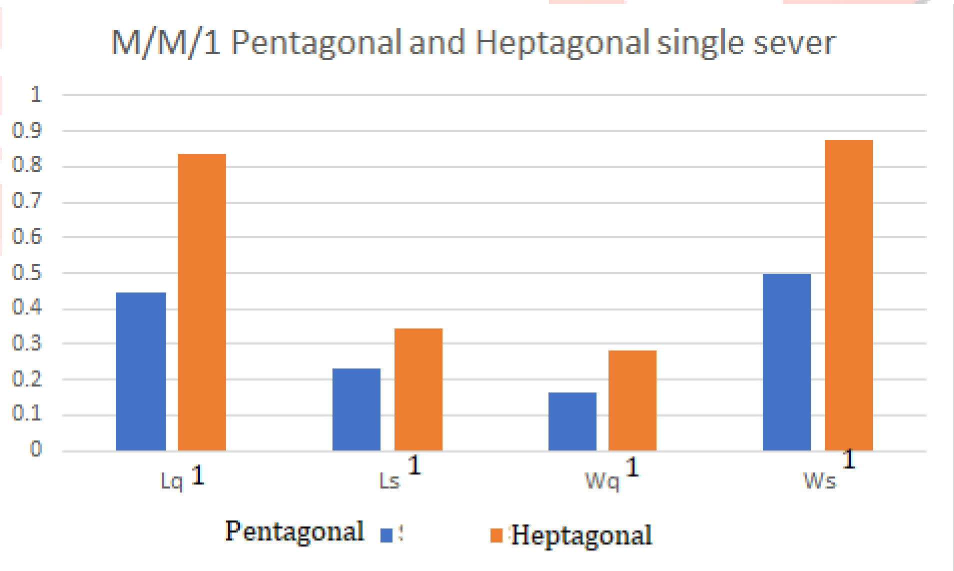

Figure 1:M/M/1 Pentagonal and Heptagonal single server

TABLE 2

PENTAGONAL AND HEPTAGONAL MULTIE SERVER

Membership Function	$L_q^{(2)}$	$L_s^{(2)}$	$W_q^{(2)}$	$W_s^{(2)}$
Pentagonal	0.21354	0.63353	0.263629	0.641406
Heptagonal	0.448356	0.97344	0.34322	0.873523

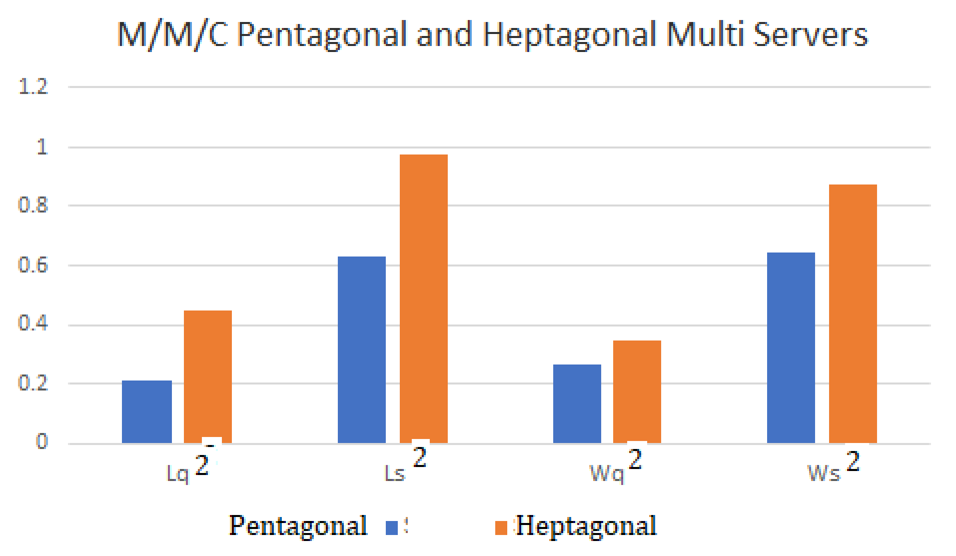

Figure 2:M/M/C Pentagonal and Heptagonal multi servers

(Figure 1) The graphical representation of pentagonal and heptagonal single server shows that the heptagonal arrival is higher than the pentagonal arrival. Hence the service time is greater in heptagonal then the pentagonal single server. Similarly, the graphical representation of pentagonal and heptagonal multi servers (figure 2) shows that the heptagonal arrival is higher than the pentagonal arrival. Further the service time is greater in heptagonal multi servers than the pentagonal multi servers.

7. Nomenclatures

$F(H_1,H_2)$=	Fuzzy administration rate with 2 classes (classes/second)
FM=	Fuzzy landing rate (second)
LS =	Average number of customers in the system (customers/ second)
Lq =	Average number of customers in the queue (customers/ second)
Ws =	Average waiting time of customers in system (second)
Wq =	Average waiting time of customers in queue (second)
X =	Set of inter arrival time
Y,Z =	Set of inter Service time

Greek symbols

$\mu\tilde{A}(x)\tilde{A}(x)$ = membership of X

λ = Average arrival rate (seconds)

μ= Average service rate (seconds)

ρ = stability steady state

Abbreviation

FCFS = First Come First serve

8. CONCLUSION

We discussed about the queuing models with the technique for transformation from fuzzy using pentagonal and heptagonal capacities finally we came to the conclusion that pentagonal capacities provides better solution. Also the computation of the expected waiting time of customers in the queue and in the whole system is obtained to it is observed in all the case that the execution proportions of single server less(or) greater than the multiple server.

It is analysed that a fuzzy queuing model, when service rate follows exponential distribution and arrival rate is Poisson distribution using heptagonal and pentagonal fuzzy numbers. Here both arrival and service rates are fuzzy numbers. Also performance measures such as L_q,W_q,L_s,W_s of the above queuing model for various values are computed.

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