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A Study of Queueing Models for a Stochastic and Fuzzy Setting with Communications Framework

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Abstract – Queue Models Mathematical Analysis Offers the basic structure work in communication system as there is a near similarity between queue and communication networks. Messages reaching a communications system can be customers or jobs, contact buffers can be considered as waiting lines and all the operations involved should be treated as services, buffer capacity can be considered as queues, while service control should be taken first served (FCFS), depending on the situation. Infect, buffer is a physical memory storage area used to store data temporarily when travelling from one location to another. Buffers are often usually used when the rates at which data are obtained vary from the rates at which they can be processed, or if those rates are variables (e.g. online video streaming). By implementing the queue memory algorithm, Buffer often customises the timing at one rate and reads the data at a different rate in a queue. The relation of the communications system arises because of the imprevisible existence of demand for transmission lines. Queue models contributed to the exact study of current communication system. Modern communication systems are an integral part of voice call modelling. The essence of traffic has changed drastically with the introduction of faxes and the Internet. This has resulted in the packet networks being switched over circuit networks becoming increasingly relevant. The circuit switching phone is unsuitable for interactive data traffic since it is designed for lower frequency demands for service with long service times, while transmission links in packet switches are divided as required. Every packet is forwarded when the relevant link is available but there is no source transmission when there is nothing to send. Each packet is forwarded. This increases the use of the connection at the cost of storage and control in the model. The switching of packets involves the division into small bundles of data and its transmission to their indented destination using computer control switches through communication networks. Only few circuits are used in circuit switching, a good amount of new drive power is idle, while the active users gain by shortening the normal delay times in a light loading condition. Network resources for any packet node communications system are handled by statistical multiplexing or dynamic memory allocation, in which an arbitrary number of logical bit rate channels or data streams is essentially separated into a communication channel.

Key Words – Queue Models, Stochastic and Fuzzy Setting, Communications Framework, Mathematical Analysis

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INTRODUCTION

In recent years, the researchers in the queuing review have researched the communications mechanism, the method of data traffic. In general, the arrival and the service processes are expected to be separate but they are interdependent in a variety of realistic circumstances. The communications network has been examined by most researchers in this field as linked queues, on the premise that Jenq[1984], Hosida[1993], Rao Srinivasa et al. are interdependent in terms of arrival and service patterns[2000]. Few attempts were made to build and evaluate interdependent communication networks which can have a major impact on device efficiency, and which are most frequently found in packet radio systems. Store and forward data or transmission of voices, teleprocessing etc.

Rao Schwinivasa et al [2003] has established a network of interdependent communication networks, supposing that the mechanism of arrival and transmission at the network node is interrelated to the one in which Poisson is bi-variable and that there is a joint probability mass function (pmf). Packet arrivals are expected to be single, i.e. every packet has its own arrivals. However, when changing packets, messages are split into small random packets. Consequently, message arrives in bulk of packets in the buffer. In the further process of creating an interdependent communications system, Rao Srinivas et al. [2006] believed that arrivals were huge.

Singh T.P [2011] recently expanded Rao Srinivasa's study[2006] to develop a communication-network queue model for geometrical distribution of arrival messages. Singh T.P measured the average transmission of delays and difference in the number of packets in the buffer using the Chapmann Kolmogrov equations. Singh T.P. expanded the work further. & Kusum et al. [2012] & explored a fluid queue model of interdependence in a voice-packed communication system, statistical multiplexing under a triangular, fuzzy environment.

Communication was investigated because the demand on the transmission line is volatile and uncertain, congestion in the communications system exists. The messages and the activities involved were therefore considered to be trapezoidal fluorescences in nature in the transmission of massages, service pattern, etc. Often called trapezoidal fuzzy in nature are the co- variance from the composite arrival to the completion of transmission. Our model is more practical than previous authors' work. This interdependent network will minimise the mean buffer length and buffer content variability when the environment is fluctuating. Through statistical multiplexing of the transmission network, the delay in packet switching can be minimised.

FUZZY QUEUE MODEL TO AN INTERDEPENDENT COMMUNICATION SYSTEM

We apply an interdependence fluorescent queue model in this section to a communication system with statistical multiplexing packed data/voice integration. In an overload case, the transmission of the packet is lowered into the multiplex queue in order to relive the congestion. The arrival processes are often approximated as the amount of arrivals is divided into different random length packets in the bundled data/voice transmission. The communications, utilities and the completion of transmission were believed to be trapezoidal in nature. Fuzzy Set is a powerful method for modelling ambiguous and imprecise situations under which reliable analysis is difficult or not. In order to calculate the ambiguities of a fumbling set, Zadeh established his fluid theory. The idea of fugitious set is central to the theory, which is the common crisp set that captures progressive transitions from affiliation to non-belonging to setting. It is also theoretical and realistic to see how various characteristics of crisp collection can be generalised in the foggy situation. These studies have led to major interesting findings that we have tried to cover in this section. The model is applied in minimising variance in the average time spent on transfer and variability of the buffer material and is closer to the situation in the real world.

MODEL DESCRIPTION & NOTATION:

Take into account the arrival of packets and the number of transmissions. Both follow a bi-variate mechanism based on Milne [1974] & Rao Srinivasa et al [2000] that has a similar probability mass function. The buffer capacity is expected to be infinite and a random x variable is taken in the fuzzy setting for the number of packets arriving in any module.

λ_x: Arrival rate of message of size having x packets in fuzzy.

ε_x : Covariance between arrival of packets and number of transmission completion in fuzzy.

µ: Average transmission rate in fuzzy.

C_x : Probability that a batch of size x packets will arrive to buffer in fuzzy environment.

The composite arrival rate of packets

$$\lambda = \quad {}_x \lambda_x$$

and the covariance of the composite arrivals and transmission completions

$$\varepsilon = \quad {}_x \varepsilon_x$$

The covariance is created by a bit of a flux control mechanism which induces a reliance on messages from services.

MATHEMATICAL STUDY:

The differential equation of the fuzzy system can be seen in transient form by connecting the probability consideration. as:

$$P'_x\ t \ = - \ \lambda + \mu - 2\varepsilon \ P_n \ t \ + \ \mu - \varepsilon \ P_{n+1} \ t \ + \ \lambda - \varepsilon \ \sum_{r=1}^{n} P_{n-r} \ t \ C_r, \quad n \geq 1 \tag{1}$$

$$P_0' \ t \ = - \ \lambda - \varepsilon \ P_0 \ t \ + \ \mu - \varepsilon \ P_1 \ t$$

STEADY STATE:

If the system's behaviour becomes independent of the time, the stable state is reached.

The steady state equations are:

$$t \rightarrow \infty$$

$$\left.\begin{array}{l} 0=-\ \lambda+\mu-2\varepsilon\ P_n+\ \mu-\varepsilon\ P_{n+1}+\ \lambda-\varepsilon\ \ {}_{r=1}^{n} P_{n-r} C_r, \\ 0=-\ \lambda-\varepsilon\ P_0+\ \mu-\varepsilon\ P_1, \qquad n\geq 1 \end{array}\right\} \quad n\geq 1 \qquad (2)$$

Assumes the p.g.f number of the buffer packets and the number of packets that separate the message:

$$P\ z\ =\ {}_{n=0}^{\infty} P_n z^n,\ z\ \leq 1$$

$$C\ z\ =\ {}_{n=0}^{\infty} C_n z^n,\ z\ \leq 1$$

Multiplying (2) with z^n & summing over $n = 0$ to ∞, after simplification, we get

$$0=-\ \lambda-\varepsilon\ P\ z\ -\ \mu-\varepsilon\ \ P\ z\ -P\ 0\ \ +\frac{\mu-\varepsilon}{z}\ P\ z\ -P\ 0\ \ +$$
$$\lambda-\varepsilon\ C\ z\ P\ z \qquad (3)$$

From

$$(3)\ P\ z\ =\frac{\mu-\varepsilon\ (1-z)}{\mu-\varepsilon\ \ 1-z\ -\ N-\varepsilon\ z(1-C\ z\ )}P_0 \qquad (4)$$

Let the batch size c_x is geometrically distributed:

i.e $C_x = (1-\alpha)\alpha^n \quad 0< \alpha < 1$ then,

$$C(z)=\frac{1-\alpha\ z}{1-\alpha z} \qquad (5)$$

Use (5) in (4) we have

$$P(z)=\frac{\mu-\varepsilon\ (1-\alpha z)P_0}{\mu-\varepsilon\ \ 1-\alpha z\ -\ \lambda-\varepsilon\ z} \qquad (6)$$

For

$$\lambda-\varepsilon\ <\ \mu-\varepsilon\ (1-\alpha)$$

PERFORMANCE MEASURE:

Using condition

$$P(1) = 1$$

Probability that the system is empty is

$$P\ (0) = 1-\frac{\lambda-\varepsilon}{\mu-\varepsilon\ (1-\alpha)} = 1-\rho_0 \qquad (7)$$

Expanding *P(z)* and collecting the coefficient of z^i, the probability that the system size is 'i' as,

$$P_x = (1-\rho_0\ )\ \alpha +\ 1-\alpha\ \rho_0\ ^{i-1}(1-\alpha)\rho_0 \qquad (8)$$

Note: if we take limit $\alpha \to 0$ we get

$$P_i = (1-\rho_0)(\rho_0) \qquad i>0$$

This allows the interdependent contact network to enter the fugitive world without bulk arrivals.

The average fluidity in the system is

$$\text{(i)} \quad L = \frac{\rho_0}{1-\alpha\ (1-\rho_0)} \qquad \text{where } \rho_0 = \frac{\lambda-\varepsilon}{(1-\alpha)\ \mu-\varepsilon}$$

(*ii*) The variance of the fuzzy number of packets in the system

$$\text{Variance} = \frac{\alpha\rho_0\ 1-\rho_0\ +\rho_0}{1-\alpha\ ^2\ 1-\rho_0\ ^2}$$

Values of Average number of packets (*L*)

Table-1

		λ=(3,4,5,6)	μ= (9,8,7,6)		
Average fuzzy number of packets in the system					
α	ε	(.1,.2,.25,.3)	(.26,.30,.34,.36)	(.35,.40,.42,.45)	(.5,.6,.7,.72)
0.1		(2.2, 2.14, 1.97, 1.73)	(2.0822, 2.01, 1.9 ,1.64)	(2.05,1.95,1.83,1.62)	(1.89,1.85,1.7,1.5)
0.15		(3.23,2.87,2.51,1.77)	(2.75,2.58,2.31,1.96)	(2.65,2.47,2.22,1.88)	(2.50,2.35,2.05,1.72)
0.2		(4.82,3.8,3.2,2.52)	(3.95,3.57,2.96,2.37)	(3.87,3.35,2.83,2.32)	(3.67,2.63,2.52,2.07)
0.25		(8.26,5.48,4.2,3.14)	(6.66,5.12,4.3)	(6.6,4.8,3.8,2.9)	(6.13,4.53,3.3,2.50)

Table-2 After defuzzified the average number of packets

α	ε	(.1,.2,.25,.3)	(.26,.30,.34,.36)	(.35,.40,.42,.45)	(.5,.6,.7,.72)
0.1		2.58	1.92	1.87	1.74
0.15		2.62	2.39	2.31	2.12
0.2		3.46	3.23	3.09	2.67
0.25		5.12	4.66	4.45	3.01

Table-3

Variance of number of packets in the system					
α	ε	(.1,.2,.25,.3)	(.26,.30,.34,.38)	(.35,.40,.42,.45)	(.5,.6,.7,.72)
0.1		(11.2,7.9,6.1,4.07)	(9.4,7.6,5.6,3.85)	(9.1,6.9,5.2,3.65)	(7.8,6.5,4.5,3.1)
0.15		(20.1,13.6,9.4,6.6)	(13.8,11.3,8.5,5.1)	(15.2,10.1,7.7,4.7)	(14.8,9.7,6.2,3.9)
0.2		(48.4,23.1,13.7,7.9)	(30.1,22.5,12.3,7.3)	(29.2,17.8,11.2,6.9)	(27.8,17.3,9.4,5.3)
0.25		(120.8,43.7,22.6,11.7)	(99.6,38.5,20.5,10.7)	(84.17,34.2,14.2,10)	(82.5,32.5,15.8)

Table-4

After defuzzified the Variance of number of packets in the system					
α	ε	(.1,.2,.25,.3)	(.26,.30,.34,.36)	(.35,.40,.42,.45)	(.5,.6,.7,.72)
0.1		7.21	6.60	6.15	5.4
0.15		12.1	10.1	9.2	8.3
0.2		21.6	17.8	15.6	14.4
0.25		44.1	38.05	33.4	30.9

Tables 1 and 2 indicate that, if they are positive and other parameters set, the average number of packets within a network as well as in the buffer is decreasing as separate parameters increase. Also, the average packet number in the fuzzy Network and buffer increases as the α value increases of $\lambda, \mu, \varepsilon$. This network has a medium buffer length lower than the traditional mass-arrival network with no interdependence. But if the covariance of composite arrivals and the completion of the transmission is flat in nature, the results are not so horizontally constrained. All system parameters are floating in nature and the behaviour of the system is not inherently monotonous. The monotone behaviour of the number of packets in the buffer is again noted in table 3 & 4. As α increases the variance, other parameters are also set as α increases. The result also indicates the same actions when defuzzing.

(i) If the arrival models are crisp in terms of operation and conversion, the outcome of the model is the timing of the work carried out by the Rao Srinivasa[2006] and Singh T.P[2011].

(ii) If the data are considered in triangular fluidity rather than the trapezoidal fluid numbers, the findings are consistent with the work done by Singh T.P., Kusam et al [2012].

STOCHASTIC ANALYSIS OF INTERDEPENCE COMMUNICATION QUEUE SYSTEM WITH VOICE TRANSMISSION

This section looks at how an interdependency queue model is used to interact with the statistical multiplexing bundled in voices. Approximating the arrival of packets and transmission under a bi-variable Poisson method tests the efficiency of the statistical multiplexing, assuming data packets are saved for transmission and transmitted in an uninterrupted way following the transmission of speech. The transmitter's idle time assumes the negative exponential distribution. Determined and analysed for the model are a robust solution and the device characteristics. For better understanding, table and diagram are given. Integrated data/voice transmission techniques for the optimum usage of the channel are discussed.

The analysis was done with the same rating and hypothesis as in this section the world was deemed probable by some additional hypotheses and ratings.

P(1,i)= Probability that i packets of voice are in buffer.

P (0,i) = Probability that i packets of data are in buffer.

Flow control is important since a device can transfer information at a fastened rate than it can be received and processed by the destination computer. It can be distinguished from the congestion control, which is used when the congestion actually occurs to control the data flow. This is only possible if the computer is heavily trafficed than the computer it sends or if the computer receives less computing power.

Additional Assumptions:

[1] Provided the data packets are stored for transmission and forwarded after voice transmission as and when the transmitter is idle.

[2] Sender idle time assumes the negative exponential parameter distribution $\frac{1}{\eta}$.

POSTULATES OF THE MODEL:

(1) The probability that there is no arrival and no service completion during a small intervals of time Δt, when the system is in faster rate of arrival is $1-(\lambda+\mu-2\varepsilon)\Delta t + O(\Delta t)$.

(2) The probability that there is one arrival & no service completion during a small interval of time Δt, when the system is in faster rate of arrivals, is $(\lambda-\varepsilon)\Delta t + O(\Delta t)$

(3) The probability that there is no arrival and one service completion during a small interval of time Δt, when the system is either in faster or slower rate of arrival is $(\mu-\varepsilon)\Delta t + O(\Delta t)$

STEADY STATE EQUATION:

The transition densities of the process are given by:

$$a_{ij} = \begin{cases} -\lambda-\varepsilon & i=j=0 \\ -\lambda+\mu-2\varepsilon & i=j=1 \\ \lambda-\varepsilon+\eta & i=0, j=1 \\ \mu-\varepsilon & i=1, j=i+1 \end{cases}$$

The Steady state Equations of Network which are written through matrix of densities [aij] are given by:

$$(\lambda-\varepsilon)\,P(0,0) = (\mu-\varepsilon)\,P(1,1) \qquad i=1,2,3............ \quad (9)$$

$$(\lambda-\varepsilon+\eta)\,P(0,1) = (\lambda-\varepsilon)\ {}_{x=1}^{i} P(0,i-x)\,C_x \quad (10)$$

$$(\lambda+\mu-2\varepsilon)\,P(1,1) = \eta\,P(0,1) + (\mu-\varepsilon)\,P(1,2) \quad (11)$$

$$(\lambda+\mu-2\varepsilon)\,P(1,i) = \eta\,P(0,i) + (\mu-\varepsilon)\,P(1,i+1) + (\lambda-\varepsilon)\ {}_{x=1}^{i} P(0,i-x)\,C_x$$

$$i=1,2,3............ \quad (12)$$

CONCLUSION

The majority of fuzzy Queueing Networks methods varies from probability theory and use fluctuating numbers for arrivals and prices. Before deriving fuzzy queueing networks, Negi and Lee propose combining randomness with fluidity in order to take advantage of both approaches. This research field of high interest follows our analysis with the use of fluid statistics to construct estimators for the probability distribution parameters of the Queueing networks. The fouzzy probabilistic method we propose combines fouzzy estimators with parallel service channels in queueing networks (M/M/S queueing models). We demonstrate that, as well as a more accurate evaluation of performance metrics, the proposed analysis approach can also be carried out with our elaborated formulas in a simpler and more efficient way. Using fuzzy estimators, a new method has been proposed for calculating the fog efficiency of M/M/S Queueing systems. If the unsafe data has been used to build and/or analyse a queue model, the proposed method may be used. We thus remove the drawbacks of an approximate point or trust interval, if inaccurate sample information cannot estimate the distribution parameters of a Queueing network. A new method of analysing the fluttered tails called the L-R method was studied, based mainly on L-R fluttered arithmetic. For the output measurements of the model, the L-R representation was used. This approach is used to successfully measure the anticipated number of customers and the average wait times on the model FM/FM/1 and to find results in L-R representation. This representation offers a lot of details for blurry results rather than crisp results. In conventional Queuing theory, the mean value of the fuszy measure corresponds to the average. Both spreads help to make the fluid weigh lower and higher. We are optimistic that the L-R approach will support further research in the creation and assessment of fuse Queueing network performance measures to generate results for some open problems.

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