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A Case Study of Queuing System At ATM Machine

Abdullah Furquan [1] , Abdul Wahid Nasir [2] , Dr Amaresh Kumar [3]
[1] *Department of MANUFACTURING ENGINEERING , N.I.T. JAMSHEDPUR , 831014*
[2] *Department of ELECTRICAL AND ELECTRONICS ENGINEERING , N.I.T JAMSHEDPUR , 831014*
[3] *Department of MANUFACTURING ENGINEERING , N.I.T. JAMSHEDPUR , 831014*

Abstract: - This paper discusses a case study of a queuing system [1] at ATM machine which originally operates on single server (single ATM machine). In our daily life we generally find a long queue at the atm machine. As a result of this a customer has to spend considerable amount of time in queue. In such a situation if instead of using a single ATM machine if we use double ATM machine than it will decrease the waiting time in queue.Against this background, the queuing process is employed with interarrival time and service time having exponential distribution. The data for this study was collected from primary source and is limited to ATM service point of state bank of India located at Ramesh chowk, Aurangabad ,bihar ,India. The assistance of three colleague was sought in collecting the data. The Interarrival time and service time data was collected during busy working hours (i.e. 10.30am to 4:00pm)for a period of 60 days.MATLAB R2014a has been used for simulation of queuing models.

Keywords*: queue, ATM, interarrival time, service time.*

I. INTRODUCTION

Although there has been significant reforms in recent times all in an effort to maximize profit, reduce cost and satisfy customers optimally in the most generally acceptable international standard. Despite these entire sterling efforts one phenomenon remains inevitable: queue. It is a common practice to see a very long waiting line of customers to be serviced either at the Automated Teller Machine (ATM) or within the banking hall. Though similar waiting lines are seen in places like; busstop, fast food restaurants, clinics and hospitals, traffic light, supermarket, etc. but long waiting line in the banking sector is worrisome be.[2] Queue is a general phenomenon in everyday life. Queues are formed when customers (human or not) demanding service have to wait because their number exceeds the number of servers available; or the facility doesn't work efficiently or takes more than the time prescribed to service a customer. 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. [3] defines queue as simply a waiting line, while[4] put it in similar way as a waiting line by two important elements: the population source of customer from which they can draw and the service system. The population of customer could be finite or infinite

Waiting line management has the greatest dilemma for managers seeking to improve the on investment of their operation; as customers don't tolerate waiting intensely. Whenever customer feels that he/she has waited too long at a station for a service, they would either opt out prematurely or may not come back to the station next time when needed a service. This would of course reduce customer demand and in the long run revenue and profit. Moreover, longer waiting time might increase cost because it equals to more space or facilities, which mean additional cost on the management [5].

Despite being in the technology era; line are experienced at within and Banks ATMs in developing nations than elsewhere. ATM are adopted so as to reduce waiting time., offers considerable ease to both the bank and their customers; as it enables customers to make financial transactions at more convenient times and locations, during and after banking hours. Most importantly, ATM, are designed to provide efficient and improved services to customers at the shortest possible time. Yet customers spend a considerable time before they are finally served. Businesses especially banks are striving very hard to provide the best level of service possible, minimizing the service time, giving the customer a much better experience. However, in situations where queue arises in a system, it is appropriate to attempt to minimize the length of the queue rather than to eliminate it completely; complete elimination may be infeasible Therefore, a systematic study of waiting line system would assist the management of the Bank in making certain decisions in an effort minimize the time a customer spends in a service facility.

1.1 Queuing Models

Model as an idealized representation of the real life situation; in order to keep the model as simple as possible however, some assumptions need to be made

1.1.1 Assumptions Made on the System

(1) Single channel queue.
(2) There is an infinite population from which customers originate.
(3) Poisson arrival (Random arrivals).
(4) Exponential distribution of service time.
(5) Arrival in group at the same time (i.e. bulk arrival) is treated as single arrival.
(6) The waiting area for customers is adequate.
(7) The queue discipline is First In First Out (FIFO).

1.1.2 M/M/s:(∞ /FIFO) Queuing System

Here the inter arrival time and service time both has an exponential distribution,s server, FIFO is the queue discipline and infinite population size from which the system can draw from.

II. DATA AND CALCULATIONS

2.1Data Collected

The Inter Arrival Time Data and the service time data for the Incoming Population at ATM Machine has been shown below

2.1.1 Inter Arrival Time Data Of People At Atm Machine[6]

2.1.1.1

Table-1Frequencies For The Interarrival Time At The ATM Machine

X	Y
0-1	1382
1-2	1352
2-3	949
3-4	641
4-5	452
5-6	408
6-7	209
7-8	191
8-9	180
9-10	181
10-11	103
11-12	60
12-13	30

At X=0-1 implies that 1382 times, customers arrived at an inter arrival time between 0 to 1minute.

2.1.1.2 Histogram Of Interarrival Time Data Of The Incoming Population

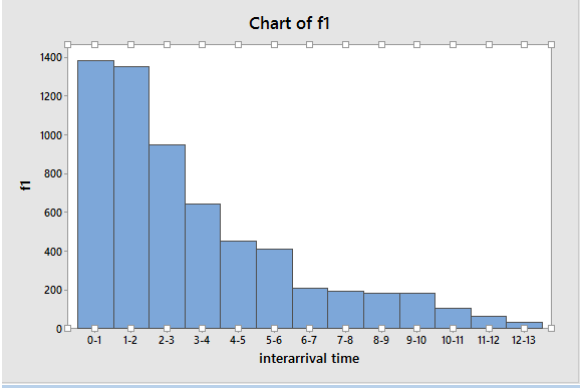


Figure-1 histogram of interarrival time

From above histogram we see that interarrival time data is exponential in nature.

2.1.2 Service Time Data Of People At Atm Machine

2.1.2.1

Table-2Frequencies For Service Time For The Incoming Population At ATM Machine[6]

M	N
0-1	2179
1-2	2100
2-3	1004
3-4	525
4-5	172
5-6	97
6-7	50
7-8	11

At M=0-1 implies that 2179 times, customers served at an service time between 0 to 1minute

2.1.2.2 Histogram Of Service Time Data Of The Incoming Population At ATM Machine

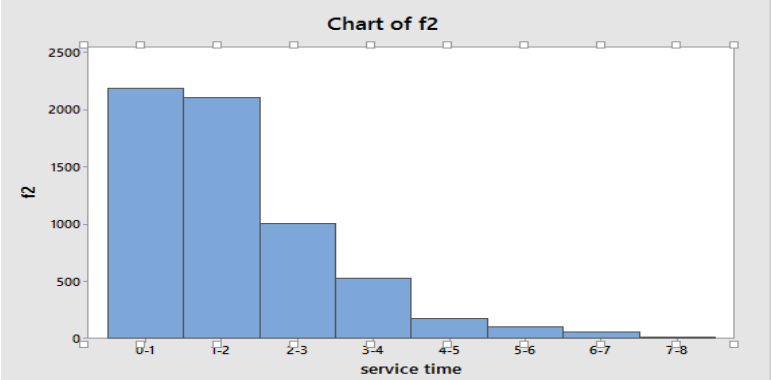


Figure-2 histogram of service time

From above histogram we see that service time data is exponential in nature.

2 Calculation Of Arrival Rate And Service Rate Of Incoming PopulationAt ATM Machine [7]

Here we will calculate arrival rate and service rate. And these calculated values will be used subsequently in simulation of queue.

Interarrival time of the incoming population at atm machine= $\frac{1}{\lambda} = \frac{\sum_{i=1}^{13} X_i * Y_i}{\sum_{i=1}^{10} Y_i} = \frac{19800}{6138} = 3.2258$

Arrival rate per hour= $\lambda = \frac{60}{3.2258} = 18.6$

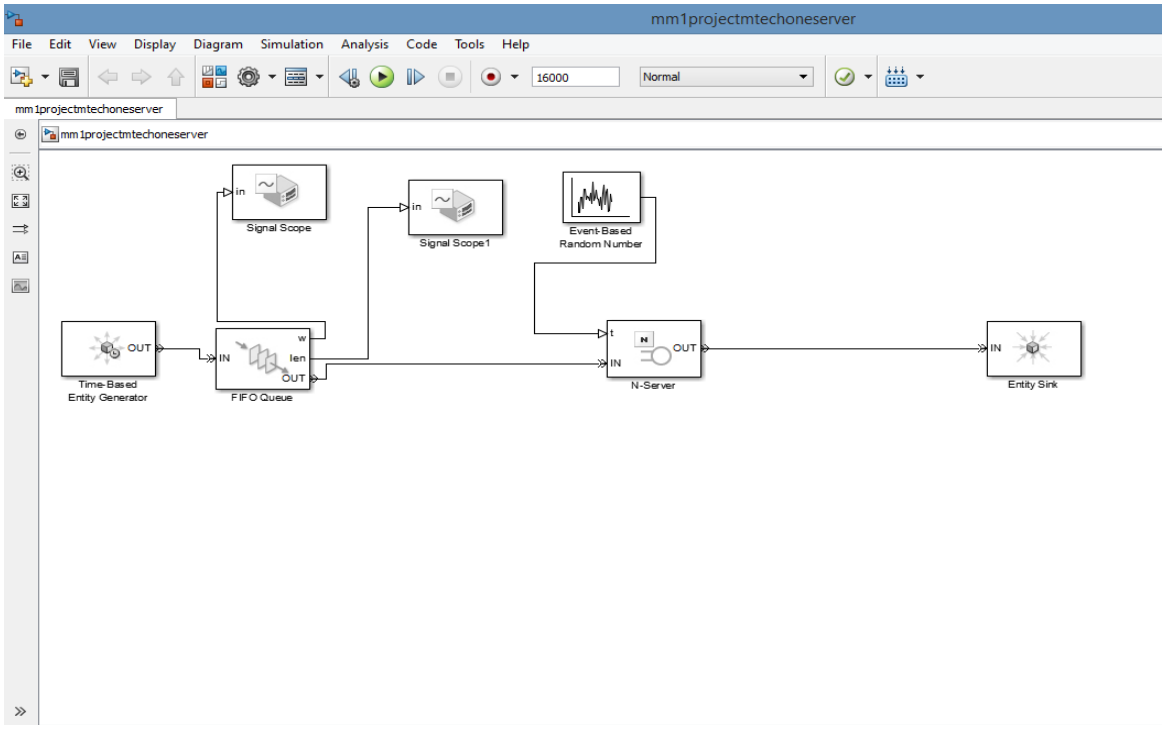
Service time of the incoming population at atm machine= $\frac{1}{\mu} = \frac{\sum_{i=1}^{8} M_i * N_i}{\sum_{i=1}^{8} N_i} = \frac{10302}{6138} = 1.6784$

Service rate per hour= $\mu = \frac{60}{1.6784} = 35.7483$

2.3 Use Of MATLAB R2014a

Now using the above obtained parameter of interarrival time and service time in MATLAB simulation

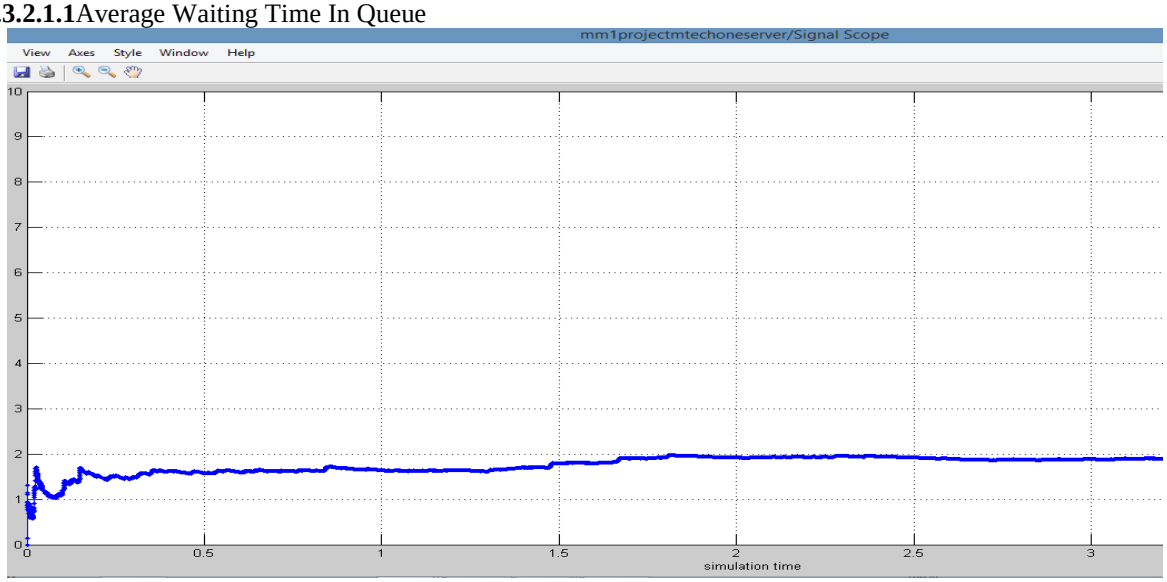
2.3.1Matlab Block Diagram For Single/Double Server (ATM Machine) Simulation



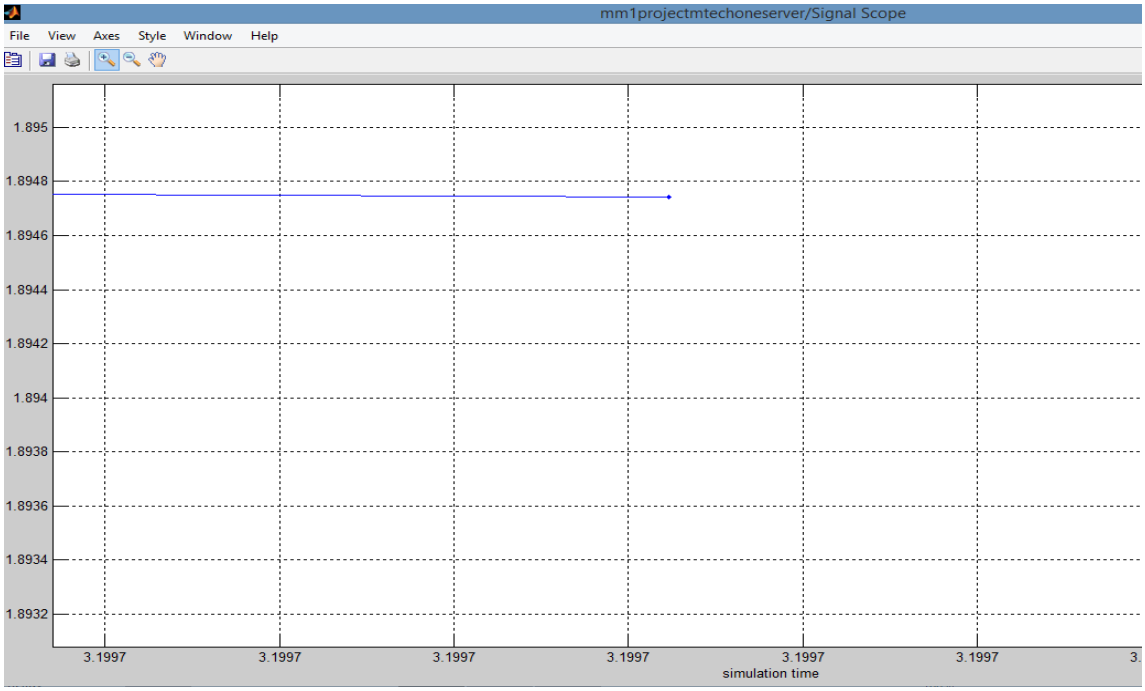
2.3.2 Results From MATLAB Simulation

2.3.2.1 For Single ATM Machine (Server)[M/M/1]

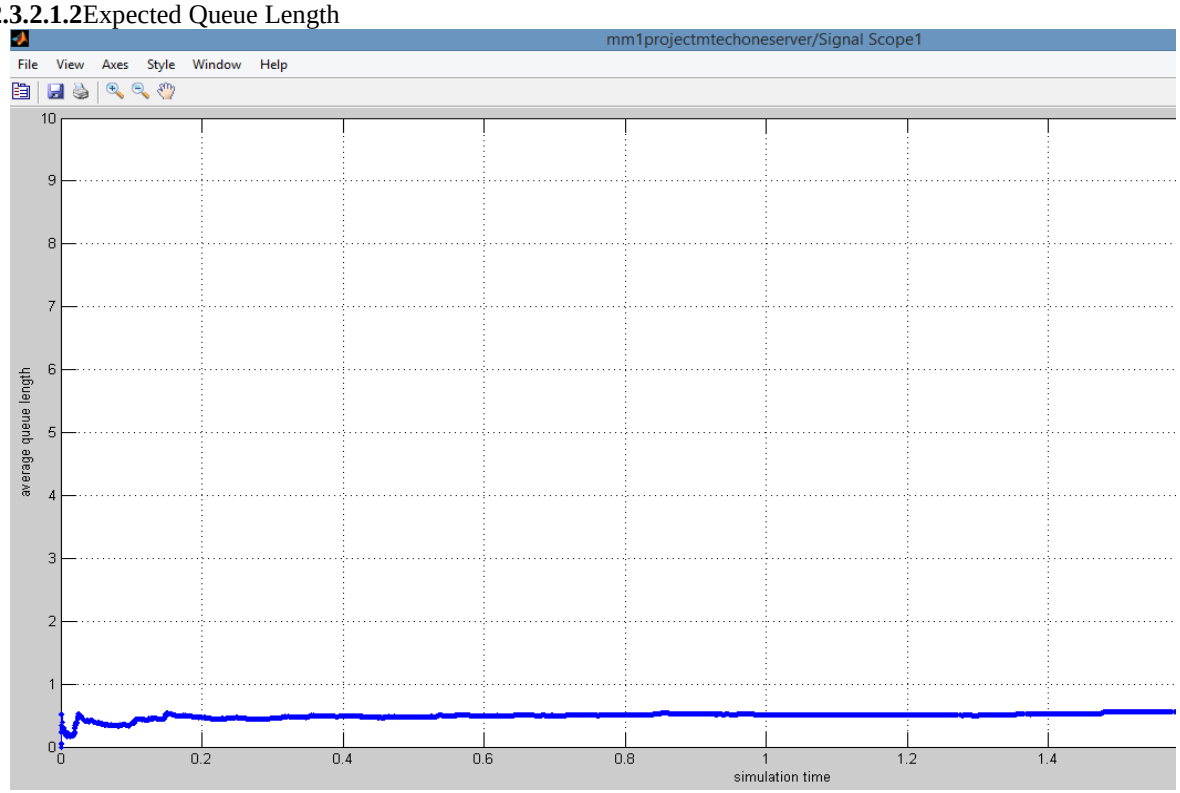
2.3.2.1.1 Average Waiting Time In Queue



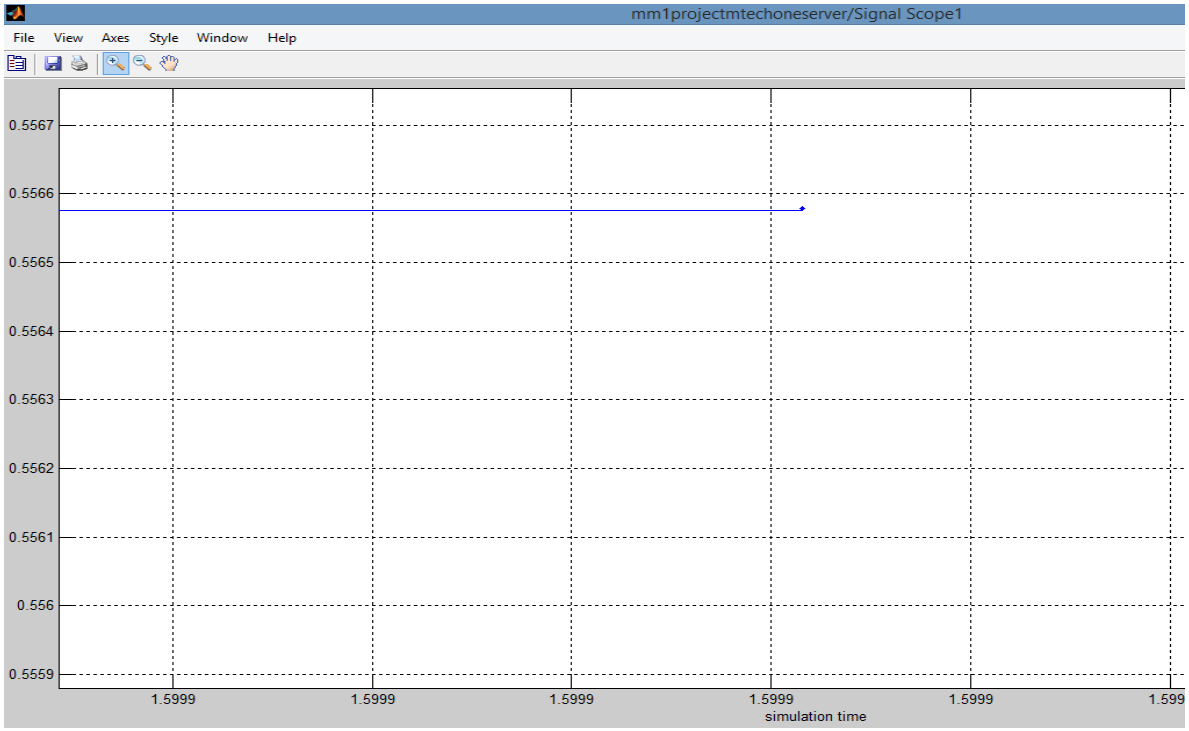
Following graph is obtained by magnifying the above graph. We see that in the steady state the average waiting time in queue is equal to1.8947 min



2.3.2.1.2 Expected Queue Length

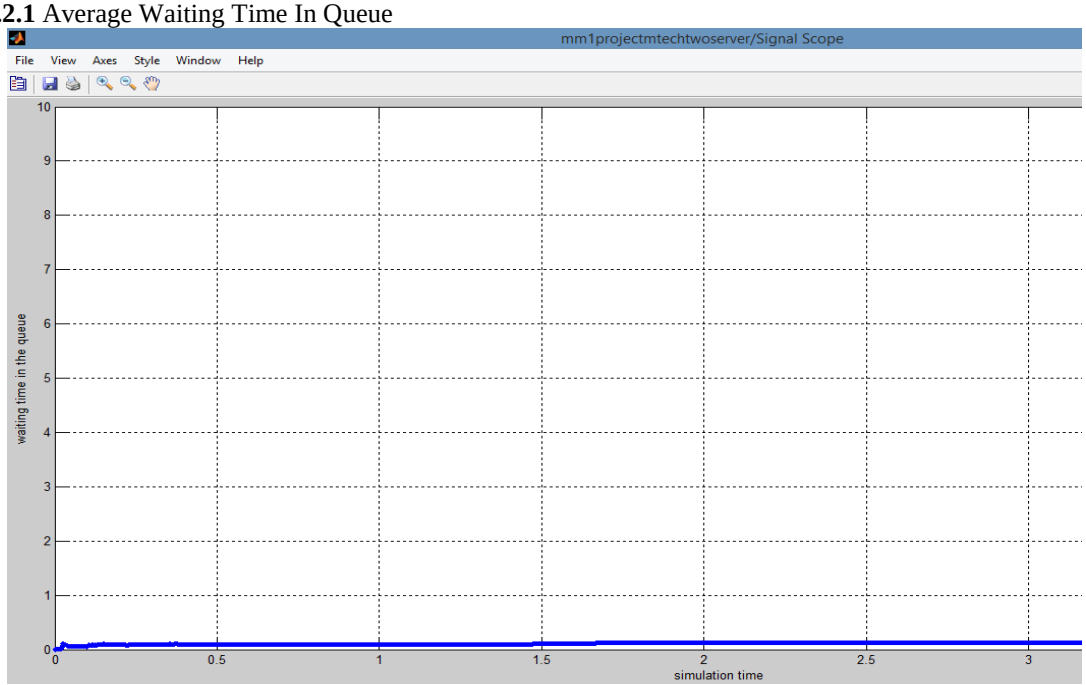


Following graph is obtained by magnifying the above graph. We seethat in the steady state the expected queue length is equal to 0.55655

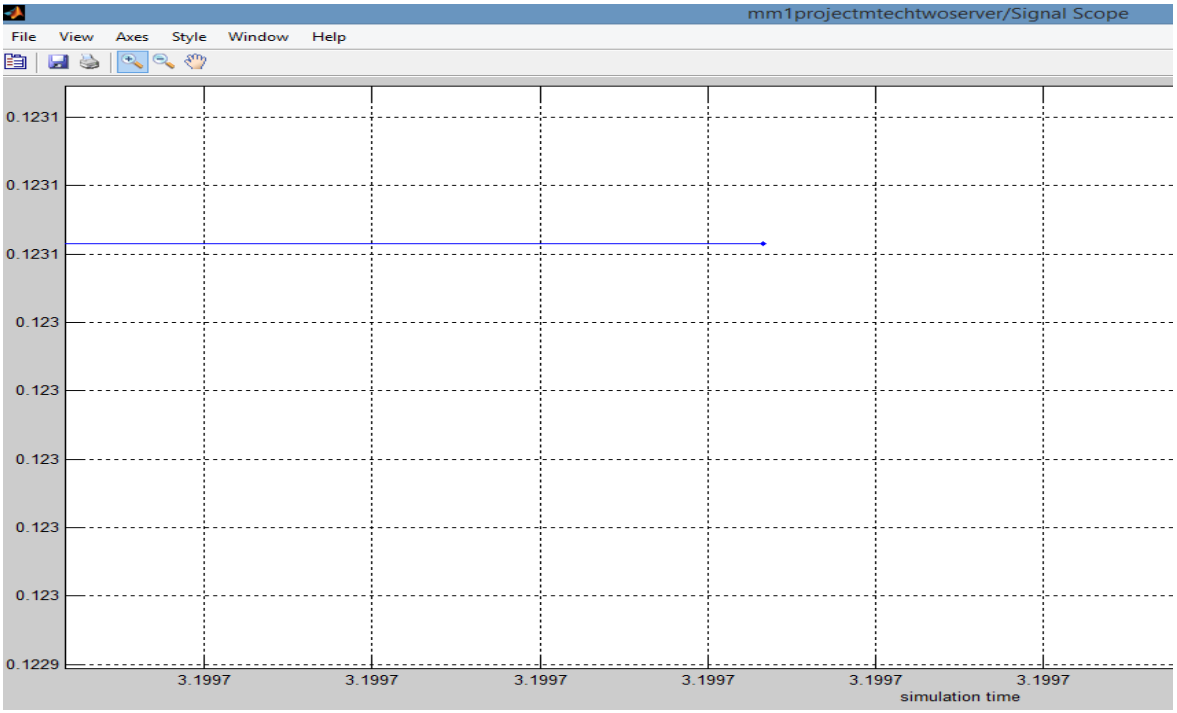


2.3.2.2For Two ATM Machine (Server)[M/M/2]

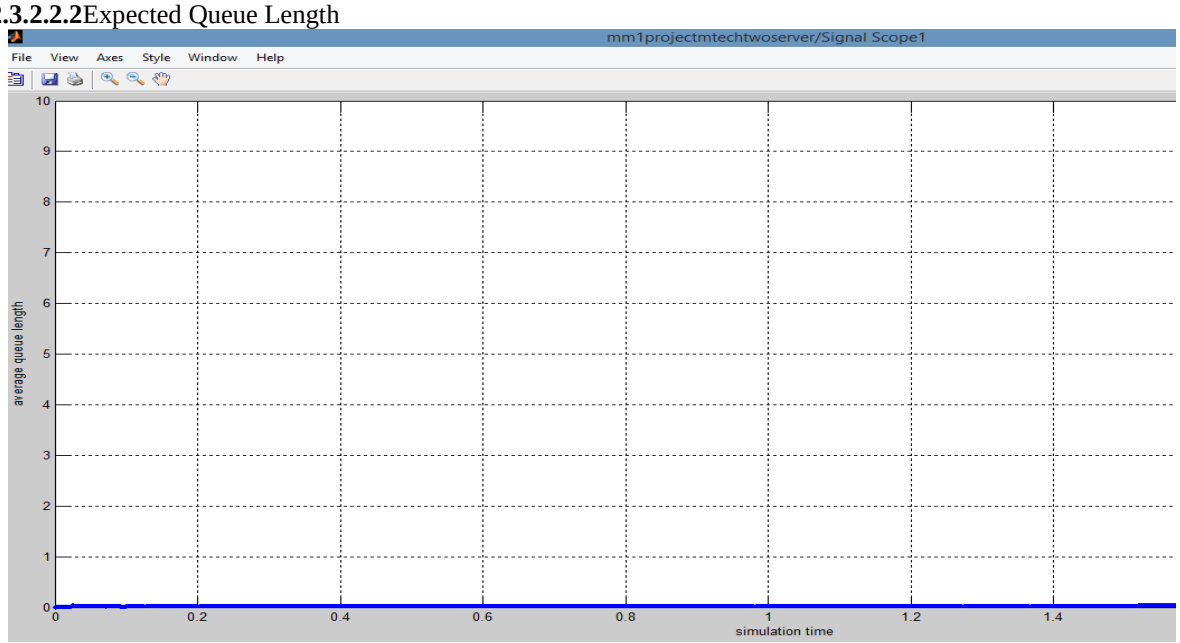
2.3.2.2.1 Average Waiting Time In Queue



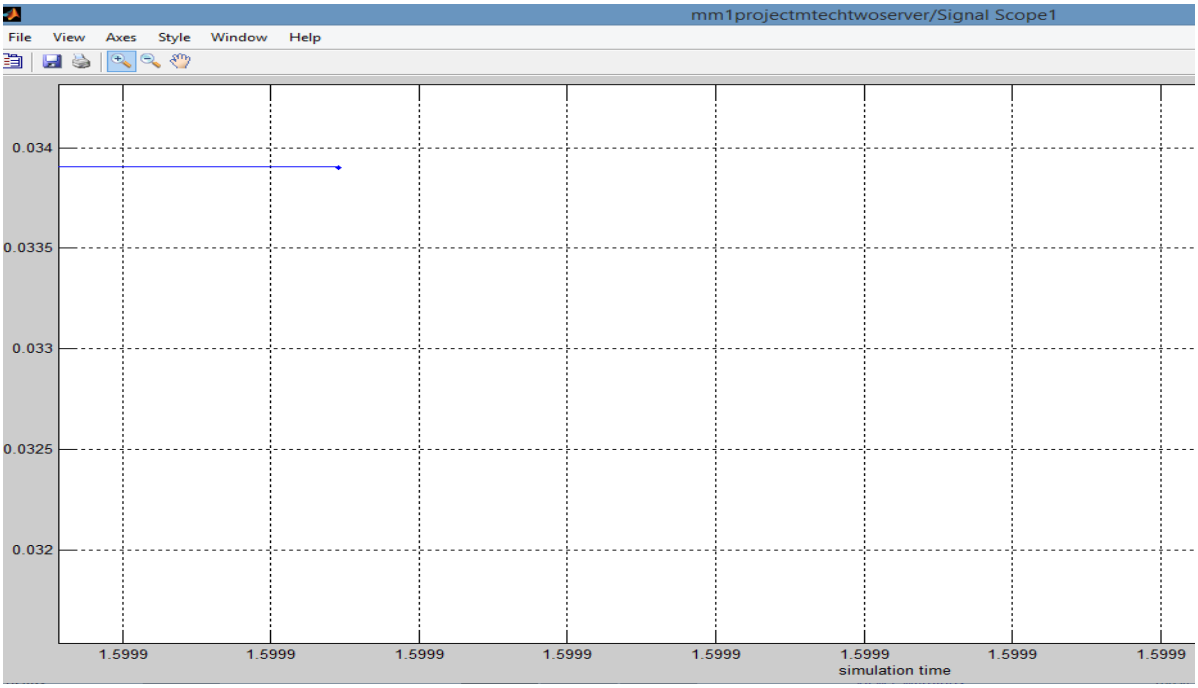
Following graph is obtained by magnifying the above graph. We see that in the steady state the average waiting time in queue is equal to 0.1231 min



2.3.2.2.2 Expected Queue Length



Following graph is obtained by magnifying the above graph. We see that in the steady state the expected queue length is equal to 0.034



2.4 Comparison Of Single Server And Double Server Case

The above results have been tabulated for comparison purpose

Table-3 Average Waiting Time And Expected Queue Length Under Single And Double Server

Parameter	M/M/1	M/M/2
Average waiting time in queue(minute)	1.8947	0.1231
Expected queue length	0.5565	0.034

III. CONCLUSION

We see that because of use of double server the average waiting time has decreased from 1.8947 min to 0.1231 min which is very small figure.Thus a customer coming to ATM does not have to wait at all at ATM machine.Also the expected queue length has decreased from 0.5565 to 0.034.According to [8], in designing queuing systems we need to aim for balance between service to customers (short queues implying many servers) and economic considerations (not too many servers). Though, the provision of an additional service mechanism may be capital intensive, it would pay the bank more since the primary aim of every business organization besides profit making is customer satisfaction.On account of above discussion double server queuing modelcould be applied in our case without affecting the customer demand, revenue and profit of the bank. This case study will act as a reference for implementing double server models in atm machine.

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