PROJECT REPORT

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CONTENTS

→1) Introduction

In this section, we briefly describe on introduction of MATLAB, Queuing Systems and how real life examples of Queuing Systems can be implemented on MATLAB .

Introduction to MATLAB:

MATLAB is a high performance programming language and a multi-paradigm numerical computing environment which allows matrix manipulations, plotting of functions, plotting of data , implementing algorithms etc. and acts as user interface and interacts with programs written in other languages including C,C++, JAVA, Python etc.

Introduction to Queuing Systems

Let us first examine about Queuing theory , it is a mathematical study of congestion and especially delay of waiting in line . It determines every component of waiting in line to be served including arrival process, service process, number of servers, no. of systems, no. of customers . Queuing theory helps to build efficient and cost effective workflow systems.

Queuing Systems represent an example of detail class of interesting dynamic system which referred as " systems of flow " .

Queuing systems on MATLAB :

Elementary queuing theory are implemented in MATLAB and several queuing systems are used which can describe the work flow of system according to given input data and more real life examples are implemented.

Several Queuing systems are M/M/1 , M/M/inf. , M/M/m , M/M/k, M/M/1/K, M/M/inf./M etc. which are known widely and among these **M/M/1 is a classical queuing system** which is mostly used queuing system which is simple and can put our ideas in it.In our **Project** we will be using **M/M/1** queuing system and more details are in upcoming sections.

→2) <u>Goal of the Project</u>

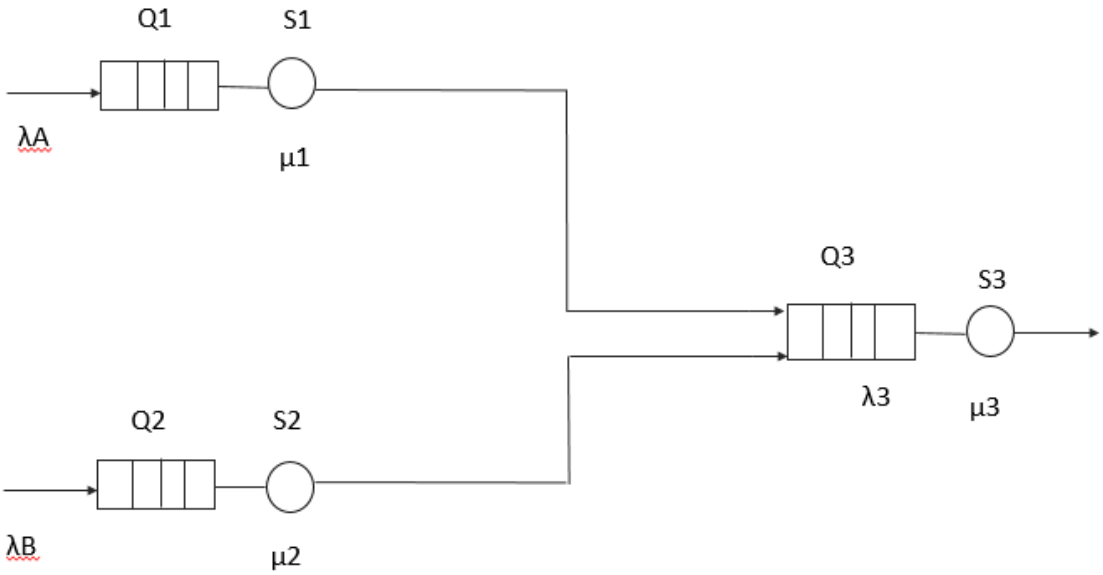
Goal of the project: **To find average number of customers in queuing net** (N= N1 + N2 +N3) i.e; who get gambling services from all casino tables.

Experimental design :

There are three M/M/1 queues and these three servers S1 , S2 and S3 work with service rates $\mu 1$ =10 customers /min, $\mu 2$ =81 customers/min, respective $\mu 3$ =210 programs /min. New customers arrive at servers S1 and S2 according to Poisson processes of rate λA = 28, and λB =14 customers per minute. In each M/M/1 system we assume the departure rate is same of arrival rate .

In our project we consider 3 M/M/1 servers , where services define activities done on its respective Casino table.

→3) Pictorial Representation



3 M/M/1 servers , where services define activities done on its respective Casino table. New customers arrive at servers S1 and S2 according to Poisson processes of rate. Queuing net is the sum of average customers of each server i.e; N=N1 + N2 + N3. We calculate it by using input data Q5MM1.M

→4) Used Material

1) MATLAB R2018b

2) To develop the casino idea we have taken input data from "**Q5MM1.m**" from '**CapacityAnalysisExamBTH20190320.zip**' and main reason to take this as input data is 5^{th} problem from above zip folder (exam) is very close to casino idea as well as to reach goal of the project and second part of 5^{th} problem is useful for simulating .

→5) Used Method

In our project to implement the casino idea we used **M/M/1** queuing system to get the results (goal of project) .

→6) **Result**

Result from MATLAB

Average no. of customers in

(i) E[N1] = 0.3649

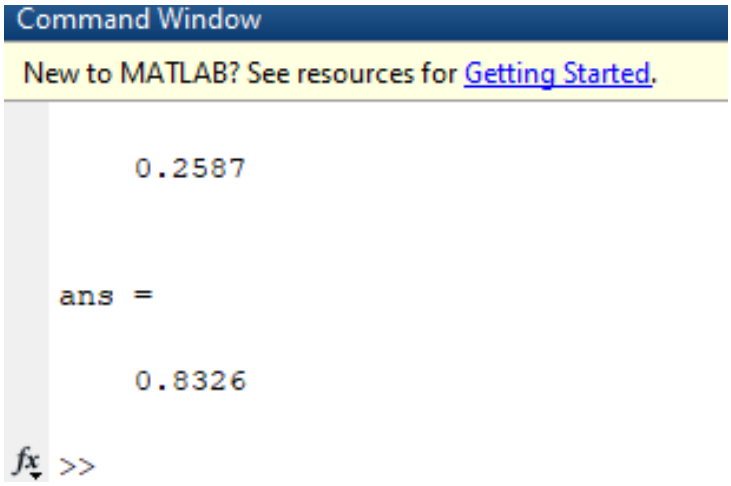
(ii) E[N2] = 0.2089

(iii) E[N3] = 0.2587

(iv) E[N] = E[N1] + E[N2] + E[N3] = 0.3649 + 0.2089 + 0.2587

E[N] = 0.8326

General formula of E[N] = p/1-p where p = lambda / mu



By Calculating theoretically with above mentioned formula we get 0.812 average number of customers in queuing net who do gambling activities on casino table.

→7) Appendix:

Code written in MATLAB :

```
lambda_A = 28;
lambda_B = 14;

lambda_1 = lambda_A;
lambda_2 = lambda_B;
lambda_3 = lambda_1 + lambda_2; % from figure it is clear that
lambda3=(lambda1 + lambda2)

mu_1 = 104;
mu_2 = 81;
mu_3 = 210;


trials = 100;
N = zeros(4, trials);
for i = 1:trials
    endtime = 1600/60; % convert seconds to minutes;
    N1 = Q5MM1(lambda_1, mu_1, 1600/60);
    N2 = Q5MM1(lambda_2, mu_2, 1600/60);
    N3 = Q5MM1(lambda_3, mu_3, 1600/60);

    N(1, i) = mean(N1);
    N(2, i) = mean(N2);
    N(3, i) = mean(N3);
    N(4, i) = mean(N1) + mean(N2) + mean(N3);
end

mean(N(1,:))
mean(N(2,:))
mean(N(3,:))
mean(N(4,:))
```

→**References**

1) Queuing Systems volume 1 : theory by Leonard Kleinrock
2) Wikipedia (to gather information on casino)
3) MATLAB support
4) 'CapacityAnalysisExamBTH20190320.zip' folder (input data)