**Answer 1:**

**Problem definition:**

Chick-fil-A is one of the largest American fast food restaurant chains located at Student Union building of Texas Tech University. This place is very popular especially in the lunch hour to the students because of its food quality and service. To maintain the quality of the service the system needs to be designed for maximum efficiency. Real time data for two consecutive days (2 hours each day) was collected for the system. The data needs to be fitted to an appropriate distribution. Depending on the distribution a queuing model needs to be established. A simulation will be built to simulate the system by using SIMIO software in different terminating conditions. The result of the simulation needs to be compared with the actual output from system. Further suggestions are required to improve the system. After collecting and fitting the data with goodness of fit test, the following problem can be suggested:

This is M/M/5 model where Inter-Arrival time is exponentially distributed with mean 0.5330 minutes and Service time is exponentially distributed with mean 1.6772 minutes with the single queue and 5 servers in the system.

**Objective:**

The objective of this project work is to observe a system and collect real time data. This data will be used to analyze the performance of the system by using SIMIO software. The result of the simulation will be compared to the actual result derived from queueing theory. Some objectives of this study are as follows:

1. Building a simulation model from real life data obtained from an actual system (Chick-fil-A at Student Union)
2. Describing the key aspects of the system
3. Fitting the collected data to a statistical distribution model and building a simulation model by using SIMIO
4. Determining a desired accuracy of the simulation by alternating the number of replication and suggesting alternate model configuration to improve the efficiency of the system.

**Answer 2:**

Arrival times and serving times Data were collected for 2 consecutive days. Lunch time was chosen to observe the system. The system has a single queue and five servers. The data are tabulated in excel file which is attached to this file.

**Answer 3:**

We have observed on 15 customers picked randomly with an interval of 5 minutes between each customers arrival time and calculated their actual waiting time in the queue and system. Also, we collected the size of the queue lengths while each customers leave the system (refer to the attached excel file “Output Data”). On the other hand, we have collected total of 225 customers data to calculate mean Inter-arrival time and collected 150 customers service time to calculate mean service time. Since we have picked total of 15 customers data who has got served with mean inter-arrival time of 5 minutes between them so the arrival rate and the service rate will be different from the actual arrival and service rate data which has calculated in the attached excel file (refer to the attached excel file “Input Data” & “Output Data”). As a result, average number of customers in queue and system, average waiting time in queue and system (for 15 customers) will vary accordingly from the actual data (with 225 customers mean IAT and 150 customers mean ST).

**Answer 4:**

![Chart, histogram

Description automatically generated]()Inter arrival times and serving times in five servers of the system follows the exponential distribution curve which was determined by using StatFit software. We used Chi-square test to confirm the goodness of fit.

![Graphical user interface

Description automatically generated with low confidence]()

**Figure 1**: Exponential distribution and goodness of fit for the inter-arrival time.

A picture containing text, receipt

Description automatically generated

**Figure 2**: Chi-square test for goodness of fit of the serving time in five servers

Graphical user interface

Description automatically generated

**Figure 3**: Exponential distribution fit for the service time in five servers