Project 1

**Due date:** March 6th , 2020

**This is a Group Game/Simulation Project**

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# Queue Theory Refresher for M/M/1:

|  |  |  |
| --- | --- | --- |
| **Metric** | **Symbol** | **Remarks** |
| Mean rate of arrival |  | Arrivals per unit of time |
| Mean inter-arrival time | 1/ | In units of time between arrivals |
| Mean rate of service |  | Serviced clients per unit of time |
| Mean service time | 1/ | In units of time per service |
| Traffic intensity | / |  |
| Probability that system is idle | 1- |  |
| Probability Customer doesn’t wait |  |  |
| Probability Customer waits |  |  |
| Probability that n Customers in system | ^n |  |
| Probability that >=n Customers in system | ^n |  |
| Average number of customers in system | / |  |
| Average number of customers in queue (even if no queue) | ^2/ |  |
| Average number of customers in queue if there is one | / |  |
| Average time a customer is in queue | /1/ | In units of time |
| Average time a customer is in a system | /1/ | In units of time |

# Task 1 – As a group select one project from the given list of topics (5%) (Due: Friday, Feb.22nd, 2020)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Original System | Activities | Observable Elements | Obtainable Data | Simulation Events | Simulation Input Data | Collectible Data |
| Traffic Intersection | Arrival,  Wait (red light),  Drive Away | Lights, lanes, vehicles | Timing of lights (changes), arrival times, departure times | Arrivals, departures | Arrival and departure times | Queue length, wait times |
| Waiting Room (Hospital, Dental, Emergency) | Patients (sit /stand /complain  /fill out forms  /give up-leave  /get served) | Patients, Nurses, Doctors | Arrival times, Departure times (with/without being served) | Arrivals,  Form Filling, Departures to service,  Departures (Exit building) | Arrival times,  Service Times,  Wait time before “reneging” (giving up before being served)  departure times | Wait times,  % of patients who stay to be served |
| Enrollment Services | Students (take a ticket, get advised),  Receptionist (gives tickets),  Adviser(s) (call(s) next ticket, advise(s)) | Students,  Receptionist,  Adviser(s) | Arrival times, Departure times (with/without being served) | Arrivals,  Obtain Ticket, Departures to service,  Departures (Exit building) | Arrival times,  Service Times,  Wait time before “reneging” (giving up before being served)  departure times | Wait times,  % of students who stay to be served |
| Tim Hortons Drive-in | Cars (give order /get served /pay),  Server (serves the order, gets payment) | Cars, Server | Arrival times, Departure times | Arrivals,  Give order,  Gets served,  Pays, Departures | Arrival times,  Service Times | Wait times |
| McDonals Drive-in | As above | As above | As above | As above | As above | As above |
| College’s Main Tim Horton’s | Students (give order /get served /pay),  Server (serves the order, gets payment) | Students,  Server | As above | As above | As above | As above |
| College’s Second Cup | As above | As above | As above | As above | As above | As above |
| College’s E-Building Tim-Horton’s | As above | As above | As above | As above | As above | As above |
| Library Checkout-s (4-th floor) | Students (check out, [optionally pays fines]),  Librarian (serves the order, [optionally gets fine payment]) | As above | As above | As above | As above | As above |
| Surprise me (should have the queuing elements with arrivals, servicing and departures) | Defined by you | Defined by you | Defined by you | Defined by you | Defined by you | Defined by you |

Let’s have a different project for each group, so one group member posts in GroupSelections a text file with group topic selection including at least two topics in order of descending preference (in case the topic is selected already). The last entry gets a 5% bonus for novelty/innovation (provided that it is an acceptable project)

# Task 2 – Decide on and do the required observations (15%)

Focus on timing data:

. decide on the duration of observations (at least 30 min) and any other data except the two below (3%)

. keep the times of arrivals of new customers – one member of the group keeps these in an excel sheet for the decided duration. (6%)

. keep the duration of “service” for each customer – one member of the group keeps these in another excel sheet for the decided duration. (6%)

# Task 3 – Process the observed data (15%)

. Create 2-3 Histograms for each of the sets of data (arrivals/service) with different bin size (as in class).

. decide on the bin size that produces the “smoother” histogram.

. Use the Curve Fitting with exponential (enable Analysis Pack as in class). Keep track of the parameter for the following.

# Task 4 – Create an Excel Simulation of the Queue Subsystem (15%)

Use the data obtained from the curve-fitting above for the average inter-arrival time and average service time parameters to create the excel simulation (as in class) assuming M/M/1 queue. Answer the following:

. What is the probability that the server is idle?

. What is the average number of “customers” waiting in line for service?

. What is time a “customer” spends in the premises (including the serving time)?

. How many “customers” per hour will be “served” by this service?

. Create a graph with probabilities that there are n “customers” in the queue for n from 0 to 30. (as in class)

# Task 4 – Create a Unity Game/Simulation that uses the data from above for its Queue core subsystem (40%)

. You can use animations from the asset store for the customers and/or other actors in the system.

. Use the following input data customized for your selected scenario (which you arrived at in the previous tasks):

a) The unit of time, b) The average of arrivals per unit time at the (single) service and c) the average service time for each customer/car/patient.

. Assume that the queue created complies with the assumptions of the M/M/1 queue.

. Create a UI for experimenting with parameters; take snapshots of your experiments in a snapshot .docx

**Make two builds of your simulation: Exe and WebGL**

# Total: 100%