# **Mini Project - Deliverable 01**

## **EEX5362 - Performance Modelling**

## **Call Center Simulation Based on Queues**

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**Note -** In ILS01 it was mentioned that we can use the same system that we built for the case study, for this mini project as well. So this report proceeds using the same system.

## **Problem Description**

The system we will be looking at for this project is a **call center simulation system based on a queue**. A call center is a service where agents or customer service representatives handle any incoming customer calls to provide support, resolve any issues or complaints and deliver requested information. For example, a customer can call for technical support or even a service activation.

In a customer service environment like a call center, managing incoming calls in an efficient way is important in order to maintain the customer satisfaction as well as the quality of the service. A usual call center faces challenges like call arrival rates, limited staff availability or customer patience levels. When the demand goes beyond the available capacity, customers might face delays, leading to dissatisfaction or sometimes even leaving the waiting queue due to frustration. But the other way around can also be less efficient, as in overstaffing which can lead to higher operational costs and during a less busy period, staff can have idle time which is a waste of resources.

This system functions as a simulation model based on a queue, designed to represent the behaviour of a call center with limited agents. The simulation processes two key components which are

1. Customer arrival process (demand)
2. Agents providing the service (capacity)

To study the performance of the call center system in a realistic and controlled way, we develop a discrete event simulation (DES) model. This is a technique that is used to analyze and predict the behaviour of complex real world systems by modelling them as a sequence of distinct events over a period of time. In this scenario, events such as *customer arrivals*, *service start*, *service end* are tracked over time. Each customer is represented as an entity with attributes like arrival time, service duration and patience limit while agents can only handle a single customer at a time and are limited in number too. When all agents are busy, incoming customers will be placed in a waiting queue. If their waiting time exceeds their patience level, they leave the queue.

By changing the number of agents, service time, arrival rate, or customer patience, the model can give different operating conditions like low, medium or high load, overstaff or impatient customers. These scenarios will help us identify how resource availability, service efficiency and customer behaviour directly affects the overall performance of the system, aligning with the performance goals in complex systems.

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## **Performance Objectives**

The primary objective of this system is to analyze and evaluate how different operational parameters can affect both efficiency and customer satisfaction. We will analyze the following:

* **Minimizing average wait time in the queue -** Reduce the time customers spend waiting before they receive service by an agent
* **Balance cost and service quality -**  Evaluate how staffing levels and service speed can affect both operation costs and customer satisfaction.
* **Reduce customer abandonment -** Minimize the number of customers leaving the queue before receiving service
* **Maximize throughput (calls completed per hour) -** Increase the number of customers successfully served within the simulation time
* **Optimize agent utilization (how busy each agent is) -** Ensure agents are efficiently used without being overworked nor left idle.
* **Identity performance bottlenecks -** Detect conditions under which the system performance decreases such as for example, high arrival rate or low patience.

The performance insights we derive from this system will be important for strategic planning in staffing, service speed and system design. It will also help the system maintain high responsiveness, efficient resource usage and minimal customer loss.

### **Input Dataset**

These are the parameters we will be using to control the system. Adjusting these will allow us to test different scenarios. These values will be generated using random distributions to mimic a realistic system.

| **Parameter** | **Description** | **Example value** |
| --- | --- | --- |
| numOfAgents | Number of agents available in the call center | 4 |
| meanArrivalRate | Average rate of incoming customer calls | 2.0 |
| meanServiceTime | Average service time for each customer | 2.0 |
| meanPatienceTime | Average time customers are willing to wait before leaving the queue | 10.0 |
| simulationDuration | Total simulation time span | 10,000 seconds |

Git repo : <https://github.com/Amanyyy27/call_center_simulation.git>