**EEX5362:**

**Performance Modelling**

**Deliverable 01**

**For**

**Mini Project**

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**High-Level Problem Description**

This report presents a Call Center Simulation created using Python and SimPy to study system performance under varying workloads.

A call center is a service-based system where customers contact agents to receive assistance or information.

The number of incoming calls is uncertain, and the time required to handle each call is different, making this system complex and dynamic.

The main challenge in such systems is maintaining a balance between customer satisfaction and resource efficiency.

* If there are too few agents, customers experience long waiting times.
* If there are too many agents, resources remain underutilized.

This simulation helps understand how different agent configurations affect performance and waiting times.

1. **Identified Complex System**

The selected system is a Call Center Queue Management System.  
It is an example of a service-oriented queueing model with measurable and variable performance characteristics.

**Main Components:**

* Customers (Callers): Enter the system randomly to request support.
* Agents: Limited number of workers who serve one customer at a time.
* Queue: A waiting line that holds customers when all agents are busy.

This system is considered complex because it involves random call arrivals and variable service times.

The interaction between customer flow, queue length, and resource availability changes over time, affecting overall performance.

**Measurable Performance Characteristics**

Several measurable parameters are used to analyze the performance of the call center system.

These performance characteristics help evaluate both customer experience and resource usage.

|  |  |
| --- | --- |
| **Performance Measure** | **Description** |
| Average Waiting Time | Average time a customer waits before being served |
| Average Queue Length | Average number of customers waiting in line |
| Throughput | Number of calls completed per minute |
| Agent Utilization | Percentage of time agents are busy handling calls |
| Arrived and Finished Calls | Total number of customers who entered and completed service |

1. **Performance Objectives**

The main performance objectives of the simulation are to:

* Reduce waiting time by improving service capacity.
* Maintain a manageable queue length to ensure consistent service quality.
* Maximize agent utilization without overloading staff.
* Increase throughput to handle more calls within the same time frame.
* Identify bottlenecks that reduce system efficiency or customer satisfaction.

By focusing on these objectives, the simulation helps evaluate the trade-offs between fast customer service and efficient resource use.

**Dataset Description**

The dataset used in this study is generated by the simulation.  
It represents realistic behavior by using random intervals for customer arrivals and service durations based on exponential distributions.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Description** | **Example Value** |
| Simulation Time | Total time the simulation runs | 100 minutes |
| Agents | Number of available service agents | 2, 3, or 5 |
| Arrival Gap | Average time between new calls | 5 minutes |
| Service Time | Average time taken per call | 7–9 minutes |
| Random Seed | Used to produce repeatable random results | 10 |

**Simulation Parameters:**

**Output Table from results.csv:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | Agents | Avg Wait | Avg Queue | Throughput | Utilization | Arrived | Finished |
| Scenario A | 2 | 14.22 | 2.67 | 0.15 | 0.6 | 19 | 15 |
| Scenario B | 3 | 0.56 | 0.11 | 0.2 | 0.467 | 20 | 20 |
| Scenario C | 5 | 0 | 0 | 0.18 | 0.324 | 20 | 18 |

**Summary**

* The call center system serves as a practical example of a queue-based performance model.
* It allows observation of how resource allocation, such as the number of agents, directly affects waiting time, queue size, and utilization.
* The simulation demonstrates that efficient service depends on achieving the right balance between the number of agents and the incoming call rate.
* This dataset and model can be used to support decision-making in real service environments, such as determining staff requirements or predicting system behavior during busy periods.

**Appendix**

**A screenshot of a computer

AI-generated content may be incorrect.Result file’s screenshot:**

**Github Repository:**

[**https://github.com/SusalSandeepa/Call-Center-Simulation-Code-for-Mini-Project**](https://github.com/SusalSandeepa/Call-Center-Simulation-Code-for-Mini-Project)