

**Bachelor of
Software Engineering Honors**

EEX5362

Performance Modelling

Mini Project (A)

Supermarket Checkout Queue

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High-Level Problem

This study focuses on analyzing the performance of a **supermarket checkout queue system**. In this system, multiple customers arrive randomly and are served by three checkout counters. The goal is to understand the system's efficiency by measuring waiting times, throughput, and counter utilization.

Efficient checkout management is essential to minimize customer delays and ensure optimal use of staff and resources. By analyzing queue behavior and identifying bottlenecks, improvements can be suggested to enhance the overall performance of the system.

2. System Description

- **Type of System:** Queueing system (supermarket checkout)
- **Number of counters:** 3 checkout counters
- **Queue discipline:** First Come, First Served (FCFS)
- **Arrival pattern:** Random arrivals
- **Service times:** Random durations
- **Data Source:** Synthetic dataset generated to simulate realistic customer arrivals and service durations.

Each customer record in the dataset contains:

- Customer ID
- Arrival Time (in minutes)
- Service Time (in minutes)

3. Performance Objectives

The main objectives of this performance analysis are:

1. **Minimize Average Waiting Time:** Ensure customers spend less time waiting in line.
2. **Maximize Throughput:** Increase the number of customers served per hour.
3. **Optimize Resource Utilization:** Balance workload among all counters.
4. **Identify Bottlenecks:** Detect if any counters are overloaded or underutilized.
5. **Measure 95th Percentile Waiting Time:** Identify worst-case waiting delays.

4. Methodology

The performance of the supermarket queue system will be analyzed using simulation-based modeling. The approach involves:

- Modeling arrivals and services using random data from customers.csv.
- Simulating the queue behavior with 3 parallel servers.
- Measuring waiting time, total time in the system, throughput, and utilization.
- Generating simple visualizations to identify patterns or bottlenecks.

6. Expected Results and Discussion

Based on initial analysis expectations:

- Average waiting time will depend on arrival rate and service speed.
- Throughput will stabilize when all counters are optimally utilized.
- Utilization above 85% at any counter may indicate potential congestion.
- The results will help suggest strategies like adding an extra counter or managing peak hours efficiently.

7. Conclusion

This study provides insights into how queue management affects overall performance in a supermarket checkout environment. By analyzing waiting times, throughput, and utilization, we can identify performance bottlenecks and recommend improvements to enhance customer experience and operational efficiency.

8. Github Repository

<https://github.com/KethA06/Supermarket-Checkout-Queue>