

Supermarket Queue Simulation Report

Introduction This lab models a supermarket check-out system with two different queueing disciplines:

1. Separate Queues: Each cash register has its own separate queue.
2. Single Queue: A single common queue serves customers at the next available register.

The objective is to determine which system minimizes customers' average waiting time.

2. Implementation Details 2.1 Customer Class The Customer class represents a supermarket customer with:

Arrival Time: The time when the customer arrives at the queue.

Service Time: The time taken to complete checkout in minutes.

2.2 Simulation1: Separate Queues

Each cashier operates an independent queue.

New customers join the shortest queue upon arrival.

Idle registers serve the next customer from their respective queues.

Waiting times are recorded for analysis.

2.3 Simulation2: Single Queue

A single common queue serves all available cashiers.

Customers join the common queue upon arrival.

If a register becomes available, the next customer in line is served.

Waiting times are monitored for analysis.

3. Simulation Parameters

Arrival Probability: 0.3 (Chance of customer arrival per minute)

Number of Registers: 3

Total Simulation Time: 1000 minutes

Service Time: Random between 1 and 5 minutes

4. Results and Analysis

Average waiting times observed:

Separate Queues: 2.33 minutes

Single Queue: 1.95 minutes

```
/opt/homebrew/bin/python3 /Users/shinde/Desktop/oops/MarketSimulation-Python/Simulation1.py
● (base) → MarketSimulation-Python /opt/homebrew/bin/python3 /Users/shinde/Desktop/oops/MarketSimulation-Python/Simulation1.py
Average waiting time (separate queues): 2.33 minutes
● (base) → MarketSimulation-Python git:(main) ✕ /opt/homebrew/bin/python3 /Users/shinde/Desktop/oops/MarketSimulation-Python/Simulation2.py
Average waiting time (single queue): 1.95 minutes
○ (base) → MarketSimulation-Python git:(main) ✕
```

Observations:

The single queue system distributes workload more efficiently, preventing long lines at individual registers.

The separate queue system may lead to unbalanced wait times if certain queues grow significantly longer.

At high customer volumes, the single queue system minimizes overall wait times more effectively.

Conclusion

The simulation demonstrates that a single queue system generally results in lower average wait times than separate queues. This is due to an even distribution of customers across registers, leading to faster service. However, real-world factors such as customer behavior and store layout may influence the effectiveness of each system.