THE OPEN UNIVERSITY OF SRI LANKA

FACULTY OF ENGINEERING TECHNOLOGY

THE DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

**EEX5362 Performance Modeling**

**Mini Project - Deliverable 01**

**Food Delivery Dispatch System Simulation**

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**Overview of the scenario**

**Selected system: Food Delivery Dispatch System Simulation**

In the modern food delivery industry, ensuring fast, reliable, and cost-efficient service is a major performance challenge. Delivery platforms must manage uncertain order arrivals, changing traffic conditions, and varying rider availability in real time. When rider availability is low, customers experience longer waiting times, while excessive rider allocation leads to idle resources and reduced efficiency. Achieving an optimal balance between customer satisfaction and resource utilization is therefore a central performance concern.

This mini-project models a complex and dynamic food delivery dispatch system using discrete-event simulation to evaluate how rider assignment strategies and traffic conditions affect overall system performance. The simulation captures the stochastic and time-dependent behavior of a real-world delivery process, providing insights into key performance trade-offs.

To reflect real-world operational complexity, the model incorporates two major enhancements:

* Dynamic Rider Assignment Algorithm: Each incoming order is assigned to the nearest available rider within a 10×10 km service region, replicating intelligent, location-based dispatching strategies used in modern platforms.
* Traffic Variation Model: Rider travel speeds fluctuate according to simulated time-of-day traffic patterns, such as peak lunch and dinner periods, directly influencing delivery durations and service reliability.

By integrating these mechanisms, the system behaves as a dynamic, queue-based environment where both demand and service conditions vary over time. This makes it an ideal scenario for performance modeling, enabling detailed analysis of waiting times, delivery efficiency, throughput, and resource utilization under diverse operating conditions.

**Key parameters and default values:**

* Number of riders: 4
* Mean order interval: 5 minutes
* Average delivery time: 10 minutes
* Simulation duration: 320 minutes
* Random seed: 42

**Performance Metrics Recorded:**

* Average wait time (from order to assignment)
* Average delivery time (from order to completion)
* Rider utilization (%)
* Throughput (orders completed per minute)
* Percentage of customers who waited vs. served immediately
* Maximum queue length

**High-Level Problem**

The food delivery industry operates in a highly dynamic environment characterized by fluctuating order arrivals, varying delivery times, changing traffic conditions, and limited rider availability. Efficiently assigning riders to orders under these uncertainties is a critical challenge that directly impacts service quality and operational efficiency.

Inefficient dispatching can lead to several performance issues, including:

* Long customer waiting times
* Underutilized riders
* Excessive queue buildup
* Reduced customer satisfaction

Therefore, understanding how changes in rider numbers, order frequency, and delivery speed impact system performance is essential for optimizing resource allocation and maintaining high service quality.

**Performance Objective**

**Objective: Minimize Average Wait Time**

The main objective of this simulation study is to minimize the average waiting time experienced by customers before order assignment. This metric reflects the responsiveness and efficiency of the dispatch system. It is evaluated across multiple scenarios with varying rider availability, order arrival rates, and delivery conditions.

By analyzing the simulation dataset, the project aims to identify performance bottlenecks, assess the impact of dynamic rider assignment and traffic variations, and recommend strategies to improve delivery speed, rider utilization, and overall system reliability.

**Dataset**

Git Repository link: <https://github.com/AsrinJumana712/EEX5362-Performance-Modelling_Mini_Project.git>