Dynamic Pricing for Urban Parking Lots – Final Report

1. Introduction

This project implements dynamic pricing models for urban parking lots using real-time streaming data. The goal is to optimize parking prices based on demand indicators such as occupancy, queue length, traffic conditions, and special events.

2. Models Used

2.1 Model 1: Occupancy-Based Pricing

Model 1 uses a simple rule-based approach where the parking price increases linearly with occupancy percentage. It assumes that higher occupancy implies higher demand and should result in increased pricing.

2.2 Model 2: Demand-Based Pricing

Model 2 computes a demand score using multiple features:
- Queue Length (normalized)
- Traffic Conditions (mapped to scores)
- Special Day indicator (binary)
- Vehicle Weight (based on type: car, bike, truck)

The demand function used is:
demand = 2 * (occupancy / capacity) + queue_norm + traffic_norm + is_special_day + vehicle_weight

Then we normalize this score and apply the pricing function:
price = 10 + 5 * norm_demand

3. Assumptions

- Occupancy reflects real-time availability of parking slots.
- Traffic conditions and queue lengths are positively correlated with demand.
- Vehicles with greater weight are assumed to require more space or priority pricing.
- A fixed base price of ₹10 is assumed, and demand can scale it up to ₹15.
- No penalty or dynamic surge logic is applied for overcapacity.

4. Price Behavior with Demand and Competition

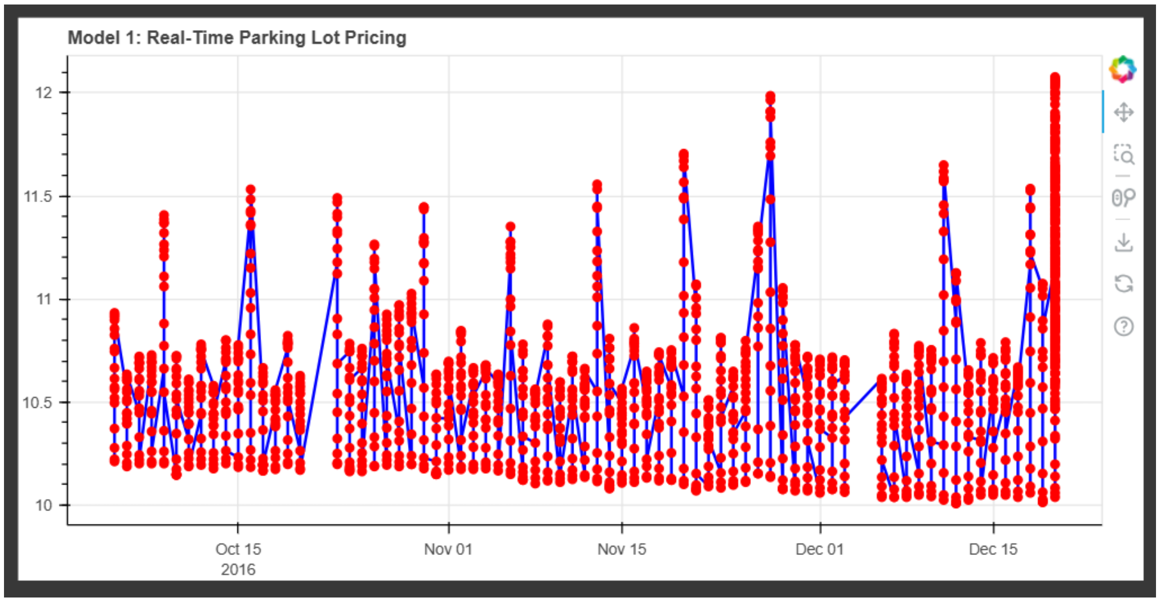
In Model 1, price fluctuates solely based on occupancy percentage. This results in stable pricing patterns with occasional spikes.

In Model 2, pricing becomes more adaptive. As demand factors like queue, traffic, or event days increase, the price reflects that change.
This leads to more granular price movement. The model is better suited for real-world applications where multiple external factors affect parking usage.

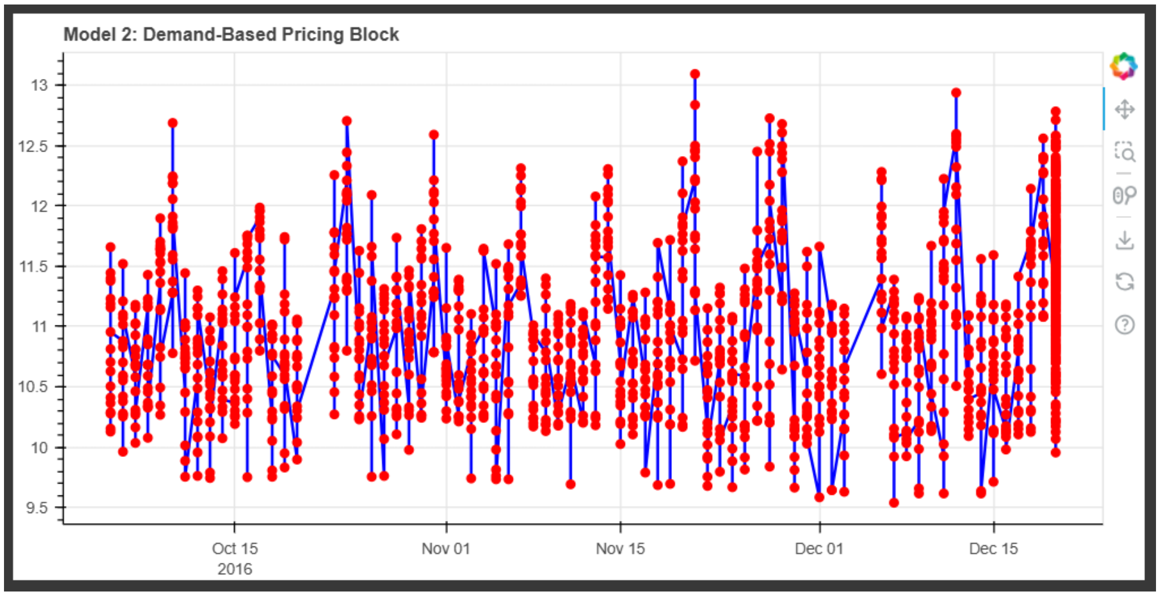
5. Visualizations

The following Bokeh plots show pricing over time:

Model 1:



Model 2:



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