Model 1

This report explains the reasoning behind the selection of features, functions, and values used in Model 1 for dynamic parking price prediction using streaming data.Model 1 serves as the baseline for dynamic parking pricing, employing a simple, explainable linear relationship between parking lot occupancy and price.

Rationale for Feature Selection

1. Occupancy Rate

- Definition: The ratio of the number of parked vehicles to the total parking capacity at a given time.
- Reason for Inclusion: Occupancy rate directly reflects demand.

2. Base Price

- Definition: The starting price for parking, set at $10 as required by the project guidelines.

3. Price Function

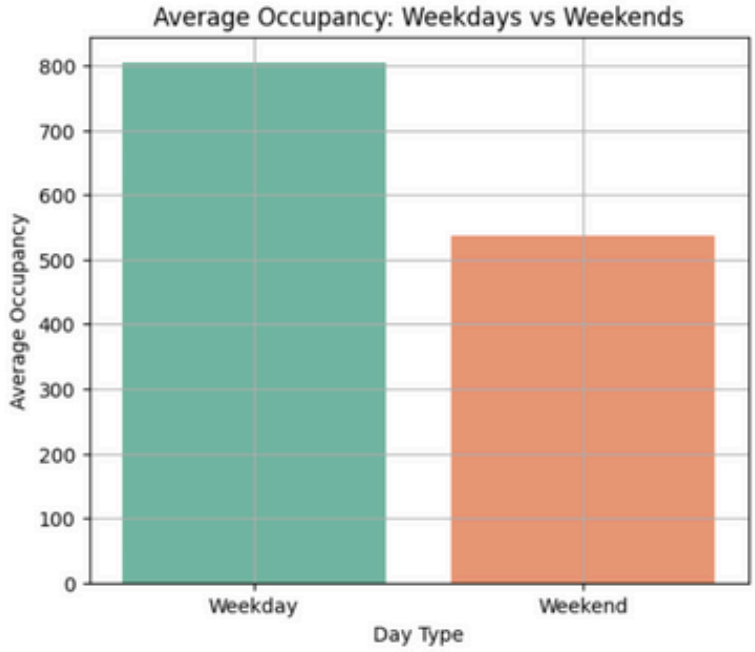
a. **Formula Used**: 10.0 + 2.0 * occ_rate * tod_weight * wd_weight

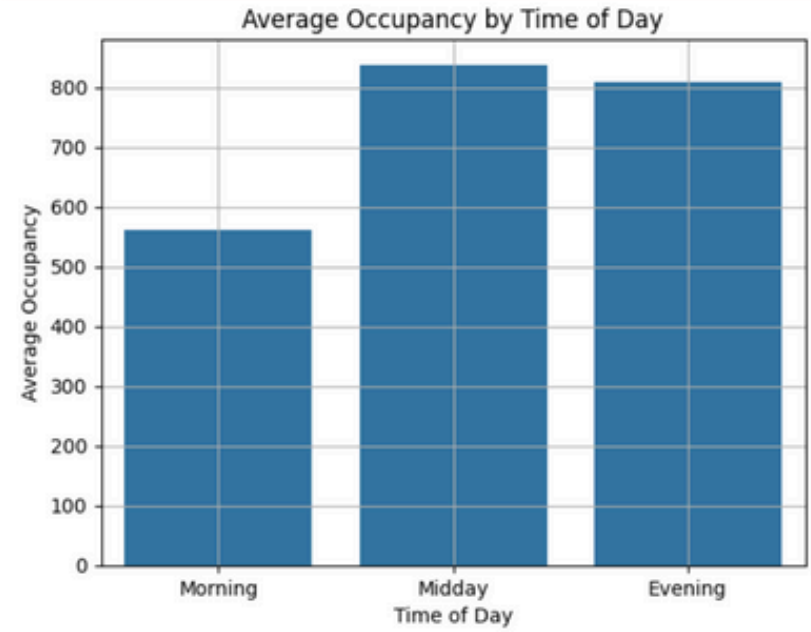
where,

tod_weight = time-of-day multiplier
wd_weight = weekday/weekend multiplier
alpha=2.0 ---> to make price changes noticeable but not erratic.

Why This Formula?

Simplicity: Easy to implement and explain.
Direct Demand Response: Price increases smoothly with higher occupancy.
Transparency: Stakeholders can easily understand and trust the mechanism.





b. **Time of Day Weight**:

Midday (11–2 PM) is peak urban activity

Evening (2–5 PM) sees tapering demand

Morning is typically low demand

c.**Weekday Weight**:

Weekdays usually see more routine vehicle movement (commutes, business).

Weekends may have lower, less predictable demand → reduce price to encourage usage.

Why These Parameters?

- **Simplicity**: This model serves as a baseline. It's interpretable, traceable, and easy to debug.
- **Scalability**: These weights can be easily modified or extended.
- **Smooth Pricing**: Using a multiplier design ensures gradual, explainable variations in price.

Data Processing Steps

- Timestamp Creation: Combined date and time for accurate sequencing.
- Lot-wise Calculation: Each lot handled separately to reflect individual demand.
- Sorting: Data sorted by time to ensure correct price updates.

Assumptions

- Only Occupancy Drives Price: Other factors (queue, traffic, vehicle type) are ignored in Model 1 for clarity.
- No Negative Prices: Prices never fall below the base price.
- Smooth Adjustments: Linear function prevents abrupt price jumps.

Visual Justification (Bokeh Plots)

Each parking lot has:

- A real-time price graph with timestamps.
- Plot reflects:
  - Time-varying occupancy
  - Price variation patterns over hours
  - Prices peak around midday.

Summary

This model acts as a baseline dynamic pricing engine, using only real-time capacity-related data and basic time context to drive pricing decisions. It lays the foundation for more complex demand and competition-aware models in subsequent stages.