

# Final Report: Dynamic Pricing for Urban Parking Lots

## Objective:

This project implements a dynamic pricing system for city parking lots using Python and real-time streaming with Pathway.

## Data Overview:

- Dataset: time-stamped data on occupancy, queue length, traffic, and location for ~14 parking lots.
- Key fields: Occupancy, Capacity, QueueLength, TrafficConditionNearby, VehicleType, Latitude, Longitude, Date/Time.

## EDA Summary:

- Checked and handled missing values and duplicates.
- Visualized data using histograms, bar charts, and correlation heatmap with annotations.
- Detected and treated outliers using boxplots and winsorisation (1st to 99th percentile).

## Feature Engineering:

- Created  $\text{OccupancyRate} = \text{Occupancy} / \text{Capacity}$ .
- Derived IsSpecialDay, Hour, LatRound, and LongRound features.

## Pricing Models:

- Model 1 (Linear): Price based on OccupancyRate.
- Model 2 (Demand): Adds queue length, traffic, and event impact.
- Model 3 (Competitive): Adjusts price based on nearby lot averages.

## Real-Time Streaming (Pathway):

- Used Pathway to stream row-by-row data from cleaned DataFrame.
- Prices computed using @pw.udf, printed via pw.io.subscribe.
- Streaming logic handles inserts and outputs real-time price decisions.

## Results:

- Prices range between \$5 and \$20 based on dynamic inputs.
- Live console output reflects working stream pipeline.