

Dynamic Pricing Algorithms and Rules Document

Objective

To design a dynamic pricing system that adjusts class prices based on demand, time of booking, and location, ensuring optimized revenue, increased utilization, and customer satisfaction.

1. Pricing Algorithm

The pricing algorithm dynamically adjusts prices based on weighted factors: **Demand**, **Time**, **Location**, and **Activity Type**.

1.1 Base Formula

$\text{Price} = \text{BasePrice} \times (1 + \text{DemandFactor} + \text{TimeFactor} + \text{LocationFactor} + \text{ActivityFactor})$

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$\text{ActivityFactor})$

- **BasePrice**: Default price for the class.
 - **DemandFactor**: Adjustment based on current demand.
 - **TimeFactor**: Adjustment for time of day.
 - **LocationFactor**: Adjustment for the class location.
 - **ActivityFactor**: Adjustment based on activity type/popularity.
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2. Algorithm Steps

Step 1: Data Preprocessing

- Load class data including location, activity type, base price, maximum capacity, and number of bookings.

- Calculate **Demand Ratio**: $\text{DemandRatio} = \frac{\text{Number of Booked Slots}}{\text{Max Capacity}}$

Step 2: Apply Factors

- **DemandFactor:**
 - If DemandRatio > 90%, increase price by 20%.
 - If DemandRatio < 50%, decrease price by 10%.
 - Else, no change.
- **TimeFactor:**
 - Peak hours (6–9 AM, 6–9 PM): +15%.
 - Off-peak hours (12–3 PM): -10%.
- **LocationFactor:**
 - High-demand locations (urban centers): +20%.
 - Low-demand locations (suburban/rural): -10%.
- **ActivityFactor:**
 - Premium classes (e.g., yoga, Zumba): +25%.
 - Low-demand activities (e.g., niche fitness): -15%.

Step 3: Calculate Final Price

Combine the factors and round to the nearest ₹10.

Step 4: Constraints

- Enforce a minimum and maximum price limit (e.g., ₹100–₹500).
- Ensure prices do not fluctuate more than once per booking window.

3. Example Calculations

Case 1: High Demand, Peak Time, Popular Location

- **Base Price:** ₹300
- **DemandFactor:** +20% (High demand, >90%)
- **TimeFactor:** +15% (Peak hours)
- **LocationFactor:** +20% (Urban center)
- **ActivityFactor:** +25% (Premium activity)

$$\text{Price} = 300 \times (1 + 0.20 + 0.15 + 0.20 + 0.25) = ₹471$$
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Case 2: Low Demand, Off-Peak Time, Suburban Location

- **Base Price:** ₹250
- **DemandFactor:** -10% (Low demand, <50%)
- **TimeFactor:** -10% (Off-peak hours)
- **LocationFactor:** -10% (Suburban)
- **ActivityFactor:** -15% (Low-demand activity)

$$\text{Price} = 250 \times (1 - 0.10 - 0.10 - 0.10 - 0.15) = ₹175$$
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4. Dynamic Pricing Rules

4.1 Time-Based Rules

- Peak hours (6–9 AM, 6–9 PM): Prices increase by 15–20%.
- Off-peak hours (12–3 PM): Prices decrease by 10–15%.

4.2 Demand-Based Rules

- High-demand classes (>90% utilization): Increase price by up to 20%.

- Low-demand classes (<50% utilization): Offer discounts up to 15%.

4.3 Location-Based Rules

- High-demand locations: Prices increase by 20%.
- Low-demand locations: Prices decrease by 10%.

4.4 Activity-Based Rules

- Popular activities (e.g., yoga, Zumba): Prices increase by 20–25%.
 - Niche activities: Discounts up to 15%.
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5. Implementation Workflow

Step 1: Data Input

- Collect real-time data: bookings, class type, location, and timing.

Step 2: Apply Algorithm

- Compute the price using the dynamic pricing formula.

Step 3: Update System

- Update prices in the booking system dynamically (e.g., hourly or based on thresholds).

Step 4: Monitor Performance

- Use metrics like revenue per class, utilization rates, and customer satisfaction.
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6. Business Recommendations

1. Surge Pricing:

Apply higher prices for peak hours and high-demand classes to maximize revenue.

2. Discount Campaigns:

Offer discounts for off-peak hours and low-demand locations to increase utilization.

3. Class Bundling:

Provide discounted packages for customers booking multiple classes.

4. Loyalty Rewards:

Introduce loyalty points for frequent bookings, redeemable for discounts.

5. Predictive Adjustments:

Use historical data to anticipate demand patterns and adjust prices proactively.

7. Challenges and Mitigation

Challenges

- Sudden demand spikes may lead to customer dissatisfaction.
- Price sensitivity among customers.

Mitigation

- Implement a cap on maximum price increases.
- Communicate the benefits of dynamic pricing to customers (e.g., flexibility, fairness).