OUTCOME

Model Performance Summary

Model	MAE ↓	RMSE ↓
Linear Regression	5.59	7.00
Random Forest	5.81	7.42
XGBoost	5.22	6.61

Best Model: XGBoost

🔸 **Why XGBoost is the best choice:**

- **Lowest MAE (5.22)** → It makes the most accurate predictions on average.
- **Lowest RMSE (6.61)** → It handles large errors better than the other models.
- **Feature importance capability** → You can extract which factors impact delivery time the most.

XGBoost strikes the best balance between bias and variance, handling complex relationships like non-linear interactions (e.g., how traffic + distance jointly affect time).

Actionable Steps to Decrease Delivery Time

Based on the analysis, let's figure out how to **optimize each factor**:

Serial No.	Feature	Importance
0	Road_traffic_density_encoded	0.358298
1	multiple_deliveries	0.237240
2	Delivery_person_Age	0.173336
3	Distance_km	0.118476
4	Festival	0.112651

Road Traffic Density (35.8% Impact)

- **Real-time Traffic Optimization:** Use live traffic data from Google Maps API or similar services.
- **Dynamic Rerouting:** Implement routing algorithms like A* or Dijkstra's to avoid congested areas.
- **Time-Based Delivery Incentives:** Encourage users to order during off-peak hours by offering discounts or rewards.
- **Traffic-Aware Vehicle Assignment:** Use smaller, faster vehicles like scooters or bikes for high-traffic areas.

Multiple Deliveries (23.7% Impact)📦

- **Intelligent Order Batching:** Group nearby orders, but cap multiple deliveries to 2–3 per courier.
- **Route Clustering:** Use K-means clustering to group deliveries within tight geographic zones.
- **Priority-Based Scheduling:** Deliver time-sensitive orders first and batch less urgent ones.

Delivery Person Age (17.3% Impact) 🏍️

- **Skill-Based Route Assignment:** Give longer, simpler routes to older, experienced couriers, and shorter, more complex routes to younger, faster ones.
- **Training & Gamification:** Offer training for speed and safety, and reward couriers with bonuses for meeting delivery time targets.

Distance (11.8% Impact)

- **Restaurant Location Optimization:** Use historical data to identify high-demand areas and recommend restaurant expansions.
- **Fastest vs. Shortest Path:** Use dynamic routing to choose the quickest path, not just the shortest.
- **Hub-and-Spoke Model:** Set up micro-hubs in high-demand areas to shorten last-mile delivery distances.

Festivals & Holidays (11.3% Impact)

- **Demand Forecasting:** Use historical data and public holiday APIs to predict spikes.
- **Fleet Scaling:** Pre-schedule additional couriers and optimize shifts during peak periods.
- **Order Time Buffering:** Add estimated delays to user-visible delivery times during high-demand events.

Final Optimization Strategy

By implementing these steps, we can tackle the most influential delivery time factors, cut delays, and improve the overall customer experience.