Introduction

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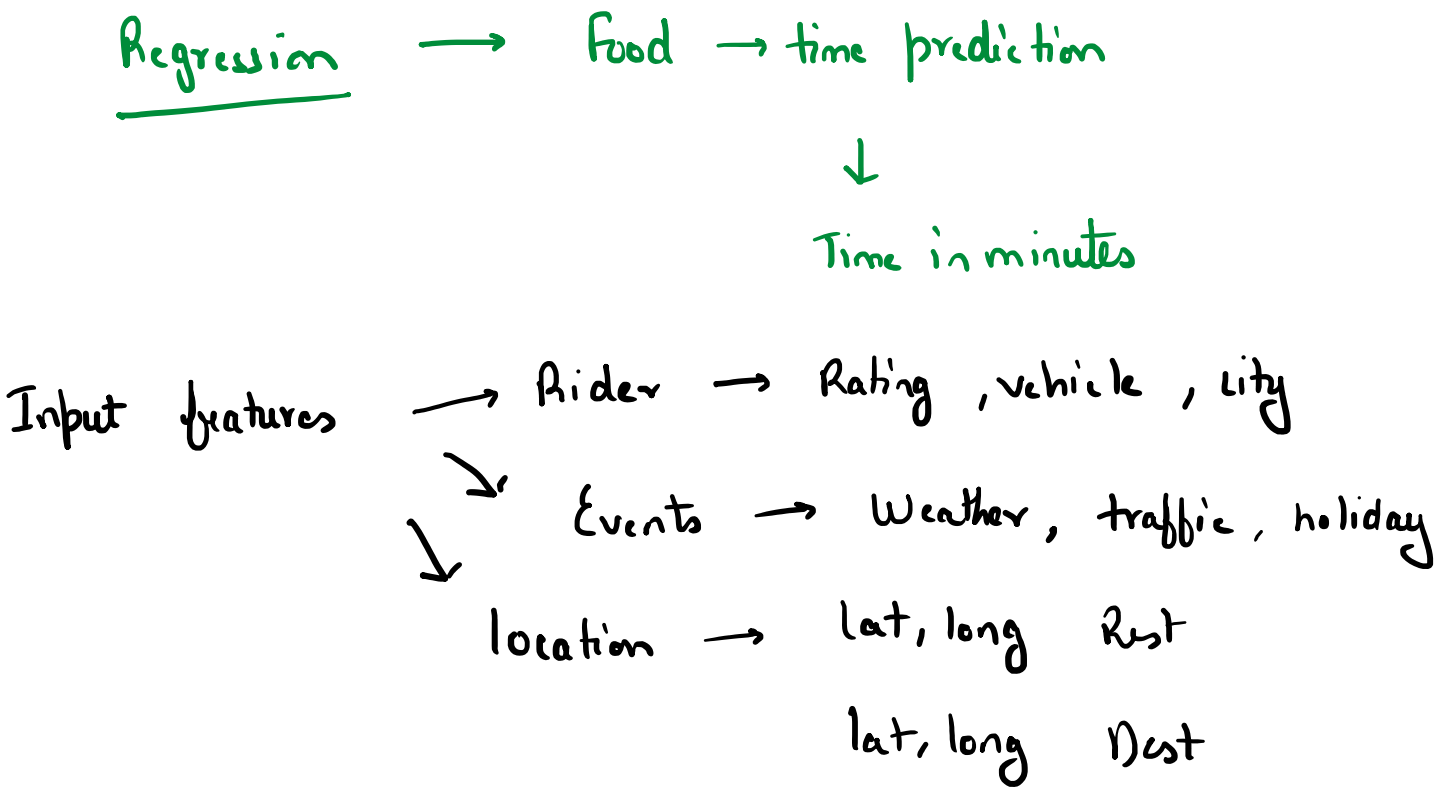
The project is a **regression problem** that has input features about the rider, the vehicle he owns, the weather condition, traffic and location of restaurant and delivery.

Goal: Predict the time in min to deliver the order from origin to destination.



Business Use Case

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→ Uber Eats

Resources
↓ ↘
Riders Origin

Business Use Case

In the competitive food delivery market, on-time delivery is critical for customer satisfaction, retention, and operational efficiency. A company wants to optimize delivery time predictions to improve customer experience by providing accurate estimated delivery times (ETAs) and to manage resources effectively. Accurate predictions of delivery time can also allow the business to:

40 min

1. **Improve Delivery Efficiency**: Identifying factors that slow down deliveries enables better resource allocation, such as more reliable scheduling for delivery personnel.
2. **Enhance Customer Satisfaction**: Reliable delivery ETAs can improve the customer experience by reducing wait-time uncertainty.
3. **Optimize Operational Costs**: If the model can predict scenarios with higher delays, additional resources (like more drivers or prioritizing specific orders) can be allocated.

Why is accurate time predictions imp?

Customers → Final

Riders → Intermediate

Restaurants → Origin

Accurate → Plan

Rider → Route, Deliveries

Rest → Food orders prioritize

How ML helps?

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1. Enhanced Customer Experience

- **Customer Satisfaction and Retention**: Delivering on promised ETAs is critical to customer satisfaction. When customers know exactly when their order will arrive, they can plan accordingly, reducing their anxiety over wait times. Reliable ETAs mean customers aren't left guessing or feeling frustrated, which increases trust and brand loyalty. A happy customer is more likely to become a repeat customer, directly impacting revenue growth through increased retention.

- **Improved Transparency**: Clear, accurate ETAs improve transparency, a factor increasingly valued by customers. If a delay is predicted due to conditions like traffic or weather, proactive updates to ETAs reassure customers that they are informed. This builds trust and creates a positive brand image, especially important in a crowded food delivery market.

- **Reduced Customer Support Load**: Accurate predictions minimize delays and the subsequent customer service calls and complaints that typically follow. Fewer service interactions reduce operational costs associated with customer support, allowing the business to reinvest these resources into growth initiatives or new customer service features, like a rewards program or app improvements.

2. Operational Efficiency for Delivery Management

- **Better Resource Utilization**: With predictive insights on delivery times, the dispatch team can plan routes and schedules more effectively, avoiding high-traffic times or preparing for weather disruptions. For instance, if peak traffic density is predicted, drivers could be assigned specific zones, ensuring they can make more deliveries in a shorter timeframe. This reduces idle times, maximizes the time each driver spends on productive tasks, and makes the fleet more efficient overall.

- **Dynamic Allocation**: When anticipated delays are flagged in advance, dispatch teams can make real-time decisions, such as reassigning drivers, adjusting routes, or rescheduling specific deliveries to ensure on-time arrivals for high-priority orders. This adaptability in resource management ensures smoother operations and helps the business consistently meet or exceed delivery expectations, even during busy or challenging periods.

- **Operational Scalability**: As the business grows, knowing the expected delivery times allows for planning more delivery zones or micro-fulfillment centers in strategic locations. This can help scale operations smoothly, ensuring the business meets increased demand without overburdening resources.

3. Financial Optimization

- **Cost Control through Efficiency**: Accurate delivery time predictions enable better route planning, which reduces fuel costs, overtime pay, and wear on vehicles. This kind of operational efficiency keeps delivery costs manageable and reduces the cost-per-delivery, which has a direct impact on profitability.

- **Minimized Compensation Costs**: Predicting delays allows the business to manage customer expectations in advance, avoiding the need for compensations (e.g., refunds, discounts on next orders) due to late deliveries. Lowering such costs contributes to higher profit margins.

- **Increased Customer Lifetime Value (CLV)**: A happy customer who receives reliable ETAs is more likely to order again and again. Over time, this leads to increased customer lifetime value, as each repeat order adds to revenue without the acquisition cost associated with new customers.

4. Strategic Decision-Making

- **Peak and Off-Peak Planning**: The model can identify patterns related to demand peaks, like specific times, holidays, or weather conditions that impact delivery time. This information allows the business to prepare, such as increasing driver availability during expected peaks and adjusting promotions or delivery charges in response to anticipated conditions. Properly managing high-demand periods ensures smooth service and maintains customer satisfaction

during peak times.

- **Operational Flexibility**: When data highlights challenging delivery periods, such as during festivals or high-traffic hours, businesses can implement strategies like surge pricing or limit orders to high-capacity areas only. This flexibility helps avoid bottlenecks, ensuring that resources are stretched only to manageable levels.

- **Data-Driven Expansion Plans**: Insights from delivery time predictions guide strategic planning for geographic expansion or new fulfillment centers. If certain locations consistently show high delivery times, it might signal a need for a local hub to streamline deliveries, improving service without straining existing resources.

In Summary:

Overall

1. Increase customer satisfaction as customers can plain the ETA of their orders.
2. Increases customer trust in company. Clear, accurate ETAs improve transparency, a factor increasingly valued by customers. If a delay is predicted due to conditions like traffic or weather, proactive updates to ETAs reassure customers that they are informed.
3. Accurate time predictions reduces chances of cancelled orders.
4. Increased transparency can help in lower customer service calls which eases up traffic of complaints those are time related.
5. The dispatch team for riders can plan routes and manpower accordingly to serve customers on time.
6. They can focus on hotspots in the city which have increased orders at certain time of day, month, year.
7. Can help company implement surge pricing in extreme weather or congestion events.

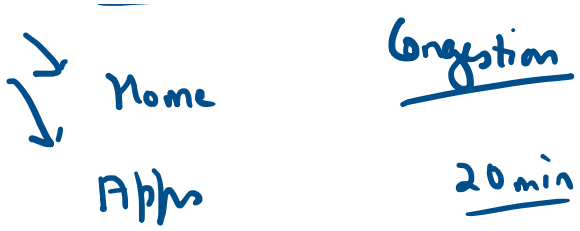
Riders

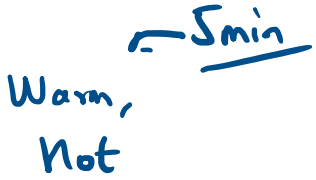
1. Riders can plan pickups and deliveries accordingly.
2. They have a foresight of time taken for delivery so can manage multiple orders along the same route.
3. Can help in route planning in case of traffic congestions.
4. Can do faster deliveries and limit wait times to increase number of deliveries per day which increases their earning potential.
5. Drivers do not have to rush or do risky driving during high rush hours as their delivery times are in synchrony with the on ground situation which gives them peace of mind and reduces the chances of unnecessary cancellations and do not impact their ratings.
6. Can opt for other providers when demand is less to increase their earnings.
7. Can tackle multiple deliveries.

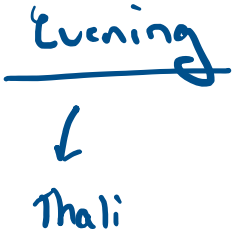
Restaurants

1. They can prioritize their orders if delivery times are available.
2. They can manage staff to balance out between in house orders vs home deliveries.

1. They can prioritize their orders if delivery times are available.
2. They can manage staff to balance out between in house orders vs home deliveries.
3. They can scale up staff and resources during events of increased demands.
4. Company can also leverage discounts and coupons to increase demand during off peak hours which results in continuous revenue generation.







What metrics to use?

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RMSE , MAE → Units min^2

$$RMSE = \sqrt{\sum_{i=1}^{n} \frac{(y_i - \hat{y}_i)^2}{n}}$$

→ Extreme weather holidays. Traffic ↑

$$MAE = \sum_{i=1}^{n} \frac{|y_i - \hat{y}_i|}{n}$$

Model → Eval → off.

MAE → MAE

Improvements in Business

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1. Customer Satisfaction Score (CSAT)

- **Impact**: With accurate ETAs, customers feel more informed and are less likely to experience frustration from delays or inaccurate delivery windows.
- **Measurement**: Customer satisfaction surveys or ratings post-delivery. A rise in CSAT often indicates positive customer experiences.

2. Customer Retention Rate

- **Impact**: Satisfied customers are more likely to reorder, especially if the delivery experience meets or exceeds expectations consistently.
- **Measurement**: Percentage of customers who continue ordering after their initial experiences. Improved ETAs help build customer trust and encourage repeat business.

3. Average Order Value (AOV)

- **Impact**: When customers trust the delivery process, they may place larger or more frequent orders, especially during promotions or peak times.
- **Measurement**: Monitoring trends in order value over time can indicate that enhanced delivery service is encouraging higher spending.

4. Delivery Success Rate

- **Impact**: Reduced late deliveries and minimized cancellation rates can increase the proportion of successful deliveries.
- **Measurement**: Percentage of orders successfully delivered within the promised time frame. Lowering cancellation rates or delays directly impacts delivery success.

5. Operational Efficiency Metrics:

- **Driver Utilization Rate**: Predictive ETAs allow for better routing and delivery clustering, optimizing each driver's workload.
- **Delivery per Hour**: Accurate predictions reduce idle time and allow drivers to complete more orders per shift.
- **Cost per Delivery**: Fewer delays and optimized routing reduce fuel costs, time on the road, and labour costs per delivery.

6. Customer Support Cost

- **Impact**: Fewer customers will call support for delivery updates if they have a reliable ETA. This reduces operational costs tied to customer service.
- **Measurement**: Reduced volume of time-related inquiries and complaints means lower customer support costs, indicating a positive impact from reliable delivery predictions.

7. Order Cancellation Rate

- **Impact**: With accurate ETAs, customers are less likely to cancel orders due to long or uncertain wait times.
- **Measurement**: The percentage of orders cancelled by customers can drop with improved delivery time accuracy.

Model Evaluation → MAE

Flow of the project

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