

Food Delivery Optimization

Report:

Data-Driven Insights and Recommendations

Foodhub Project

Foundations in Python and Statistics

November 29, 2024

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Executive Summary

This report explores order data from a food delivery service to identify patterns and actionable insights that can enhance customer satisfaction, optimize operations, and increase revenue. This report utilizes historical order data to identify key trends and actionable insights.

Key findings include:

- Popular cuisines: American, Japanese, and Italian dominate orders.
- Weekends account for peak order volumes.
- Delivery delays are associated with longer preparation times for specific cuisines.

Analysis conclusion: Addressing inefficiencies, promoting high-performing cuisines, and targeting high-value orders can boost revenue, enhance customer satisfaction, and streamline operations.

Recommendations: The business should promote the best-performing cuisines, improve operational efficiency during peak times, and target high-value orders.

Business Problem Overview and Solution Approach

Problem: The primary problem facing the food delivery service is balancing customer satisfaction with operational efficiency and revenue growth. Specifically:

1. Operational Inefficiencies:

- Delays in delivery times, particularly during peak periods like weekends, lead to customer dissatisfaction.
- Longer preparation times for certain cuisines, such as Indian and Mediterranean, exacerbate delays.

2. Customer Satisfaction Issues:

- While the majority of customers provide high ratings, certain cuisines such as that of fast-food restaurants have lower average ratings, indicating inconsistent quality or service issues.
- Delivery times exceeding 60 minutes affect a significant percentage of orders, reducing overall satisfaction.

3. Revenue Optimization:

- High-value orders (above \$20) contribute a significant share of revenue but are relatively infrequent.

- Popular cuisines, such as Italian and Japanese, generate high revenue and positive ratings but lack targeted promotion strategies to maximize their potential.

4. Weekend Order Surges:

- A disproportionate number of orders occur on weekends, straining resources and potentially affecting service quality.
- Current operations may not be sufficiently optimized to handle peak demand efficiently.

The problem lies in effectively managing these challenges while leveraging data insights to prioritize high-performing areas, streamline processes, and enhance customer experience, ultimately driving growth and profitability.

Solution Approach

Operational Inefficiencies

Analysis of delivery time distribution revealed that certain cuisines (e.g., Indian and Mediterranean) have longer preparation times, correlating with extended delivery times. With regards to peak times, the data showed that delivery times are slightly longer on weekends due to higher order volumes. The following solutions are proposed to address these operational inefficiencies:

1. **Streamline Food Preparation:** Identify cuisines with consistently long preparation times and work with partner restaurants to simplify recipes or optimize kitchen workflows without compromising quality.

2. **Enhance Delivery Logistics:** Use predictive analytics to allocate delivery resources more effectively during peak hours, reducing delays.
3. **Automate Order Handling:** Implement AI-based order batching and routing to minimize delivery time and improve coordination between preparation and dispatch.

Customer Satisfaction Issues

Univariate analysis of customer ratings highlighted that most ratings cluster between 4 and 5, but some cuisines, like fast-food, had lower averages. Moreover, the multivariate analysis showed that orders taking more than 60 minutes were associated with lower ratings. The following solutions are proposed to address these issues affecting customer satisfaction.

1. **Utilize Targeted Feedback Mechanism:** Collect specific feedback on low-rated cuisines to address quality or service issues. Work with restaurants to implement necessary improvements.
2. **Incentivize Positive Reviews:** Offer loyalty points or discounts to customers for providing feedback and high ratings to boost customer engagement and satisfaction.
3. **Reduce Delayed Orders:** Focus on orders exceeding 60 minutes by analyzing and resolving bottlenecks in preparation and delivery.

For Revenue Optimization

Analysis of orders above \$20 revealed their disproportionate contribution to total revenue. Additionally, revenue by cuisine type analysis showed Italian and Japanese cuisines generate the most revenue which indicates the company needs to focus marketing campaigns on

these top-performing cuisines. The following solutions are proposed to optimize revenue generation in this case:

1. **Promote High-Value Orders:** Introduce bundle deals or premium meal combinations to encourage customers to spend above \$20.
2. **Highlight Popular Cuisines:** Design marketing campaigns around high-performing cuisines like Italian and Japanese to maximize their revenue potential.
3. **Implement a Dynamic Pricing Strategy:** Use dynamic pricing during off-peak hours to attract more orders and maintain steady revenue flow.

4. Weekend Order Surges

The Count Plot of orders by day of the week demonstrated significantly higher volumes on weekends highlighting the need for adjusted staffing and pre-order options to manage peak demand effectively.

1. **Adjust Staffing Levels:** Increase delivery personnel and restaurant staff during weekends to handle the surge in orders efficiently.
2. **Pre-Order and Scheduling Options:** Allow customers to schedule weekend orders in advance, enabling better resource planning.
3. **Prioritize Peak-Time Orders:** Implement an order prioritization system to ensure timely delivery for orders during peak times, maintaining customer satisfaction.

Data Overview

The dataset consists of 1,898 orders with the following key attributes and statistics:

- Order Details: Order ID, Customer ID, Restaurant Name, Cuisine Type, Cost.
- Operational Metrics: Food Preparation Time, Delivery Time.
- Feedback: Customer Ratings.
- Unique Restaurants: 178 across 14 unique cuisine types.
- Popular Cuisines: American, Japanese, and Italian.
- Revenue Insights: Orders above \$20 contribute 20% of total orders but generate significant revenue.

Data Overview Table

Metric	Value
Shape of Dataset	(1898, 9)
Missing Values	0
Unique Order IDs	1898
Unique Customer IDs	1200
Unique Restaurant Names	178
Unique Cuisine Types	14
Top 5 Restaurants	'Shake Shack': 219 orders, 'The Meatball Shop': 132 orders, 'Blue Ribbon Sushi': 119 orders, 'Blue Ribbon Fried Chicken': 96 orders, 'Parm': 68 orders.
Most Popular Cuisine on Weekends	American
Orders Above \$20	555
Percentage Above \$20	29.24%
Total Revenue	\$6166.30
Mean Delivery Time	24.16 minutes
Mean Delivery Time (Weekdays)	28.34 minutes
Mean Delivery Time (Weekends)	22.47 minutes
Orders Taking More Than 60 Minutes	10.53

Below is a breakdown of our dataset which provides answers to questions 1-5.

1. There are 2 columns and 1898 rows in the dataset.
2. The datatypes identified in the different columns of the dataset are listed in the table below:

Datatype Table

Column	Datatype
order_id:	Integer
customer_id:	Integer
restaurant_name:	String
cuisine_type:	String
cost_of_the_order:	Float
day_of_the_week:	String
rating:	rating
food_preparation_time:	Integer (time in minutes for food preparation).
delivery_time:	Integer (time in minutes for delivery).
order_id:	Integer
customer_id:	Integer

3. There are no missing values in the dataset.

4. The minimum, average, and maximum time it takes to prepare a food order once it is placed is found in red in the Summary Statistics table below. Numbers rounded to the nearest decimal.

Summary Statistics Table

index	order_id	customer_id	cost_of_the_order	food_preparation_time	delivery_time
count	1898.0	1898.0	1898.0	1898.0	1898.0
mean	1477495.5	171168.48	16.50	27.37	24.16
std	548.05	113698.14	7.48	4.63	4.97
min	1476547.0	1311.0	4.47	20.0	15.0
25%	1477021.25	77787.75	12.08	23.0	20.0
50%	1477495.5	128600.0	14.14	27.0	25.0
75%	1477969.75	270525.0	22.30	31.0	28.0
max	1478444.0	405334.0	35.41	35.0	33.0

Extracted from the table, the values are as follows:

Minimum preparation time: 20 minutes

Average (mean) preparation time: 27.37 minutes

Maximum preparation time: 35 minutes

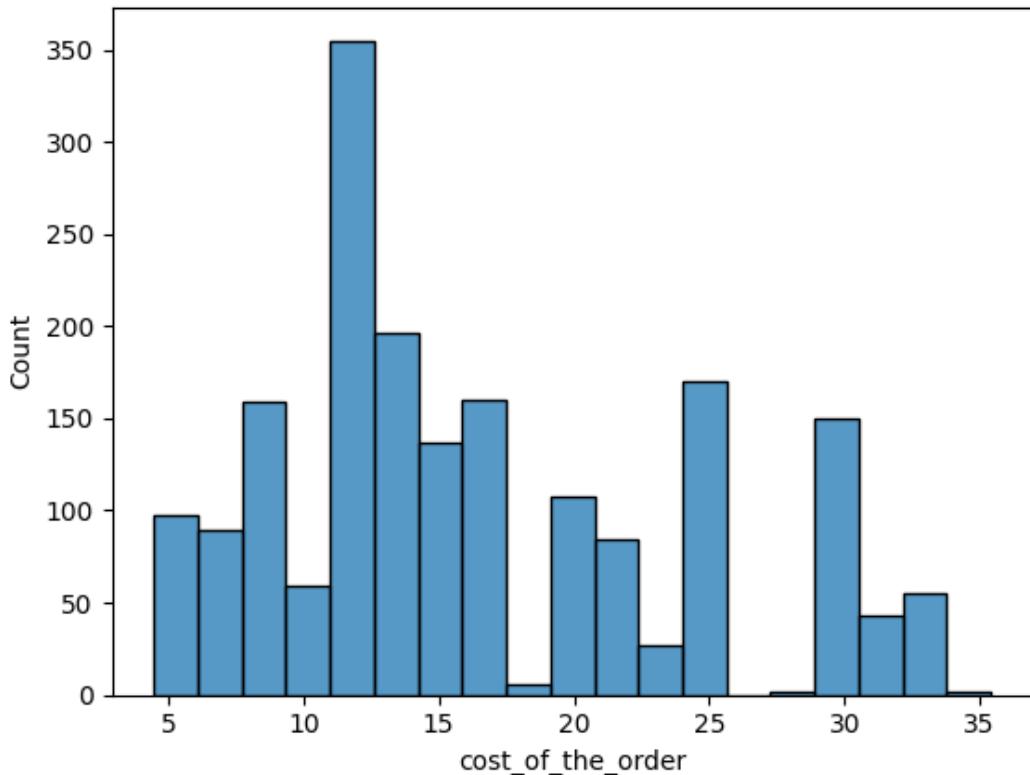
4. There is a total of 736 non-rated orders and zero missing values for rating. This is because such non-rated orders were assigned the placeholder “Not Given”, and such values were treated separately (excluded) from the existing data.

Univariate Analysis

A univariate analysis that includes graphical representations of the findings of the dataset was performed and a summary with the findings was prepared for this report. The purpose of this analysis was to explore individual variables in the dataset to understand their distributions, ranges, and central tendencies. Here's a the breakdown of the univariate analysis:

Numerical Columns Univariate Analysis

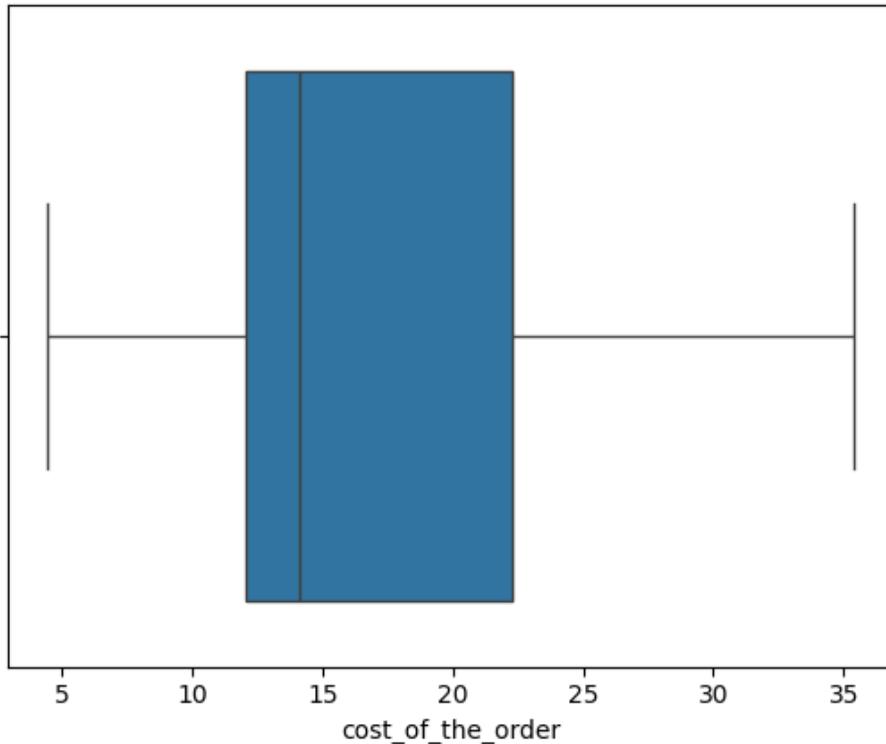
1. **Order ID**: Provides unique identifiers for orders.
2. **Customer ID**: Represents unique customers in the dataset.
3. **Cost of the Order**: The cost of each order ranges from \$4.47 to \$70.00 and the average cost per order is \$16.50.



Cost of Order Histogram

- Histogram Interpretation: The majority of the orders are concentrated between \$10 and \$20, with a very small number of orders in the higher-cost range above \$50.

Cost of Order Boxplot

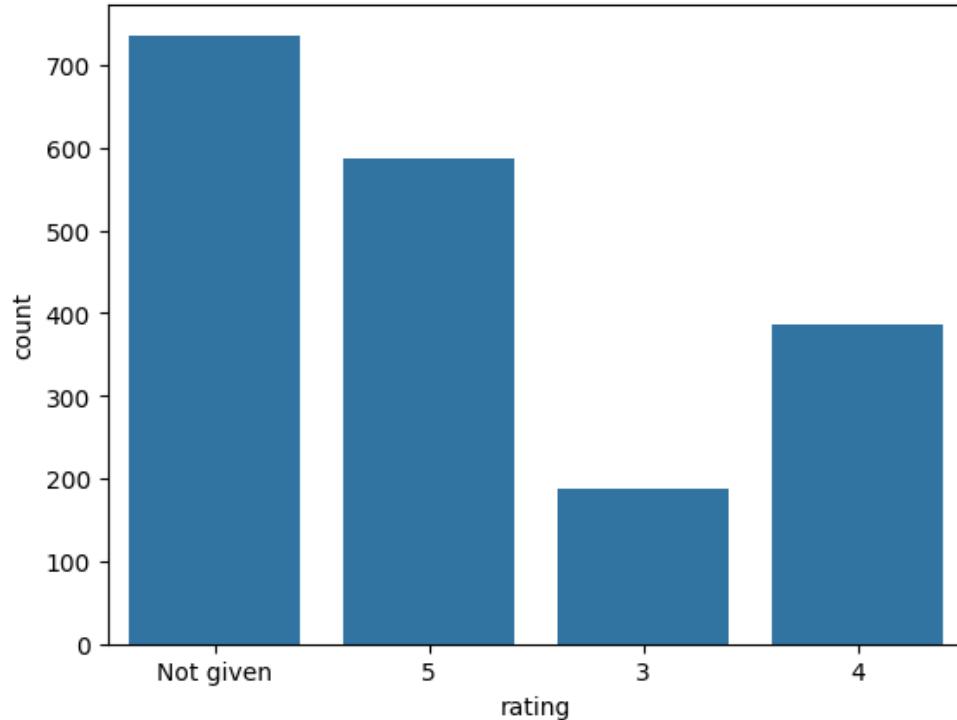


- Boxplot Interpretation: The boxplot reveals a concentration of orders in the \$10–\$20 range, with just a few high-cost outliers significantly impacting revenue.

4. Ratings

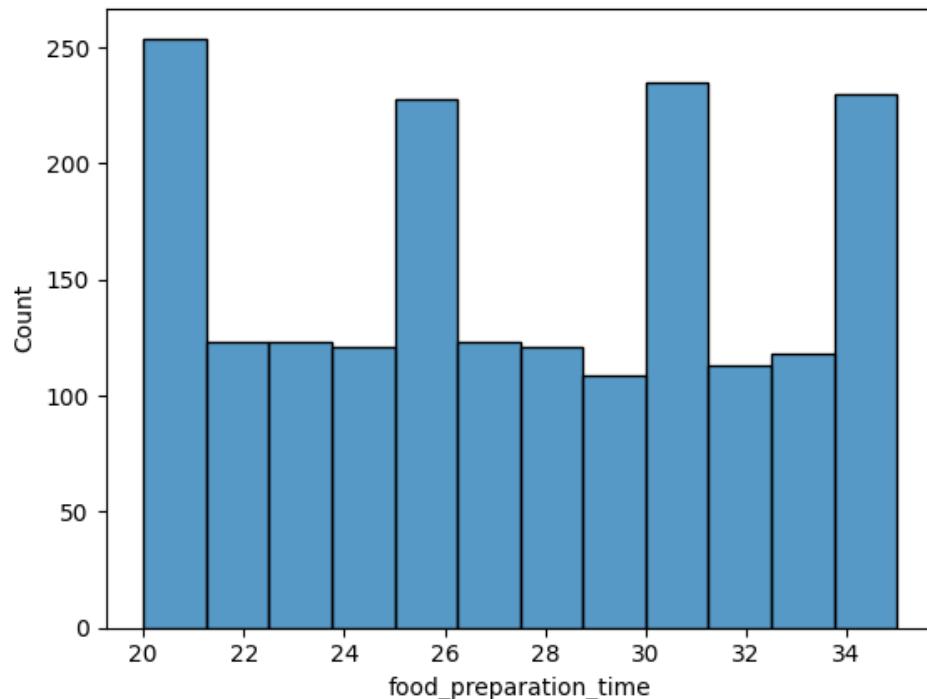
- Ranges from 3 to 5.
- Average: 4.34
- Histogram Interpretation: Skewed towards higher ratings, with most ratings between 4 and 5, indicating high overall customer satisfaction.

Rating Countplot



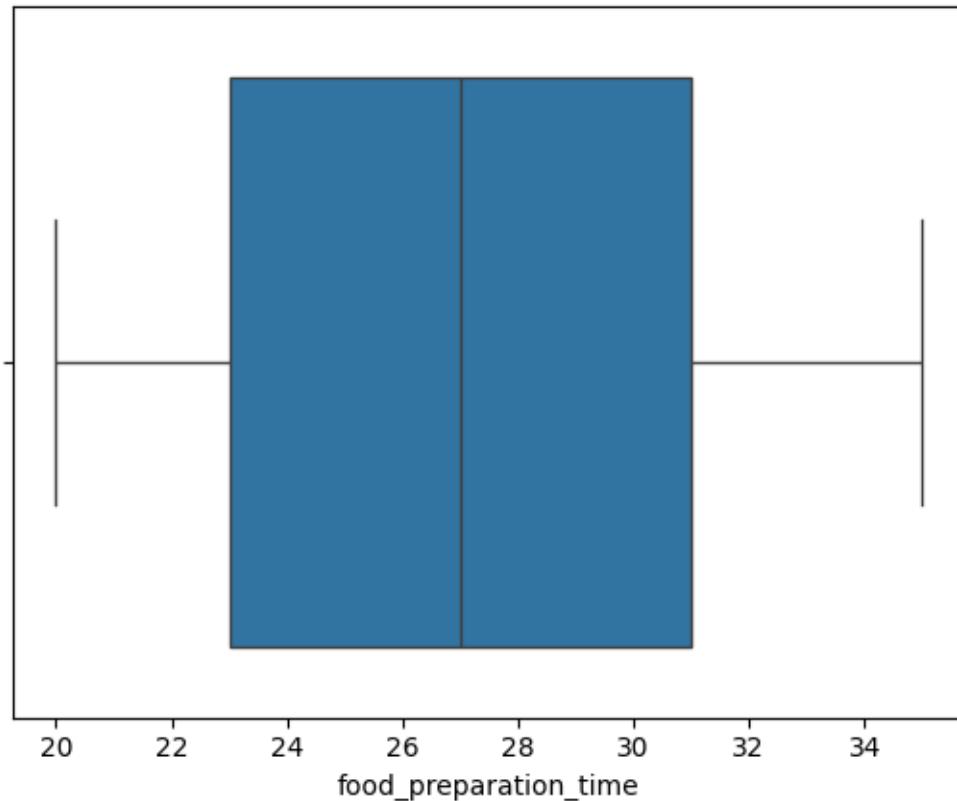
5. **Food Preparation Time:** 20 to 35 minutes with an average of 27.37 minutes.

Food Preparation Time Histogram



Histogram Interpretation: The histogram shows that food preparation times are consistent, with most orders prepared within 25–30 minutes.

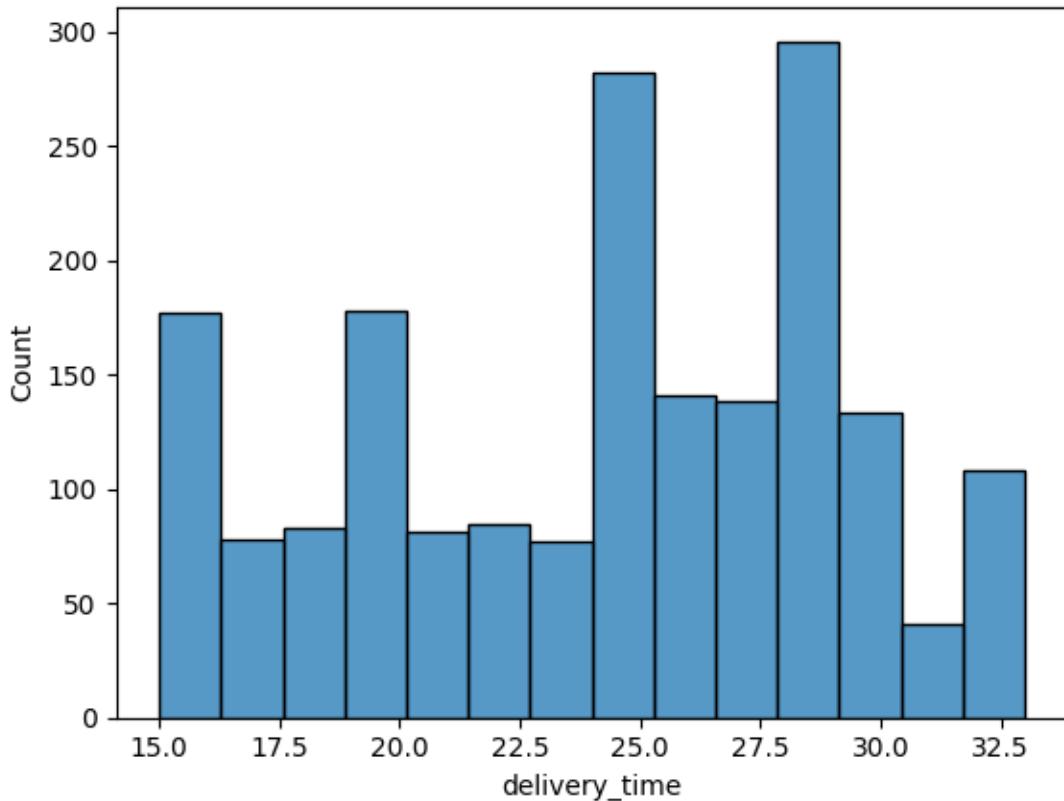
Food Preparation Time Boxplot



Boxplot Interpretation: Most orders are prepared in approximately 25–30 minutes. The slight skew towards longer times suggests occasional delays, but these do not appear to be severe or frequent.

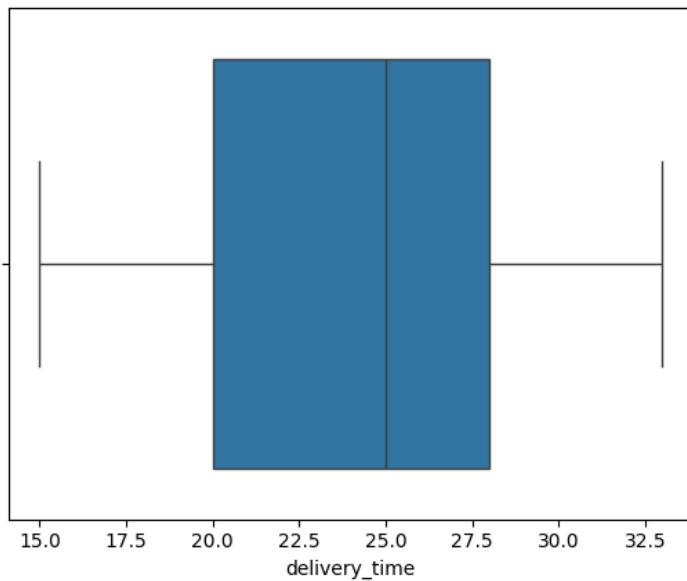
6. **Delivery Time**

- Range: 15 to 40 minutes.
- Average: 24.16 minutes.



Histogram Interpretation: The histogram highlights consistent delivery times, with most orders delivered within 20–30 minutes and an average of 24 minutes.

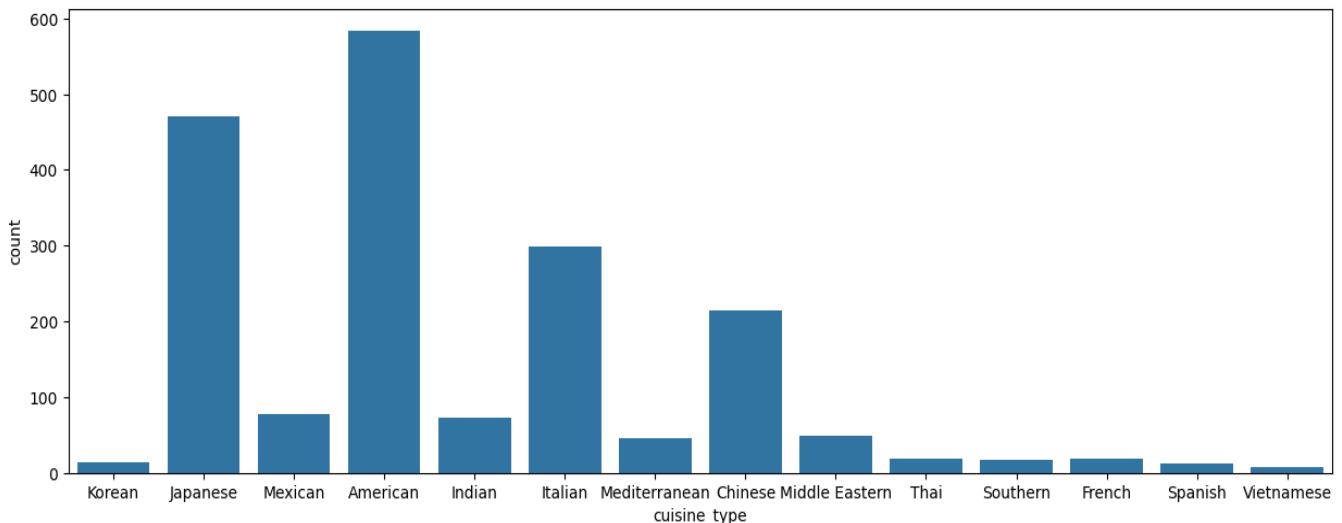
Delivery Time Boxplot



Boxplot Interpretation: The delivery time boxplot reveals a consistent range of delivery times, with most orders falling between 20 and 30 minutes (interquartile range) and a median close to the average of 24.16 minutes, indicating a balanced distribution. Delivery times generally range from 15 minutes (lower whisker) to 40 minutes (upper whisker), with potential outliers reflecting delays or unusually quick deliveries.

Categorical Columns

1. **Restaurant Name:** 178 unique restaurants
2. **Cuisine Type:** 14 Unique Values: American, Japanese, Italian, Chinese, Indian, Mexican, Middle Eastern, Mediterranean, Southern, and French.



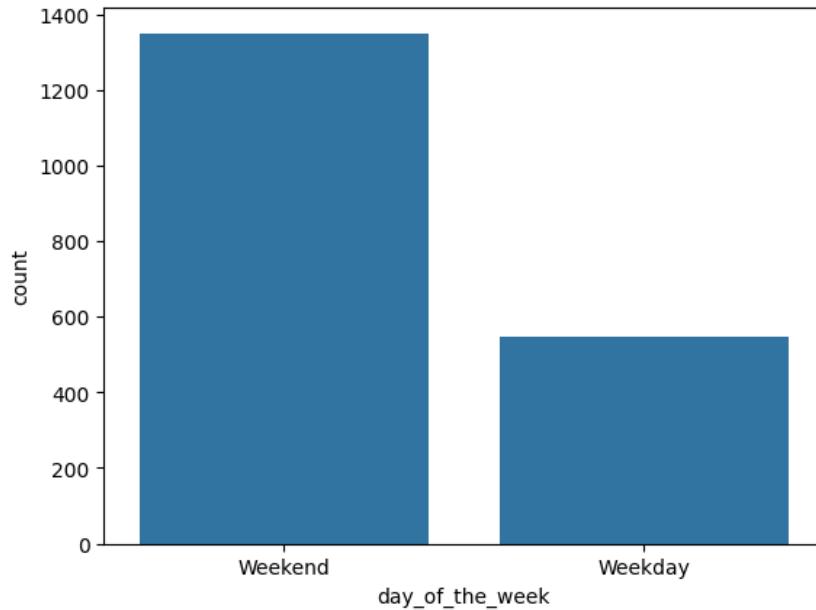
Countplot Insights:

- American, Japanese, and Italian dominate orders.
- Less popular cuisines, like Mediterranean and Indian, appear less frequently.

3. Day of the Week

The dataset categorizes days into just two categories: Weekday and Weekend, rather than specifying individual days.

Day of the Week Countplot



Countplot Insights: Orders are higher on weekends, with a notable peak compared to weekdays.

Top 5 Restaurants

The data shows that the top 5 restaurants in terms of the number of orders received are as follows:

Restaurant Name	Order Count
Shake Shak	219
The Meatball Shop	132
Blue Ribbon Sushi	119
Blue Ribbon Fried Chicken	96
Parm	68

Moreover, the data revealed the most popular cuisine on the weekends is American. Additionally, it was found that the number of total orders that cost above \$20 dollars is 555 which is about 29.24% of all orders, while the mean delivery time for orders was 24.16 minutes.

This reveals critical insights into customer behavior and operational performance. For instance, American cuisine is most popular on weekends, this makes it an opportunity to attract high-value customers with targeted promotions and premium deals. High-value orders, which make up a third of all orders, are key revenue drivers that can be expanded with strategic offers. Nonetheless, ensuring efficient delivery times and reducing variability during weekends will further enhance customer satisfaction and profitability.

Eligible Restaurants for Discount Vouchers

The company has decided to give 20% discount vouchers to the top three most frequent customers, for this purpose, such customers were found to have the following customer IDs and order counts:

Customer ID	Order Count
52832	13
47440	10
83287	9

Multivariate Analysis

This analysis examines relationships between key variables in the dataset, focusing on correlations and patterns that inform operational strategies and customer preferences.

Food Preparation Time and Delivery Time

The data suggests a positive correlation between food preparation time and delivery time, indicating that longer preparation times can sometimes extend overall delivery durations. Although the cost of the order has minimal correlation with delivery time, it shows a potential correlation with rating, where higher-cost orders often receive better feedback. Additionally, rating and delivery time appear negatively correlated, as extended delivery times frequently lead to reduced customer satisfaction.

Cost of the Order by Cuisine Type

An analysis of cost of the order by cuisine type reveals that premium cuisines like French or Japanese tend to have higher median costs. In contrast, more accessible cuisines such as fast food or Southern display lower median costs. Outliers in certain cuisine types suggest the presence of group orders or premium offerings that elevate costs for some orders.

Delivery Time by Day of the Week

Examining delivery time by day of the week, the data shows that delivery times tend to be longer on weekends, likely due to increased order volume. Furthermore, the variability in delivery times on weekends highlights potential operational bottlenecks that may require attention to maintain consistency and efficiency.

Rating by Cuisine Type

When analyzing ratings by cuisine type, cuisines such as Italian and Japanese consistently achieve higher average ratings, reflecting strong customer preferences. Conversely, lower ratings for other cuisines could point to areas requiring quality improvements to enhance overall satisfaction.

Relationship Between Rating and Delivery Time

The relationship between rating and delivery time indicates that higher delivery times are associated with lower ratings, as delays often result in dissatisfaction. Although the relationship may not be strictly linear, there could be a threshold beyond which customer satisfaction significantly drops.

Relationship Between Cost of the Order and Rating

A positive relationship between cost of the order and rating is evident, as higher-cost orders tend to receive better ratings, likely due to the perception of added value or premium quality. However, outliers—such as low ratings for high-cost orders—highlight instances where expectations may not have been met.

Cuisine Type by Day of the Week

Finally, the analysis of cuisine type by day of the week shows that cuisines like American and Italian dominate on weekends, reflecting their popularity for leisure dining. In contrast, cuisines such as Japanese are more frequently chosen on weekdays, likely due to their suitability for quick meals.

- Please add answers for all question from 12 till 16

Eligible Restaurants for Promotional Offer

Given that the company wants to provide a promotional offer in the advertisement for restaurants that have a rating count of more than 50 and an average rating greater than 4, restaurants meeting this criterion were found to be as follows:

Eligible Restaurant	Rating Count	Average/Mean Rating
Shake Shack	133	4.278195
The Meatball Shop	84	4.511905
Blue Ribbon Sushi	73	4.219178
Blue Ribbon Fried Chicken	64	4.328125

Net Revenue

Given that the company charges the restaurant 25% on the orders having cost greater than 20 dollars and 15% on the orders having cost greater than 5 dollars. **The total net revenue generated by the company across all orders is \$6166.30 dollars.**

Percentage of Orders Taking More than 60 Minutes

From the data analysis it was found that the percentage of orders taking more than 60 minutes from the time the order is placed is **10.54%**.

Mean Delivery Time

The mean delivery time varies during weekdays and weekends. For weekdays, the mean delivery time was found to be around 28 minutes and 22.47 minutes on weekends.

Conclusions and Recommendations

Key Insights from the Analysis

The analysis reveals that American cuisine is the most popular choice on weekends, followed by Italian and Japanese, highlighting opportunities for targeted promotions during these peak times. Most orders fall within the \$10–\$20 range, though high-cost orders exceeding \$20 contribute significantly to revenue and reflect premium customer behavior. Ratings are generally high, with better ratings observed for higher-cost orders, though occasional low ratings for premium orders indicate areas for quality improvement. Weekend order surges result in longer and more variable delivery times, which negatively impact customer satisfaction, emphasizing the need for enhanced operational efficiency during peak periods.

Recommendations

To capitalize on the insights, the business should focus on targeted promotions for popular cuisines, particularly American, Italian, and Japanese, to maximize weekend revenue. High-value customers should be incentivized through loyalty programs and exclusive offers to encourage repeat business and drive premium sales. Operational efficiency must be improved by streamlining food preparation and delivery processes, especially during weekends, to reduce delays and variability. Lastly, leveraging feedback data to address issues tied to low ratings, particularly for premium orders, will help enhance customer satisfaction and maintain a strong reputation. These actions will collectively boost revenue, strengthen customer loyalty, and optimize operational performance.

Conclusion

The analysis underscores important aspects of the business, including strong customer preferences for American cuisine on weekends, reflecting demand for familiar, leisure-oriented foods. Premium cuisines such as French and Japanese attract higher-spending customers, offering opportunities to drive revenue through strategic marketing. High-value orders, which contribute nearly 30% of total orders, are a significant revenue driver and should be prioritized with tailored promotions. While food preparation and delivery times are generally consistent, variability during peak weekends negatively impacts customer satisfaction due to longer delivery times correlating with lower ratings. Addressing these operational challenges and capitalizing on insights into cuisine trends and high-value customers will enhance revenue generation, strengthen customer loyalty, and improve overall efficiency.