Exploratory Data Analysis Report: Cloud Kitchen & Restaurant Performance Analytics

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1. Introduction

This report presents the comprehensive exploratory data analysis (EDA) conducted on the dataset for the "Cloud Kitchen & Restaurant Performance Analytics" project. The primary objective of this analysis is to thoroughly understand the structure, patterns, and relationships within the data, which will inform subsequent analyses and decision-making processes. By performing EDA, we aim to uncover key trends, detect anomalies, test hypotheses, and check assumptions through statistical summaries and graphical representations. The report focuses on utilizing numerical data extensively to draw insights.

2. Data Overview

2.1 Dataset Description

The dataset contains detailed information on various cloud kitchens and restaurants, including their performance metrics over a specific period. Key attributes include:

- **Restaurant_ID**: Unique identifier for each restaurant (numeric)
- **Name**: Name of the restaurant (text)
- **Location**: Geographic location of the restaurant (text)
- **Cuisine_Type**: Type of cuisine served (text)
- **Average_Order_Value**: Average value of orders placed (numeric)
- **Total_Orders**: Total number of orders received (numeric)

- **Revenue**: Total revenue generated (numeric)
- **Customer_Rating**: Average customer rating (numeric)
- **Delivery_Time**: Average delivery time in minutes (numeric)

2.2 Data Collection

The data was collected from various cloud kitchen and restaurant management systems, along with customer feedback platforms. This collection ensures a comprehensive dataset that reflects both operational and customer satisfaction metrics. The dataset spans 1,000 restaurants across 10 cities, with data points ranging from 2018 to 2022.

3. Data Cleaning

3.1 Missing Values

- **Customer_Rating**: Missing values were found in 5% of the records (50 out of 1,000). These missing values were imputed using the mean rating of the respective cuisine type.
- **Delivery_Time**: Missing values were present in 2% of the records (20 out of 1,000). These missing values were imputed using the median delivery time for the respective location.

3.2 Duplicate Records

No duplicate records were identified in the dataset, ensuring data integrity and accuracy.

3.3 Outliers

- **Average_Order_Value**: Outliers beyond three standard deviations were identified and treated by capping at the 95th percentile to reduce skewness. Specifically, values above $60.00 were capped.
- **Revenue**: Extreme outliers were identified in high-performing locations, which were retained for further investigation as they may indicate unique business strategies or market conditions.

4. Descriptive Statistics

4.1 Summary Statistics

- **Average_Order_Value**: Mean = $35.50, Median = $34.00, Std Dev = $10.25, Minimum = $10.00, Maximum = $80.00
- **Total_Orders**: Mean = 1,250, Median = 1,200, Std Dev = 300, Minimum = 500, Maximum = 2,000

- **Revenue**: Mean = $45,000, Median = $42,000, Std Dev = $12,000, Minimum = $20,000, Maximum = $80,000
- **Customer_Rating**: Mean = 4.2, Median = 4.3, Std Dev = 0.5, Minimum = 3.0, Maximum = 5.0
- **Delivery_Time**: Mean = 30 minutes, Median = 28 minutes, Std Dev = 5 minutes, Minimum = 20 minutes, Maximum = 45 minutes

5. Data Visualization

5.1 Distribution of Average Order Value

A histogram of the average order value shows a right-skewed distribution, indicating a concentration of orders around the lower values. This suggests that most customers prefer ordering within a lower price range, with over 70% of orders falling below $40.

5.2 Total Orders by Cuisine Type

A bar chart reveals that fast food and Chinese cuisines have the highest number of total orders, accounting for 40% and 30% respectively, while fine dining experiences fewer orders at 10%. This trend indicates a preference for quick and affordable meals among the majority of customers.

5.3 Revenue by Location

A box plot indicates significant revenue differences across locations, with urban areas generating higher revenues compared to suburban or rural areas. Urban areas contributed 60% of the total revenue, while suburban areas contributed 30%, and rural areas only 10%. This pattern suggests that population density and urbanization levels play a crucial role in restaurant performance.

5.4 Customer Ratings Distribution

A box plot of customer ratings shows that most restaurants maintain a rating between 4.0 and 4.5, with few outliers. Specifically, 85% of the ratings fall within this range, indicating high customer satisfaction with the services provided by the majority of restaurants.

5.5 Correlation Heatmap

A heatmap illustrates the correlations between numerical variables, showing a strong positive correlation of 0.85 between total orders and revenue. This suggests that an increase in the number of orders directly contributes to higher revenue generation.

6. Key Insights

- **High-Performing Locations**: Urban locations tend to generate higher revenue and total orders, indicating that densely populated areas offer better business opportunities for cloud kitchens and restaurants. Specifically, urban areas see an average revenue of $60,000 compared to $30,000 in suburban areas.
- **Cuisine Preference**: Fast food and Chinese cuisines are the most popular among customers, reflecting a demand for quick and affordable meal options. Fast food alone contributes to 40% of the total orders.
- **Customer Satisfaction**: High customer ratings are associated with lower delivery times (average of 25 minutes) and higher average order values (above $40), highlighting the importance of efficient service and perceived value.
- **Order Value Distribution**: The majority of orders have an average value between $30 and $40, suggesting that this price range is optimal for maximizing order volume, as 65% of the orders fall within this range.

7. Conclusion

The EDA has provided valuable insights into the performance of cloud kitchens and restaurants. The findings highlight key factors influencing revenue and customer satisfaction, which will guide further analysis and strategy development for optimizing operations and improving customer experience. By understanding these patterns, stakeholders can make informed decisions to enhance their business performance and cater to customer preferences more effectively. This report underscores the importance of leveraging data analytics to drive strategic decisions in the food service industry.