Sales Pattern Analysis and Operational Bottlenecks in a Dine-In Restaurant Using POS Data

A Mid Term report for the BDM capstone Project

Submitted by:

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Contents

1. Executive Summary

This capstone project focuses on "The Royale Place," a vegetarian multicuisine restaurant located in Bhawanipur, Kolkata, West Bengal. Offering a wide range of dishes with special attention to Jain dietary needs and fresh daily catering, the restaurant operates in the B2C food and beverage sector and has built a loyal dine-in customer base. Despite its strengths, the business faces two major challenges: low online sales and limited visibility into sales patterns. Without clear insights into weekly demand, peak hours, or category-wise performance, the restaurant struggles with staff allocation, slower service during rush periods, and missed opportunities to optimize its menu offerings, limiting its ability to scale in a competitive market.

For this project, three months of transactional data (January to March) were collected from the restaurant's POS system. The dataset includes two key reports: an Orders Master Report capturing invoice-level details such as order dates, payment methods, order types, revenue components, and taxes; and an Item-Wise Report providing granular insights into individual dishes, quantities, pricing, and table allocations. Preliminary descriptive statistics reveal variations in sales volumes, uneven category performance, and potential mismatches between staffing and customer demand, forming a strong foundation for data-driven analysis.

I have applied descriptive and visual analytics using Google Sheets and Google Colab to uncover key sales patterns. Time-series analysis identified peak and off-peak hours, while item-level trends highlighted top-selling dishes, popular combinations, and underperforming menu items.

Charts and graphs were used to visualize sales trends, highlighting peak hours, and identifying frequently paired items for creating combos to boost digital engagement. These insights also guided optimized staff scheduling during peak hours.

2. Proof of Data Originality

As part of the proof of originality for the collected data, I am providing the following supporting documents and materials: Letter from the Organization, Images of the Restaurant and a video capturing an interaction.

Picture 1 - Front side of The Royale Place

Picture 2 - Sitting area

Proof Links :

The mode of the Interaction video is in Hindi Language majorly and an English transcript is provided below for your reference and review.

- Interaction video : Interaction video.mp4
- Video of Restaurant: Inside resturant
- Front side Image: Front_side.png

- Sitting area: Sitting_area.jpg
- Authorization Letter: Authorization Letter.pdf
- Subtitle/Audio Transcript: subtitle.txt, subtitle.srt

3. Metadata

3.1. Metadata

Dataset Link: Data_BDM

Data collection duration: 3 months

Data collection dates: 01-01-2025 to 31-03-2025

In above workbook, there are 8 worksheets namely:

JAN_MASTER	JAN_ITEM_WISE	FEB_MASTER	FEB_ITEM_WISE
MARCH_MASTER	MARCH_ITEM_WISE	COMBINED_MASTER	COMBINED_ITEM_WISE

Table 1-All sheet names

Out of these, six worksheets (MASTER and ITEM_WISE sheets for January, February, and March) were provided by the restaurant, while two combined sheets (COMBINED_MASTER and COMBINED_ITEM_WISE) were created by me for consolidated analysis across the three months.

- **Sheet COMBINED_MASTER**

  The Master sheet contains 20 columns and 1,230 records.

S. No.	Data Feature	Datatype	Comments
1	Invoice No.	Categorical	Unique invoice number for each invoice.
2	Date	Datetime/String	Date and time of the transaction
3	Biller	Categorical	Name of the person or system generating the bill
4	Payment Type	Categorical	Mode of payment (e.g., UPI, Cash, Card)
5	Order Type	Categorical	Type of order (e.g., Dine In, Delivery)
6	Status	Categorical	Status of the order (e.g., Success, Cancelled)
7	Area	Categorical	Section within the restaurant
8	Group Name	Categorical	Category of items sold (e.g., Food, Beverages)
9	Order Cancel Reason	Categorical	Reason for cancellation, if any

10	My Amount (₹)	Numeric	Total billed amount before discounts
11	Discount (₹)	Numeric	Discount applied on the bill
12	Net Sales (₹)	Numeric	Amount after discount
13	Total (₹)	Numeric	Final bill amount including taxes
14	Online Tax Calculated	Numeric	Online tax calculated, if applicable
15	GST Paid by Merchant	Numeric	GST paid by the merchant
16	GST Paid by Ecommerce	Numeric	GST paid by the e-commerce platform
17	Amount (CGST)	Numeric	CGST component amount
18	CGST	Numeric	CGST rate
19	Amount (SGST)	Numeric	SGST component amount
20	SGST	Numeric	SGST rate

Table 2- Column names for Master sheet

- **Sheet COMBINED_ITEM_WISE**

The Item Wise Sheet contains 13 columns and 2,608 records.

S. No.	**Data Feature**	**Datatype**	**Comments**
1	Date	Datetime/String	Date on which the transaction occurred
2	Timestamp	Datetime/String	Exact date and time of the transaction
3	Invoice No.	Categorical	Unique invoice number for each invoice.
4	Item Name	Categorical	Name of the sold item
5	Price	Numeric	Price per unit of the item.
6	Qty.	Numeric	Number of units sold for this item
7	Sub Total	Numeric	Total amount for this item before discount and tax (Price × Qty)
8	Discount	Numeric	Discount applied to this item, if any
9	Tax	Numeric	Tax amount applied to this item
10	Final Total	Numeric	Final amount for this item after applying discount and tax
11	Table No.	Categorical	Table number where the order was served

12	Server Name	Categorical	Name of the staff member who served the item, same as biller.
13	Category	Categorical	Category of the item (e.g., Beverages, Main Course, Tandoor, Oriental)

Table 3- Column names for Item wise sheet

3.2. Descriptive Statistics

- **Sheet COMBINED_MASTER**

	My Amount(₹)	CGST	SGST	Total
Mean	379.345528	8.450837	8.450837	370.581301
Standard Error	24.239787	0.540869	0.540869	22.808677
Median	98	1.75	1.75	100
Mode	20	0	0	20
Standard Deviation	850.122198	18.969027	18.969027	799.931234
Sample Variance	722707.7511	359.823972	359.823972	639889.9783
Kurtosis	36.923437	36.005483	36.005483	36.33432
Skewness	5.157565	5.047744	5.047744	5.067385
Range	10512	233.37	233.37	9942
Minimum	0	0	0	0
Maximum	10512	233.37	233.37	9942
Sum	466595	10394.53	10394.53	455815

Table 4- Stats for Master sheet

1. **My Amount (₹)**: Here 'My Amount' means total billed amount before discounts, so average is around ₹379.35 per order, showing a wide variation from ₹0 to ₹10,512. The median of ₹98 with a mode of ₹20 highlights that many transactions are on the lower side.
2. **CGST and SGST:** On average, CGST per transaction is ₹8.45, with values ranging from ₹0 to ₹233.37.
3. **Total:** Here Total means final bill amount including taxes, the average total amount per transaction is ₹370.58, with a minimum of ₹0 and a maximum of ₹9,942. The standard deviation of ₹799.93 shows that transaction totals vary widely. A positive skewness of 5.07 indicates a few extremely high-value transactions are stretching the distribution. Most transactions fall between the

25th percentile of ₹25 and the 75th percentile of ₹50 (in relative scale), showing typical daily amounts remain moderate.

- **Sheet COMBINED_ITEM_WISE**

	Price	Qty.	Sub Total	Tax	Final Total
Mean	124.706672	1.750192	178.893788	7.969532	174.628907
Standard Error	2.371045	0.043109	5.393851	0.262515	5.43821
Median	59	1	99	4.9	103.96
Mode	20	1	20	0	20
Standard Deviation	121.085904	2.201536	275.456314		277.721694
Sample Variance	14661.79617	4.846759	75876.18089		77129.33953
Kurtosis	-0.903885	190.249463	270.109873	303.079041	318.667367
Skewness	0.818484	11.41066	12.885987	13.824245	14.342544
Range	425	44.5	6705	335.26	7040.26
Minimum	0	0.5	0	0	0
Maximum	425	45	6705	335.26	7040.26
Sum	325235	4564.5	466555	20784.54	455432.19
Count	2608	2608	2608	2608	2608

Table 5- Stats for Item wise sheet

1. **Price**: The average price per **item ordered** is ₹124.71, which says most of the items are ordered from ₹0 to ₹425, reflecting both low-cost and premium items. With a median of ₹59 and a mode of ₹20, the majority of products fall in the affordable category, but occasional high-value items create outliers.
2. **Qty**.: On average, quantity per transaction is 1.75 units, but the range extends from 0.5 to 45 units, showing that while most sales involve single items, bulk orders are not uncommon. The median and mode of 1 highlight that single-unit purchases dominate the dataset.
3. **Tax**: Taxes average ₹7.97 **per item**, ranging from ₹0 to ₹335.26. The standard deviation of ₹277.72 relative to the mean highlights substantial fluctuations caused by large-value transactions.
4. **Final Total**: The final total per transaction averages ₹174.63 per item, with values ranging from ₹0 to ₹7,040.26. A standard deviation of ₹277.72 indicates wide

variation, while the positive skewness of 14.34 shows that most bills are relatively small, but rare very large transactions push the average higher. The median of ₹103.96 and mode of ₹20 highlight that most customers spend moderately, while extreme outliers inflate the overall variability.

4. Detailed Explanation of Analysis Process/Method

4.1. Data Collection

The dataset was collected over a duration of a few weeks through several visits to the restaurant. Mr. Soni uses **Petpooja software** for managing and storing their data at one place. Petpooja is a restaurant management software (RMS) platform that helps merchants manage their end-to-end operations. For this project, the restaurant provided month-wise data in two formats: a Master Report containing sales-wise details and an Item-wise Report capturing product-level sales. Since the raw reports were separated by month (January, February, and March), they had to be carefully consolidated and integrated into a single dataset to ensure continuity. This integration step was essential for enabling a comprehensive three-month analysis rather than isolated monthly insights.

4.2. Data Cleaning and Preprocessing

Since the reports were split across January, February, and March, the first step was to consolidate and integrate them into a single combined sheet for each format. This ensured continuity and enabled a seamless three-month analysis instead of restricting the study to isolated months.

For preprocessing, minimal cleaning was required because the data was already structured and organized directly from the RMS. The main preprocessing task was integration of the three monthly reports into one consolidated dataset, making it suitable for further analysis.

4.3. Analysis Process/Method

After aggregating all three months of data, I uploaded the Excel sheet to **Google Colab** for analysis. Google Colab provides an easy, cloud-based environment for Python and

data uploading. In it, I have used the Pandas library to load the dataset from the Excel sheet into a DataFrame, and the Matplotlib library for data visualizations.

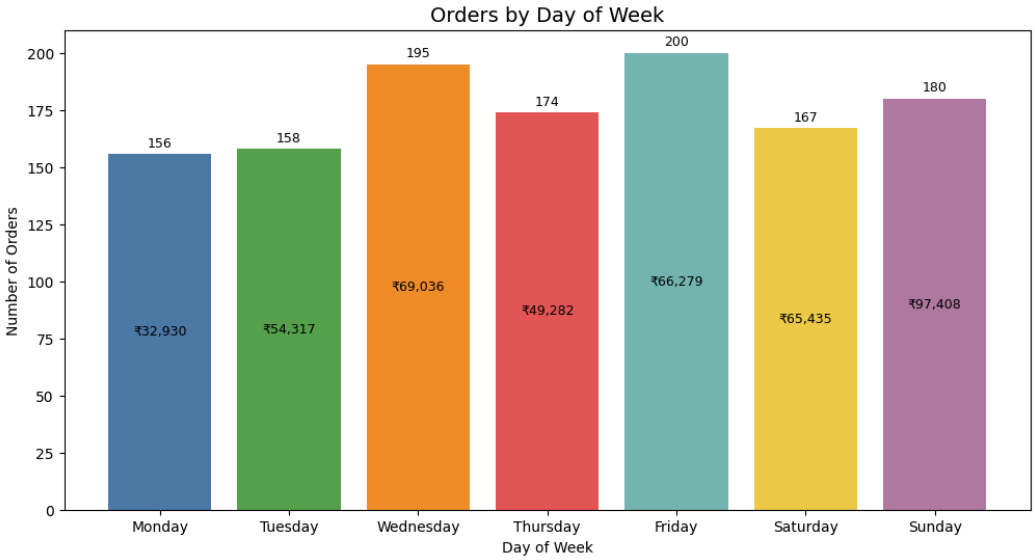
For understanding customer behavior, I have created five different bar charts for better insights. Four of these—orders by days of the week, orders by hours, month-wise orders, and top 15 most ordered items—are time series analyses, while the payment type bar chart (API or cash) is not. These charts helped me identify key patterns in sales and customer behavior over the three months.

Google Colab: BDM Analysis.ipynb

5. Results and Findings

By the end of my mid-term report, here are my results and findings. I have created five bar charts to visualize the data more effectively. The observations presented below are based on three months of data: January 2025, February 2025, and March 2025.

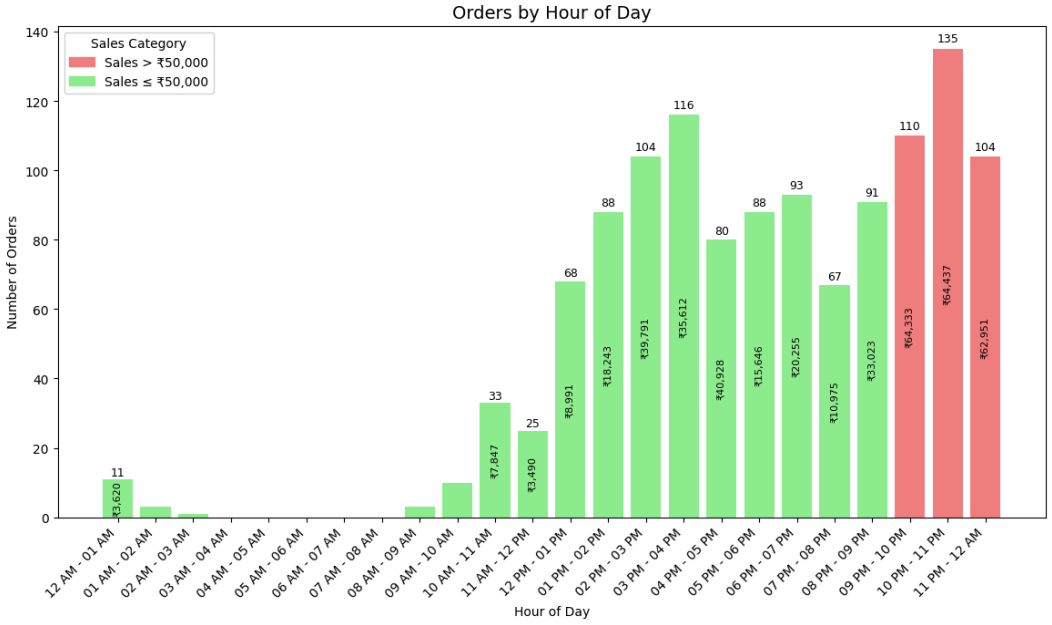
5.1. Orders by Day of the Week and Sales



Picture 3 - Chart of No. of Order v/s Day of Week

This chart shows how orders and total sales were distributed across different days of the week in the restaurant. I found that **Friday (200 orders, ₹66,279)** had the most orders and **Sunday, even with only 180 orders, brought in the highest sales (₹97,408)**, so people probably spend more on bigger meals or family dining on weekends. On the other hand, **Monday was the slowest day**, with the lowest sales (₹32,930).

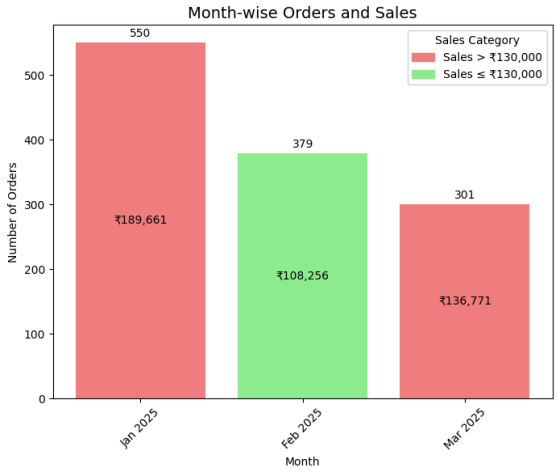
5.2. Orders by Hour of the Day and Sales



Picture 4-Chart of No. of Order v/s Hours of Day

This chart shows when customers usually place their orders throughout the day at the restaurant. I noticed that the busiest times were **late evening around 10 PM–11 PM (135 orders, ₹64,437)** and **11 PM–12 AM (104 orders, ₹62,951)**, which means a lot of people prefer late-night dining or food delivery. On the other hand, mornings were almost inactive, with very few orders before 10 AM. Shows that the restaurant's main rush hours are in the **afternoon and late evening**.

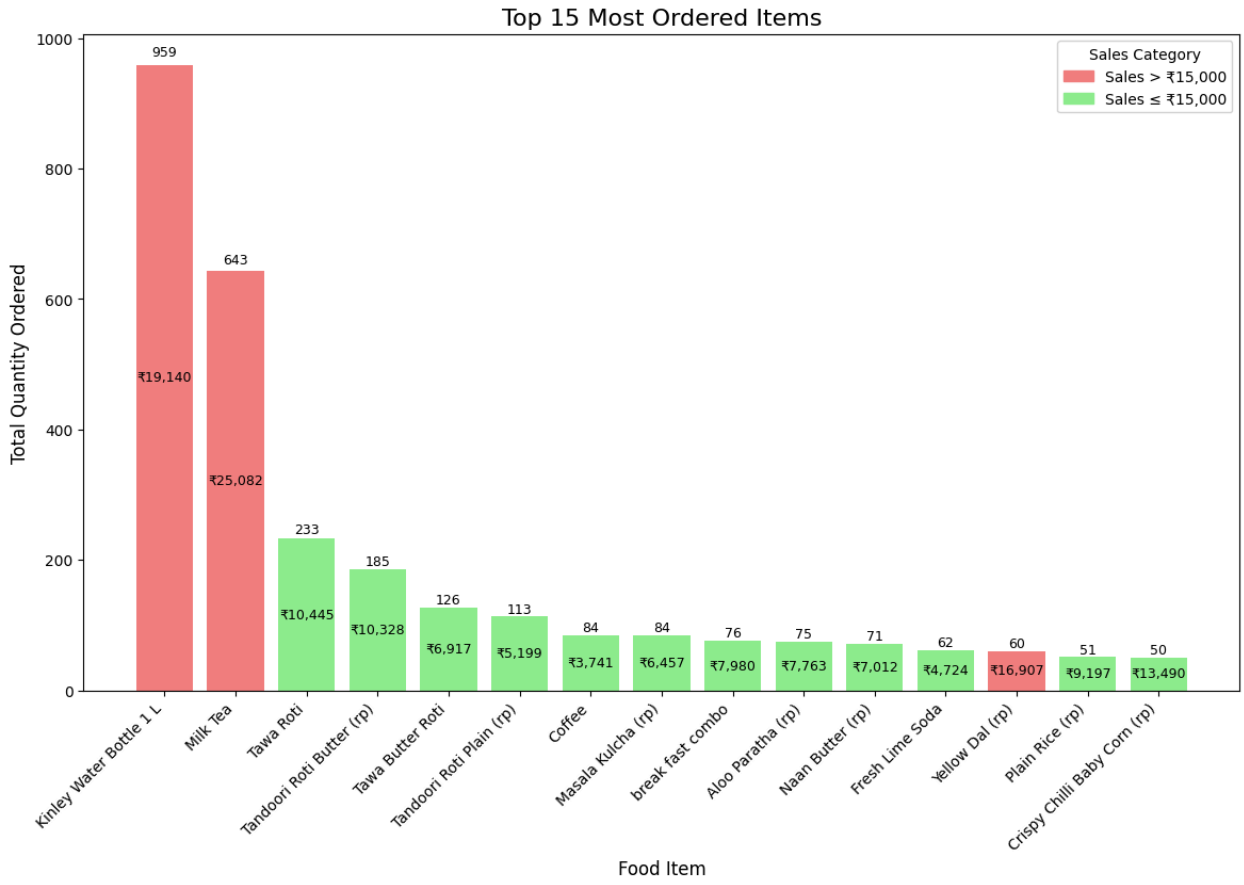
5.3. Month-wise Orders and Sales



Picture 5 - Chart of No. of Order v/s Month

This chart shows the restaurant's performance over three months (Jan–Mar 2025). **January had the highest orders (550) and sales (₹189,661)**, which might be because of New Year celebrations and people eating out more at the start of the year. In **February, orders dropped to 379 with sales of ₹108,256**, showing a clear decline in demand. Interestingly, in **March the number of orders was even lower (301), but sales were higher (₹136,771)** compared to February. This means customers in March spent more per order, even though overall visits were fewer.

5.4. Top 15 Most Ordered Items and Sales

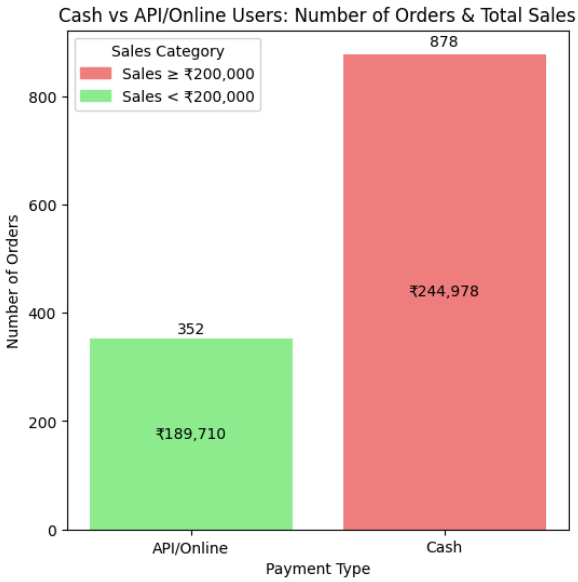


Picture 6 - Total Quantity Ordered v/s Food Item

This chart highlights the most popular items sold at the restaurant. The **Kinley Water Bottle (959 pieces)** and **Milk Tea (643 pieces)** are on top, showing that drinks are in very high demand. Among food items, **Tawa Roti (233 pieces), Tandoori Roti Butter (185 pieces), and Tawa Butter Roti (126 pieces)** were the most frequently sold breads, which means customers usually

pair their meals with different types of rotis. An interesting point is that **Yellow Dal (60 portion, ₹16,907)**, even though sold in smaller quantities, is often paired with breads, making it one of the best combinations to eat. Overall, this chart shows that **basic accompaniments like water, tea, and breads dominate customer choices**, while dishes like dal add strong value when combined with them.

5.5. Cash vs API/Online Users and Sales



Picture 5 - Chart of No. of Order v/s Payment Type

This chart shows the preferred payment methods of customers. The majority of orders were made through **cash (878 orders, ₹244,978)**, while **online/API payments were much fewer (352 orders, ₹189,710)**. Even though online orders were almost half in number, their total sales value is still quite close to cash payments, which means online users tend to spend more per order. This highlights that while cash is still the most common payment method at the restaurant, **online transactions are becoming valuable because of higher average spending**.

All Charts: Charts