OPTIMIZING INVENTORY MANAGEMENT FOR ENHANCED BUSINESS EFFICIENCY AND MINIMIZING OPERATIONAL COSTS

BDM CAPSTONE PROJECT MID-TERM SUBMISSION

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(BS) DEGREE IN DATA SCIENCE AND APPLICATIONS

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Executive Summary

‘Pizzalicious’ is a small pizzeria located at C78, Jhilmil Colony, Near Yamuna Sports Complex, Dilshad Garden, New Delhi. It is a B2C that deals directly with customers in the segment of ‘Food Service’.

The major issue that the pizzeria is facing is in tracking inventory and keeping stocks of the amount of product inflow and outflow. The fast-paced nature of the restaurant and the wide variety of materials utilized make inventory management a complex task. This problem has led to potential wastage, stock discrepancies, and operational inefficiencies.

The main objectives include implementing a data-driven approach to inventory management, accurately tracking and quantifying inventory, and identifying cost-saving opportunities. By utilizing tools such as Excel, Python, and Machine Learning, the pizzeria seeks to streamline data processing and decision-making, optimizing stock levels, and minimizing wastage and stockouts.

The expected outcome includes enhanced operational efficiency, reduced food wastage, and improved customer satisfaction.

Proof of Originality

To establish the authenticity of the data, the supporting evidence as listed below:

1. **Letter from the Organization:** Access to the letter can be obtained through the G-Drive link: [https://drive.google.com/file/d/1I70IK7pHv6h99fF6qfvrDFIjNkPd9Wzq/view?usp=sharing]
2. **Images of Inventory snapshot and organisation overview:** These images are included in Appendix A, located on page 10. They can also be accessed through the G-Drive link: [https://drive.google.com/drive/folders/13ZXUd9f4b-8sSwSN5MiQrR-psRTFpsaN?usp=sharing]
3. **Images of Organisation:** These visuals are enclosed within Appendix B, which can be found on page 11.
4. **Emails from the Owner:** Emails exchanged with the organization's owner, supported by official student identification, serve as confirmation of data authenticity. However, due to confidentiality considerations, sharing this data requires a formal request.

Metadata and Descriptive Statistics

METADATA:

The owner generously granted me access to varied data sources as listed:

1. **Sales Data for June 2023:** The owner shared a compiled sales report excel sheet containing details of product categories, specific item names, item codes, quantities sold, and the total revenue generated per item.
2. **Initial Inventory Image Overview**: The owner provided an initial inventory snapshot in the form of an image. This initial glimpse provided a rudimentary inventory material list used in the pizzeria.
3. **Initial Organisation Overview**: The owner provided the
4. **Inventory Information Sheet:** Through correspondence, an inventory excel file was collaboratively developed. The owner actively participated by filling in the inventory details. The inventory file consists of two distinct sheets.
    a. **Inventory Data Sheet:** This sheet presents an extended and categorized inventory list, derived from the initial rough inventory overview. The items are categorized and include essential details such as the quantities used on a weekly and monthly basis, and the units of measurement ranging from kilograms, units, packets, litres, to sachets, are specified.
    b. **Top 10 Products Material Usage Approximations:** This sheet contains the top selling products that contribute significantly to revenue. The approximate quantities of inventory items used in these products are documented.

Sales Data Metadata Keys:

Key	**Description**
Category	Category of the product being sold
Item	Specific name of the item sold
Code	Code assigned to the item
Qty.	Quantity of the item sold
Total (Rs.)	Total revenue generated from the sales of item

Inventory Data Metadata Keys:

Key	**Description**
Item Name	Name of the inventory item
Item Category	Category of the inventory item
Amount Used Weekly	Amount of item used weekly
Amount Used Monthly	Amount of item used monthly

Unit measurement	Total revenue generated from the sales of item
Restocking Frequency	Frequency of restocking in days
Cost of Item	Cost associated with the inventory item

Products Material Usage Approximations Metadata Keys:

Key	Description
Item	Specific name of the item
Material Used	Approximate amount of material used for the item

DESCRIPTIVE STATISTICS:

After data processing and cleansing, the following is a concise overview of the dataset using descriptive statistics. I have attempted to condense the information by highlighting the descriptive stats below relevant for both sales and inventory data.

Descriptive statistic measure	Descriptive statistic definition
Sum	The total value.
Mean	The average value.
Standard Error	The variability of mean, across multiple samples drawn from the same population.
Median	The middle value when arranged in ascending order.
Standard Deviation	The measure of spread of values from mean in single sample.
Minimum	The smallest value.
Maximum	The largest value.

For Overall Sales Data (June 2023):

Descriptive statistic measure	Quantity	Total Revenue	Price Per Item
Sum	4117	₹660854.51	₹41222.11
Mean	29.83	₹4788.80	₹298.71
Standard Error	5.33	₹693.89	₹22.15
Median	8	₹1675	₹202.58
Standard Deviation	62.69	₹8151.40	₹260.25
Minimum	1	₹40	₹19.05
Maximum	414	₹48080.60	₹1248.61

The sales items have been organized into eight primary categories for the purpose of analysis. These categories are as follows:

1. **Pizzas:** Encompassing Pizza, Pizza Mania (Single), Pizza Mania (Doubles), and Chef's Special items.
2. **Combos**: Including various combo offerings and the Work from Home Combo.
3. **Garlic Breads:** Comprising the Garlic Breads category.
4. **Beverages**: Encompassing both Beverages and Mocktails.
5. **Pasta:** Encompassing Pasta items.
6. **Burgers:** Encompassing Burger offerings.
7. **Dessert**: Including Dessert items and Extras.
8. **Mixed Sides:** Encompassing a variety of items such as Sides, Sandwiches, Conizza, and Guilt-Free options.

The focus of the analysis will be directed towards the top 20 selling items across prominent categories such as Pizzas, Combos, Beverages, Garlic Breads, and Desserts.

For the entire category of Pizzas:

D-statistic measure	Quantity	Total Revenue	Price per item	Percentage Revenue
Sum	1,675.00	₹ 369,137.56	₹ 26,494.30	55.86%
Mean	29.39	₹ 6,476.10	₹ 464.81	0.98%
Standard Error	8.57	₹ 1,321.96	₹ 36.84	0.20%
Median	6	₹ 2,245.38	₹ 400.00	0.34%
Standard Deviation	64.7	₹ 9,980.59	₹ 278.16	1.51%
Minimum	1	₹ 420.00	₹ 114.20	0.06%
Maximum	414	₹ 48,080.60	₹ 1,248.61	7.28%

For the entire category of Combos:

D-statistic measure	Quantity	Total Revenue	Price per item	Percentage Revenue
Sum	147	₹ 40,433.58	₹ 3,824.34	6.12%
Mean	21	₹ 5,776.23	₹ 546.33	0.87%
Standard Error	12.9	₹ 2,623.49	₹ 146.81	0.40%
Median	10	₹ 3,802.03	₹ 380.20	0.58%
Standard Deviation	34.13	₹ 6,941.10	₹ 388.43	1.05%
Minimum	1	₹ 1,020.49	₹ 212.40	0.15%
Maximum	97	₹ 20,602.81	₹ 1,185.03	3.12%

For the entire category of Beverages:

D-statistic measure	Quantity	Total Revenue	Price per item	Percentage Revenue
Sum	752	₹ 37,932.42	₹ 1,186.34	5.74%
Mean	57.85	₹ 2,917.88	₹ 91.26	0.44%
Standard Error	30.29	₹ 959.30	₹ 14.84	0.15%
Median	25	₹ 1,980.00	₹ 110.00	0.30%
Standard Deviation	109.23	₹ 3,458.81	₹ 53.49	0.52%
Minimum	1	₹ 177.01	₹ 19.05	0.03%
Maximum	410	₹ 12,300.00	₹ 177.01	1.86%

For the entire category of Garlic Breads:

D-statistic measure	Quantity	Total Revenue	Price per item	Percentage Revenue
Sum	370	₹ 66,175.04	₹ 1,674.33	10.01%
Mean	41.11	₹ 7,352.78	₹ 186.04	1.11%
Standard Error	18.39	₹ 3,354.14	₹ 9.61	0.51%
Median	10	₹ 1,700.00	₹ 190.58	0.26%
Standard Deviation	55.18	₹ 10,062.41	₹ 28.82	1.52%
Minimum	3	₹ 678.82	₹ 146.28	0.10%
Maximum	151	₹ 28,777.25	₹ 226.27	4.35%

For the entire category of Desserts:

D-statistic measure	Quantity	Total Revenue	Price per item	Percentage Revenue
Sum	200	₹20,798.72	₹361.56	3.15%
Mean	33.33	₹3,466.45	₹60.26	0.52%
Standard Error	23.55	₹3,105.84	₹18.76	0.47%
Median	11.5	₹327.50	₹40.00	0.05%
Standard Deviation	57.69	₹7,607.71	₹45.94	1.15%
Minimum	1	₹40.00	₹20.00	0.01%
Maximum	150	₹18,983.72	₹126.56	2.87%

For Overall Inventory Data (June 2023):

Descriptive statistic	Cost of item	Monthly Bill	Restocking Frequency (in days)
Sum	₹11947.50	₹354297.42	1138
Mean	₹254.20	₹7538.24	24.21
Standard Error	₹45.06	₹2627.42	3.64
Median	₹150	₹2035.71	20

Standard Deviation	₹308.94	₹18012.70	25.02
Minimum	₹1	₹180	1
Maximum	₹1800	₹111428.57	110

Analysis processes and methods

The process of data analysis encompasses defining the problem, data collection, organization, cleaning, transformation, applying analysis techniques, and drawing conclusions.

The first step of this journey was an arduous six-month process of data acquisition, which proved to be the most challenging. Engaging with approximately forty businesses, and encountering a mix of rejections and hesitations, with some willing to share data verbally, but hesitant about sharing any raw data. Finally, a gracious business owner was willing to share the data, establishing one of the most important milestones in the journey of data analysis: data acquisition.

The subsequent phase involved inquiring into the fundamental aspects of the business to identify specific challenges that required attention. Upon obtaining the initial dataset outlining the essential components of the business, it became evident that the owner was content with customer retention and profits. Consequently, the focus shifted towards analyzing the inventory management aspects of the business. Precautionary measures included backing up the original files measure in case the data was accidentally deleted or lost.

The data furnished by the owner was a blend of clean and mixed data, requiring preliminary cleaning before conducting analysis. The sales data provided by the owner, while mostly clean, required minor cleaning and further feature analysis. In contrast, the inventory sheet along with the material usage sheet, is still ongoing work in progress, demanding extensive cleaning, categorization efforts, encompassing the merging of data with the sales and material used, and adding new features that might help gain more insight into inventory optimization demanded. The process of data cleaning necessitates confirmation from the owner to ensure accuracy of inventory usage.

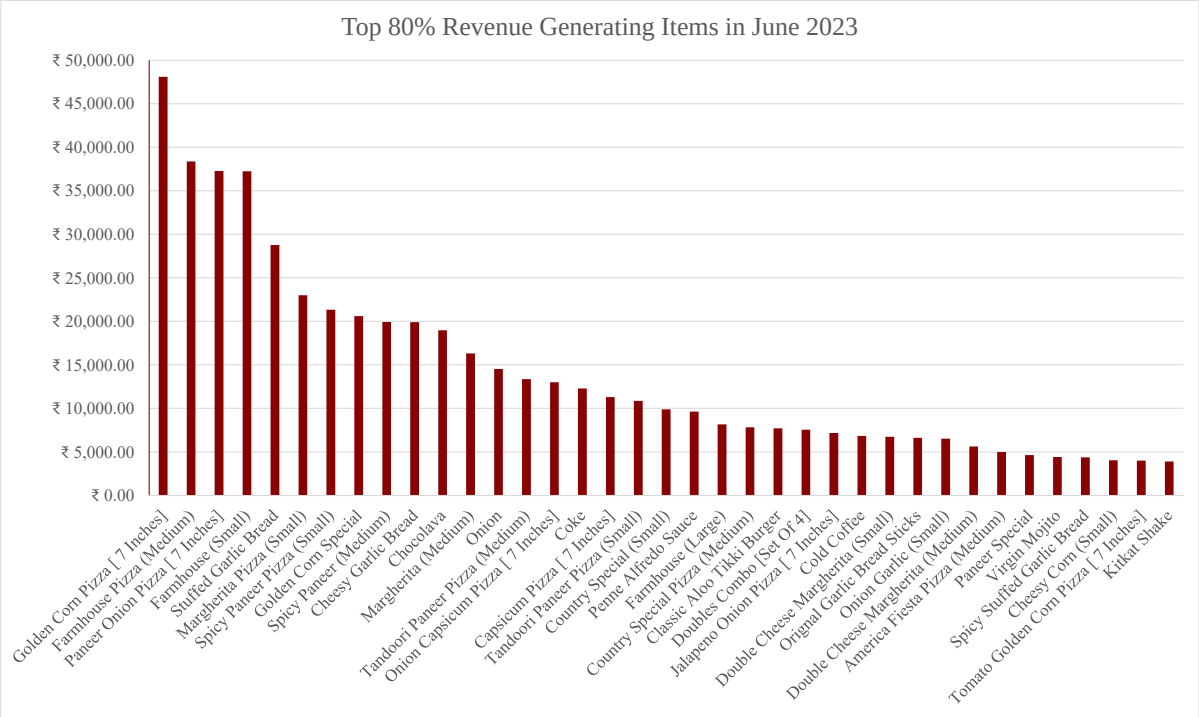
The data analysis process heavily relied on utilizing Microsoft Excel tools, including Excel Data Analysis ToolPak, Pivot tables, Pivot charts, custom formulas, and Excel add-ins. The foundational analysis provided comprehensive insights into the data. The descriptive statistics highlighted in this report have been meticulously formulated by systematically organizing and exploring data within each category.

Methods such as 'ABC analysis' were employed to classify inventory items into high, medium, or low value categories. 'Pareto Analysis' helped identify the key contributors to inventory and sales, while 'Inventory Classification' has been utilized to group items based on their restocking frequency.

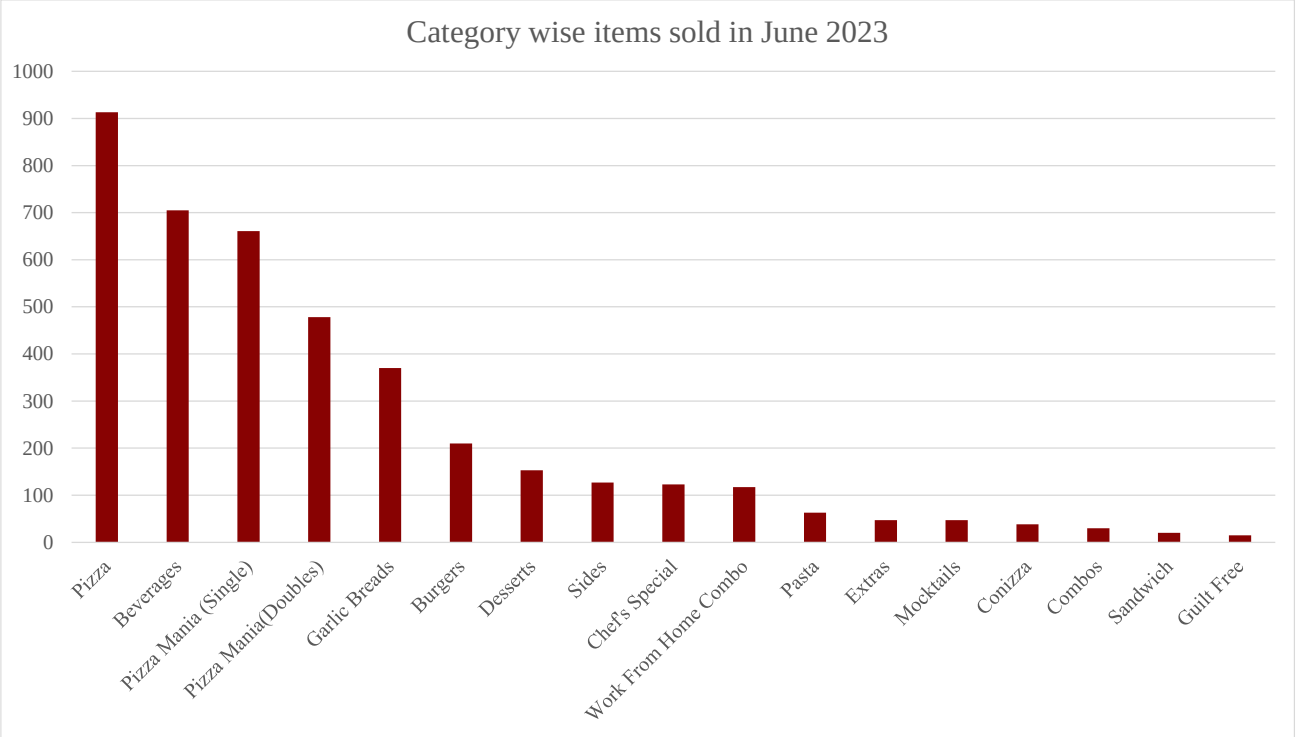
Results and Findings

Some insights gained from sales data:

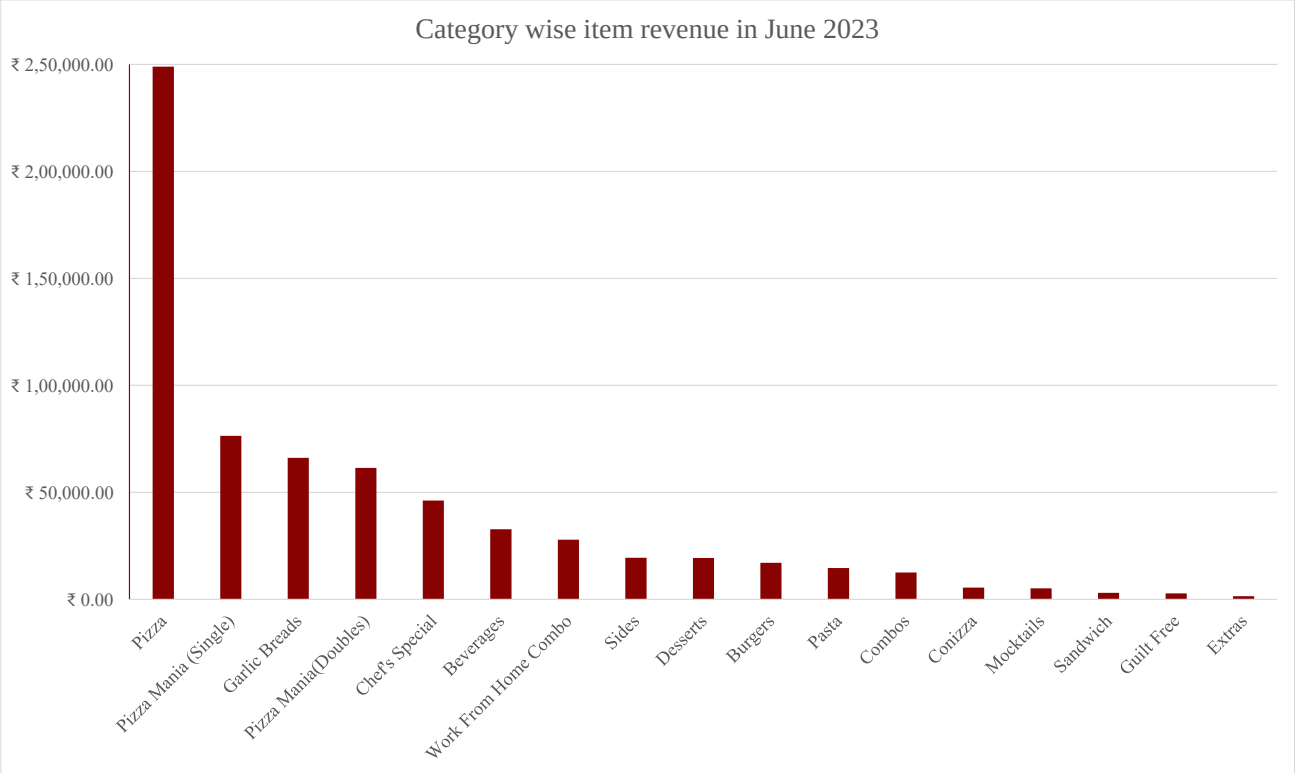
- A total of 4117 items were sold in June 2023, averaging approximately 137.23 items per day making an average daily revenue of ₹22028.48 and a monthly gross revenue of ₹660854.51.



- The top five items that were ordered the most include *Golden Corn Pizza [7 Inches], Farmhouse Pizza (Medium), Paneer Onion Pizza [7 Inches], Farmhouse (Small), and Stuffed Garlic Bread.* These items collectively contributed 28 percent of the total revenue, with a total of 1132 items sold.
- Among the top items, pizzas emerged as the most popular and the most revenue generating item category. The *"Golden Corn Pizza [7 Inches]"* stood out as the top-selling and highest revenue-generating items with a remarkable 414 units sold at ₹116.14 each, generating a total revenue of ₹48080.60.
- Following closely, the "Farmhouse Pizza" secured the second spot for most revenue generating item, with a combined sales total of 277 pizzas, resulting in a substantial total revenue of ₹75619.63.
- Considering the *"Farmhouse Pizza (Medium)"* pizza's price was 1.88 times that of the *"Farmhouse Pizza (Small),"* the smaller version outsold the medium by a factor of 1.83.
- The items with the lowest sales were the *"Large" and "Extra Large" pizzas*, along with *Peri-Peri Fries*. Additionally, *Vanilla Shake* stood out as the least sold beverage option.



The top-selling categories with the highest quantity of items sold were Pizza, Beverages, and Garlic Breads.



The highest revenue-generating items were Pizzas and Garlic Breads.

The sales analysis provides valuable insights for effective inventory management strategies.

Appendix A: Proof of Originality

Letter from the Organization and proof of Email Correspondence:

PIZZALICIOUS

C-78 Jhilmil Colony, Vivek Vihar near Yamuna Sports Complex, Delhi 110095

Date: 27/7/2023

Dear Garima Sikka,

I am writing to confirm that Pizzalicious has provided you with data for your analysis project. We understand that this data will be used solely for the purpose of your project and will be kept confidential between both parties.

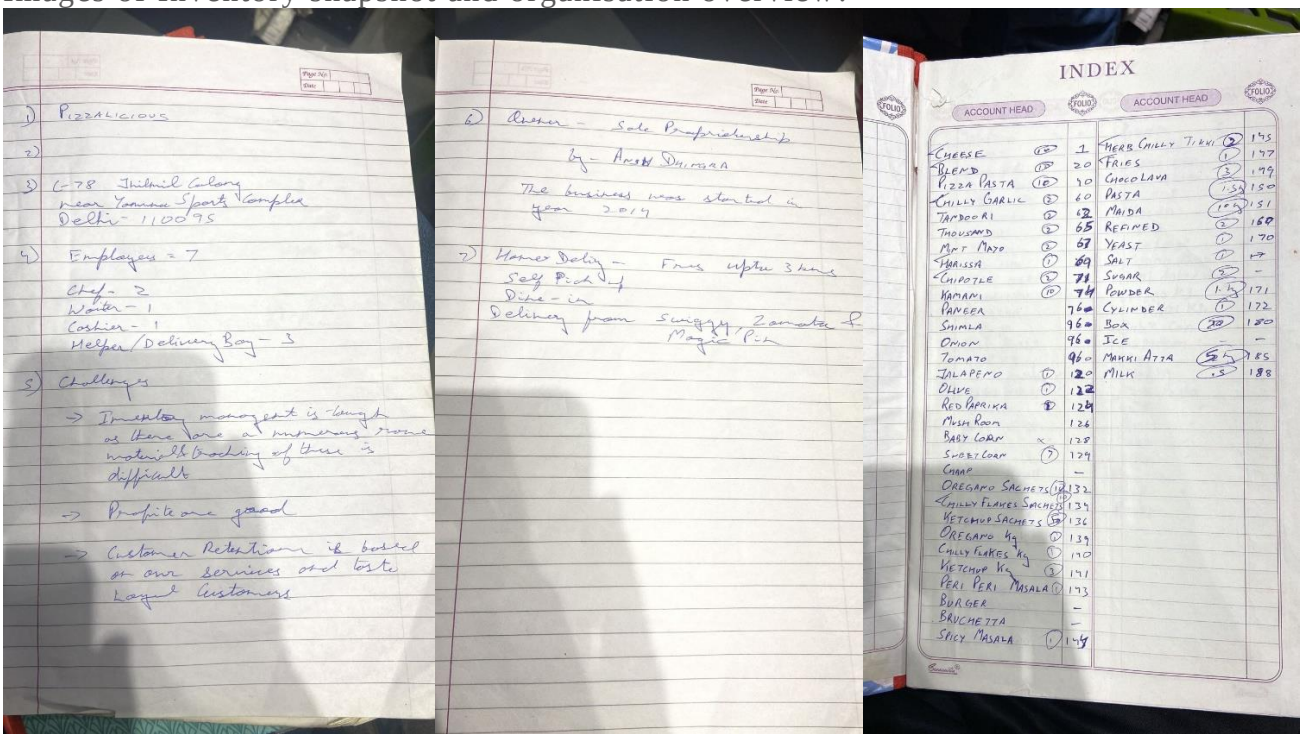
We would like to express our gratitude for your interest in Pizzalicious and for the time and effort you have put into analysing our data. Your insights will be of great help to us and would help improve our daily operations.

We look forward to seeing the results of your analysis.
Best of Luck for your future.

Sincerely,
Mr. Ansh Dhingra
Pizzalicious Owner
Location: C78, Jhilmil Colony, Vivek Vihar Near Yamuna Sports Complex, New Delhi.
Email: pizzalicious0423@gmail.com
Phone: +91 98736 82346

from: **Ansh Dhingra** <pizzalicious0423@gmail.com>
to: 21f1005923@ds.study.iitm.ac.in
date: Aug 9, 2023, 6:46 PM
subject: Business Data for the project
mailed-by: gmail.com
signed-by: gmail.com
security: Standard encryption (TLS) Learn more
: Important according to Google magic.

Images of Inventory snapshot and organisation overview:



Appendix B: Images

Location: https://goo.gl/maps/C387HwpJ1pz61uV17