Optimizing Inventory and Pricing to Enhance Profitability and Reduce Impact of Currency Fluctuations in Wholesale Distribution

A Mid Term report for the BDM capstone Project

Submitted by

Name: Deev Bharat Savla

Roll number: 23F1001931

IITM Online BS Degree Program,

Indian Institute of Technology, Madras, Chennai

Tamil Nadu, India, 600036

Contents

1 Executive Summary and Title

The wholesale business "Kid Shopper Stop Limited", located in Nairobi, Kenya, imports and sells aluminum cans, stainless steel hotpots and pressure cookers. In a highly competitive market, the company faces several challenges that impacts its profitability. One major issue is currency fluctuations which increase the cost of imported goods, reducing profit margins and complicating pricing strategies. Another issue is due to limited storage availability it is difficult to manage inventory effectively.

Additionally, market competition puts pressure on pricing and profit margins. The approach to overcome these challenges will be a data-driven strategy using tools like Excel and Python-based machine learning. This will enable the business to analyze key metrics and insights that can help improve the business. For example, by studying historical sales and exchange rate data, this will help the business to find products with highest margins and which products to order over a period of time and minimizing the risks associated with currency fluctuations.

Seasonal trends can also be analyzed to adjust prices during off-periods, keeping sales steady and raising prices during high demand periods to maximize profits. Till now the owner used to keep a fix rate of the product for the consignment he received. We can also analyze the loyal customers that buy frequently and give them discounts to improve customer retention. Data analytics will help in optimizing inventory management allowing company to track turnover rates and adjust stock levels and minimize the wastage of goods.

Through these data-driven strategies, Kid Shopper Stop Limited aims to achieve smoother operations, better pricing strategies, improved sales performance and become a stronger competitor in the market. By deriving insights from the data, the company can ensure sustainable growth and profitability in the market more effectively.

2 Proof of Originality of the Data

Details:

Wholesale Business – Kid Shopper Stop Limited

Owner – Mr. Rajesh Haria

Location – Nairobi, Kenya

Letter from organization - https://drive.google.com/file/d/1nn5MrvQKkQsC2Sy52rzsOX-CVsj_5ypD/view?usp=drive_link

Short video interacting with the owner - https://drive.google.com/file/d/1wlmTQNuB-Kbx6O_entBAxMuzY2-DWzYA/view?usp=drive_link

Transcription for the short video – https://drive.google.com/file/d/1-AOa6yofFJylC6pdMFbfc80fcRedtP4f/view?usp=drive_link

Link for the photo of the warehouse - https://drive.google.com/file/d/1gCQZicbVLgih_QoJcOw8KOTHg0SfCgXH/view?usp=drive_link

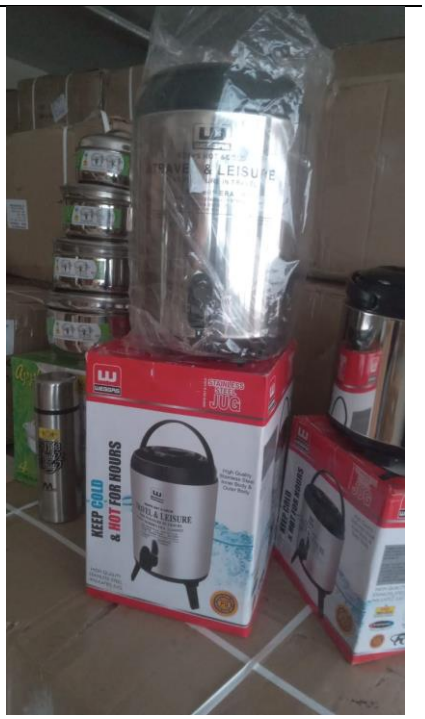
Dataset - https://docs.google.com/spreadsheets/d/17xgt4vni-7FXR5rdYqHPl336O3jAzrAS/edit?usp=drive_link&ouid=106346955764196514584&rtpof=true&sd=true

BDM Project folder (All data stored in this folder) - https://drive.google.com/drive/folders/1BNsFY6IcLuN0pbf_zB5I2HTYAf_AcV2a?usp=drive_link

The owner, Mr. Rajesh Haria works and stores the good in a warehouse, the photo of the same is given below

Picture of the warehouse

Stainless Steel Hotpots



Aluminium Cans

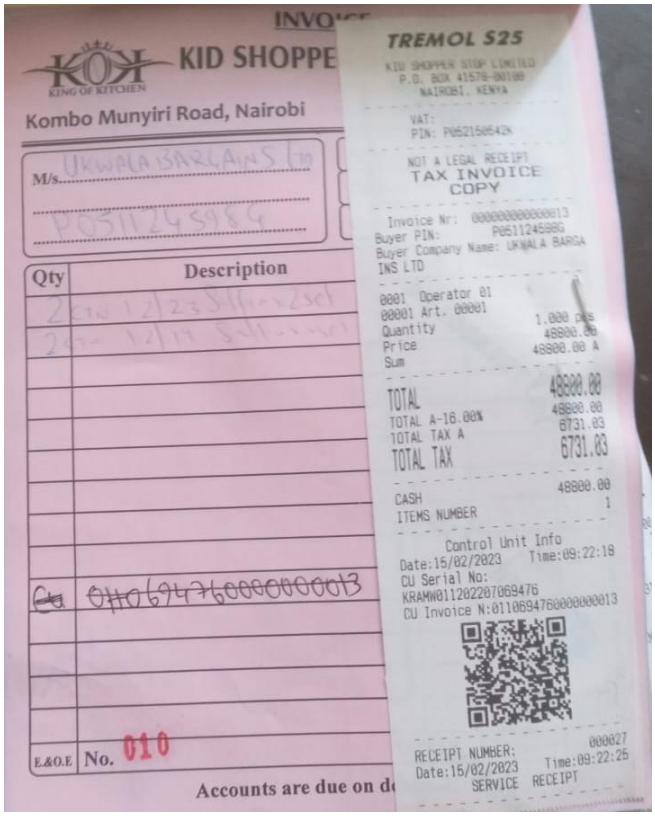
(2.1) Warehouse and its goods

3 Metadata

The owner granted me access to the sales data over the period of one year from January – December 2023 which is the financial year of Kenya.
It includes:

1. **Date**: Date of sale.
2. **Invoice number**: It is used to track and reference specific transactions.
3. **Customer_Name**: Name of the Customer.
4. **Tax** – This is A-16.00% tax of Kenya for each sale.
5. **Quantity_PC** – Quantity of pressure cookers bought by the customer.
6. **Quantity_Hotpots** – Quantity of hotpots bought by the customer.
7. **Quantity_cans** – Quantity of aluminum cans bought by the customer.

8. **Selling_Price** – Price paid by the customer.



(3.1) A snippet of the bills provided by the owner

A	B	C	D	E	F	G	H	I	J	K	L	M
Date	Month	Invoice_No	Customer_Name	Quantity_PC	Sales_PC	Quantity_Hotpots	Sales_Hotpots	Quantity_cans	Sales_cans	Selling_Price	Tax	US_to_KES_ExchangeRate
05-01-2023	January	00000001	Helix LTD	8	1,20,000	8	88,000	7	84,000	2,92,000	43,298	123.5
06-01-2023	January	00000002	Global Mart LTD	11	1,65,000	3	33,000	2	24,000	2,22,000	26,573	123.45
08-01-2023	January	00000003	Kasturi Smkt LTD	13	1,95,000	5	55,000	3	36,000	2,86,000	41,354	123.55
08-01-2023	January	00000004	Simba Global LTD	7	1,05,000	4	44,000	1	12,000	1,61,000	15,789	123.55
09-01-2023	January	00000005	Stellar Ventures LTD	1	15,000	1	11,000	1	12,000	38,000	4,765	123.55
10-01-2023	January	00000006	Premier Traders LTD	2	30,000	2	22,000	0	-	52,000	21,345	123.6
10-01-2023	January	00000007	Prime Super Store LTD	2	30,000	5	55,000	2	24,000	1,09,000	7,856	123.6
12-01-2023	January	00000008	Apex Distributors LTD	10	1,50,000	9	99,000	8	96,000	3,45,000	43,325	123.7
12-01-2023	January	00000009	Unity Supplies LTD	3	45,000	3	33,000	1	12,000	90,000	6,053	123.7
14-01-2023	January	00000010	Universal Traders LTD	3	45,000	2	22,000	1	12,000	79,000	7,568	123.75
14-01-2023	January	00000011	Apex Distributors LTD	2	30,000	1	11,000	0	-	41,000	6,753	123.75
16-01-2023	January	00000012	Nexus Goods LTD	3	45,000	0	-	1	12,000	57,000	8,432	123.8
20-01-2023	January	00000013	Zenith Traders LTD	7	1,05,000	7	77,000	6	72,000	2,54,000	43,362	124
21-01-2023	January	00000014	Prime Super Store LTD	4	60,000	0	-	3	36,000	96,000	8,346	124.01
22-01-2023	January	00000015	Omega Distributors LTD	4	60,000	5	55,000	2	24,000	1,39,000	16,234	124.03
28-01-2023	January	00000016	Rapid Mart LTD	8	1,20,000	5	55,000	3	36,000	2,11,000	12,589	124.35
02-02-2023	February	00000017	Prime Super Store LTD	4	60,000	5	55,000	2	24,000	1,39,000	13,457	124.45
03-02-2023	February	00000018	Quantum Global LTD	9	1,35,000	8	88,000	7	84,000	3,07,000	43,389	124.65

(3.2) A snippet of creating an excel sheet from the bills given by the owner

New fields: -

1. **US_to_KES_ExchangeRate** – Provides with rate of KES for a dollar for every month in 2023
2. **Sales_PC** – Amount paid by the customer for pressure cooker.
3. **Sales_PC** – Amount paid by the customer for hotpots.
4. **Sales_cans** – Amount paid by the customer for Aluminum cans.

These are the fields that I have created from the data provided by the owner.
US to KES exchange rates source - https://in.investing.com/currencies/usd-kes-historical-data
The total sales for each product were derived from the quantities given by the owner.

The owner sold for: -

I. Pressure Cooker – 15000 KES for 1 box which contains 6 pieces.
II. Aluminum Cans – 12000 KES for 1 box which contains 2 sets.
III. Hotpots – 11000 KES for 1 box which contains 2 sets.

The owner had 3 consignments in entire 2023 year which took from Jan – Mar, Apr – July and Aug – Dec for Consignment 1,2 and 3 respectively.

Data Cleaning

Row Labels	Sum of Sales_PC	Sum of Sales_Hotpots	Sum of Sales_cans	Sum of Selling_Price
January	1320000	660000	492000	2472000
February	1290000	935000	720000	2945000
March	1500000	748000	444000	2692000
April	750000	528000	372000	1650000
May	735000	605000	324000	1664000
June	825000	682000	588000	2095000
July	735000	473000	384000	1592000
August	705000	440000	396000	1541000
September	480000	561000	588000	1629000
October	780000	506000	648000	1934000
November	465000	341000	240000	1046000
December	480000	462000	396000	1338000
Grand Total	**10065000**	**6941000**	**5592000**	**22598000**

Row Labels	Sum of Sales_PC	Sum of Sales_Hotpots	Sum of Sales_cans	Sum of Selling_Price
Allied Distributors	180000	88000	84000	352000
Apex Distributors LTD	480000	363000	312000	1155000
Elite Distributors LTD	555000	330000	336000	1221000
Global Mart LTD	210000	33000	24000	267000
Helios Ventures LTD	105000	0	24000	129000
Helix LTD	960000	506000	348000	1814000
Helix Ventures LTD	75000	44000	24000	143000
Horizon Enterprises LTD	330000	286000	192000	808000
Infinity Enterprises	210000	88000	72000	370000
Kasturi Smkt LTD	600000	561000	648000	1809000
Kibuye Matt LTD	270000	253000	168000	691000
Maximize Enterprises	330000	198000	120000	648000
Mega Wholesalers LTD	195000	121000	48000	364000
Mombasa Suppliers LTD	135000	99000	96000	330000
Nexus Goods LTD	210000	121000	60000	391000
Nirma Kenya LTD	810000	649000	492000	1951000
Omega Distributors LTD	330000	308000	240000	878000
Patel Traders LTD	240000	143000	168000	551000
Powerline Solutions	240000	165000	120000	525000
Premier Traders LTD	180000	121000	72000	373000
Prime Super Store LTD	630000	352000	312000	1294000
Quantum Global LTD	420000	275000	240000	935000
Rapid Mart LTD	165000	154000	132000	451000
Shiv Shakti LTD	435000	341000	204000	980000
Shrim Wholes Alers LTD	75000	154000	132000	361000
Simba Global LTD	225000	154000	96000	475000
Stellar Ventures LTD	240000	132000	132000	504000
Swift Mart LTD	360000	275000	240000	875000
Techmax Distributors LTD	75000	44000	36000	155000
Unity Supplies LTD	180000	121000	84000	385000
Universal Traders LTD	45000	22000	12000	79000
Vimit LTD	390000	330000	240000	960000
Vortex Traders LTD	75000	33000	12000	120000
Zenith Traders LTD	105000	77000	72000	254000
Grand Total	**10065000**	**6941000**	**5592000**	**22598000**

4 Descriptive Statistics

Descriptive statistics of US to KES exchange rates and Selling Price:

	Selling Price	Exchange Rate
Count	150.000000	255.000000
Mean	150653.3333	140.031980
Standard Deviation	85420.6321	9.665119
Minimum	12000.000000	123.300000
25%	79000.000000	132.450000
50% (Median)	142000.000000	140.700000
75%	203000.000000	148.175000
Maximum	445000.000000	156.500000

Descriptive Statistics for sales of pressure cookers, aluminum cans and hotpots.

	Quantity_PC	Quantity_cans	Quantity_hotpots
Count	150.000000	150.000000	150.000000
Mean	4.4733	3.1067	4.2067
Standard Deviation	3.0558	2.9947	2.8925
Minimum	0.000000	0.000000	0.000000
25%	2.000000	1.000000	2.000000
50%	4.000000	2. 000000	4.000000
75%	6.000000	4. 000000	5.000000
Maximum	20.000000	24.000000	19.000000

Descriptive Statistics for sales of pressure cookers, aluminum cans and hotpots.

	Sales_PC	Sales_cans	Sales_hotpots
Count	150.000000	150.000000	150.000000
Mean	67100	37280	46273.33
Standard Deviation	45873.7281	35936.7677	31817.1995
Minimum	0.000000	0.000000	0.000000
25%	30000.000000	12000.000000	22000.000000
50%	60000.000000	24000.000000	44000.000000
75%	90000.000000	48000.000000	55000.000000
Maximum	300000.000000	288000.000000	209000.000000

Variance statistics:

	Variance
Quantity_PC	9.3382
Sales_PC	2101,097315.4362
Quantity_cans	8.9684
Sales_cans	1291451275.1678
Quantity_hotpots	8.3664
Sales_hotpots	1012,34183.4452
Selling Price	7296684384.7875
US to KES Exchange Rate	93.414526476

Sales: The variance in sales for PCs is higher than of cans and hotpots. This indicates that revenue generated from PCs have more fluctuations compared to cans and hotpots this may be due to price variations or demand changes. The lower variances of cans and hotpots suggest more stable selling of these products.

Average Price: The high variance of 7296684384.7875 indicates fluctuations in the pricing of products over time. This may be due to market conditions and external factors such as inflation that impact the different product pricing.

US to KES Exchange Rate Variance (93.414526476): This shows that US dollar to KES exchange rate fluctuates considerably. This can have direct impact on the profitability of the business.

Skewness Statistics

	Skewness
Quantity_PC	1.328499
Sales_PC	1.328499
Quantity_cans	2.943969
Sales_cans	2.943969
Quantity_hotpots	1.416883
Sales_hotpots	1.416883
Selling Price	0.6931
US to KES Exchange Rate	-0.2399

Sales and Quantities: Rightly skewed (1.328 to 2.944) indicate that most transactions involve smaller sale volumes and quantities and have very few large orders.

Revenue & Amt Paid: Slightly rightly skewed (0.6931), suggesting that most products are sold at consistent prices with minor variations and few sales occur at higher selling prices which reduces the overall profit margin.

US to KES Exchange Rate: Slightly left skewed (-0.24) indicates that exchange rates are generally stable or increasing there are no dips towards lower value.

Correlation Matrix

	Sales_PC	Quantity_PC	Sales_Hotpots	Quantity_Hotpots	Sales_cans	Quantity_cans	US_to_KES_ExchangeRate
Sales_PC	1.00	1.00	0.37	0.37	0.25	0.25	0.11
Quantity_PC	1.00	1.00	0.37	0.37	0.25	0.25	0.11
Sales_Hotpots	0.37	0.37	1.00	1.00	0.38	0.38	0.17
Quantity_Hotpots	0.37	0.37	1.00	1.00	0.38	0.38	0.17
Sales_cans	0.25	0.25	0.38	0.38	1.00	1.00	-0.45
Quantity_cans	0.25	0.25	0.38	0.38	1.00	1.00	-0.45
US_to_KES_ExchangeRate	0.11	0.11	0.17	0.17	-0.45	-0.45	1.00

Hotpots and Cans: There is a moderate relationship which means that as sales of hotpots increase the sales of cans also tend to rise.

There is no direct or strong correlation between PCs and Hotpots.

US_to_KES_ExchangeRate and cans: Negative correlation (-0.45) shows that as exchange rate increases, the sales of cans tend to decrease. This negatively impacts the sales. This means that less order of cans should be made if the exchange rates are high and would help in inventory optimization.

5 Detailed Explanation of Analysis Process/Method

12 months of data was cleaned, organized and analyzed.

Firstly, the owner did not have a computerized way of storing the data so I had to store in an organized way through which analysis could be done and insights could be found. So, the 12 months data was first had to input in an excel file to make it structured. Some in depth look was also needed due to missing values and duplicate information while creating the dataset. One of the key tasks was to line up the data by date, so that I could have a chronological order for analysis.

The owner's bills had very limited number of column fields and it would be very difficult to analyze things from it. The data at the start only contained the quantities sold of each product and the total bill price for each customer. So, new fields of individual sales of each products had to be created for better analysis. These columns were formed by multiplying the quantities to the price of each product which was given by the owner. These fields were needed for inventory optimization such as to find the best-selling product etc.

Another important part was to create a field to store exchange rates between USA and Kenya which would help to analyze the problem of impact of currency fluctuations.

The data was then sorted by date. It was also categorized and separated according to the relevant month, making the data useful for reviewing and comparing monthly performance. This data was reviewed briefly and the key information was filtered out for further analysis.

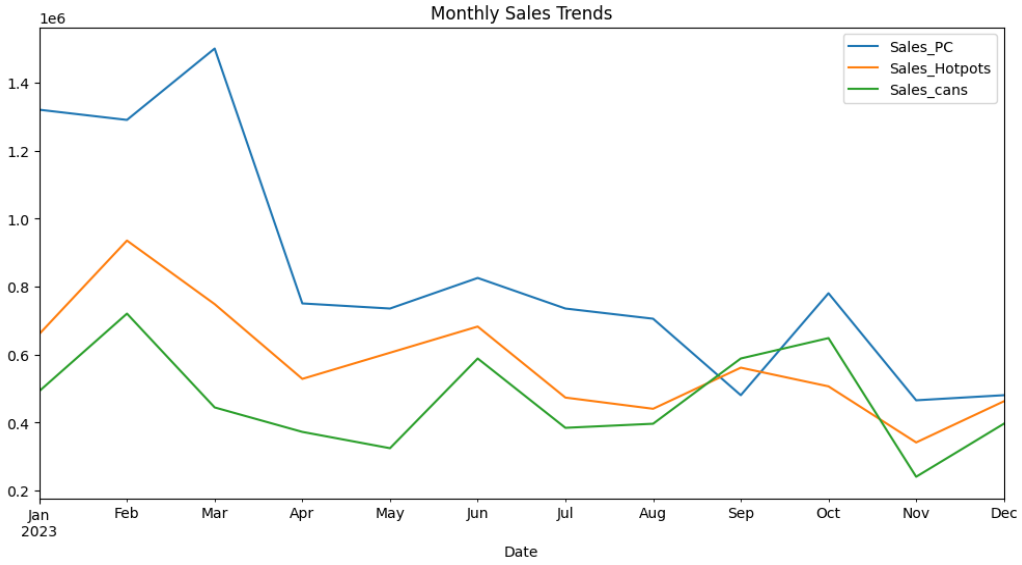
The information was then summarized and rearranged using pivot tables to enable the extraction of any key insights and patterns to be observed across the various dimensions. Pivot tables provide very powerful dynamic analysis which helps in changing the view of the data and identify any trends or patterns in the data.

After, several visualizations were created to gather insight into trends and distributions within this data. Line chart was used to show trends in total revenue over the year, which helps us see how these metrics change month by month.

Then the core business was analyzed and it was found that Pressure Cooker has more percentage in the sales revenue compared to cans and hotpots. Cans had the least revenue generated. A pie chart was used to show this comparison. A line chart was also made to show the monthly sales of each product over the entire 2023 year.

The steps helped transform the data from a jumbled collection of records to a structured and insightful data. The cleaning and analysis of data was done using excel and python libraries like NumPy, pandas, matplotlib and seaborn. SARIMA is also used for analyzing and predicting the exchange rates from historical data and trends.

6 Results and Findings



(6.1) Monthly Sales of each product.

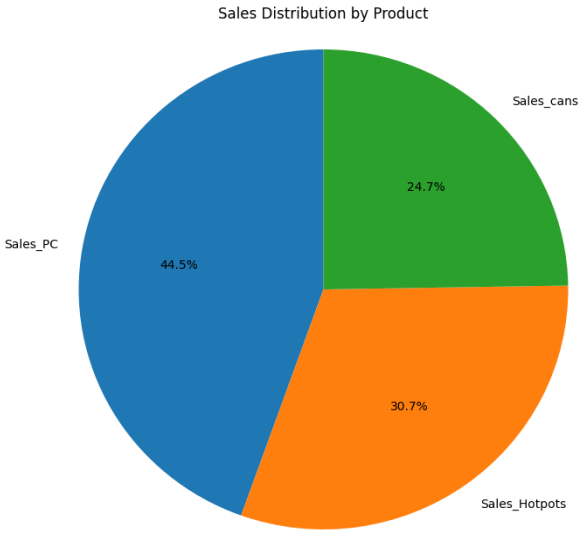
Based on the graph a few things can be observed -

The sales pattern shows significant fluctuations, indicating variations in demands for Pressure Cookers, Hotpots and cans. There is a significant rise in sales at the first 2 months which peaked at January.

From, **March to August** there is a sharp decline in all three products mainly in Pressure Cookers and Hotpots. This can be due to inflation or cheap quality products due to which they are sold at very cheap rates.

There is a slight improvement in September mainly for pressure cookers so targeting this period with strategic marketing and inventory stocking could maximize the revenue. Despite the festive season in December, all product categories, especially Pressure Cookers and Hotpots, show a sharp decline in sales during this month.

After analyzing the graph, it highlights there is a need for flexible inventory management. The company can benefit from data-driven methods to calculate reorder points, economic order quantities, and safety stock to ensure adequate supply during peak months such as February and September, while avoiding overstock during low-demand months.



(6.2) Sales Distribution by Product

The blue segment represents the sales of **Pressure Cookers**, which account for **44.5%** of total sales. This is the largest segment, indicating that Pressure Cookers contribute the most to the company's overall revenue. This suggests that the demand for Pressure Cookers is relatively high, making it a key product for the business. Strategies to optimize sales performance for this product category, such as targeted marketing and inventory management, would likely have a significant impact on the company's overall performance.

The orange segment represents **Hotpots**, which contribute **30.7%** of total sales. This indicates that Hotpots also play a significant role in the business but are less dominant compared to Pressure Cookers. While still an important product category, the smaller share suggests there may be room to increase its market presence, perhaps by focusing on marketing campaigns or promotional offers to boost sales in this category.

The green segment represents the sales of **cans**, which make up **24.7%** of total sales. This is the smallest share of the three categories, showing that cans have a relatively lower demand compared to Pressure Cookers and Hotpots. The lower percentage may indicate an opportunity to explore ways to either boost sales of cans or manage the inventory to focus on higher-performing product categories.

Overall, the pie chart provides a clear breakdown of the company's sales distribution, with **Pressure Cookers** leading as the top-selling product, followed by **Hotpots** and **cans**. This data can guide strategic decisions regarding which products to prioritize for marketing and inventory management. It may also suggest where the company could invest in growth opportunities, such as increasing the share of Hotpots and cans in the sales mix, or focusing on expanding the lead of Pressure Cookers.

After detailed analysis for calculating ROP and EOQ here is the table which shows the ROP and EOQ and some other features of each product:

	Pressure Cookers	**Cans**	**Hotpots**
Annual Demand	1246	893	1192
Demand Std Dev	58.527	40.697	55.0401
EOQ	7	5	6
ROP	494	347	467

The demand variability is highest for Pressure Cookers (**58.53**), followed by Hotpots (**55.04**) and Cans (**40.70**). This highlights the need for more cautious inventory management for Pressure Cookers and Hotpots to prevent stockouts, while Cans show more predictable demand.

The EOQ values are small for all these 3 products, which suggests that company favors small orders to avoid high holding costs like limited storage costs or high warehousing costs which is also a problem for the business.

The demand variability is highest for Pressure Cookers (**58.53**), followed by Hotpots (**55.04**) and Cans (**40.70**). This highlights the need for more cautious inventory management for Pressure Cookers and Hotpots to prevent stockouts, while cans show more predictable demand.

The following formulas were used to find ROP and EOQ:

1) ROP = d * L + SS (L – lead time and SS – safety stock)
2) EOQ=sqrt(2DS/H) where D – demand rate, H – holding cost per year, S – ordering cost.
3) Holding Cost – Avg Selling Price * 20%
4) Annual Demand – sum of quantity of each product.

For predicting exchange rates, I have used SARIMA model as it is efficient in time series data and helps in finding seasonal patterns. It also helps in showing non seasonal trends and can offer better forecasting accuracy.

PROCEDURE:

Data Preparation: I have trained the SARIMA model with the entire 2023 exchange rates historical data between US and KES. Firstly, sorted the data by date.

Train-Test Split: split the data into 80:20 ratio of training:test set. Trained the model from the above dataset. The model predicted for the test set period.

Model Fitting: Defined the SARIMA model parameters eg: - order(1,1,1)

Making Predictions and Evaluating Metrics:
Also calculated RMSE (Root Mean Square Error) and MAPE (Mean Absolute Percentage Error) to evaluate model performance. These are the stats:

- Root Mean Squared Error: 0.6551
- Mean Absolute Percentage Error: 0.0030

This suggests that model is performing well in terms of percentage accuracy and the model has captured the patterns well.

The mathematical equation is:

$$(1-B^s)^D(1-B)^d y_t = \mu+(1+\theta_1 B+\theta_2 B^2+...+\theta_q B^q)(1+\Theta_1 B^s+\Theta_2 B^{2s}+...+\Theta_Q B^{Qs})\varepsilon_t$$

Where:

- y_t = time series data
- BBB = backshift operator (i.e., $B^k y_t = y_{t-k}$)
- ε_t = white noise error term

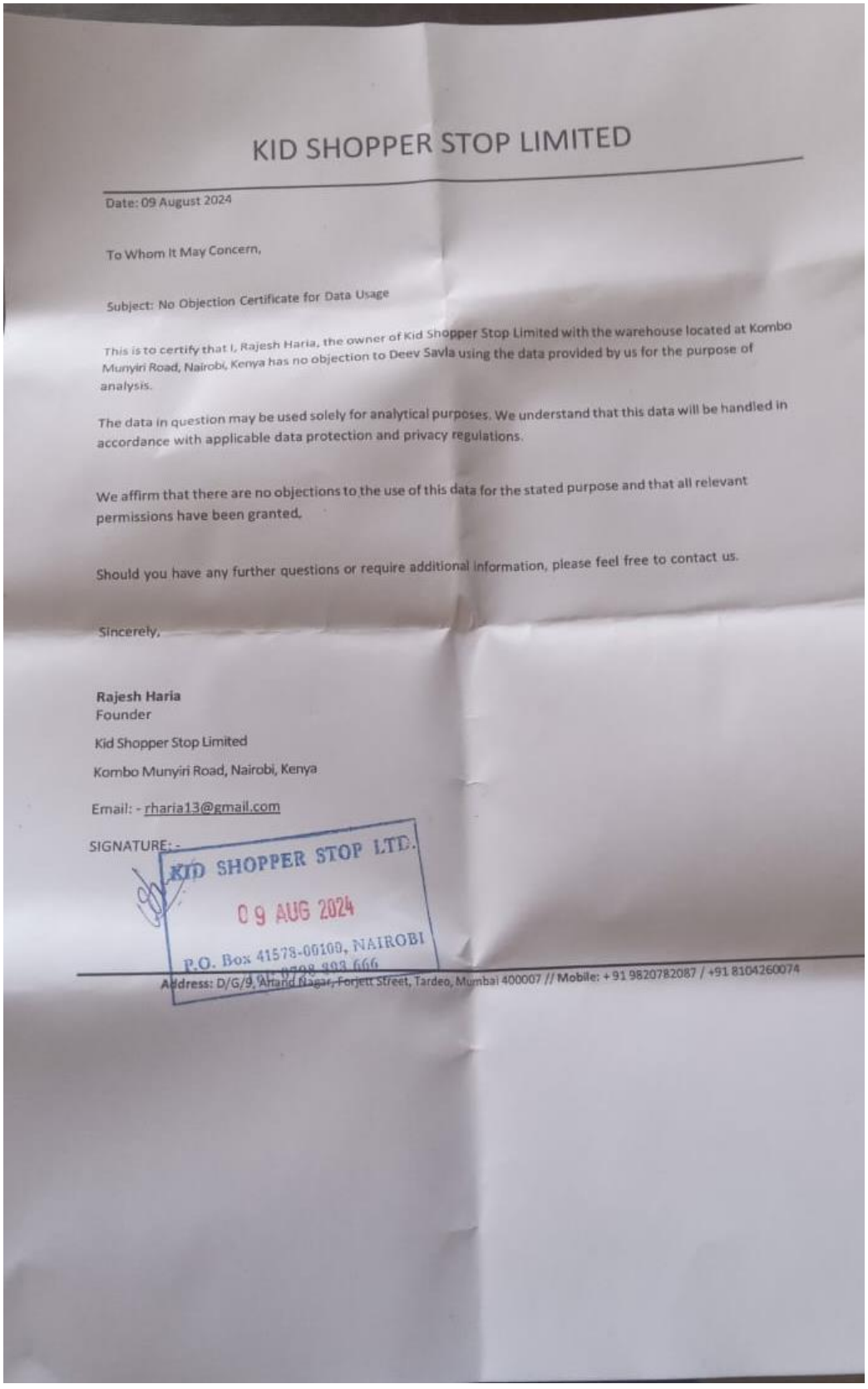
The SARIMA model is represented as:

$$SARIMA(p, d, q)(P, D, Q)_s$$

Where:

- p = order of the autoregressive part
- d = degree of differencing
- q = order of the moving average part
- P = order of seasonal autoregressive part
- D = degree of seasonal differencing
- Q = order of seasonal moving average part
- s = length of the seasonal cycle

APPENDIX A: Proof of originality



KID SHOPPER STOP LIMITED

Date: 09 August 2024

To Whom It May Concern,

Subject: No Objection Certificate for Data Usage

This is to certify that I, Rajesh Haria, the owner of Kid Shopper Stop Limited with the warehouse located at Kombo Munyiri Road, Nairobi, Kenya has no objection to Deev Savla using the data provided by us for the purpose of analysis.

The data in question may be used solely for analytical purposes. We understand that this data will be handled in accordance with applicable data protection and privacy regulations.

We affirm that there are no objections to the use of this data for the stated purpose and that all relevant permissions have been granted.

Should you have any further questions or require additional information, please feel free to contact us.

Sincerely,

Rajesh Haria
Founder
Kid Shopper Stop Limited
Kombo Munyiri Road, Nairobi, Kenya

Email: - rharia13@gmail.com

SIGNATURE: -

KID SHOPPER STOP LTD.
09 AUG 2024
P.O. Box 41578-00100, NAIROBI

Address: D/G/9, Anand Nagar, Forjett Street, Tardeo, Mumbai 400007 // Mobile: +91 9820782087 / +91 8104260074

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