LEVERAGING DATA FOR EFFECTIVE PRICE FORECASTING AND CREDIT MANAGEMENT FOR VEGETABLE DISTRIBUTOR

An End Term report for the BDM capstone Project

Submitted by

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1 Executive Summary

The endterm report focuses on leveraging data analysis for effective price forecasting and credit management for Kanhaiyalal D Jaiswal, a wholesaler of onions and potatoes. The business faces key challenges, including managing seasonal price fluctuations, inventory control, and an unstructured credit allocation process. The report proposes a data-driven approach using linear regression models to forecast price trends and improve inventory management. The project aims to provide clear insights into market trends, helping the business make informed decisions to improve financial planning and customer service.

The analysis reveals that order quantities tend to be larger, with the most frequent order quantity being around 1250 kgs. Additionally, the price elasticity of demand for onions is found to be more volatile than that of potatoes, indicating that onion prices are more sensitive to market changes. The total cost of an order is primarily influenced by the quantity of goods purchased, with unit prices having a lesser impact.

The report also highlights the need for better credit management practices, as the current system is unsystematic and lacks proper records. To address all of these issues, the study suggests several recommendations, including investing in cold storage facilities, diversifying sourcing locations, and introducing processed products. These strategies aim to stabilize supply, reduce waste, and create new revenue streams.

Additionally, the report emphasizes the importance of establishing clear credit policies, implementing a credit monitoring system, and integrating digital payment solutions to streamline the credit management process and minimize risk. Overall, the document provides valuable insights and recommendations for vegetable distributors looking to leverage data for effective price forecasting and credit management.

2 Detailed Explanation of Analysis Process/Method

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

Kanhaiyalal Jaiswal provided data for the time period June 2023 - June 2024. The data was available in offline format. It was not maintained digitally or in any form online. All the transactions and orders were noted in various statement books and laal khata books. This made the data acquisition difficult as all the records had to be manually entered into a spreadsheet for analysis. This was a very time consuming task and was very exhausting. The benefit of this was that this ensured that the dataset was near 100% accurate and clean. There were hardly any discrepancies in the dataset.

The dataset was imported to google colab and the following code was run to drop rows that had nan values.

(2.1) Code to drop NAN rows

(2.2) Shape Of The Dataset

The following code shows us that there are 594 records and 6 columns . The columns involved in the given dataset were Order Date, Category, Quantity (In Bags), Quantity (In Kgs), Cost(Per 10 Kg), Total .

```
# Select only numeric columns
numeric_df = df.select_dtypes(include=['number'])

# Basic Descriptive Statistics
print("Basic Descriptive Statistics:")
print(numeric_df.describe())

# Variance of each numerical column
print("\nVariance of each numerical column:")
print(numeric_df.var())

# Skewness of each numerical column
print("\nSkewness of each numerical column:")
print(numeric_df.skew())

# Kurtosis of each numerical column
print("\nKurtosis of each numerical column:")
print(numeric_df.kurt())

# Correlation Matrix
print("\nCorrelation Matrix:")
print(numeric_df.corr())
```

(2.3) Code Snippet For Descriptive Statistics

The code given in (2.3) was used to find out various descriptive statistics which help us in understanding the data better .

Linear Regression is a statistical method used to model the relationship between a dependent variable (also called the target or outcome) and one or more independent variables (also called predictors or features). The goal is to find the linear equation (line) that best fits the data points by minimizing the difference (error) between the predicted and actual values.

Equation of a Line: The formula for simple linear regression (one predictor) is

$$y=mx+b$$

Where:

y is the dependent variable (the value we are trying to predict),

x is the independent variable (the predictor),

m is the slope of the line (shows how much y changes with a unit change in x),

b is the y-intercept (the value of y when x=0).

Linear regression is a good starting point when the relationship between the variables is assumed to be linear. In this case, linear regression can help estimate the price of onions and potatoes based on factors like supply, demand, and weather. The regression coefficients will provide insights into how much each factor influences the price. For example, if the coefficient for supply is negative, it indicates that an increase in supply is expected to lower the price.

Alternative Approaches to Regression:

Polynomial Regression:

1. If the relationship between predictors and price is non-linear (for example, prices might increase rapidly with lower supply but level off after a certain point), polynomial regression can be more effective than simple linear regression. Polynomial regression allows the inclusion of higher-order terms, enabling the model to fit more complex relationships.
2. Why or why not considered? While polynomial regression might offer a better fit for non-linear relationships, it increases model complexity and the risk of overfitting. For the price forecasting problem, if the relationships between factors are expected to be mostly linear, the simpler linear regression is a more efficient choice.

Decision Trees and Random Forests:

1. Decision Trees break the data into distinct segments based on feature values, providing predictions for each segment. Random Forests, an ensemble method, combine multiple decision trees to improve predictive accuracy and reduce overfitting.
2. Why or why not considered? Decision trees and Random Forests are powerful for capturing complex, non-linear interactions between variables, but they can be harder to interpret and more prone to overfitting when working with small datasets. For price forecasting with a relatively small dataset, linear regression provides a simpler and more interpretable approach.

```python
from sklearn.linear_model import LinearRegression

# Prepare data for forecasting
# Assuming the current month is July, we'll use data up to June for training
train_data = onion_potato_data[onion_potato_data['Month Number'] < 7]
test_data = onion_potato_data[onion_potato_data['Month Number'] >= 7]

# Separate onion and potato data
onion_train = train_data[train_data['Category'] == 'ONION']
potato_train = train_data[train_data['Category'] == 'POTATO']

# Create and fit linear regression models
onion_model = LinearRegression()
onion_model.fit(onion_train['Month Number'].values.reshape(-1, 1), onion_train['Cost( PER 10 KGS)'])

potato_model = LinearRegression()
potato_model.fit(potato_train['Month Number'].values.reshape(-1, 1), potato_train['Cost( PER 10 KGS)'])

# Forecast prices for the remaining months (July to December)
future_months = np.arange(7, 13).reshape(-1, 1)
onion_forecast = onion_model.predict(future_months)
potato_forecast = potato_model.predict(future_months)

# Create a DataFrame for forecasted prices
forecast_df = pd.DataFrame({
    'Month Number': future_months.flatten(),
    'Onion Forecast': potato_forecast,
    'Potato Forecast': onion_forecast
})

# Map month numbers to month names
forecast_df['Month Name'] = forecast_df['Month Number'].apply(lambda x: calendar.month_name[x])

# Plotting the forecasted prices
plt.figure(figsize=(12, 6))
plt.plot(forecast_df['Month Name'], forecast_df['Onion Forecast'], label='Onion Forecast', marker='o')
plt.plot(forecast_df['Month Name'], forecast_df['Potato Forecast'], label='Potato Forecast', marker='o')
plt.title('Forecasted Price per 10 kg of Onion and Potato')
plt.xlabel('Month')
plt.ylabel('Price per 10 kg')
plt.xticks(rotation=45)
plt.legend()
plt.tight_layout()
plt.show()

# Display the forecasted prices
print(forecast_df[['Month Name', 'Onion Forecast', 'Potato Forecast']])
```

(2.4) Linear Regression Model

- The code performs price forecasting for onions and potatoes using a linear regression model.
- The historical data up to June is used for training, and the model forecasts the prices for the remaining months that is July to December.
- Forecasted prices are then plotted and displayed, providing a visual representation of future price trends.

Given the business problem—forecasting prices for onions and potatoes based on multiple influencing factors—linear regression offers several advantages:

Simplicity: Linear regression provides a simple, transparent approach to understanding how different factors influence the price. Each coefficient in the model tells us the effect of a specific variable, such as weather, supply, or demand.

Interpretability: Unlike some machine learning methods, linear regression results are easy to interpret. This is important for businesses that need clear, understandable insights to make pricing decisions.

Scalability: If new data becomes available, the model can be updated with minimal computational overhead. Additionally, it can handle multiple predictors (features) simultaneously, allowing for a broader understanding of the factors that influence price.

For the problem of credit management there was no dataset available as there were no proper records present for it. All the credit was being managed unsystematically through various discounts and bills. There was no proper system of tracking how much credit is being given to a vendor or customer. It is being conducted on the basis of goodwill and no records are maintained.

To tackle this issue I have created a sample credit management system on excel which would help the business to keep track of the various loans and credits being offered . It would also help them manage whether the credit is being paid in full or is partially paid.

Credit Tracker

Customer Name	Invoice Number	Invoice Date	Due Date	Invoice Amount	Amount Paid	Balance Due	Status
Ram Kumar	1001	2023-03-01	2023-03-15	₹1,000.00	₹600.00	₹400.00	Partially Paid

(2.5) Credit Management Sheet

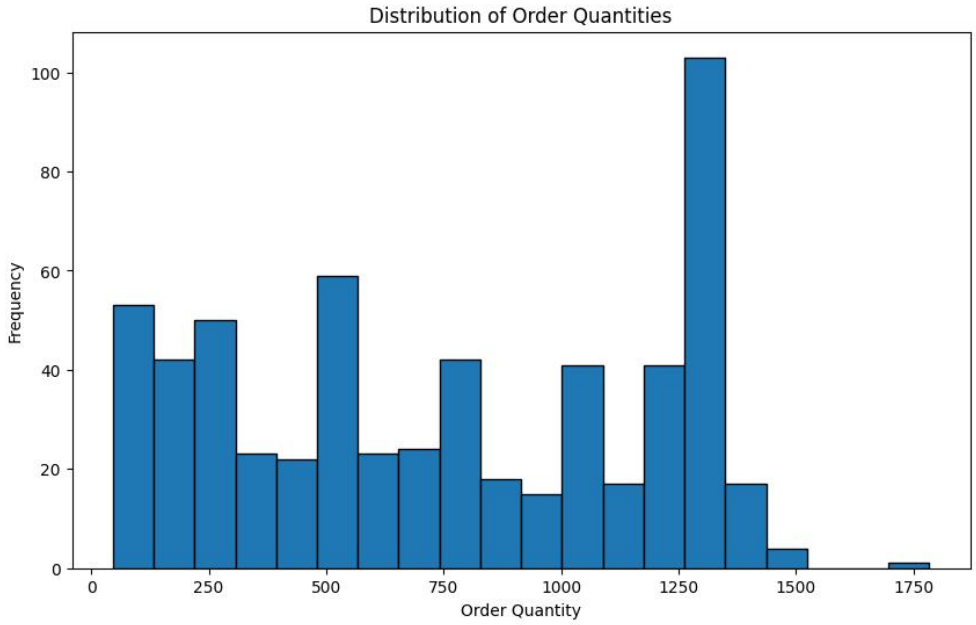
Balance Due Calculation = The balance due column keeps track of the balance remaining from the transaction . It is calculated using a simple formula :

Balance Due = Invoice Amount - Amount Paid

Status Calculation = The status keeps track of the overall status of the payment . It helps to understand which consumers have payments pending and which have completed their payment. It is calculated using the following formula :

Status =IF(Balance Due=0,"Paid in Full",IF(Balance Due=Invoice Amount,"Unpaid","Partially Paid"))

3 Results and Findings



(3.1) Distribution Of Order Quantities

The Distribution of Order Quantities graph illustrates the frequency of different order sizes, helping us understand the variety and concentration of order quantities in this dataset. In this histogram:

- The x-axis represents order quantities, ranging from small to large.

- The y-axis shows the frequency of each quantity range, indicating how often orders of a particular size are placed.

Peaks and Central Tendency:

- A noticeable peak is observed around the 1,250 quantity mark, suggesting that a substantial number of orders are concentrated around this value. This likely represents a common order size, possibly linked to standard purchasing behavior among a large segment of customers.

- Other quantity ranges (around 0–500 and 750–1,000) also have moderate frequencies, though they are notably lower than the peak at 1,250. This implies some variation in order sizes but with a strong preference for a particular range.

Distribution Shape:

- The distribution is not uniform or normal, as we see a significant spike rather than a smooth bell-shaped curve. This skewed distribution, with a higher frequency at specific points, indicates that certain quantities are favored.

- The low frequency of orders at the higher end (1,500 and above) suggests that very large orders are relatively rare.

Outliers and Range:

- A few very low and very high order quantities appear infrequently, representing outliers in the distribution. These could correspond to unique customer needs (small-scale retail or occasional bulk buyers) or specific events where unusually large or small orders are placed.

- The graph's tail towards the right (near 1,750) indicates that while possible, very high order quantities are uncommon.

Standard Order Sizes and Customer Behavior:

- The significant peak at 1,250 suggests that a large portion of customers may be making regular purchases in that specific quantity range, which may correspond to a standard pack size, a monthly stocking level, or a pricing advantage at that quantity.

- The distribution pattern also implies that there are structured buying patterns, possibly driven by customer needs or established purchasing habits (like regular stock replenishment for small businesses).

Diverse Customer Needs:

- The presence of moderate frequencies across smaller and mid-range quantities could reflect diversity in the customer base, with orders catering to both individual consumers (or small businesses) and mid-scale operations. This spread shows flexibility, accommodating both low and high-volume buyers.

Inventory and Marketing Insights:

- The concentration at specific quantities can guide inventory planning and promotional strategies. For example, if 1,250 is a common order quantity, the business may consider

optimizing stock levels for this range, or offering incentives to encourage similar order sizes.

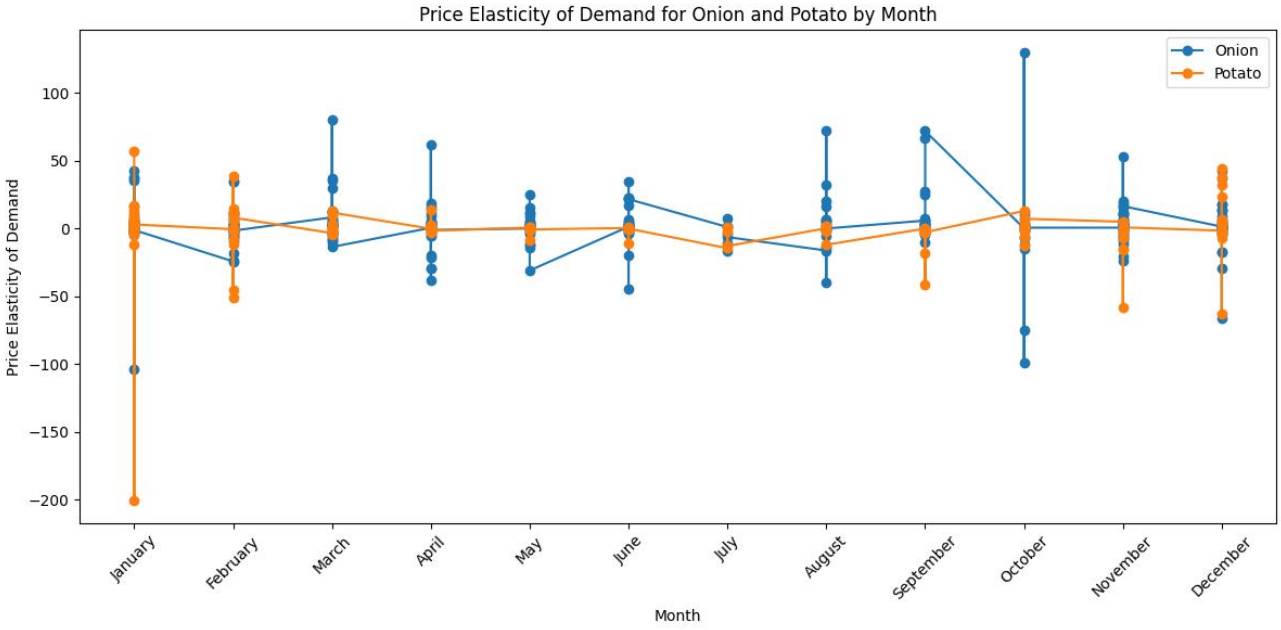
- Understanding outliers and less common order sizes can also help tailor promotional strategies for larger quantities, possibly encouraging bulk purchases by offering discounts or incentives.

This analysis is directly relevant to demand forecasting and inventory management. Knowing that most orders fall within a specific quantity range allows the business to focus on stocking levels that meet this demand while minimizing excess inventory. Additionally, the data provides insights into customer segmentation:

- Retail vs. Bulk Purchasers: Identifying order size preferences helps segment customers into small buyers and potential bulk buyers, allowing for targeted marketing and pricing strategies that align with their purchasing habits.

- Stock Optimization: By forecasting demand around the most frequent order sizes, the business can optimize stock levels, reduce storage costs, and ensure availability for high-demand quantities.

- Promotional Opportunities: If the goal is to shift demand toward larger quantities, the business might create bundle offers or discounts to encourage customers who typically order smaller quantities to buy more.



(3.2) Price Elasticity Demand

The Price Elasticity of Demand (PED) for Onion and Potato by Month graph illustrates the variations in price elasticity for these two commodities across the months. The y-axis represents the price elasticity of demand, with positive values indicating that demand is elastic and responsive to price changes, and negative values suggesting that demand is inelastic or that demand decreases as price rises. Each data point represents the PED value for onions and potatoes each month, showing how sensitive consumers are to price changes of these commodities over time.

Onion Price Elasticity:

- The price elasticity of onions fluctuates across the months, with a notable high variability, especially in months like October and January.

- In some months, the elasticity reaches positive values (above zero), indicating an elastic demand where a drop in price could increase demand, while an increase in price may significantly reduce demand.

- However, the variability and large PED swings, particularly the spikes, suggest a volatile market for onions, likely influenced by seasonality, regional supply issues, or fluctuations in availability.

Potato Price Elasticity:

- The price elasticity of potatoes also shows fluctuations, though it appears to be generally more stable than onions, with fewer extreme peaks and dips.

- In January, there is a significant negative spike, indicating that demand for potatoes is highly inelastic in this month—consumers are less responsive to price changes, possibly due to essential demand during that time.

- Overall, potatoes tend to have a slightly more stable demand pattern than onions, as evidenced by fewer extreme fluctuations in PED values.

Seasonal Demand and Supply Fluctuations:

The variability in price elasticity across months can be attributed to seasonality. Both onions and potatoes are agricultural products, and their supply is often influenced by harvest seasons, regional climate conditions, and storage capabilities. For example, shortages due to poor harvests could drive prices up, making demand more inelastic since consumers will purchase these items regardless of price changes.

Commodity-Specific Demand Patterns:

Onions and potatoes serve different culinary needs, and their demand elasticity varies accordingly. Onions may have more substitutes available (e.g., green onions, leeks), leading to greater elasticity during certain months. Potatoes, however, are a staple food in many diets, contributing to relatively stable and less elastic demand.

Market Sensitivity:

The sharp fluctuations, especially for onions, suggest sensitivity to market conditions, potentially driven by changes in government policy, export restrictions, or import adjustments to stabilize prices during times of shortage. This could explain the sharp spikes in demand elasticity.

Understanding the price elasticity of demand for onions and potatoes provides valuable insights into pricing strategies and inventory management. For instance:

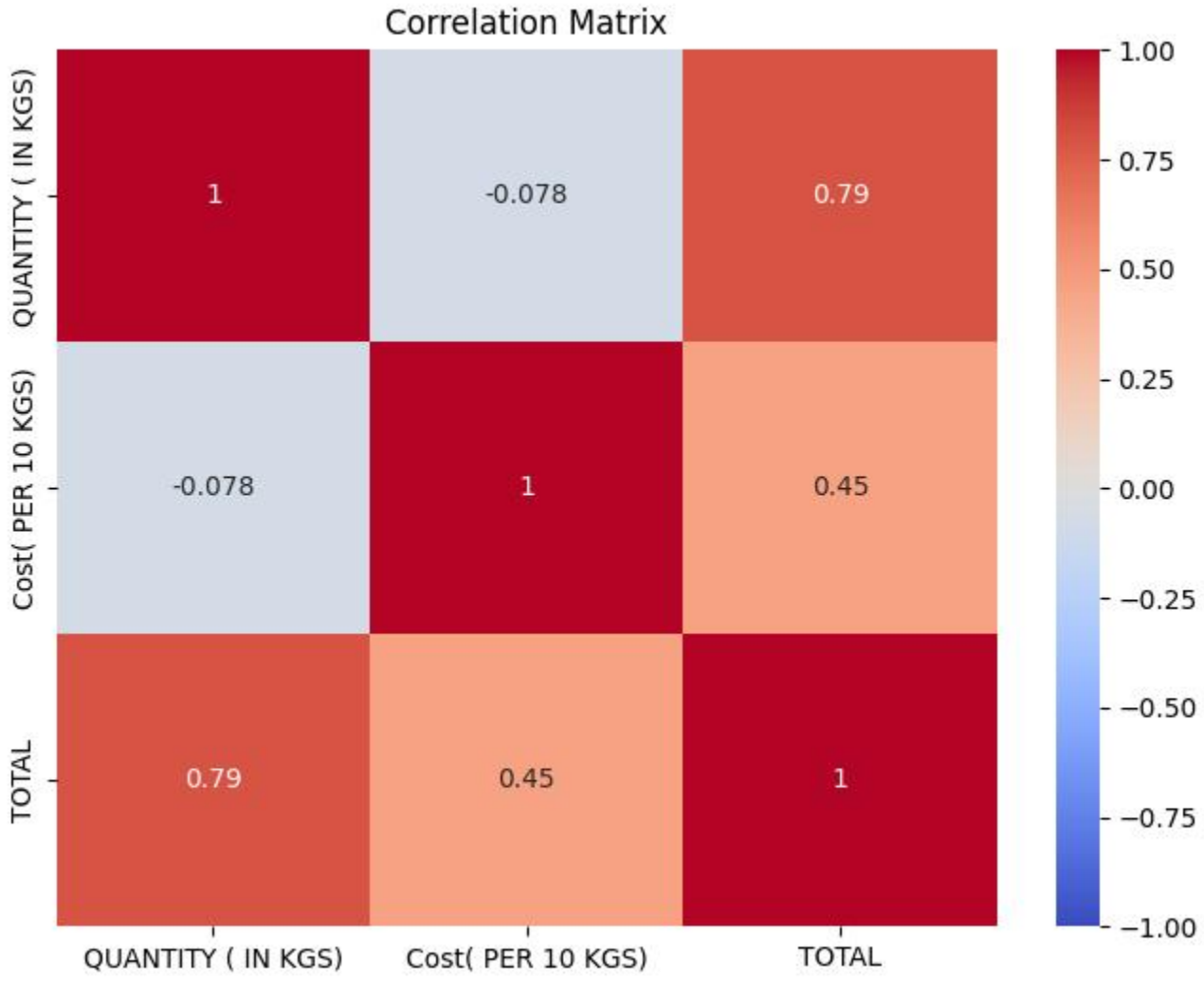
- Elastic Months: During months with high elasticity for either commodity, price reductions may significantly boost demand. This can help manage excess inventory and increase sales volumes.

- Inelastic Months: In months with inelastic demand, such as January for potatoes, prices could

be set higher without greatly affecting demand, allowing the business to maximize revenue during peak consumption periods.

- Stabilization Strategy: For onions, which show greater price sensitivity, the business may consider storage solutions or sourcing strategies to maintain stable supply and prices, reducing market volatility and ensuring steady demand.

This analysis aligns with the goal of effective demand management and pricing optimization for fresh produce. By identifying months where consumers are less sensitive to price changes, the business can adjust prices strategically to maximize revenue without risking a drop in demand. Conversely, in months of high elasticity, promotional pricing can help drive up sales. Overall, this PED insight allows for a responsive approach to market conditions, improving both customer satisfaction and profitability.



(3.3) Correlation Matrix

The correlation matrix provides insights into the relationships between the variables Quantity (in kgs), Cost (per 10 kgs), and Total. Here's a breakdown of each relationship and the implications:

1. Quantity and Total:

The correlation between Quantity (in kgs) and Total is 0.79, indicating a strong positive

correlation. This suggests that as the quantity of items ordered increases, the total cost also increases proportionally. This relationship is logical, as purchasing more units should result in a higher total cost. For the business, this correlation confirms that higher order volumes drive up revenue, which is crucial for forecasting income based on expected order sizes. It also implies that encouraging bulk purchases could be an effective strategy to increase total sales.

2. Cost (per 10 kgs) and Total:

The correlation between Cost (per 10 kgs) and Total is 0.45, showing a moderate positive correlation. This indicates that while there is some connection between the cost per unit and the total expenditure, the effect is not as strong as with quantity. This relationship may imply that price changes (or varying product prices) moderately impact the total cost, but not as significantly as quantity does. For the business, this suggests that while increasing prices may raise revenue, volume is a more critical factor. This insight can influence pricing strategies—such as setting price breaks for larger quantities—allowing the business to maximize revenue through volume-based incentives.

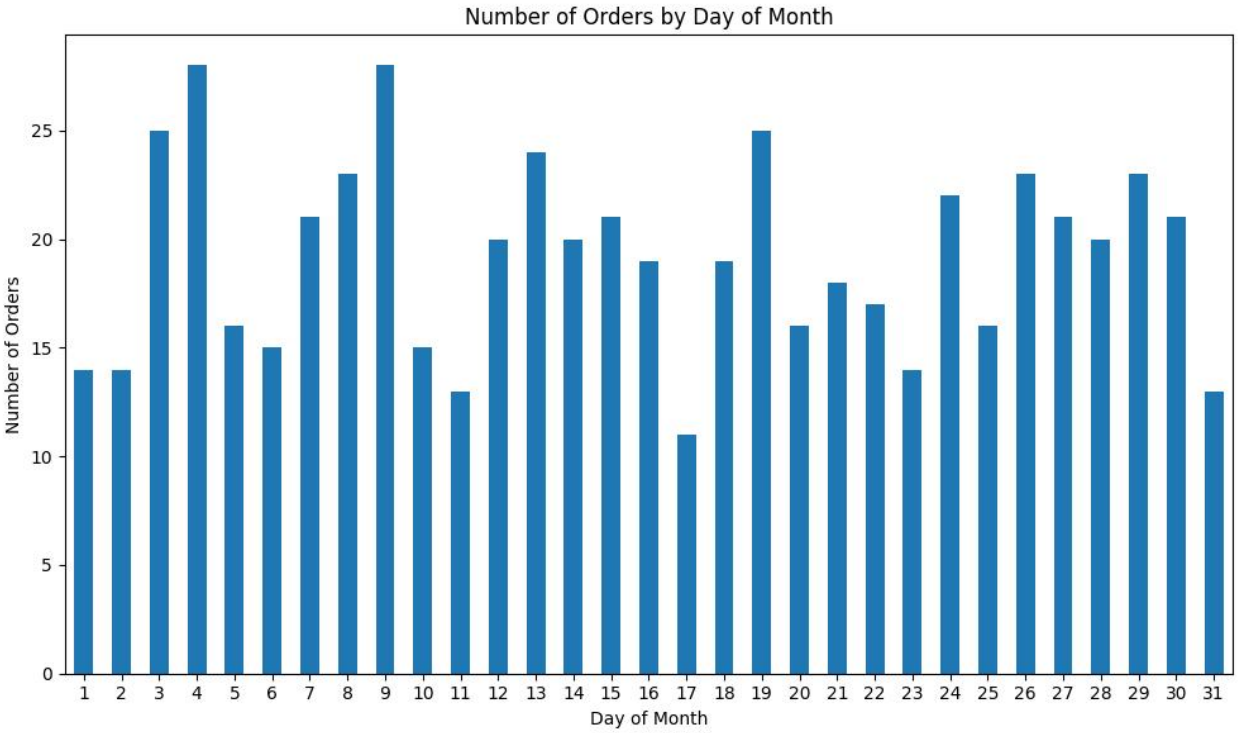
3. Quantity and Cost (per 10 kgs):

The correlation between Quantity (in kgs) and Cost (per 10 kgs) is -0.078, indicating a very weak negative correlation. This near-zero correlation implies that the cost per unit (per 10 kgs) is largely independent of the quantity ordered. This is beneficial from an operational perspective, as it suggests that bulk orders do not come with significant cost increases or decreases per unit. In other words, customers are likely to pay a similar price per unit regardless of order size. This independence supports a consistent pricing structure where customers do not experience major price fluctuations based on order quantity. It also simplifies pricing for the business, as they can apply a relatively fixed unit cost without needing complex adjustments for different order volumes.

This correlation analysis ties back to the problem statement by helping the business understand the primary drivers of total revenue. Since Quantity has a stronger influence on the Total than Cost (per 10 kgs), the company can focus on strategies to boost the quantity of items ordered rather than relying solely on price increases.

For example, marketing efforts could emphasize discounts or incentives for bulk purchases to leverage the strong quantity-total correlation. This approach would maximize revenue without the need for frequent pricing adjustments. Additionally, the independence between Quantity and Cost (per 10 kgs) supports a stable pricing model, making it easier for the business to maintain predictable revenue margins regardless of order size. This stability is essential for long-term financial planning, inventory management, and customer relationship strategies, ensuring the business remains competitive without sacrificing profitability.

In conclusion, the correlation matrix highlights that Quantity (in kgs) is the most influential factor in driving Total revenue, with Cost (per 10 kgs) playing a secondary role. The weak correlation between Quantity and Cost (per 10 kgs) further supports a straightforward, stable pricing strategy. Together, these insights provide a clear direction for the business to prioritize volume-driven revenue strategies while maintaining consistent unit pricing, directly aligning with the objective of efficient revenue growth and effective resource allocation.



(3.4) Number Of Orders By Day Of Month

The analysis of the number of orders by day of the month reveals a generally consistent level of orders with some fluctuations throughout the month. Most days observe between 15 and 25 orders, with a few days reaching slightly higher peaks around 27 orders. There are some notable dips below 15 orders on certain days, but these are exceptions rather than the rule. This pattern suggests that order volume does not significantly vary by specific days within the month but instead follows a relatively stable daily demand.

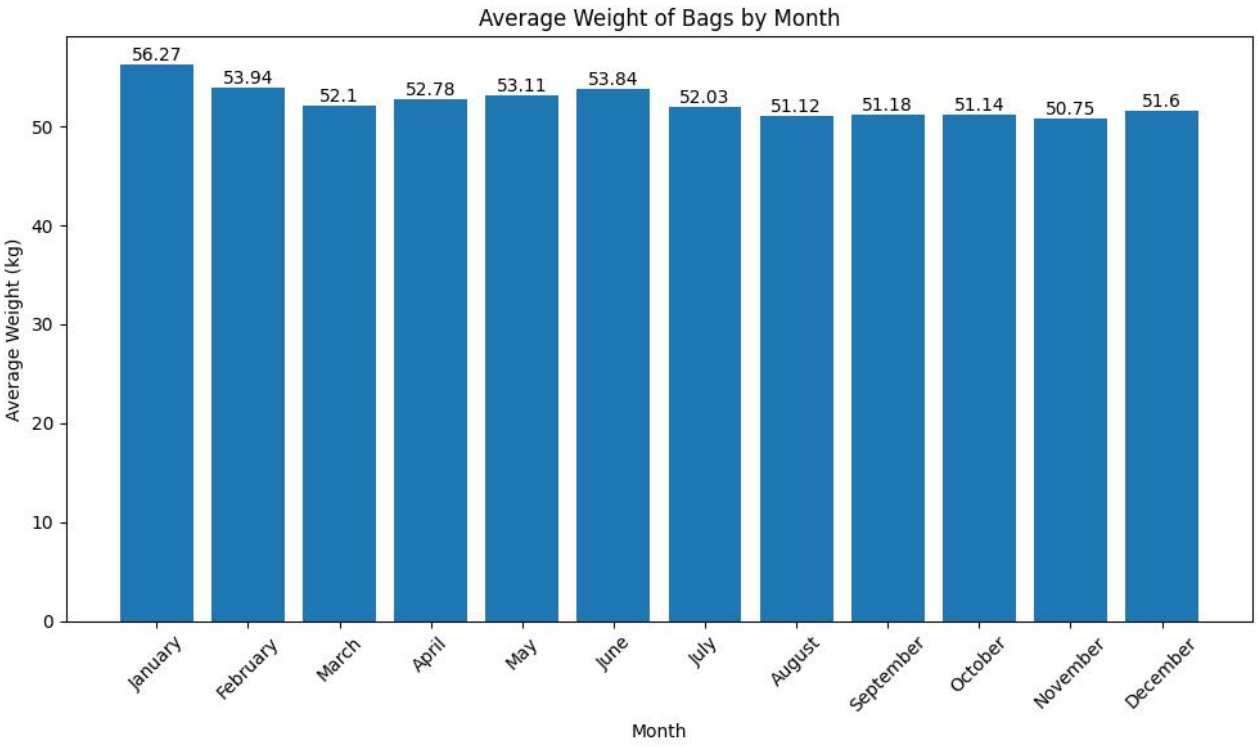
This even distribution of orders across the days implies that consumer demand is steady rather than concentrated around specific dates. Unlike cases where orders might spike at the beginning or end of the month—often due to paycheck cycles or end-of-month deals—this data suggests that the demand for the product or service remains consistent. The lack of pronounced peaks or troughs also indicates that consumer behavior may not be heavily influenced by day-of-the-month factors, such as recurring sale events or payment cycles, which would otherwise cause a surge or dip in orders at predictable intervals.

From an operational and strategic perspective, this insight is valuable for the business as it relates to the problem statement of managing order fulfillment, resource allocation, and inventory levels efficiently. A stable order pattern means that businesses can streamline their processes, knowing they will face similar demand each day. For instance, staffing levels in order fulfillment centers, inventory restocking schedules, and delivery logistics can be planned with a consistent workload in mind, reducing the need for high-cost adjustments. If the business can predictably expect a steady flow of orders, it can optimize resource use, ensuring employees, storage space, and transportation are utilized at a consistent rate.

However, the few days with slight decreases in order volume could provide opportunities for operational adjustments. On days with lower orders, the business might plan for maintenance activities, inventory checks, or other non-urgent tasks that are best carried out when demand is lower. Conversely, on days with slightly higher order volumes, additional staff or resources could be scheduled to ensure timely processing and prevent bottlenecks.

This steady daily demand also allows the company to maintain more accurate inventory levels, minimizing both overstock and stockouts. Since order volumes are stable, businesses can keep inventory levels at an optimal point, ordering just enough to meet daily demand without tying up capital in excess stock. This predictability contributes to more efficient inventory turnover and better cash flow management.

In summary, the analysis of the number of orders by day of the month suggests that consumer demand remains relatively consistent throughout the month. This consistency aids in operational planning, as it allows the business to allocate resources, manage inventory, and schedule labor with fewer disruptions. Tying this insight to the problem statement, a steady demand across days helps the business minimize costs and optimize processes, as it can reliably plan for a uniform workflow without needing to accommodate for demand spikes or dips. This stability ultimately supports a more predictable and efficient operational strategy, reducing both excess costs and logistical challenges.



(3.5) Average Weight Of Bags By Month

The analysis of the average weight of bags by month shows some variation, with January standing out due to its significantly higher average bag weight of 56.27 kg, while the other months maintain a narrower range between 50 kg and 53 kg. This trend suggests that January may experience distinct factors influencing the weight of bags, which could have implications for logistics, inventory management, and operational costs.

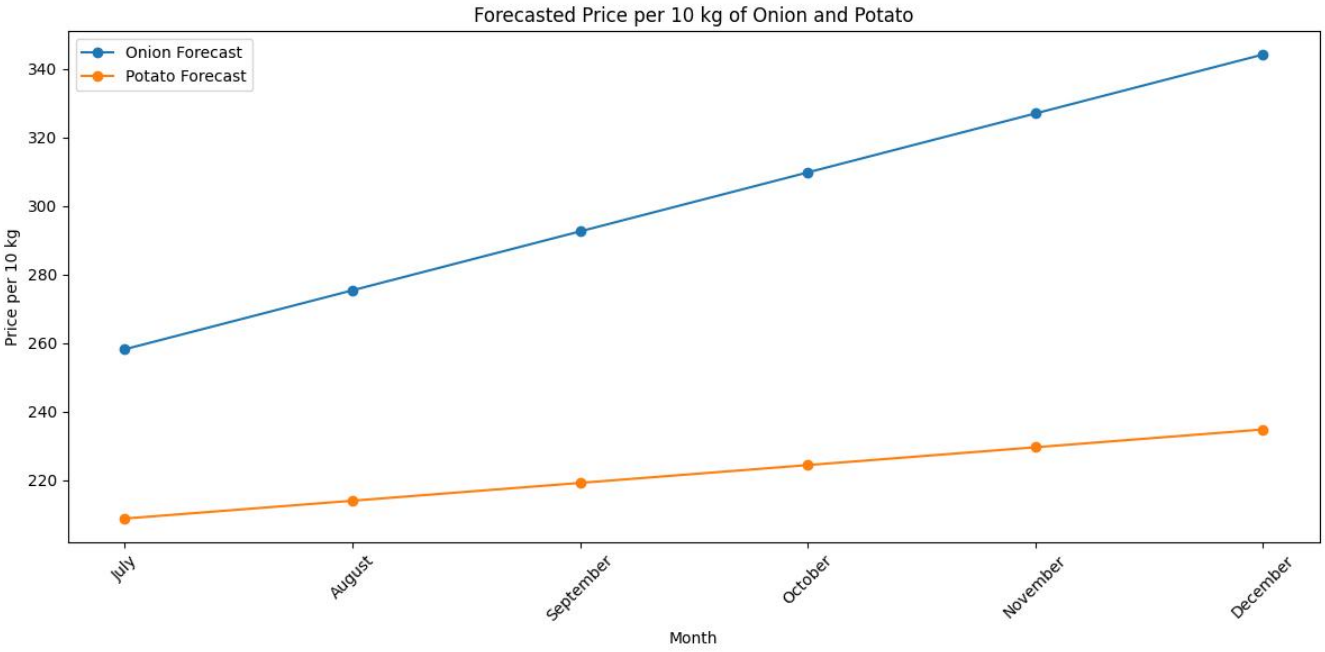
The higher average weight in January could be attributed to several potential causes. One reason might be seasonal demand variations, particularly if January aligns with a period of increased purchasing activity, possibly due to winter-related demand or post-holiday stocking. Businesses might increase their stocking levels to meet this higher demand, leading to heavier loads per bag. Alternatively, January could coincide with bulk shipments or replenishment cycles, where companies receive new inventory in larger quantities. This would naturally result in heavier bag weights due to the need to store and handle more stock at once.

Another possible explanation is operational practices that may vary seasonally. For example, some companies might adjust their packaging or stocking processes at the beginning of the year to start afresh or to implement updated supply chain strategies. This could involve consolidating goods more efficiently, thereby increasing the average weight per bag for January compared to other months.

Understanding these variations is essential when considering the problem statement, which could involve optimizing inventory, transportation, and storage costs across the year. Heavier bag weights in January imply higher handling and transportation requirements. This increase could affect operational costs due to the added strain on storage capacity, transportation logistics, and even labor if more intensive handling is needed. By identifying January as a peak month in terms of bag weight, businesses can prepare by allocating additional resources—such as scheduling extra storage space, reinforcing transportation equipment to handle heavier loads, or planning for more robust logistical arrangements.

This insight is valuable for cost management and operational efficiency. For instance, by predicting that January requires extra capacity, companies can avoid last-minute adjustments, which tend to be more costly. Instead, they can pre-emptively secure additional storage facilities or arrange for more cost-effective transportation solutions. Additionally, knowing that bag weights stabilize after January allows businesses to optimize their resources for the rest of the year, ensuring that logistics are managed efficiently without overspending on unnecessary capacity.

In summary, the observed trend in bag weights, particularly the spike in January, offers actionable insights into inventory and logistical planning. This understanding helps align business operations with seasonal fluctuations, ultimately supporting cost-effective resource allocation and improved logistical efficiency. This seasonal analysis, when tied to the broader problem statement, can enhance the strategic planning and operational resilience of the organization, allowing it to meet demand without incurring unnecessary expenses.



(3.6) Price Forecasting For Next Five Months

The line chart, which forecasts the price per 10 kg of onions and potatoes from July to December, highlights a divergent trend in the price movements of these two essential commodities. Both commodities experience a steady increase in price over the six-month period, but the rate at which their prices rise differs significantly. The price of onions shows a pronounced upward trajectory, while the price of potatoes increases at a more gradual pace. Several factors may explain these trends.

Onions: Steeper Price Rise

In July, the price of onions starts at around ₹260 per 10 kg, rising sharply to approximately ₹340 by December. This significant price increase suggests that onions are subject to greater volatility and market sensitivity. The reasons for this could include seasonal variations in onion production. Onions are a perishable crop, and their supply is highly influenced by harvest cycles. A decrease in supply due to off-season production or adverse weather conditions can lead to sharp price hikes.

Additionally, the demand for onions often remains relatively constant, as they are a staple in Indian households and many food industries. This constant demand, coupled with a fluctuating supply, creates a gap that drives up prices. Transportation issues or supply chain disruptions, common in perishable commodities, can further exacerbate price increases. As a result, onions are more susceptible to significant price swings over time.

Potatoes: Gradual Price Increase

On the other hand, the price of potatoes exhibits a much slower increase, starting at around ₹210 per 10 kg in July and rising to about ₹230 by December. This moderate growth suggests that potatoes face less market volatility compared to onions. Several reasons contribute to the stability in potato prices. Unlike onions, potatoes are less perishable and can be stored for extended periods in cold storage facilities. This allows producers to regulate supply more effectively, minimizing large fluctuations in availability and thus price.

Potatoes also tend to have a more stable and predictable supply chain. They are grown in multiple seasons and are less affected by seasonal disruptions compared to onions. Furthermore, the demand for potatoes is generally steady, and their production is distributed more evenly throughout the year. This contributes to a more consistent price trend.

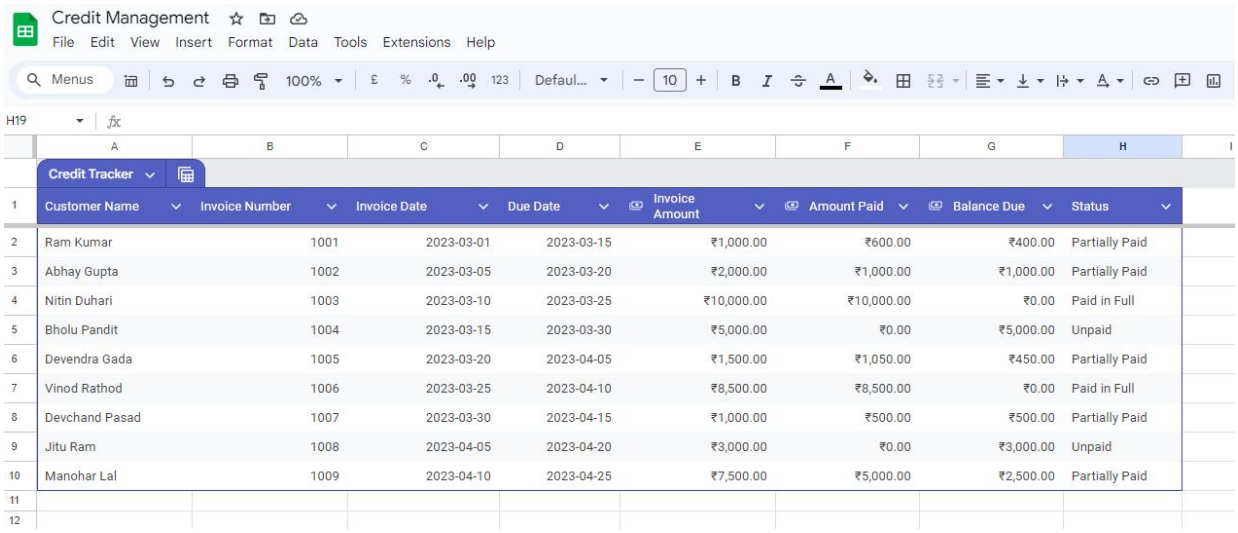
Overall Analysis

The overall upward trend in both commodities reflects broader market dynamics, such as rising input cost, inflationary pressures, and possibly changes in consumer behavior. However, the rate of increase in prices differs substantially between onions and potatoes due to their unique market characteristics.

Onions, being more perishable and seasonally dependent, exhibit greater price volatility. They are more sensitive to changes in supply and demand, as well as external factors like

weather, transportation costs, and market speculation. Potatoes, with their longer shelf life and stable production patterns, show more resilience to such factors, resulting in a slower and more controlled price increase.

Thus, the chart demonstrates the complex interaction of supply-demand dynamics, perishability, and market stability, which collectively influence the prices of these two staple crops over time. The steep price rise in onions underscores the challenges faced by both consumers and suppliers in managing seasonal crop fluctuations, while the relative stability in potato prices highlights the benefits of more consistent production and storage capabilities.



Customer Name	Invoice Number	Invoice Date	Due Date	Invoice Amount	Amount Paid	Balance Due	Status
Ram Kumar	1001	2023-03-01	2023-03-15	₹1,000.00	₹600.00	₹400.00	Partially Paid
Abhay Gupta	1002	2023-03-05	2023-03-20	₹2,000.00	₹1,000.00	₹1,000.00	Partially Paid
Nitin Duhari	1003	2023-03-10	2023-03-25	₹10,000.00	₹10,000.00	₹0.00	Paid in Full
Bholu Pandit	1004	2023-03-15	2023-03-30	₹5,000.00	₹0.00	₹5,000.00	Unpaid
Devendra Gada	1005	2023-03-20	2023-04-05	₹1,500.00	₹1,050.00	₹450.00	Partially Paid
Vinod Rathod	1006	2023-03-25	2023-04-10	₹8,500.00	₹8,500.00	₹0.00	Paid in Full
Devchand Pasad	1007	2023-03-30	2023-04-15	₹1,000.00	₹500.00	₹500.00	Partially Paid
Jitu Ram	1008	2023-04-05	2023-04-20	₹3,000.00	₹0.00	₹3,000.00	Unpaid
Manohar Lal	1009	2023-04-10	2023-04-25	₹7,500.00	₹5,000.00	₹2,500.00	Partially Paid

(3.7) Credit Management System

Figure (3.7) represents a Credit Management system in an Google Sheets format. It tracks the details of credit transactions for various customers.

1. Customer Name:

- This column lists the names of customers (e.g., Ram Kumar, Abhay Gupta) who have invoices and credit associated with them.

2. Invoice Number:

- This represents the unique identifier for each invoice. For example, Ram Kumar's invoice number is 1001, and Nitin Duhari's is 1003.

3. Invoice Date:

- The date when the invoice was issued. For instance, Ram Kumar's invoice was issued on March 1, 2023, and Manohar Lal's on April 10, 2023.

4. Due Date:

- This column displays the last date by which the payment is due. After the due date, the payment might be considered late. For instance, Ram Kumar's invoice was due on March 15, 2023, and Devendra Gada's on April 5, 2023.

5. Invoice Amount:

- This shows the total amount the customer is supposed to pay for the invoice. The amounts vary, like ₹1,000.00 for Ram Kumar and ₹10,000.00 for Nitin Duhari.

6. Amount Paid:

- This column reflects the amount already paid by the customer. Ram Kumar has paid ₹600.00, while Nitin Duhari has cleared his entire invoice by paying ₹10,000.00.

7. Balance Due:

- The remaining balance that the customer still owes. It's calculated as the difference between the Invoice Amount and Amount Paid. For example, Ram Kumar still owes ₹400.00, while Nitin Duhari has no outstanding balance (₹0.00).

8. Status:

- This indicates the payment status of each customer's invoice. Some possible statuses are:

- Partially Paid: The customer has paid a portion of the invoice, but not the entire amount (e.g., Ram Kumar, Abhay Gupta).

- Paid in Full: The customer has paid the entire invoice amount (e.g., Nitin Duhari, Vinod Rathod).

- Unpaid: No payment has been made for the invoice (e.g., Bholu Pandit, Jitu Ram).

Observations:

- This system is effectively tracking credit by displaying the invoices, payment progress, and the outstanding dues.

- It gives a clear view of which invoices are paid, partially paid, or unpaid, allowing better follow-up and financial management.

- Having columns like Invoice Date and Due Date is crucial for ensuring timely follow-ups with customers who have unpaid balances.

4 Interpretation of Results and Recommendation

(4.1)Price Forecasting

(4.1.1) Investment in Cold Storage and Warehousing Facilities

One of the most pressing issues that causes price volatility in perishable crops like onions and potatoes is the lack of proper storage facilities. Due to their short shelf life and sensitivity to environmental conditions, onions, in particular, suffer significant post-harvest losses. Investing in cold storage facilities would allow the business to store these crops in optimal conditions for extended periods, ensuring a steady supply when demand is high, and prices are rising.

By partnering with or developing their own cold storage infrastructure, the business could maintain a buffer stock during the peak harvest seasons when prices are low. During off-seasons, this stored produce can be gradually released into the market to meet demand, thus preventing price spikes caused by supply shortages.

Benefits:

- Reduced spoilage: Cold storage significantly reduces the chances of spoilage, especially for highly perishable items like onions.

- Market leverage: Having control over a stockpile allows the company to better time its market releases, offering competitive pricing when competitors are forced to charge higher rates.

- Stabilized income: Seasonal price fluctuations would have less impact on the company's revenue, as supply could be regulated to match demand.

(4.1.2) Diversification of Sourcing Locations and Cultivation in Alternative Regions

Relying on a single or a limited number of regions for sourcing onions and potatoes exposes the business to the risk of regional disruptions. Weather patterns, pests, or diseases that affect one area can cause a dramatic reduction in supply and a subsequent price spike. By diversifying sourcing locations, both domestically and internationally, the business can reduce its reliance on a few key areas and stabilize its supply chain.

Additionally, the business could explore partnerships with agricultural cooperatives or governments in regions with favorable climates for growing onions and potatoes. This diversification strategy ensures that if one region experiences a poor harvest, other regions can compensate for the shortfall.

Benefits:

- Risk mitigation: A more diversified supply chain minimizes the impact of localized disruptions, ensuring a steady flow of produce to the market.

- Increased bargaining power: With multiple suppliers, the business can negotiate better prices and terms, as they are not dependent on any one source.

- Broader supply base: Different regions may offer various growing seasons, allowing for a more continuous supply of fresh produce throughout the year.

(4.1.3) Introduction of Processed and Value-Added Products

While the business primarily focuses on fresh produce, there is a significant opportunity in expanding into processed and value-added products like dehydrated onions, frozen potatoes, or onion powder. Processed products have a longer shelf life and are less vulnerable to market fluctuations caused by fresh produce shortages. During periods when the price of fresh onions or potatoes spikes, processed alternatives could serve as a more affordable option for consumers.

By developing a line of value-added products, the business can better utilize excess produce during peak seasons and reduce waste. Processing also opens up new market opportunities in segments such as the restaurant industry, where convenience products like pre-cut or frozen vegetables are in high demand.

Benefits:

- Extended shelf life: Processed products can be stored for much longer than fresh produce, reducing waste and offering more flexibility in market timing.

- New revenue streams: Diversifying into processed products creates additional revenue streams that are less affected by fresh market price fluctuations.

- Waste reduction: By processing surplus fresh produce, the company can minimize waste, further enhancing profitability.

(4.1.4) Collaboration with Government Schemes and Agricultural Co-operatives

Many governments offer price support or subsidy schemes for essential agricultural commodities like onions and potatoes to protect both farmers and consumers from price volatility. The business could explore collaborations with such government programs, particularly during periods of high price volatility. These schemes often provide financial assistance or reduced prices for bulk buyers, which would allow the company to offer competitive pricing to consumers even when market prices rise.

Additionally, working closely with agricultural cooperatives could help the business secure a stable and continuous supply of produce. Cooperatives often pool resources from multiple farmers, reducing the risk of shortages and providing better pricing for buyers.

Benefits:

- Financial support: Government schemes can offer subsidies that help the company maintain stable prices, even in times of market instability.

- Stable supply: Agricultural cooperatives provide access to a large pool of farmers, ensuring a more consistent supply of produce.

- Market stability: Collaborating with government and cooperative initiatives helps to stabilize the overall market, benefiting both consumers and suppliers.

(4.2) Credit Management

To implement effective credit management for the business, several strategies can be introduced to streamline the process, minimize risk, and ensure a healthy cash flow.

(4.2.1) Establish Clear Credit Policies

- Credit Terms and Limits: Set clear, transparent credit terms that include the maximum credit limit and payment duration. The terms should outline the interest charged for overdue payments, penalties, and potential actions for default.

- Credit Risk Assessment: Implement a thorough vetting process to assess the creditworthiness of new and existing customers. This can involve reviewing their financial history, credit scores, and previous payment behaviors.

- Customer Segmentation: Classify customers into risk categories and assign credit limits based on their risk profile. High-risk customers can be given shorter credit terms or lower limits, while trustworthy customers may be rewarded with higher credit limits and flexibility.

(4.2.2) Credit Monitoring and Alerts

- Automated Credit Monitoring System: Utilize a credit monitoring tool or software that tracks outstanding balances, payment due dates, and credit usage. Automated alerts should notify the business and the customer when payments are nearing due dates, when accounts are overdue, or when credit limits are reached.

- Payment Reminders: Set up automated or manual reminders that are sent to customers at regular intervals (such as one week before the due date) to ensure timely payment.

- Proactive Communication: Establish a system of communication with customers about their outstanding balances and due dates. This can be done via email, SMS, or phone calls, ensuring consistent follow-ups on pending dues.

(4.2.3) Digital Payment Integration

- Adopt Digital Payment Solutions: Implement a seamless digital payment gateway that allows customers to make quick, convenient payments. Offering multiple payment methods (e.g., credit card, bank transfer, digital wallets) makes it easier for customers to pay their invoices on time.

- Partial or Scheduled Payments: Enable options for customers to make partial payments or set up automatic scheduled payments in cases where paying the full amount upfront is not feasible. This helps maintain cash flow while reducing the risk of default.

- Payment Tracking Dashboard: Use software to track payments, receipts, and pending invoices in real-time. This will give The business complete visibility into its credit situation and outstanding payments.

(4.2.4) Regular Review of Credit and Financial Data

- Credit Audits: Regularly review and audit the credit performance of customers, tracking their payment patterns and updating credit limits or terms accordingly. Monitoring their ongoing creditworthiness ensures that the business does not overextend credit to unreliable customers.

- Financial Health Monitoring: Track internal financial metrics, such as accounts receivable turnover, average collection period, and aging reports. These indicators help the business stay aware of its liquidity and evaluate the overall effectiveness of its credit management practices.

- Data Analytics for Better Forecasting: Use data analytics to forecast cash flows, assess credit risk, and predict potential payment defaults. By analyzing customer behavior and market conditions, The business can proactively adjust its credit policies and mitigate financial risks.

5 Important links

BDM Project folder - https://drive.google.com/drive/folders/1GAjYjlMpbO3tr64BYYgkBOsiid8-eMyQ?usp=sharing