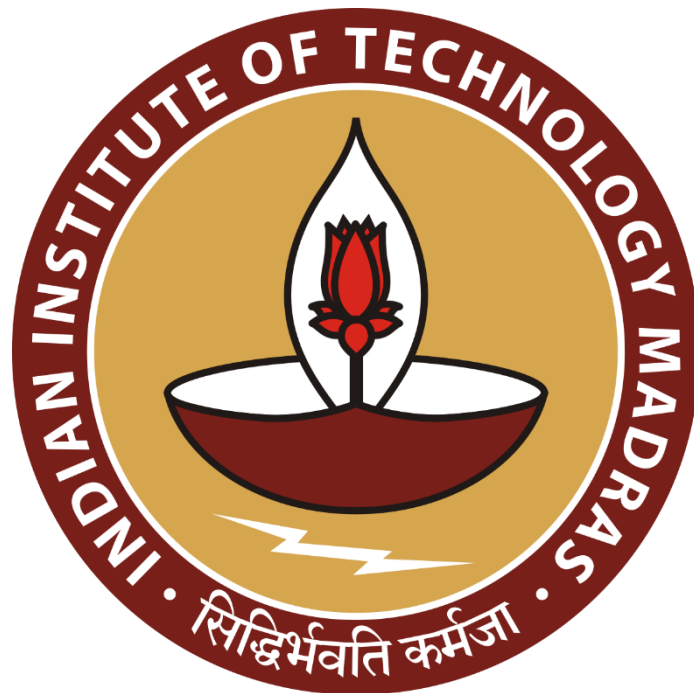# Performance analysis for Sharma Paneer Bhandaar

A Final report for the BDM capstone Project

Submitted by

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Contents

1) Executive Summary

This report explores key profit and demand insights for Sharma Paneer Bhandaar, focusing on strategies to improve inventory management, optimize sales, and enhance profit margins.

The analysis began by collecting and preprocessing data to ensure consistency and remove errors. Once the data was ready, correlation analysis was performed to identify products that could be paired together for potential bundling opportunities. Items having high correlation were compared to identify the differences in sales, for each day of week.

Price Elasticity of Demand was calculated to measure how sensitive the demand for each product was to changes in price. Additionally, the sales-to-purchase ratios were analysed to evaluate inventory efficiency. Moving averages were used to forecast demand for the next 12 days, and a linear regression model was developed to predict profits based on purchase and sales quantities.

The findings revealed several notable insights. Sales of Gulab Jamun Dough and Rasgulla Dough were strongly correlated, particularly on Saturdays and Tuesdays. This indicates an opportunity to implement bundling promotions for these products on those specific days. The analysis of Price Elasticity of Demand highlighted that products such as Peas are highly sensitive to price changes, while Cottage Cheese showed low price elasticity, maintaining steady demand regardless of price adjustments. The evaluation of sales-to-purchase ratios showed that inventory management was efficient for most products, although some areas still had room for improvement due to wastage or slow sales.

Based on the findings, several recommendations have been made. A bundling strategy for correlated products such as Gulab Jamun Dough and Rasgulla Dough should be implemented on high-demand days like Saturdays and Tuesdays. Pricing strategies should be adjusted in accordance with the elasticity of demand, ensuring that prices for sensitive products like Peas are competitive while taking advantage of stable demand for products like Cottage Cheese. Inventory management practices need to be refined for products that show signs of wastage or slower sales.

Additionally, targeted promotions should be introduced to stimulate sales during slower periods, such as post-festival seasons, to maintain consistent profitability.

This project provides Sharma Paneer Bhandaar with a comprehensive and data-driven approach to optimizing its operations. By implementing these strategies, the business can increase profitability, reduce wastage, and better meet customer demands, ensuring a more efficient and successful future.

2) Detailed Explanation of Analysis Process/Method

The analysis process followed a systematic, data-driven approach to identify patterns, optimize inventory management, and develop promotional strategies for Sharma Paneer Bhandaar. The steps involved are outlined below:

1. **Data Collection and preprocessing:**
   i) The first step involved gathering sales, purchase, and inventory data for all products over a specified period. This data provided insights into how the business was performing on various days and how different products interacted with each other.
   ii) This data was cleaned to remove inconsistencies such as missing values, duplicate entries, and outliers that could distort the analysis. Data cleaning included ensuring consistent formatting, correcting errors in product names or categories, and aligning date formats.

2. **Correlation Coefficient analysis for products on specific days:**
   To identify product pairings for potential bundling strategies, correlation coefficients were calculated between products based on their sales performance.
   i) This allowed the identification of products that showed a positive relationship in sales on certain days, indicating they could be effectively promoted together.
   ii) The correlation coefficients were computed for various products, such as Gulab Jamun Dough and Rasgulla Dough (0.72), to determine the strength of their relationship on specific weekdays.

3. **Price Elasticity of Demand (PED) Calculation:**
   The PED for each product was determined by analysing the change in price versus the change in quantity sold. This was done using the formula:

   PED = Change in Price / Change in Quantity

   By calculating the PED for products like Cottage Cheese, Peas, and Cream, the price sensitivity of each product was established. This helped to identify which products are more elastic or inelastic, guiding decisions on pricing strategies.

4. **Sales-to-Purchase Ratio Analysis:**
   The sales-to-purchase ratio for each product was calculated to ensure inventory was being managed efficiently. This ratio showed whether products were being purchased in line with their sales performance, highlighting any potential overstocking or understocking issues.
   A ratio close to 1 indicated a good balance between sales and purchases.

5. **Moving average and Weighted moving average for 12 days:**
   It helps in identifying recent changes in data, such as an increase or decrease in demand for a product. By looking at a longer Moving Average (MA) period, you can observe general trends, like seasonal variations or gradual growth/decline in sales. Weighted moving average and moving average was forecasted for 12 days.

6. **Profit Trend Analysis and Prediction:**

i)   **Weekly profit** data was analysed for trends and fluctuations. Special attention was given to identifying days with significant profit drops or spikes. This analysis helped in understanding the impact of external factors, such as festivals, on sales and profit.

ii)   **Linear regression**, from scikit-learn library, was used to predict profit based on purchase and sales quantities. By using the purchase quantity and sales quantity as

predictors, the model attempts to understand how these quantities impact profit. This is useful because it allows forecasting future profits based on expected quantities sold and purchased, even without considering price fluctuations, which can be more difficult to predict.

The key performance metrics (intercept, RMSE, and R-squared) help evaluate how well the model is capturing the relationship between these variables and actual profit.

7. Identifying Promotion Opportunities:

Using the insights from the **Pearson correlation analysis**, bundling opportunities were identified. Days with strong sales correlations (e.g., Saturday and Tuesday for Gulab Jamun Dough and Rasgulla Dough) were chosen for targeted promotions.

On days with balanced demand (e.g., Sunday and Wednesday), no bundling promotions were recommended.

8. Final Optimization Strategy:

Based on the findings from the analysis, a strategy was developed to optimize sales, reduce wastage, and improve profits.

This included recommendations for bundling promotions, targeted price adjustments, and stock management practices, ensuring that all products were being utilized efficiently while maintaining profitability.

3) Results and Findings

1. Promotion of High-Margin Products on specific days:

The items, which are positively correlated can be promoted together on some specific week days. This could include special offers and bundle promotions.

Days	Sales of Gulab Jamun Dough - Rasgulla Dough		Sales of Rasgulla Dough – Cream	
Monday	24	14.12%	10	10.31%
Tuesday	31	18.24%	19	19.59%
Wednesday	10	5.88%	8	8.25%

Thursday	22	12.94%	14	14.43%
Friday	27	15.88%	16	16.49%
Saturday	48	28.24%	18	18.56%
Sunday	8	4.71%	12	12.37%

Figure: Weekly Sales Data of Gulab Jamun Dough & Rasgulla Dough with Cream (%)

i) Bundling promotio1ns should be used on Gulab jamun and Rasgulla Dough or Rasgulla Dough and Cream on Saturday and Tuesday. But they should not be paired on Sunday and Wednesday, as of both days. Also, both pairs are strongly correlated.

ii) On Saturday and Tuesday, the sales difference between the paired products (Gulab Jamun Dough & Rasgulla Dough, and Rasgulla Dough & Cream) is the **highest**. This indicates a strong opportunity for bundling promotions to maximize sales for the lower-selling product while capitalizing on the popularity of the higher-selling one. It can keep its customers over a long period by providing perceived value, resulting in high customer retention.

iii) On Sunday and Wednesday, the demand for both products in each pair is more **balanced**. Bundling promotions on these days might not create significant value for customers as both products are already selling proportionally. Instead, consider promoting these pairs individually or offering standalone discounts to sustain consistent sales.

Purchase		Correlation Coeff
Gulab Jamun Dough	Rasgulla Dough	0.72
Cream	Rasgulla Dough	0.61
Sales		
Gulab Jamun Dough	Rasgulla Dough	0.80
Cream	Rasgulla Dough	0.23

Figure: Correlation Coefficients of Purchases and Sales for Gulab Jamun Dough, Rasgulla Dough, and Cream

The strong correlation between some pairs suggests that customers tend to buy these items together. This can be leveraged further by creating **regular promotional campaigns** or **loyalty rewards** specifically for these combinations.

2. PED

It measures how sensitive the quantity demanded is to changes in price. A higher value indicates greater sensitivity.

Products	Cottage Cheese	Peas	Soybean Nuggets	Gulab jamun Dough	Rasgulla Dough	Cream
PED	0.26	-11.25	0.00	1.17	1.35	0.00
	Inelastic	perfectly elastic	perfectly inelastic	elastic	elastic	perfectly inelastic

Figure: Price Elasticity of Demand (PED) for Products

Inelastic Demand: PED ≤ 1 or 0

Elastic Demand: PED > 1

Highly Elastic Demand: PED < -1, meaning price changes have a strong effect on demand

i)   The price of **Cream** and **Soybean nuggets** does not fluctuate.

ii)   **Cottage Cheese** has low price elasticity, meaning price increases or decreases would have a minimal effect on sales. This is likely because it is a staple product or a necessity for customers.

iii)   **Gulab Jamun Dough** and **Rasgulla Dough** are somewhat price-sensitive, but price changes might still cause noticeable shifts in sales. A price increase will lead to a proportionally larger drop in demand.

iv)   **Peas** show extreme price sensitivity. A small price change could drastically affect the quantity demanded. Customers may view Peas as a non-essential item or have many substitutes available.
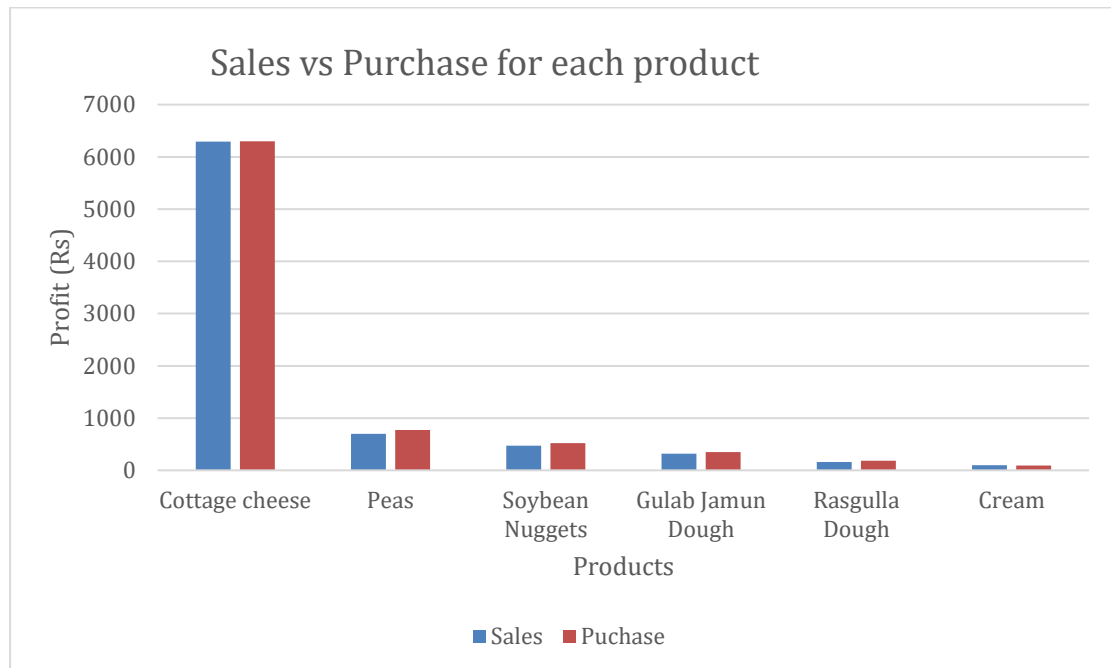
3. Sales to Purchase Ratio

Figure: Sales and Purchase (rupees) for each product

In most instances, total purchases and total sales are **closely aligned**, indicating efficient inventory planning. Sales to Purchase ratio for all the items is close to 1.

i) The **ratio above 1** suggests that Cottage Cheese is consistently selling as soon as it is purchased, indicating efficient inventory turnover and strong demand. Maintaining stock levels and ensuring consistent quality will help sustain this performance.

ii) A **ratio slightly below 1**, for Peas and Soybean Nuggets suggests minor wastage or excess stock, possibly due to over-purchasing. Better demand forecasting and regular monitoring of inventory can help minimize wastage.

iii) Gulab Jamun Dough and Rasgulla Dough have relatively **lower ratios**, indicating higher wastage or slower sales. Offering targeted discounts, bundling with complementary products like Cream, and promoting them during festive seasons can help improve sales and reduce wastage.

iv) The **ratio well above 1**, for Cream, suggests high demand and potential under-stocking, which could lead to lost sales opportunities. Increasing the stock of

Cream to meet the demand while maintaining freshness will ensure better availability for customers.

4. Forecasted the moving average for next 12 days:

The **moving average** model smoothens short-term fluctuations and highlights longer-term trends in product demand, making it a valuable tool for inventory management. **Weighted moving average**, takes into account more recent data points with greater emphasis. The forecasted values are smoothed, providing a more stable outlook. It offers a balanced prediction by smoothing out sudden fluctuations.

	Cottage cheese	Peas	Soybean Nuggets	Gulab Jamun Dough	Rasgulla Dough	Cream
Date			Forecasted Moving average			
25-08-24						
26-08-24	157	41.1111	16.33333333	23.55555556	8.444444444	10.11
27-08-24						
28-08-24						
29-08-24						
30-08-24	156.67	41.93	13.67	21.19	7.93	9.15
31-08-24						
01-09-24						
02-09-24	157.89	45.35	13.44	22.14	9.01	9.09
03-09-24						
04-09-24						
05-09-24	157.1851852	42.7942	14.48148148	22.29218107	8.46090535	9.449
			Forecasted Balanced			
25-08-24						
26-08-24						
27-08-24	157.05	43.7333	14.33333333	22.46666667	8.733333333	9.4
28-08-24						
29-08-24						
30-08-24	157.2477778	43.8458	13.85555556	22.03049383	8.629135802	9.227
31-08-24						
01-09-24						
02-09-24	157.3388333	44.1814	13.92	22.20948148	8.761407407	9.253
03-09-24						
04-09-24						
05-09-24	157.2347556	43.9519	14.00077778	22.2111321	8.708093827	9.281

Figure: Forecasted Moving average and Moving average for 12 days, for each product

i) The demand for **Cottage Cheese** fluctuates slightly but remains relatively stable at around **157 units**. This suggests that Cottage Cheese is a high-demand product with steady sales and requires a consistent inventory level. The demand for Cottage Cheese in the balanced forecast remains very close to the moving average, suggesting that its demand is consistent and predictable.

ii) The forecasted demand for **Peas** shows an upward trend, starting at **41.11 units** and increasing to **45.35 units**. This indicates rising customer demand and the need to increase stock levels accordingly. The forecast for Peas in the balanced model continues its upward trend but at a slightly lower rate compared to the moving average, signalling a steady increase in demand.

iii) **Soybean Nuggets** show a decline in demand over the forecasted days, starting at **16.33 units** and falling to **13.44 units**. This product may need stock reductions or promotional efforts to boost sales. The balanced forecast for Soybean Nuggets remains lower than the moving average, further confirming the declining demand trend.

iv) The forecast for **Gulab Jamun Dough** starts at **23.56 units** and shows a slight decrease to **22.29 units**. The trend suggests stable but declining demand, which may require strategies to improve sales, like bundling or promotions. The balanced forecast for Gulab Jamun Dough is similar to the moving average, reflecting stable but slightly declining demand.

v) **Rasgulla Dough** shows a slight increase in demand, from **8.44 units** to **9.01 units**. Although demand remains low, the steady rise indicates potential for more sales, which can be encouraged with marketing. Similar to the moving average, the balanced forecast for Rasgulla Dough indicates a small increase in demand, suggesting the potential for gradual sales growth.

vi) The forecast for **Cream** starts at **10.11 units** and decreases to **9.45 units**. As it shows a slight downward trend, the stock for Cream may need to be adjusted to avoid overstocking, which could lead to wastage. The balanced forecast suggests stable demand for Cream but at a slightly reduced rate, reinforcing the idea of low and steady demand.

5. Profit percentage from each day of the week for the products

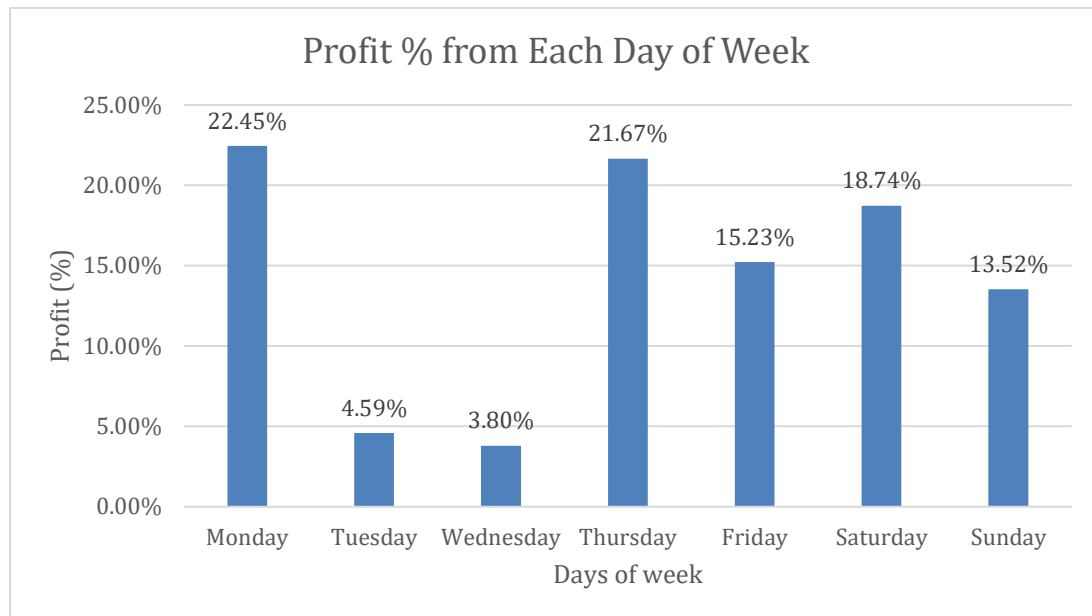It shows a diverse range of performance across the days.

Figure: Profit % from all the products for each day of week

i)   **Monday** sees the highest profits, with Cottage Cheese contributing significantly. The total profit for the day is 22.45% of the weekly total. Monday seems to be a strong day for sales, particularly for products like Cottage Cheese.

ii)   The profits on **Tuesday** are negative for several products, especially for Gulab Jamun Dough, Rasgulla Dough, and Cream. This leads to an overall loss of -4.59% of weekly profits. This suggests that Tuesday could be a day to reconsider the pricing strategy or introduce targeted promotions to recover losses.

iii)   Similar to Tuesday, **Wednesday** shows negative profits for some products, but the loss is smaller compared to Tuesday. The total profit accounts for only 3.80% of the week. This day, therefore, could benefit from focused marketing or promotional efforts.

iv)   **Thursday** sees a good profit margin of 21.67%, driven by products like Cottage Cheese and Peas. It is a solid sales day, and maintaining or boosting promotions on this day can be beneficial.

v)   **Friday** shows a drop in profits for some products but still contributes 15.23% of the total weekly profits. There may be an opportunity to improve sales on this day by adjusting stock levels or introducing targeted offers for underperforming products.

vi)   **Saturday**, with 18.74% of the weekly profits, seems to be another key day with strong sales, especially for Gulab Jamun Dough and Rasgulla Dough. This indicates a trend where people might purchase these products as part of weekend treats.

vii)   **Sunday** accounts for 13.52% of weekly profits, which is relatively moderate. Some products show small losses, but it remains a day worth focusing on for additional sales with specific promotions.

6. A notable trend is the drop in profits

Just before and after a festival, a trend in the drop of profits is noticed, which can directly impact overall performance.
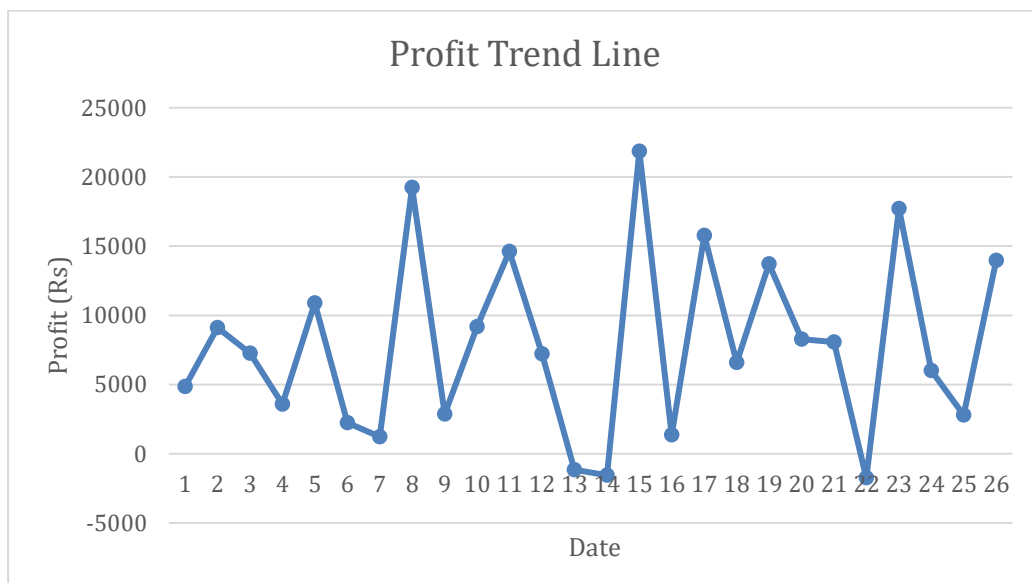

Profit Trend Line

When profit is high on the 8th, 15th, and 23rd of August, the adjacent days (7th, 9th, 14th, and 22nd) show lower profits, as seen in the *Profit (rupees) for all the products(y-axis) on different days(x-axis)*. This fluctuation points to inefficiencies in the supply chain or inventory management processes, leading to wastage despite consistent demand.

i) **Before a festival**, the drop in profits may indicate that Sharma Paneer Bhandaar is increasing stock levels in anticipation of high customer demand during the festivities. This is a common practice to ensure shelves are adequately stocked, but it can result in higher procurement or storage costs, temporarily reducing profits.

ii) **After the festival**, the decline in profits is likely due to reduced customer demand. Many customers stock up in advance or overindulge during the celebrations, leaving them less inclined to purchase immediately afterward. Additionally, unsold inventory from the festive period may lead to excess stock, further affecting profitability. define axis

7. Profit Forecasting model:

Linear regression is a statistical technique that models the relationship between dependent and independent variables. Here, the **dependent variable is profit**, and the **independent variables are purchase quantity and sales quantity**. The model assumes a linear relationship between the profit and these quantities.

To accurately forecast the profit (in rupees), without sales and purchase prices, both purchase quantity and sales quantity are considered. The linear regression model has been evaluated using key performance metrics: Intercept, RMSE (Root Mean Squared Error), and R-squared (Score).

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

R-squared is a statistical measure that represents the proportion of the variance in the dependent variable (profit) that is explained by the independent variables (sales and purchase quantities). It gives you an idea of how well the model fits the data. R^2 ranges from 0 to 1. A value of 1 indicates a perfect fit (i.e., the model explains all the variance in the data). A value of 0 means the model does not explain any variance

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

(i.e., it performs no better than simply using the mean of the actual profits as predictions).

Root Mean Squared Error is a commonly used metric to evaluate the performance of regression models. It represents the square root of the average squared differences

Intercept	rmse	R sq score
63.91324	19.38155	0.9984

between the actual and predicted profit values. The lower the RMSE, the better the model's predictions are.

Figure: Regression Model Performance Metrics

i) The model has an R-squared value of 0.9984, indicating that 99.84% of the variance in the target variable is explained by the features in the model. This high value suggests that the model has a **very strong predictive power** and can explain most of the variability in the data.

ii) The RMSE of 19.38 represents the average magnitude of error between the predicted and actual target values. Lower RMSE values generally indicate a better fit of the model to the data. Given this value, the model shows relatively **low prediction error**, which is favourable for the accuracy of the model.

	Cottage cheese	Peas	Soybean Nuggets	Gulab Jamun Dough	Rasgulla Dough	Cream
	Purchase					
Coefficient	-182.64	-76.83	-87.98	-192.86	-225.08	-221.13
	Sales					
Coefficient	212.52	98.48	111.56	192.37	265.78	242.84

Figure: Linear Regression Coefficients for Purchase and Sales of Various Products

iii) The **negative coefficients for purchase quantities** (e.g., -182.64 for Cottage Cheese) indicate that increasing the purchase quantity of a product negatively affects the profit. This makes sense because purchasing more stock increases costs. If the products are not sold as expected, it can lead to excess inventory, which results in wastage or markdowns.

A. Cottage Cheese has a relatively large negative coefficient of -182.64, indicating that buying too much of this product will significantly reduce profit.

B. Similarly, Rasgulla Dough and Cream have large negative coefficients (-225.08 and -221.13), indicating that purchasing more of these products also leads to high costs, particularly if they aren't sold.

iv) The **positive coefficients for sales quantities** (e.g., 212.52 for Cottage Cheese) suggest that increasing the sales of a product positively impacts profit. The larger the positive coefficient, the greater the profit contribution for each unit sold.

A. Cottage Cheese has a high sales coefficient of 212.52, which means that increasing its sales has a strong positive impact on profits.

B. Rasgulla Dough and Cream also have high positive coefficients (265.78 and 242.84), indicating that increasing their sales significantly boosts profit.

8. Profit (Rs) for each week does not fluctuates

Week	Cottage cheese	Peas	Soybean Nuggets	Gulab Jamun Dough	Rasgulla Dough	Cream	sum
1	54780	4583	1820	-1540	1150	-500	*60293*
2	49710	1436	1000	-980	-1530	445	*50081*
3	56160	395	2250	1600	-630	1665	*61440*

Figure: Total Profit (Rs) for each week for each item

i) While the overall profit might not change significantly, specific products like Gulab Jamun Dough, Rasgulla Dough, Cream, and Peas are likely to experience considerable fluctuations in profit. **These products' profitability can vary significantly** depending on factors such as seasonal demand or bundling strategies.

ii) On the other hand, items like Cottage Cheese and Soybean Nuggets show more stable profit margins, indicating that their **sales are less volatile** and are likely less affected by changes in demand forecasting for inventory management strategies.

4) Interpretation of the Results

1. Bundling Strategy

i) Gulab Jamun Dough and Rasgulla Dough are frequently **purchased together**, making them ideal for bundling promotions.

ii) **High-demand days** (Saturdays and Tuesdays) show strong sales potential for bundled offers like "*Buy 1, Get 1 at 50% off.*"

iii) **Low-demand days** (Sundays and Wednesdays) indicate balanced demand, where individual price reductions for products like Rasgulla Dough or Cream are more effective.

iv) Seasonal or **festive campaigns** can amplify sales by promoting bundles during special occasions.

2. Price Elasticity of Demand

    i) Products like Peas are highly **price-sensitive**, with small price changes significantly affecting sales.

    ii) Cottage Cheese has **inelastic demand**, where consistent quality is crucial to retain loyal customers.

    iii) **Festive seasons** see increased demand for Gulab Jamun and Rasgulla Dough, making *bulk discounts* and *bundling* with inelastic products like Cream effective.

3. Sales and Purchase Alignment

    i) **Inventory management** is generally effective, but some wastage indicates room for improvement in forecasting and stock management.

    ii) **High-performing items** like Cottage Cheese and Cream require consistent stock levels to meet demand.

4. Targeted Promotions

    i) **Profit drops** before and after festivals highlight the need for better forecasting and stock management to reduce wastage.

    ii) **Monday and Thursday** contribute significantly to profits, while Wednesday shows weaker sales.

5. Profit Forecasting

    i) The **low RMSE** (error margin) and **high R-squared score** (0.9984) indicate accurate profit prediction models.

    ii) Products like Rasgulla Dough, Cream, and Cottage Cheese have the **highest positive impact** on profit from sales but require careful inventory balancing to avoid wastage.

6. Stable vs. Volatile Products

    i) **Stable products**, the products with consistent and predictable demand over time, like Cottage Cheese require **consistent stock levels** with a slight buffer

for fluctuations. Their sales do not fluctuate significantly, making them easier to manage in terms of inventory and marketing.

ii) **Volatile items**, the products with fluctuating demand, like Gulab Jamun Dough and Rasgulla Dough need tailored marketing strategies to manage profit fluctuations effectively. Their sales can vary significantly, making them more challenging to manage.

5) Recommendations

1. Bundling Strategy

i) Introduce **bundled promotions** on high-demand days (e.g., Saturdays and Tuesdays) to maximize sales using offers like "*Buy 1, Get 1 at 50% off.*"

ii) On low-demand days (Sundays and Wednesdays), focus on individual **price reductions** rather than bundling to maintain steady sales.

iii) Create exclusive festive bundles with **limited-time offers** to drive urgency during special occasions.

2. Price Management

i) Keep **prices competitive** for elastic products like Peas while emphasizing unique features (e.g., organic or farm-fresh).

ii) Maintain **consistent quality** for inelastic products like Cottage Cheese to retain loyal customers.

3. Inventory Optimization

i) Use improved **forecasting methods** to align stock levels with actual demand, reducing wastage for high-performing items like Cottage Cheese and Cream.

ii) Implement **just-in-time inventory practices** for items with fluctuating demand like Gulab Jamun Dough. Just-in-Time (JIT) inventory management is a strategy that aims to minimize inventory levels by aligning orders from suppliers directly with production schedules.

4. Targeted Promotions

i) Offer discounts on **leftover stock** post-festivals to clear surplus inventory quickly.

ii) Boost sales on **weaker days** (e.g., Wednesday) through targeted promotions such as bundling or discounts on popular items like Gulab Jamun Dough and Rasgulla Dough.

5. Profit Maximization

i) Focus marketing efforts on **high-impact products** like Rasgulla Dough, Cream, and Cottage Cheese through promotions, discounts, and bundling strategies.

ii) Balance stock carefully for products with **negative purchase coefficients** to avoid over-purchasing.

6. Product-Specific Strategies

i) **Maintain consistent inventory** levels for stable products like Cottage Cheese while replenishing stocks in advance for items with increasing demand (e.g., Peas).

ii) **Reduce inventory** holding costs for slow-moving products like Soybean Nuggets by minimizing excess stock through reduction strategies.