Title: Enhancing Profitability for a Local Automotive Spare Parts Vendor and Garage Service

A Final Submission report for the BDM capstone Project

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Declaration Statement

I am working on a Project titled **Enhancing Profitability for a Local Automotive Spare Parts Vendor and Garage Service**. I extend my appreciation to **Pawansut Automobiles** for providing the necessary resources that enabled me to conduct my project. I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered from primary sources and carefully analyzed to assure its reliability. Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures. I am dedicated to adhering to the principles of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report. I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority. I understand that all recommendations made in this project report are within the context of the academic project taken up towards course fulfillment in the BS Degree Program offered by IIT Madras. The institution does not endorse any of the claims or comments.

Signature of Candidate: (Digital Signature)

Name: Podey Om Prabhakar

Date: 15-11-2024

1.Executive Summary:

This capstone project aims support the growth and effectiveness of Pawansut Automobiles by addressing challenges that hinder profitability and customer satisfaction, in their auto parts sellings and garage services business operations. Currently facing challenges such as low profits caused by excess inventory and inefficient sales tracking systems along, with ineffective customer retention strategies have led to financial insecurity and posing barriers to competitive growth.
We developed an approach based on data driven technique to identify and tackle these inefficiencies effectively. The essential analyses involved optimizing the stock levels and using market basket analysis (MBA) and dynamic pricing models to improve the stock plan efficiency and boost customer loyalty through increased sales reconciliation. By utilizing advanced analytical methods, in the study process revealed areas with high demand but insufficient stock levels, irregularities in sales and stock records and issues, with fixed service pricing models that needed to be adjusted according to actual service needs.

The findings revealed insights by highlighting the links, between engine oil and engine flush in sales that led to suggestions for strategic bundling strategies. MBA also emphasized the potential, for product combinations and promotions based on purchasing patterns. Moreover, analyzing service expenses resulted in proposing a dynamic pricing approach that allows for precise billing aligned with customer service requirements.

Following these discoveries led to suggested actions; implementing updates, for sales and inventory records; introducing a flexible pricing strategy to enhance profits; and integrating customer data for personalized marketing campaigns and engagement strategies. This combination of strategies is geared towards cutting down on costs while improving inventory control and fostering lasting growth to position Pawansut Automobiles for enduring success, in the market landscape of automotive repair market.

2. Comprehensive Analysis Methodology and Strategic Justification:

2.1 Refined Linear Regression Analysis for Service Cost Optimization by Vehicle Type.
We conducted this analysis we aimed to understand how the service costs associated with the products (specifically for bikes and scooters) vary relative to the product cost. As shown in the mid-term report we had used a simple linear regression model to evaluate the relation between total bill amount and cost of servicing, which was constant at 10% of price of product as stated earlier. While useful for an initial insight into servicing costs, this method didn't take account of the subtle differences between vehicle categories and their servicing costs.

The main motivation behind this improved analysis was to create a more targeting data-driven model by splitting the analysis with respect to the vehicle type, that are scooters and bikes. This segmentation is very important as it will allow us to view the accountability of each category in the vehicle type. By breaking down the service cost analysis into vehicle-specific models, we could uncover insights that were previously masked by the aggregated approach of using a fixed service charge rate.

Rationale for Using Linear Regression in Servicing Cost Analysis:
The essence of linear regression is such a statistical methodology used for the impression (prediction) between dependent variable and one (or multiple independent variables. This method is chosen due to the fact that it provides a predictive correlation among these variables which starts uncovering trends, fashions and feasible charge motives influencing servicing cost.

We chose to employ linear regression for the following reasons:

1. **Simplicity and Interpretability**: The default linear regression model is simple and easy to interpret, which makes it good for business analysis when decision-makers need straightforward value proposition. This way, we can actually capture the variances in servicing costs as they relate to product cost, giving us a more straightforward framework for predicting these costs.
2. **Quantifying Relationships**: This technique allows us to quantify the connection between product costs and the corresponding servicing expenses. This is particularly beneficial in our situation, as it enables us to evaluate whether the fixed 10% service cost rate is justified or if a more customized model is necessary.
3. **Identifying Trends and Variations**: This method can show how different types of vehicles (scooters vs. cars) influence servicing costs. Segmenting the analysis by vehicle type should allow us to identify better any variance in service requirements or cost trends, resulting in a clearer understanding of servicing costs per category.

Application to Servicing Costs: Segmentation by Vehicle Type.
For further targeting of our analysis, we categorized the data into two more parts, scooters and bikes. As per vehicle type, separate linear regression was carried out based on the assumption that a various servicing need is correlated with each category resulting in costs of parts and labor being different for different vehicle types. This allowed us to expose the specific service cost behaviors that could have been masked in an aggregate model.

- **Scooter Service Cost Model**: This model focused on identifying the key factors driving service costs for scooters, such as part usage, labor hours, and complexity of the service required.
- **Bike Service Cost Model**: Similarly, the bike model of linear regression keep a hand on service costs with respect to factors that are more specific to bikes, such as higher part costs, longer service times, or more complex repair requirements.

A refined linear regression analysis elaborated on how these features impacted servicing costs for the type of vehicle. This gradually helps to recognize inefficiencies or inconsistencies in the existing model of costs, which may inform a more dynamic and adaptive price setting.

2.2 Market Basket Analysis for Engine Flush Sales Optimization Based on Customer Purchasing Patterns

In our analysis, we aimed to identify key associations between engine flush and other frequently purchased products, as well details on what exactly needs optimization to potentially improve sales of the high-margin product Engine Flush which was underperforming relative to its profitability. We employed **Market Basket Analysis (MBA)** which helps to explore these kinds of associations to understand how the customers shop those products together, which may help us by setting up promotional strategies with respect engine flush.

Market Basket Analysis is used to identify patterns or associations in transaction data aimed at understanding the relationships between products that are purchased together. This is especially applicable to our analysis since it would identify product associations which might not be apparent at first but could make a valuable and significant contribution towards optimization of sales.

Rationale for Using Market Basket Analysis in Engine Flush Sales Optimization.
We chose to utilize Market Basket Analysis because it helps unveil concealed connections, in datasets and provides valuable insights into customer buying habits. By employing this method on sales data sets to discover correlations between engine flush and other vehicle parts, like engine oil and brake components that are commonly purchased together in transactions.

We selected Market Basket Analysis for the following reasons:

- **Uncovering Hidden Associations**: Discovering Secret Connections; Market Basket Analysis uncovers product linkages that might not be obvious, at glance but can offer insights for enhancing sales performance. For example, recognizing that customers often buy engine oil and engine flush, in tandem enables the development of tailored packages or special offers and allows for creation of targeted bundles or promotions.
- **Enhancing Sales Recommendations**: Providing a boost to sales suggestions involves establishing a basis, for creating tailored sales recommendations by identifying the products frequently purchased alongside engine flush and proposing them to customers to enhance the value of their purchases.
- **Optimizing Inventory and Product Placement**: By recognizing items commonly purchased together, MBA helps to enhance inventory organization and product positioning strategies effectively improves stock management. Products related to engine flush could be strategically positioned close, to each other to promote sales opportunities and increase the chances of customers buying both products simultaneously.
- **Data-Driven Decision Making**: MBA offers a data-driven approach to decision making, which ensures that recommendations and promotional strategies. This approach ensures that actions are aligned with customer purchasing patterns and not align to personal assumptions.

We applied Market Basket Analysis using the Apriori algorithm to identify important product associations that can help with sales ordering suggestions of Engine Flush. The identified segmented rules and high-confidence relationships from the analysed data will serve as essential guides to design-product bundling, and personalised recommendation engines in terms of optimising engine flush sales with targeted marketing effort.

2.3 Strategic Excel Analysis for Sales Patterns, Inventory Management, and Product Evaluation.
We applied a mixture of Excel driven analysis and graphically based techniques to extract valuable insights of the sales and inventory information. The ability to combine internal and external data together, as well as applying different analytical models for business optimization helped us identify some trends and keys that were necessary to understand the state of the business, improve inventory management and optimize product assessment.

We leverage a set of complexes excel formulas & graphical analysis to highlight different aspects in this segment. This strategy is mostly aimed at analysing sales and inventory data to identify trends, inefficiencies, and optimization opportunities. Using the native data manipulation abilities of Excel,

combined with graphical tools– like pivot tables, charts, and conditional formatting– we break down complex datasets into actionable insights.

Excel serves as the backbone of our analysis owing to its capability to handle large datasets, data summarization and categorization, as well as conducting descriptive or inferential analyses. Along with these graphical representations, it becomes a complementary to make the raw data into visual formats that allows one to easily identify and digest patterns and relationships within them so that business can take and prompt decision based on firmer data.

Rationale for Using Excel and Graphical Analysis.

The choice to use Excel and graphical analysis was driven by the need to analyse sales and inventory data because it helps us work efficiently while maintaining clarity and accessibility, in our analysis process. Here's why we chose this method:

1. **Data Handling and Manipulation**: Excel offers a set of tools for managing and analysing extensive datasets such, as pivot tables and sorting options were instrumental, in effectively managing sales and inventory data at ease.
2. **Visualization for Insights**: We utilized charts and graphs for analysis to present data in a way that's easy to understand visually and helped us highlight trends effectively while investigate and present the key findings.
3. **Customization and Flexibility**: Excels versatility enabled us to tailor the analysis to meet the requirements of each section in the report. Whether it was examining billing data or evaluating high value products. Excel's flexibility to work with data types made it a perfect tool, for our analysis.
4. **Actionable Insights for Decision-Making**: Through combining data manipulation, visual representation and analyzing data, we pinpointed critical trends and inefficiencies, in sales and inventory procedures. These findings play a role, in shaping choices related to managing inventory crafting sales strategies and running the business smoothly.

Application of the Method.
Using Excel and graphical analysis in this section provided a strong foundation to gain essential insights about the business. We provided them with rigorous analysis and clean visualizations that let us:

- Spot trends in sales for each type of vehicle per day, which can help deviate more focused marketing approaches.
- Identify high-cost, low-sell products and set the stage for dynamic inventory optimization.

3. Results and Findings:

3.1 Refined Linear Regression Analysis for Service Cost Optimization by Vehicle Type.

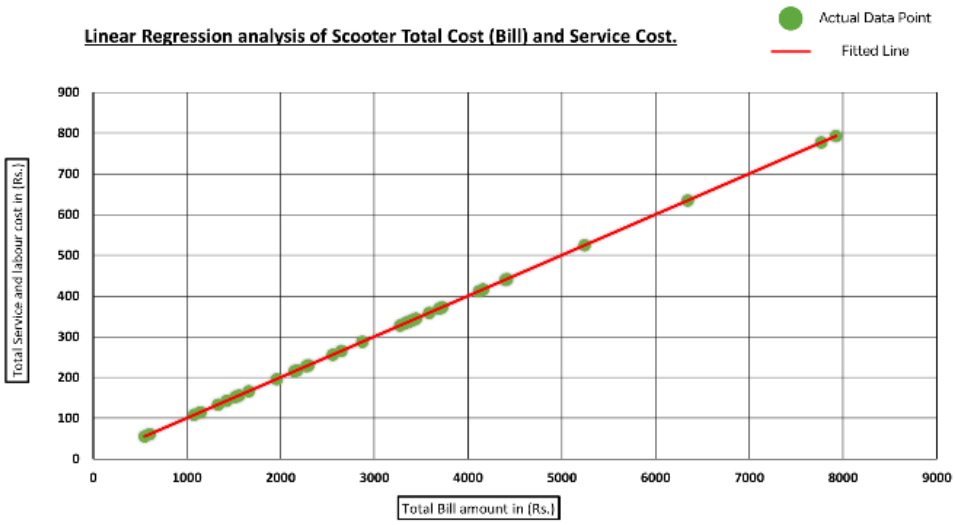
In this section, we build on our previous analysis with the service cost optimization component, using a more sophisticated linear regression model which allows us to consider how scooters and bike differ from each other. This report covers analysis upon the initial insights learnt from mid-term report, where we compared total sum of bill amount vs prices of service and focused on 10% service charge based on spare part cost. This detailed analysis aimed to assess whether the 10% service charge remain optimally set, or if there were vehicle-type specific nuances that might indicate a more dynamic pricing model.

Analysis Overview:

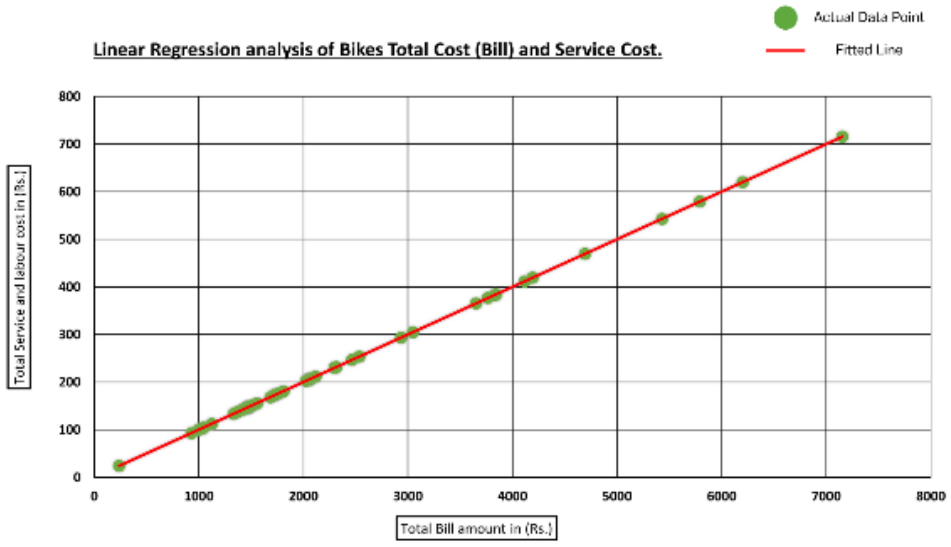
Here we utilised used linear regression models to evaluate how the total bill (which is a dependent variable) depends on one or more components of the Bill (which are independent variables), such as spare parts cost and fixed 10% service charge. The purpose for this analysis was to determine if the same cost (10% of spare part price) for service charge should be treated equally among all types of vehicles or it would be better if it is customized according to each vehicle type.

Since the dynamics between service cost may differ for scooters and bikes, we analyzed these two groups separately to assess the applicability of a dynamic pricing model by detecting any differences. We explored the residuals and coefficients in both cases to see if that 10% mandatory service charge sufficiently accounts for the time required for the service and its complexity.

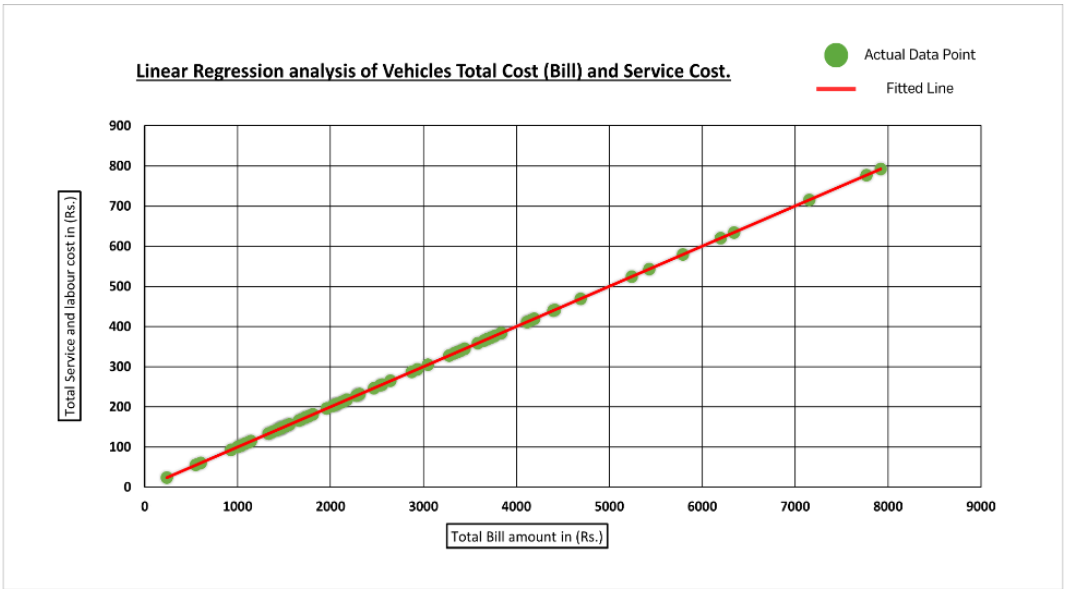
Graphical Representation of Service Cost Analysis.



Figure(3.1.a): Linear Regression analysis of Scooters Total Cost (Bill) and Service Costs.



Figure(3.1.b): Linear Regression analysis of Bikes Total Cost (Bill) and Bikes Service Cost.



Figure(3.1.c): Linear Regression analysis of Vehicles (Clubbed) Total Cost (Bill) and Service Cost.

Graphical Analysis: The charts display the results of analysing the correlation, between the bill and service charges for scooter sales (Figure 3.1.a) bike sales (Figure 3.2.b) and the combined sales of scooters and bikes (3.1.c). The x axis represents the total bill amount and the vertical y axis represent the service cost which is determined as 10% of the final bill amount.

Combined Graphical Insights (Figures A, B, and C):

1. **Linear Consistency Across Vehicle Types:** The consistent trend is visible, across types of vehicles in Figures 3.1.a, 3.1.b And 3.1.c each reveal a strong linear trend, indicating that the 10% service charge increases proportionally with the bill for scooters and bikes as well as combined vehicle data despite being analysed across different scenarios but yielding similar results in each case. Each figure depicts data points clustering around a regression line, with a slope of 0.1 Confirming the correlation set by the 10% rate. For example, in Figure 3.1.a concerning Scooters, the slope coefficient is around 0.1, indicating that service costs closely track total scooter service bills. Similarly Figures 3.1.b and Figure 3.1.c follows and verifies this trend for bikes and combined data.
2. **Minor Deviations and Outliers:** Minor deviations and outliers: The regression lines do an excellent job of capturing and aligning most points; however, minor deviations are clear from all figures suggesting potential outlier values. In Figure 3.1.a (Scooters), some data points showing bills over the range of Rs. 5,000 are slightly underestimated where a flat 10% service charge rate may not fully capture the service complexity. There are similar patterns that emerge in Fig. 3.1.b (Bikes), with deviations in high-cost services over Rs. 6,000 indicating that certain complex bike jobs may require additional labour or parts involvement beyond a percentage of ideal costs captured by a fixed percentage.
3. **Numerical Consistency Across Figures:** Numeric values across the figures reinforce the accuracy of the 10% rate. In Figures 3.1.a and 3.1.b as examples show service charges, for bills at Rs 3k consistently being about Rs 300 each time which indicates a proportional alignment is maintained

throughout the data representation shown. In Figure 3.1.c with a combination of three data points continuous affirmation is provided for the trend suggesting that a service rate of around 10% is generally adequate for both types of vehicles. Nevertheless, small variations in bills hint at improvements like a slight increase in service charges, for bills surpass us rs 6k to ensure accurate cost coverage.

Key Findings:

1. **Confirmation of the 10% Rate for Standard Services:** Confirmation of 10% Standard Services Rate — Across Figures 3.1.a, 3.1.b, and 3.1.c the linear regression lines confirm that 10% service charge covering most of scooter and bike transaction is significant and can be applied as represent cost of service. It implies that the existing model is suitable for standard services across both vehicle categories.
2. **Cross-Vehicle Service Consistency:** Cross-Vehicle Service Consistency, the aggregation of data (Figure 3.1.c) overall can handle a uniform 10% service charge as bike and scooter integration is mutually beneficial. But small tweaks to the paradigm for highest-cost, complicated services, in a way that prices more closely reflect the complex services and time could improve and enhance pricing precision by tailoring charges to service intensity.

3.2 Market Basket Analysis for Engine Flush Sales Optimization Based on Customer Purchasing Patterns.

Engine flushes are widely recommended from the oldest vehicles on the road to brand-new ones right off of the lot around 2 years of age, engine flushes are almost a universal recommendation when it comes to maintaining health in an engine, especially one that has seen better days or is simply getting old. An Engine Flush helps to remove carbon deposits, sludge and other contaminants from the engine ensuring it is working efficiently by reducing friction thus regaining lost power and efficiency of an engine. This step of preventive maintenance is in accordance with the provisions based on industry standard practices that provide that engine life can be improved, as well as increasing fuel consumption due to cleaner and better-lubricated engine components.

For the shop owner, engine flush products are a high-margin product that can contribute to bottom line profitability. The owner can then better target customers who are due for an engine flush based on changes in their vehicle maintenance patterns, leading to higher sales and happier customers. This helps to not only exploit the high-margin potential of engine flush products but also build customer relationships through providing a service that relates to longer term motoring vehicle health.

The key insights on the benefits of engine flushes have been referenced from industry-standard sources, including GaragePro Blog and Carcility. Click here.

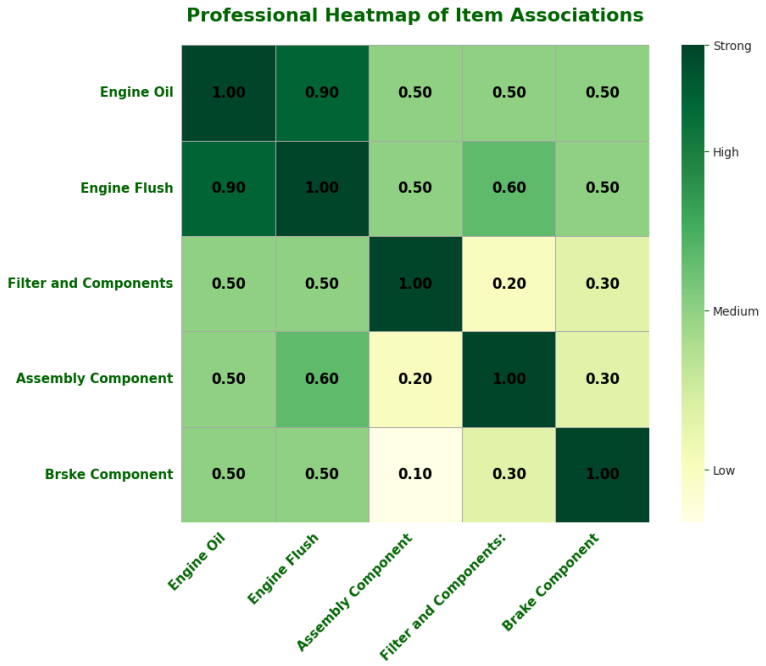
In order to make sure that the data analysis is targeted and efficient it's crucial to start by organizing and streamlining the data. Through classifying and simplifying the product details we can pinpoint the items and buying trends. This assists, in recognizing connections and prevents overloading the analysis with information. Simplifying also boosts the clarity of observations, simplifying the process of creating suggestions and develop targeted recommendations that enhance sales strategies and profitability for the store owner.

Data Preparation and Simplification

In order to streamline the analysis more efficient, transactions containing engine flush were isolated, then categorized based on related parts sold alongside it. Key products were then into product categories such, as **Engine Oil, Brake Components, Assembly Components, Clutch Components, Filter Components, Carburetor Components and Bearing Components.** By concentrating on these categories it made the data easier to understand and allowed for identification of common combinations involving engine flushes.

Visualization of Purchase Patterns

A heat map was generated to display and analyse how often various component categories are bought together and emphasizes transactions related to engine flushes. This visual representation offers a glance, at patterns of purchasing activities and indicates which product category is commonly bought alongside engine flushes to suggest a possible connection.



Figure(3.2.a): Heat map (co-occurrence) of various components.

Heat Map Calculation: Heat Map Calculation involves determining the frequency of co-occurrence between products in the dataset to understand their correlation, in customer purchasing behavior visually and provide insights for sales recommendations based on how often products like engine flush and engine oil are been purchased together frequently in transactions, which can guide targeted sales recommendations.

$$occurrence\ rate(x, y) = \frac{Number\ of\ transactions\ containing\ x, y}{Total\ number\ of\ transactions}$$

$$where, x\ and\ y\ represents : product\ pairs.\ Ex.: engine\ flush\ and\ engine\ oil.$$

In order to prioritize the connections, between products in the analysis using a heat map, only product pairs involving engine flush and other related components with a co incidence rate of 50% or higher(>=threshold) were considered relevant for the study and examination of associations leading to excluding components like bearing, carburetor and clutch due to their weaker associations.

Graphical analysis:

- The heat map (**Figure 3.2.a**) In the above graph mentions, **Engine Oil** and **Engine Flush** are highly correlated with **0.9** which means that customers who purchase one are highly likely to buy the other, making them ideal products for bundling strategies.
- **Engine Flush** appears to have a moderate correlation of **0.6** with **Assembly Components**, meaning they are sometimes purchased together but not as often (as the case with engine oil and flush).
- The relationship of **Engine Oil** and **Engine Flush** to **Filter and Components** is **0.5** which is moderate but not strong, hence the average customer has a weaker but consistent buying pattern.
- The **Brake Component** correlates weakly with **Engine Flush** (**0.3**) & **Engine Oil** (**0.5**), indicating little association between these products, and not appropriate for bundle or cross-sell promotional offers.

Market Basket Analysis (MBA) is used to reinforce our findings, allowing us to pivot from the customer level perspective into analysing on the transaction level. We aimed to discover deeper insights such as customer preferences and product associations between **Engine Oil** and **Engine Flush** using **MBA** so that the decision making is better informed leading to inventory optimization and targeted recommendations.

We utilized the Apriori Algorithm in our analysis process to discover item sets in the dataset which enables us to study product relationships and reveal trends, in customer behaviours. In our analysis process we rely heavily upon some metrics which includes **Support**, **Confidence** and **Lift**; where **Support** values out the occurrence rate in transactions, **Confidence** measures the likelihood that a product will be purchased given that another product is bought, and **Lift** showcases the increased probability of two products being bought together compared to when they're purchased independently. These metrics play a role in validating the connections identified and confirming their significance, in our analysis process. In addition to **Confidence and Lift**, we also incorporated the **Jaccard Index** to improve our analysis further. The **Jaccard Index** is a way to measure proportion of transactions containing both products, relative to the total number of transactions containing at least one of the products. This allows to better represent the strength of relationships among products, especially when Lift does not provide an adequate differentiation on relevant associations.

Mathematical models:

Support for an itemset X→YX:

$$Support(x \to y) = \frac{Number\ of\ transactions\ containing\ both\ x\ and\ y}{Total\ number\ of\ transactions.}$$

Confidence of a rule X→YX:

$$Confidence(x \to y) = \frac{Support(x \to y)}{Support(x)}$$

Lift of a rule X→YX:

$$Lift(x \to y) = \frac{Confidence(x \to y)}{Support(y)}$$

Jaccard Index of a rule X→YX:

$$Jaccard\ Index = \frac{|A \cap B|}{|A \cup B|}$$ *Where, |A∩B| is the number of transactions that contain both products A and B. |A∪B| is the number of transactions that contain either product A or product B (or both).*

Using the Apriori algorithm, we applied the following thresholds to extract meaningful associations:

- **Support threshold** of 0.6 (60%) to include items frequently appearing together.
- **Confidence threshold** of 0.7 (70%) to ensure reliable associations.
- **Lift threshold** above 1, indicating that the co-occurrence of items is more frequent than would be expected by chance.

Findings from Association Rule Analysis:

- **Elimination of Low-Support Components**:
  -Components with support values of less than 60% were eliminated. The remaining components were:
    - **Engine Oil, Engine Flush, Filter and Components**
- **Valid Association Pairs**:
  -The valid associations were:
    - **Engine Oil → Engine Flush, Engine Oil → Filter and Components, Engine Flush → Filter and Components.**

Elimination of Insignificant Associations:

- The pair **Engine Oil → Filter and Components** was eliminated due to its support value of 50%, which is below the 60% threshold.

Remaining Valid Associations:

-After this step, the remaining valid associations were:

- **Engine Oil → Engine Flush**
- **Engine Flush → Filter and Components**

- **Confidence & Lift Calculations:**
  - **Engine Oil → Engine Flush: Confidence = 100%, Lift = 1 (neutral association).**
  - **Engine Flush → Filter and Components: Confidence = 60%, Lift = 1 (neutral association).**
  - The neutral lift value suggest that all these products are bought together as often as expected by chance. However, it is crucial to note that, the analysis we did is purely based on a sample dataset that contained transaction involving **Engine Flush**. This tailored approach may mean that, while the lift value suggests an independent relationship, this might not be the case in actually or broader contexts where other factors could influence the association, to refine our understanding, the **Jaccard Index** was utilized.
  - The **Jaccard Index** refines the strength of association by looking at the overlap, between product sets rather than just their separate occurrences.
  - By applying the **Jaccard Index** to our product associations, we were able to get a more reliable picture of understanding about the relationships:
    - **Engine Oil → Engine Flush**: Jaccard Index = 0.9 (**strong association**).
    - **Engine Flush → Filter and Components**: Jaccard Index = 0.6 (**moderate association**).

Key findings:

Strong Association Between Engine Oil and Engine Flush:

- From analysis between Engine Oil and Engine Flush indicates a high likelihood (90%) that when customer buys Engine oil he also buys engine flush. The above relationship shows a very good positive correlation and it can be fairly considered that if these two products together are bundled then it shall increase the sale of both these products as well as boost the overall profitability of the shop.
- This analysis, combining Heat Map (Figure 3.2.a) visualization, Apriori Algorithm, and Jaccard Index, provides valuable insights into the product relationships, that helps in making recommendations for increasing sales and inventory placement optimization.

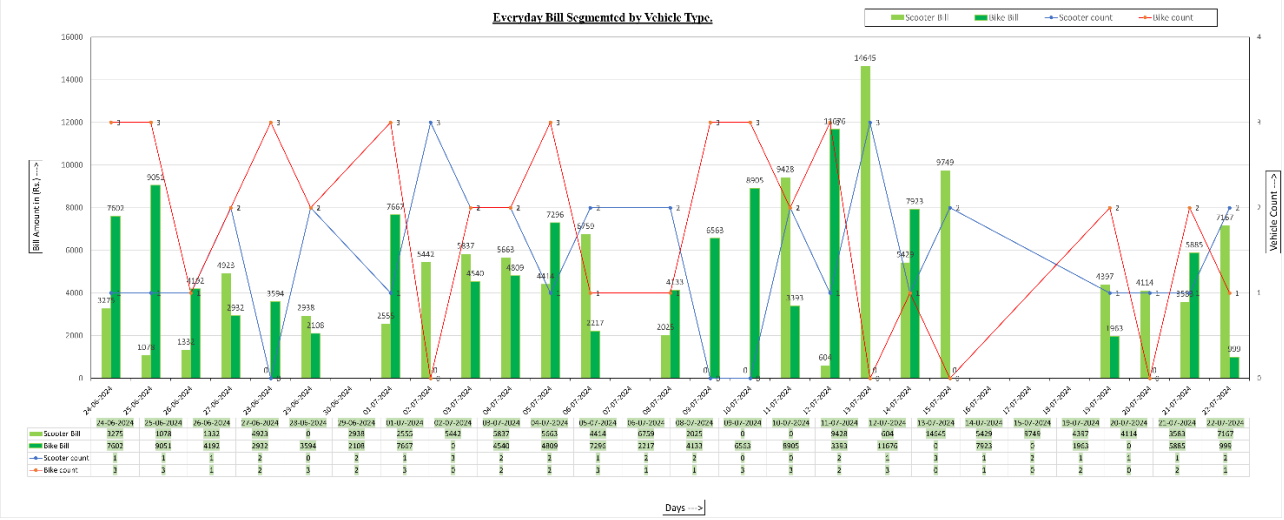
Moderate Association Between Engine Flush and Filter Components:

- The study found a 60% or (0.6) Jaccard Index, between Engine Flush and Filter and Components which shows a chance that customers buy these items often enough to be worth promoting as a pair, (depending upon the profit margin) even though they are not as closely linked as Engine Oil and Engine Flush, but for upselling and further boosting of overall sales.

3.3 Strategic Excel Analysis for Sales Patterns, Inventory Management, and Product Evaluation.

3.3.1 Analysis of Daily Bills.

In this section, analyzed and we looked into the expenses, for scooters and bicycles over a series of weeks to grasp the sales patterns and review the cost trends linked to each type of vehicle. By organizing the data according to the vehicle category (scooter vs. bike) and examine the daily bill totals, our goal is to reveal findings that can inform decisions on stock management and pricing strategies.



Figure(3.3.1.a): Everyday Bill Segmented by Vehicle Type.

Analysis

From the Figure (3.3.1.a), we can assess the overall trends by comparing the daily bill amounts for scooters as well as for bikes. The **Scooter Bill** and **Bike Bill** columns represent the total bill amounts for each vehicle type on a given day, which can help us estimate the total revenue generated by each vehicle type on a given day.

Key Points of Analysis:

- **Bill Trends:** Bill Patterns; According to the chart (Figure 2) the information illustrates fluctuations, in service volume for scooters and bikes; certain days indicate high service activity for one vehicle category compared to the other category with lower service activity, on those same days as well. For instance, on **13-07-2024**, there were three scooters serviced, leading to generation a bill of **Rs. 14,645**, while no bikes were serviced on that day.

- **Graphical Trend Analysis:** The graph (Figure 3.3.1.a) plotting the scooter and bike bills over time can reveal patterns in daily performance. For instance, days with high bike counts might correlate with higher bills, suggesting demand surges.
- **Significant Spike in Sales from 10th to 15th July:** There was an increase, in sales between **July 10th and July 15th** that caught our attention in the **bike** department. The sales figures clearly show a rise in bike transactions during this time frame. This increase is reflected in the sales figures, such as the **substantial jump in bike bills** during these dates. For example, on **July 12th** we recorded bike sales worth **₹11,676**. A considerable jump from previous days. Similarly, on **July 13th** the numbers peaked with **bike related transactions** totals **₹14,645**. There has been an increase, in sales which could suggest a **temporary rise in demand** possibly influenced by factors like promotions or seasonal fluctuations that attracted more customers or an increase in bike servicing, during this time.
- **Comparison of Scooter vs. Bike Bill:** We observe that bikes tend to generate a higher total bill compared to scooters on most days, especially when there are more bikes serviced. For example, on **12-07-2024**, when 3 bikes got serviced, the total bill generated was of amount **Rs. 11,676**, where as compared to a lower scooter bill of **Rs. 604** on the same day.
- **Cost Estimation:** The total costs for scooters and bikes over the observed period can be calculated by adding the individual daily bill amounts:
    - **Total Scooter Bill:** Rs. **1,05,357**
    - **Total Bike Bill:** Rs. **1,07,448**
    - (Again, clamming a hike in bike bills**.)**

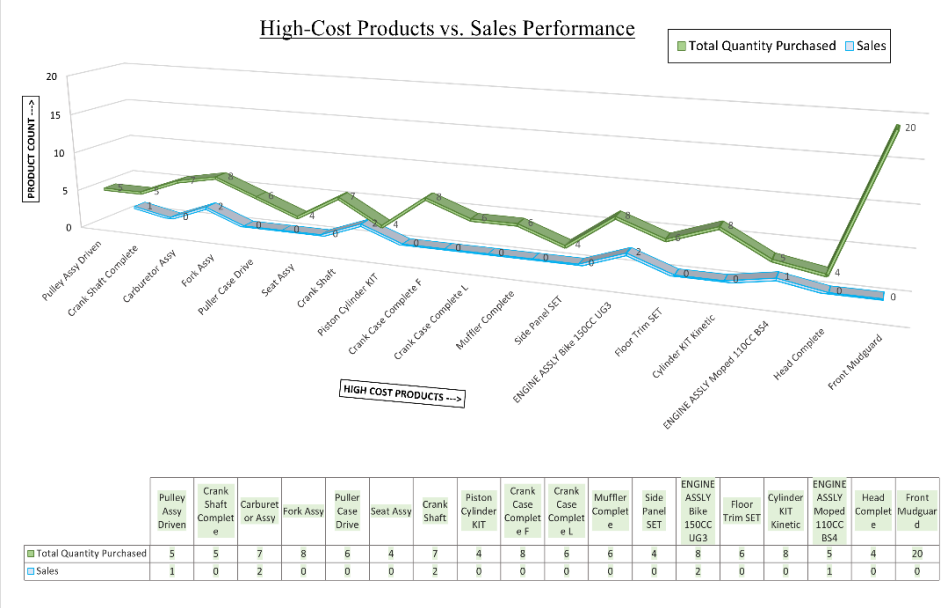
In addition to the daily bill analysis, we previously conducted an analysis of the inventory stocks availability for both scooters and bikes spare parts, as reported in the mid-term submission. In this analysis, we plotted the inventory stocks data for both vehicle types and observed notable trends.

- Inventory vs. Bill Trends: As previously discussed in our findings; bikes consistently resulted in higher billing amounts compared to scooters indicating increased service activities and possibly a greater need, for bikes spare parts. In contrast, we observed a surplus in scooter part inventory when compared to bikes parts which might signals an overstock situation with scooters spare parts. This discrepancy in inventory levels could potentially result in inefficiencies in parts management, with scooter spare parts possibly not being used effectively as bike spare parts.

3.3.2 Financial Strain from High-Cost, Low-Sales Inventory

In this analysis, we focused, on inventory items that have high purchase prices but low sales volumes that might be putting pressure on overall inventory control and profits management. We carried out the analysis by looking into the inventory data closely by concentrating on items that were purchased for more than **₹2000 per unit**. A special case was considered for the Front Mudguard (**₹1776 per unit**) which was included due to its significant quantity purchased (**20 units**) but no sales.

Using **Microsoft Excel**, the data was analyzed to find insights about the financial impact of such high-cost products in inventory with low-sales volumes. A **3D line graph** was plotted, showing the contrast between purchased quantities and sales quantities for these high-costing products over time. This visualization allows for an easy comparison between the products that are being purchased in large quantities but no or very low selling rates.



	Pulley Assy Driven	Crank Shaft Complete	Carburetor Assy	Fork Assy	Puller Case Drive	Seat Assy	Crank Shaft	Piston Cylinder KIT	Crank Case Complete F	Crank Case Complete L	Muffler Complete	Side Panel SET	ENGINE ASSLY Bike 150CC UG3	Floor Trim SET	Cylinder KIT Kinetic	ENGINE ASSLY Moped 110CC BS4	Head Complete	Front Mudguard
Total Quantity Purchased	5	5	7	8	6	4	7	4	8	6	6	4	8	6	8	5	4	20
Sales	1	0	2	0	0	0	2	0	0	0	0	0	2	0	0	1	0	0

Figure(3.3.2.a): High Cost Products vs. Sales Performance

Key Findings:

1. **High-Cost Inventory Products with Low Sales:** Many expensive inventory items, with sales were identified from Figure (3.3.2.a) several products, like **Pulley Assy Driven**, **Crank Shaft Complete**, **Fork Assy**, and **Crank Case Complete** for scooters, showed a significant difference between purchase and sales. For instance:
    - The **Pulley Assy Driven** (**₹4110** per unit) had in total of 5 units purchased, but only 1 was sold, resulting in an unsold stock value of **₹16,440**.
    - **Crank Shaft Complete** (**₹4013** per unit) had 5 units purchased, with 0 sales, resulting in **₹20,065** locked up in unsold inventory.
2. **No Sales for Some Products:**
    - The **Front Mudguard** (**₹1776** per unit), was purchased in bulk quantities (**20 units**), did not generated any sales, resulting in **₹35,520** in unsold inventory, causing a considerable financial burden on the business's capital.
    - Similarly, the **Fork Assy** (**₹3753** per unit) showed **8 units** purchased and 0 sales recorded as far, which also adds up to **₹30,024** in unsold stock.
3. **Overall Financial Impact:**
    - The total financial strain from the total of these high-cost, low-sales products inventory is calculated based on the difference between purchased quantities and sales. For the products mentioned above (Figure 3.3.2.a), a total of approximately **₹100,000** is locked up in unsold stock (if all purchases are considered with no sales).
    - **Analysis Implication:** A considerable amount of the stores funds is being held up by items that sell slowly; this situation may impact the cash flow negatively. It is crucial for the business to reassess its purchasing strategy, focusing more on products with faster turnover to enhance inventory control and alleviate financial strain.

The results underscore the importance of carefully Monitoring high value inventory items closely is crucial to align them with sales performance emphasizing the need to reevaluating the purchasing strategy, for moving products and alleviate any financial strain, on the business.

4. Comprehensive Synthesis and Proposed Strategic Recommendations:

4.1 Dynamic Pricing Model Recommendation:

This analysis considers the shift from a fixed 10% service charge on spare parts to an adjustable dynamic pricing model based on time that is designed to better reflect actual labor and service time requirements with what customers are actually charged. With the service-percentage being a fixed number, no matter how involved it is to service each vehicle, this can create discrepancies in billing fairness. The proposed model takes labor time into account as one of the more important variables that would connect service charges and servicer driven effort, which could provide a better reflection of cost-to-serve. This change aims to increase profitability, while still offering fair and accurate billing.

Current model [Fixed Service Charge] $= P + (P \times 0.10)$
$where: P = Total\ cost\ of\ spare\ parts, 0.10\ is\ service\ charge\ (10\%)$

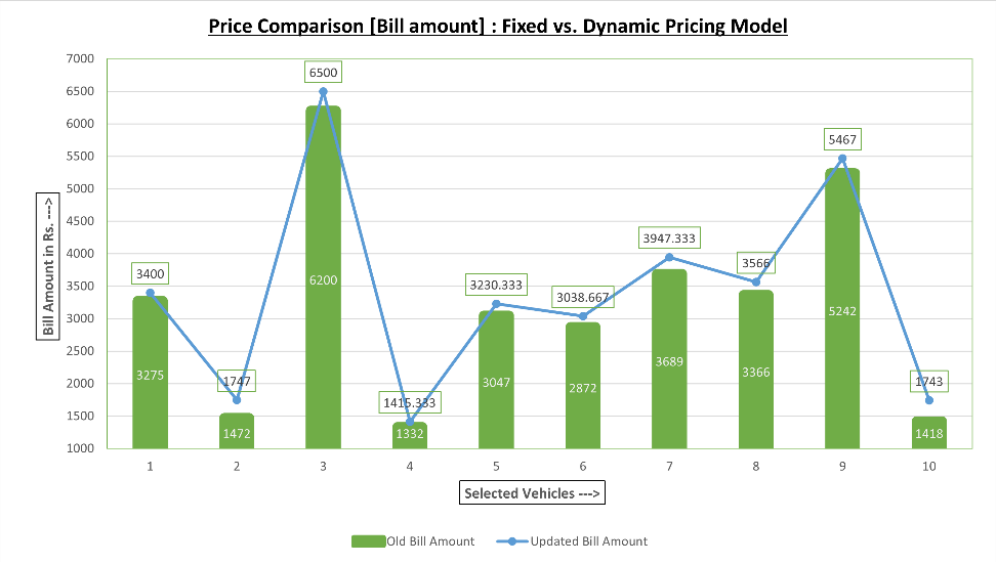
Proposed Model[Dynamic] $= P + (P \times 0.10) + T100$
$where: P =, Total\ cost\ of\ spare\ parts, 0.10\ is\ service\ charge (10\%), T = Total\ time\ of\ service\ in\ hours, 100\ is\ 100 rs.a.e.hourly$

• This formula allows flexibility by introducing an hourly labour rate on top of a base service percentage, factoring both time and material costs.

- **Hourly Labor Rate:** Industry standards suggest an hourly rate of ₹100–₹200(market research), depending on repair complexity as **₹100/hour** for basic and short-duration tasks and **₹200/hour** for intensive, specialized labour.
- According to several automotive repair benchmarks, In the Indian market, basic labor service charges are estimated between Rs. 100-200 per hour, based on location, vehicle type and level of service complexity. This will be no different from what most repair shops and service centers would charge, ensuring that the pricing structure remains competitive while covering operational costs We are obviously assuming an Rs. 100 here and this is a rough estimate, which stands in accordance with the general pricing practices within the industry.

Comparison of Fixed vs. Dynamic Pricing

1. **Sample Data Review and Selection**
   The analysis utilizes a random sample of 10 vehicle entries representing different service types such as scooters and bikes with details about spare parts and quantities used, service & labor charges, total time needed to provide the services along with respective final bill amounts for existing pricing model and proposed pricing model. Individual repair times were allocated to the different types of parts based on further market research. This was added to the parts cost in the dynamic model by summing these values and using an hourly labor rate of ₹100 for each vehicle repair time. This really illustrates the fact that time-based charges provide a more equitable billing practice for varying levels of service complexities.
2. **Graphical Representation and Proposed Model Analysis:**



Figure(4.1.2.a): Price Comparison (Bill Amount): Fixed vs. Dynamic Pricing Model.

- Visualizing the impact through bar and line graph (Figure 4.1.2.a) help visualize the effects between these two models, with the dynamic model line consistently above the fixed-rate model, especially in high-service-time cases. This comparison highlights the way in which dynamic model accommodates to service-specific demands, resulting in a steeper revenue curve.
- **Increased Revenue per Service**: Under the proposed model, the final bill is on average higher under this model as a greater share of the labour costs are absorbed. For example, in the service entry for the "vehicle-1" ,where the fixed bill was Rs. 3275, the dynamic model spiked the total to Rs. 3400, resulting in an additional Rs. 125 profit and according to data reports roughly the same difference of around Rs.2141 overall revenue from the random sample data.
- **Detailed Numerical Insights**: The time-intensive nature of the service also causes different increases on specific cases. The analysis revealed cases where the additional service charge significantly raised the total amount of bill, illustrating how a time-based billing model can lead to greater accuracy in cost recovery.

This addition clarifies the rationale behind adopting a dynamic model, illustrating how similar services are now charged at different rates depending on the time needed to complete them, which are currently undercharged for more labor-intensive work.

4.2 Strategic Recommendation for Engine Oil and Engine Flush Bundling Based on Market Basket Analysis.

From our findings, engine oil and engine flush are definitely related. Also, it maintains the vehicle engine health. While the Engine oil is responsible for lubricating and protecting the engine components, the engine flush removes the deposits and contaminants that have built up in the engine and will keep the new (or clean) oil working effectively to preserve the life of engine and increase engine longevity. This makes bundling these services a natural and beneficial option for customers. Additonally it is one of the huge profit margins earning product.

Some Recommendations to improve Engine Flush sales:

- **Engine Flush Recommendation Frequency:** Engine Flush needs to be recommended if customer buying engine oil for **a 2 years old** or above vehicle irrespective of running it on road for kilometers. This is derived from the high probability of **Engine Flush** purchased with **Engine Oil** as per the market research and market Basket Analysis method conducted.
- **Customer Segmentation:** Target **high-mileage vehicle owners** and also **old vehicles**. These vehicles tend to require more frequent maintenance and they are more likely to benefit from such a service, as these vehicles will have much higher chances of sludge building up in the engine in time. Also, customers with **higher service frequency** (such as those visiting regularly for maintenance) should be encouraged to consider this service as part of a comprehensive maintenance package.
- **Bundled Service Promotions:** Create special offers and attractive promotions like "Engine Oil + Engine Flush Combo at X% off" or limited-time deals to make customers use both services Bundle the Engine Flush with Engine Oil changes. This is a good practice in terms of vehicle health. Bundling Engine Flush with Engine Oil changes and offering it as a **package** not only increases the appeal of the recommendation but also boosts customer uptake of both services.
- **Cross-Selling Opportunities:** Influence the strong association between Engine Oil and Engine Flush to create cross-sell opportunities effectively. Uplift service staff to recommend customers Engine Flush during oil changes, making it a natural part of the service. Offer a discounted combo price to incentivize customers and if a customer declines the offer, consider negotiating with a slight lower profit margin to close the deal.
- **Informing/Educating Customers about the Need for Engine Flush:** Essentially, Educating and informing customers about the importance as well as the requirement of Engine Flush can increase the likelihood customers accepting the recommendation. Promote the immediate and long-term benefits of an Engine Flush by explaining how the process rids your engine of harmful sludge and other contaminants that can cause wear over time.

4.3Strategic Recommendations for Daily Billing Analysis and Inventory Optimization

Here are some Insights for Optimized Billing and Balanced Inventory Management:

- **Daily Service Patterns:** With evident, since the number of services done for both scooters and bikes on a given day seems to vary, targeted promotions can be created. For instance, there could be days when the counts of scooters serviced are lower than average, in such a situation, try attracting scooter owners by possibly running specials offers and targeted promotions on spare parts or bundled service offers exclusively for scooters.
- **Demand Anticipation for High-Bill Days:** Days with a significant spike in sales, like 10th to 15th July, exposes essential days/events where demand can be anticipated well in advance. By analyzing these high-sales periods, the store could implement limited time offers over the expected peaks to increase customer volume and work schedule staff accordingly.
- **Adjust Inventory to Meet Demand:** The analysis shows a mismatch between inventory and bill trends, thus adequate changes should be made in the levels of inventory as per demand, decrease unnecessary scooter parts and redistribute resources to bike parts considering bikes yield higher service bills. As a result, this will help to ensure better alignment of turn and reduced carrying costs on slow-moving items. Also, implement dynamic stock thresholds to retain higher stock for frequently serviced parts whose service is frequent and contributes significantly to revenue while stock of scooter parts should be aligned in accordance with actual servicing requirements.
- **In-depth Cost Comparison:** The overall bill stands at **₹1,07,448**for bike and **₹1,05,357**for scooter, tracking this data through types of vehicles allows to understand the margin in every type of vehicle

service. Apply these findings to prioritize services that are more profitable and perhaps implement service packages during the workflow, which will add on fees for higher-margin items.

- **Optimizing Staffing and Inventory for Cost Efficiency and Demand Alignment:** Based on our analysis, including insights from the daily service trend graph, which shows an average vehicle count of fewer than five, we recommend adjusting the number of service technicians accordingly. Currently, staffing one to two technicians should meet demand, with up to three as a flexible maximum to accommodate slight fluctuations. This approach is economical idle on labor cost and increases profits until a substantial rise in daily service volume warrants additional staff. Overall, we believe this streamlined staffing combined with a more optimized inventory position will enable margin-maximizing revenue by utilizing resources where they earn the highest return and gaining a good hand on cost controls.

4.4 Recommendations for Managing High-Cost, Low-Sales Inventory:

The analysis of high-cost, low-sales inventory has revealed a significant amount of capital tied product sitting on the shelf. For example, Slow-moving items such as the **Pulley Assy Driven**, **Crank Shaft Complete**, and **Front Mudguard** have a high value of unsold stock which exceeds **₹100000** across many products. This leaves the business with strain on business's capital and cash-flow issues, as these products are clearly not selling at expected rate despite of heavy investments.

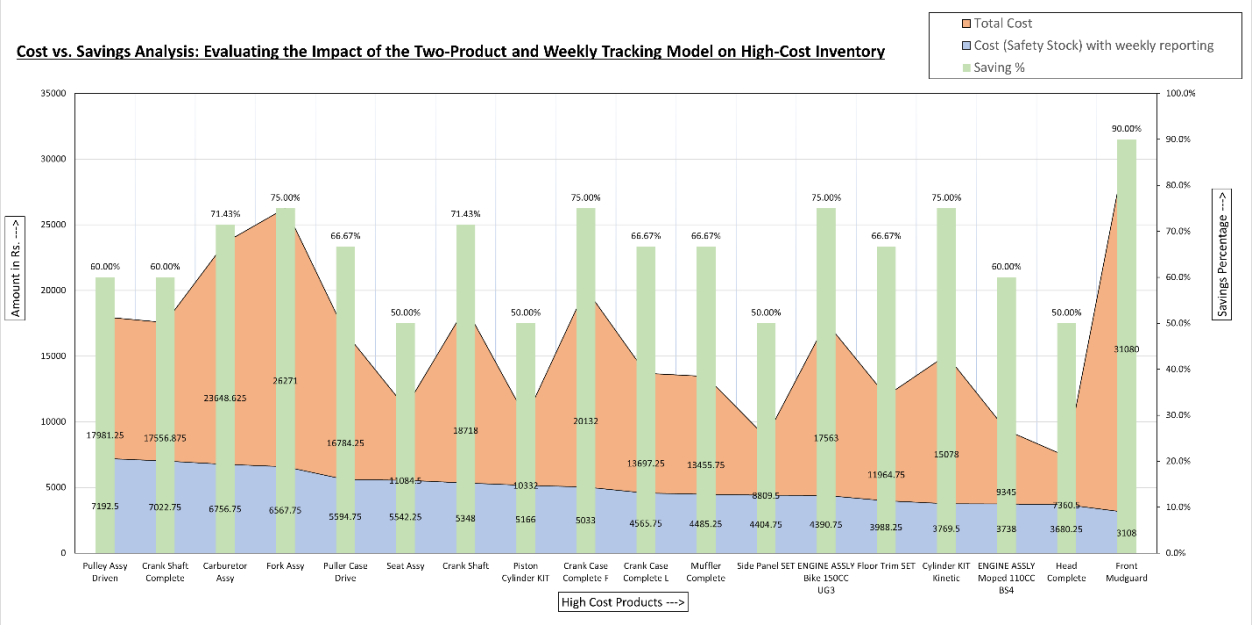
Proposed Model: Two-Product Plus Weekly Tracking System.

To address this issue, we propose a **Two-Product Plus Weekly Tracking Model**. The model focuses on two key components:

1. **Average Sales and Maximum Sales Analysis**: We analysed the average (0.4 unit) and maximum sales(2units) per product within these high-cost products, we determined optimal stock levels that would prevent from over-purchasing of these high-cost stocks. For instance, we assessed the sales performance over a specific period and identified the most efficient inventory levels based on real sales data, that is **2 unit as a safety stock.**
2. **Weekly Tracking of Inventory**: We advise tracking inventory once a week to optimize its levels. This enables to reorder supplies in time based on the demand, when stock is needed to be refilled but not overstocking and the accumulation of unsold goods.

Cost Estimation and Profit Margin Derivation: To calculate accurate costs, we derived the cost prices of the products using a average 12.5% profit margin, which are typical for two-wheeler spare parts rangers around (10-15) %. This was then applied to the selling prices in the dataset to assess an approximate buying price for each individual product.

Graphical Representation: The impact of this model is illustrated graphically, where we plot the contrast between high-purchase items and their sales trends. This graph (Figure 4.4.a) explains out the potential savings and efficiency gained by applying the proposed model, which advocates the value of tracking sales versus inventory levels and adjusting procurement practices accordingly.



Figure(4.4.a): Cost vs. Saving Analysis: Evaluating the Impact of Two-Product and Weekly Tracking Model on High Cost Inventory.

The graph reveals how the **Two-Product + Weekly Tracking Model** can free up significant cash flow from reduced overstocking. For instance, the **Pulley Assy Driven**, with 5 units purchased and only 1 sold, would have **₹8,220** in savings by purchasing just 2 units and tracking sales on weekly basis. Taking this route leads to a total savings of approximately **₹2,00,508** across the analyzed high-cost products lying in inventory. By maintaining a minimum safety stock of 2 units and replenishing based on actual sales, the products will offer better inventory turnover for the business and thus improve profitability.

Proposed Recommendations:

- **Refine Purchasing Strategy**: Focus on purchasing high-demand items while minimizing or adopting very low stock policy for slow-moving, high-cost products. Use a "Two-Product + Weekly Tracking" model to ensure replenishment is exclusively done based on sales trends.
- **Implement Weekly Tracking**: Check all inventory weekly to confirm alignment of stock matches up with the actual sales trends, which also will limit any overstocking.
- **Establish Safety Stock Levels**: Maintain a minimum stock threshold for high-cost items (e.g., 2 units), only replenishing when stock falls below that level based on sales.
- **Optimize Cash Flow**: Reduce excess inventory and free up capital, which can be reinvested in faster-moving products. This model is capable of saving approximately **₹200,508**, and boosting your overall profitability.

Extended Strategic Approaches for Business Optimization:

- Building on the findings from our previous analysis regarding low stock levels (click here for previous analysis) versus high consumption rates, it was noticed that several products, such as AIR Filter Rcf/12, BAJAJ 4 T Premium Engine Oil, S E M Two wheeler Brake Shoe Front, S E M Two

Wheeler Brake Shoe Rear, and SERVO 4T SAE 4 Stroke Engine Oil, had a good amount of consumption/sales rates (ranging from 9 to 18 units) but relatively low ordering quantities. This imbalance between actual consumption and stock orders pointed to a problem with the procurement process and the risks of "cut to cut" inventory, where stock is only ordered based on immediate needs.

Proposed Solution: To avoid the pitfalls of cut-to-cut inventory management and ensure the availability of required stocks level, we recommend switching to a strategy of orders based on bulk or wholesale purchasing from high-profit and discounted distributors in the market. By acquiring these high-selling rate products in bulk quantities, the business can reduce the risk of stockouts and can also take advantages of taking prices, and therefore minimizing the cost-per-unit costs and ensuring that inventory is always available to meet demand.

- **Sales and Inventory Data Automation:** To improve inventory management, it is recommended to automate the integration of sales data with inventory records. Sales And Inventory Are Maintained Separately at Present, Which Requires Manual Updating and Results. In Some Discrepancy. To streamline operations and enhance data accuracy, it is recommended TO Integrate sales data automatically with inventory records to reduce human intervention and ensure high-quality data. This will allow real-time updates to inventory levels as sales occur, improving stock accuracy, minimizing manual errors, and facilitating more efficient stock management and decision-making.
- **Digital Customer Data Management and Vehicle Tracking**: As of now, customer data is primarily managed through traditional way, relying on word-of-mouth marketing and personal recognition based on mutual relationships. Additionally, critical information such as vehicle kilo meters driven is not captured, henceforth limiting the use-full trends on usage and service needs. To optimize customer engagement and service efficiency, it is recommended to implement a digital system that are capable of capturing records which includes customer details, contact information, purchase history, and vehicle Kilo metes driven. Integrating this data with service records will enable personalized marketing, improve customer relationship management, and ensure timely servicing reminders based on vehicle usage patterns. This drives from manual to digital data collection. This will also empower the business with actionable insights, enhancing decision-making and customer satisfaction.