

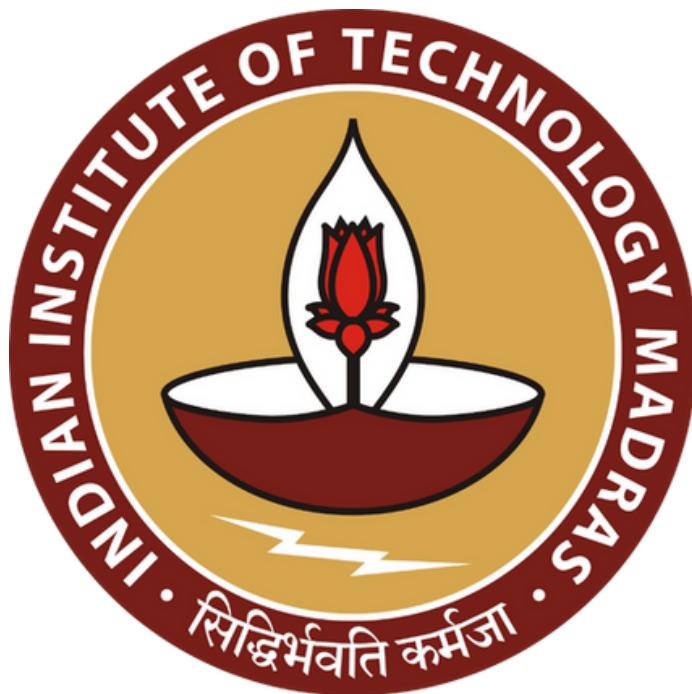
# **Increasing Operational Effectiveness: KD Hero's Demand and Inventory Analysis**

**A Final Report for the BDM Capstone Project**

Submitted by

Vishnu Kumar Jha

23f3004186



IITM Online BS Degree Program,  
Indian Institute of Technology, Madras,  
Chennai Tamil Nadu, India, 600036

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## **1. Executive Summary**

This report provides an operational analysis of KD Hero, a leading two-wheeler dealership, examining demand and inventory management from July to December 2024. The goal was to identify key sales trends, assess inventory practices, and recommend strategies to improve efficiency and profitability.

A significant operational challenge identified was the persistent misalignment between procurement and actual sales. Purchases consistently exceeded sales, especially in the post-festival period, resulting in excess inventory and increased carrying costs. The use of a static reorder point (ROP) failed to account for dynamic market demand, leading to both overstocking and stockouts at different times. Additionally, inventory imbalances were observed, with some models experiencing surplus while others faced shortages or even negative stock levels, indicating reconciliation issues.

The analysis leveraged transactional data from KD Hero's internal ERP system, encompassing purchase and sales records, and employed robust data cleaning, standardization, and segmentation techniques. Advanced analytical tools such as time series analysis, regression modeling, and ABC inventory classification were utilized to uncover sales patterns, forecast demand, and optimize inventory allocation.

Key findings indicate that sales exhibited a pronounced seasonal pattern, peaking during the Indian festive months of October and declining sharply thereafter. The dealership's revenue was heavily concentrated among a few high-performing models—particularly Splendor+, Splendor+ XTEC, Passion+, and Xtreme 125R—underscoring the importance of prioritizing these models in inventory and promotional strategies.

The report recommends adopting a dynamic inventory management system that adjusts reorder points using real-time sales data and forecasts. Procurement should be closely aligned with actual sales, leveraging just-in-time or min-max strategies to minimize excess stock. Maintaining optimal inventory for high-demand models and reducing investment in slow-movers is essential. Regularly improving forecasting and monitoring key metrics will drive efficiency and growth.

In summary, KD Hero's operational strengths in the mass-market segment are clear, but modernization of inventory and demand management practices is critical. Implementing data-driven, dynamic systems will improve efficiency, reduce costs, and position the dealership for long-term growth and customer satisfaction.

## **2.Detailed Explanation of Analysis Process/Method**

Operational analysis in the context of automotive dealerships is critical for optimizing inventory, maximizing sales, and reducing costs. For KD Hero, a leading dealership specializing in two-wheelers, the period from July to December 2024 presented an opportunity to evaluate and enhance operational efficiency. This methodology outlines the systematic approach taken to collect, preprocess, analyze, and interpret data for actionable insights. The analysis was designed to be robust, replicable, and aligned with industry best practices.

### **2. Data Collection and Preprocessing:**

#### **2.1 Data Sources**

The foundation of this analysis was transactional data sourced directly from KD Hero's internal Enterprise Resource Planning (ERP) system. For the selected six-month period (July–December 2024), the following datasets were extracted:

- **Purchase Records:** 906 entries detailing model, transaction date, color, pre- and post-GST pricing, vehicle identification number (VIN), engine number and inventory location.
- **Sales Transactions:** 579 entries with fields including date of sale, model name, VIN, engine number, customer details, price (pre- and post-GST).

#### **2.2 Data Preprocessing:**

Data preprocessing is a critical step to ensure analytical accuracy and consistency. The following procedures were meticulously followed:

##### **Data Cleaning:**

- **Missing Values:** Numerical fields with missing values were imputed using mean substitution, while categorical fields (e.g., model name) were filled using the mode.
- **Outlier Detection:** Extreme values in transaction amounts and quantities were flagged and verified with source documents.
- **Duplicate Removal:** Duplicate entries, especially in purchase and sales records, were identified using VIN and transaction date as composite keys and were removed.

##### **Standardization:**

- **Date Formats:** All date fields were standardized to the DD-MM-YYYY format to ensure consistency across datasets.
- **Currency Formatting:** All monetary values were converted and formatted in Indian Rupees (₹), ensuring uniformity in financial analysis.

- **Tax Component Separation:** Pre-GST and post-GST prices were separated for each transaction to facilitate accurate margin and tax analysis.

### **Segmentation and Categorization:**

- **Monthly Segmentation:** Data was segmented into monthly periods to enable time series analysis and trend detection.
- **Model Categorization:** Models were classified by price range (e.g., ₹60,000–₹75,000, premium segment).

## **3. Analytical Tools and Software:**

### **3.1 Microsoft Excel**

Microsoft Excel served as the primary analytical tool due to its accessibility, versatility, and robust feature set for business analytics:

- **Data Handling:** Filtering, sorting, and conditional formatting were used for initial data exploration.
- **Computation:** Formula-based adjustments (e.g., calculating margins, inventory turnover) were performed using built-in functions.
- **Visualization:** PivotTables and PivotCharts provided dynamic summaries and visual representations of key metrics.
- **Statistical Functions:** Functions such as TREND and LINEST were used for regression and predictive modeling.

## **4. Analytical Techniques:**

### **4.1 Time Series Analysis**

The primary objective was to uncover seasonal trends, cyclical patterns, and irregular fluctuations in sales volume over the six-month period.

- **Aggregation:** Sales data was aggregated at the monthly level for each model.
- **Moving Averages:** A 3-month Simple Moving Average (SMA) was applied to smooth short-term fluctuations and highlight underlying trends.
- **Visualization:** Line charts were used to visualize sales trends, overlaid with moving averages for clarity.

### **4.2 Regression Modeling:**

To quantify the relationship between sales and potential drivers, linear regression analysis was conducted:

- **Model Specification:** Sales volume was modeled as a function of time (month), festive period (October as a dummy variable), and promotional activities.

- **Regression Equation:**
  - $y = 756029x + 4E + 06$
  - where y is the sales volume and x is the time period.
- **Goodness of Fit:** The  $R^2$  value was 0.2208, indicating that time alone explained 22% of the variance in sales, suggesting additional factors were influential.

#### **4.3 ABC Inventory Classification:**

To categorize inventory based on sales contribution and optimize stock management strategies:

- **Calculation:** Total sales value for each model was computed over the analysis period.
- **Classification:**
  - **Category A:** Top 70% of cumulative sales value (e.g., Splendor+, Passion+, Xtreme 125R).
  - **Category B:** Next 20% of sales value.
  - **Category C:** Remaining 10%, typically slow-moving or niche models.
- **Actionable Insights:** Stocking and procurement priorities were aligned with ABC categories, with Category A models receiving the highest attention.

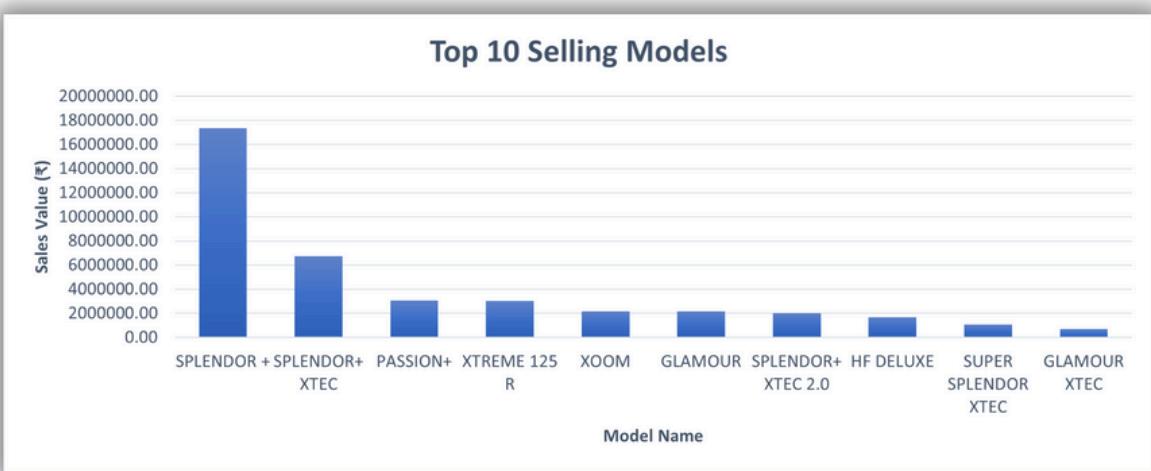
**Dataset Link:** [Click Here](#)

### **3. Results and Findings**



***Figure 1: Sales Trend Over Time***

- Sales showed a consistent upward trend from July (₹3.57 million) through October (₹11.09 million). The sharp rise, particularly from August to October, coincides with major Indian festivals such as Dussehra and Diwali, which are traditionally high-sales periods due to increased consumer spending on gifts, electronics, apparel, and other goods.
- After peaking in October, sales dropped significantly to ₹7.09 million in November and further to ₹6.46 million in December.
- The sales pattern is highly seasonal, with clear peaks during the festive months and troughs afterward. This underscores the importance of implementing seasonal inventory strategies:
  - Stock up ahead of festivals to meet increased demand and avoid stockouts.
  - Scale back inventory post-festival to minimize excess stock and reduce carrying costs.
- The trendline equation ( $y=756029x+4E+06$ ) and the  $R^2$  value (0.2208) indicate a weak correlation between time and sales growth.
- A low  $R^2$  suggests that sales are not steadily increasing month over month but are instead heavily influenced by seasonal events. This means that, while there may be some underlying growth, the primary driver of sales fluctuations is seasonality rather than consistent long-term growth.



**Figure 2: Top 10 Selling Models**

- Splendor+ and Splendor+ XTEC collectively generated the highest sales revenue by a substantial margin, far surpassing all other models in the lineup. Their dominance can be attributed to their reputation for reliability, fuel efficiency, and affordability, which have cultivated strong brand loyalty among customers.
- Passion+ and Xtreme 125R also made significant contributions to overall sales, positioning themselves as stable performers in the mid-range segment. These models appeal to customers seeking a balance between price, performance, and fuel efficiency.
- Their steady demand helps stabilize monthly sales figures, reducing dependency on just one or two models.
- Models like Xoom, Glamour, Splendor+ XTEC 2.0, HF Deluxe, Super Splendor XTEC, and Glamour XTEC contributed moderately to total sales. While their individual sales figures are lower compared to the top four, their presence is crucial for offering variety and catering to niche preferences within the customer base.
- The sales distribution clearly indicates that focusing on a few high-performing models—especially Splendor+ and Splendor+ XTEC—should be a priority for stocking and promotional activities. This strategy can optimize inventory turnover, reduce excess stock, and enhance overall profitability.



**Figure 3: ABC Inventory Classification**

### “A” Category Models: Major Revenue Drivers

- Models such as Glamour, Splendor+, and Xtreme 125R fall into the “A” category, as depicted by their large share in the cumulative percentage on the graph. These models consistently generate the highest sales and revenue, making them critical to the dealership’s success.

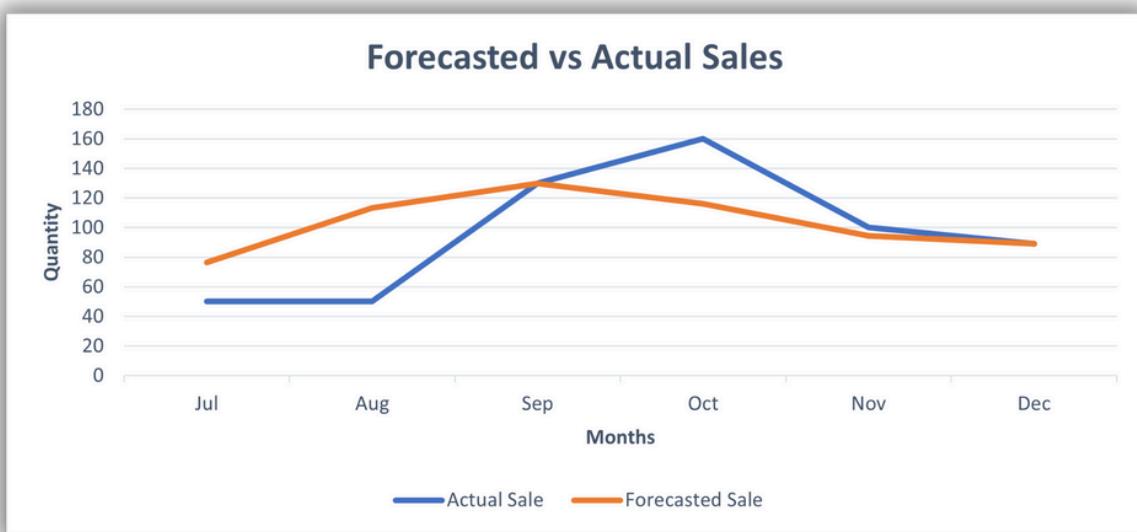
### “B” Category Models: Moderate Contributors Needing Attention

- The “B” category includes models with moderate sales contributions, positioned in the middle of the cumulative percentage curve. These models do not sell as rapidly as “A” models but still play an important role in maintaining a balanced product mix and meeting varied customer preferences.

### “C” Category Models: Low Performers and Inventory Drains

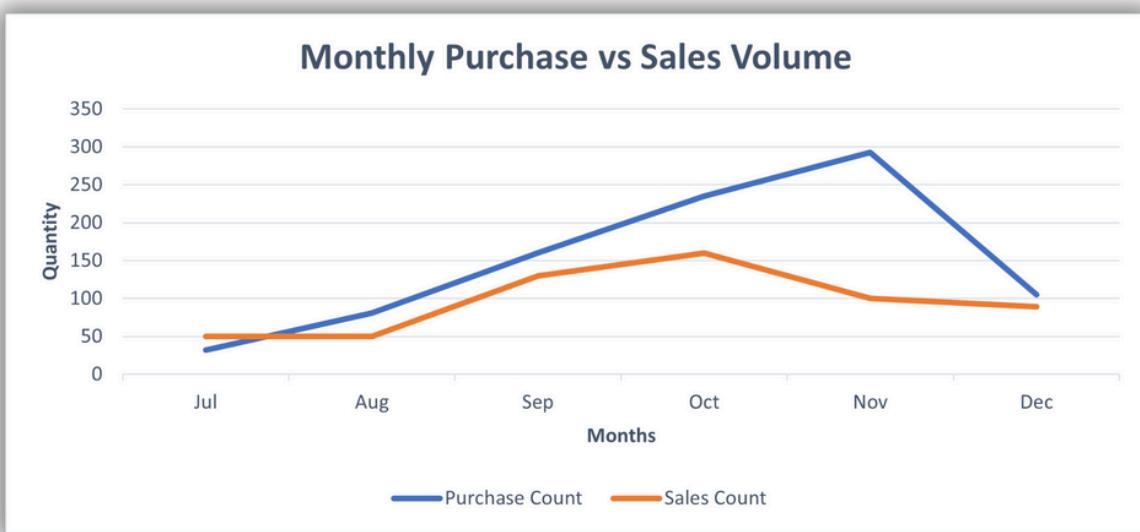
- Models in the “C” category, such as HF 100 and Destini Prime, contribute minimally to overall sales and are found at the far right of the graph with the lowest cumulative percentages. These slow-moving products can tie up valuable inventory space and capital, reducing overall efficiency and profitability.

Applying ABC analysis enables dealerships to allocate resources-capital, space, and marketing efforts-more effectively, focusing on high-impact models. This targeted approach improves operational efficiency by reducing excess inventory, minimizing stockouts of popular models, and ensuring a product mix that aligns with actual market demand.



**Figure 4: Forecasted vs Actual Sales**

- The graph shows that forecasted and actual sales followed distinctly different patterns from July through December. Contrary to tracking closely until September, the data reveals that actual sales were significantly below forecasts in July and August. In July, actual sales were approximately 50 units while forecasts predicted around 75 units. This suggests an initial overestimation of market demand during summer months.
- By September, actual sales caught up with forecasted figures, with both lines intersecting at approximately 130 units. This convergence likely occurred due to the beginning of the festive season preparations in India, when consumer spending traditionally increases as customers prepare for celebrations.
- October shows the most significant divergence, with actual sales reaching approximately 160 units-far exceeding the forecasted 120 units. This represents a substantial 33% positive variance from predictions. The dramatic spike can be attributed to:
  - Heightened festival season purchasing during Dussehra and Diwali periods.
  - Possible promotional activities and discounts offered during the festive season.
- Following October's peak, actual sales dropped sharply in November to approximately 100 units, while forecasted sales showed a more gradual decline to about 110 units.



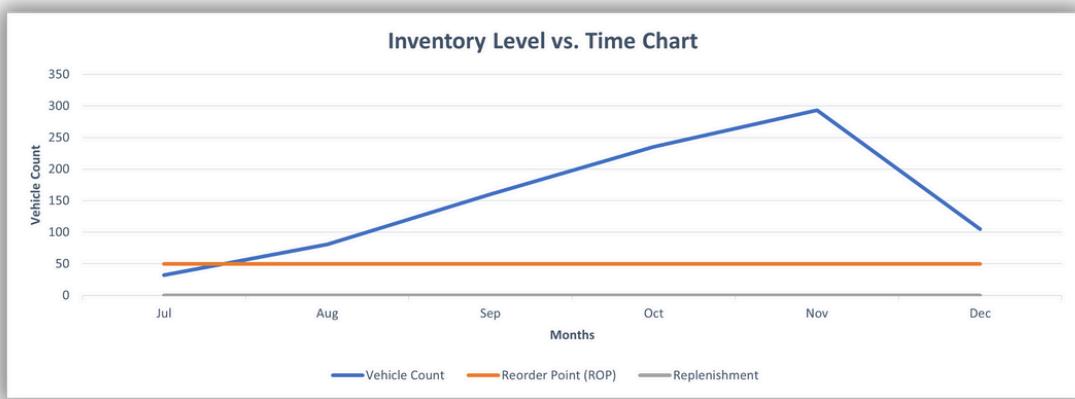
**Figure 5: Monthly Purchase vs Sales Volume**

- The data reveals a consistent pattern where purchases exceeded sales throughout the entire six-month period, creating a problematic inventory situation. In July, purchases started below sales (approximately 30 units vs 50 units), but quickly surpassed them in August and maintained this gap through December. The most concerning discrepancy occurred in November, when purchases spiked dramatically to nearly 300 units while sales declined to about 100 units-creating a massive 200-unit inventory surplus in a single month. This suggests the dealership anticipated continued strong sales following the October festive period but significantly misjudged actual market demand.
- From July through October, the purchase pattern shows better alignment with sales trends, though purchases still consistently exceeded actual sales volume. Both metrics show an upward trajectory during this period, with purchases increasing from 30 units to approximately 250 units, while sales grew from 50 units to about 160 units. This parallel growth pattern suggests some degree of strategic procurement planning.
- However, the post-festival period (November-December) reveals a critical misalignment in procurement strategy. While sales began declining after October's festive peak, purchases continued rising to their highest point in November before finally decreasing in December. This indicates a fundamental failure to accurately forecast the typical post-festival sales slump, resulting in unnecessary procurement precisely when inventory reduction should have been prioritized.



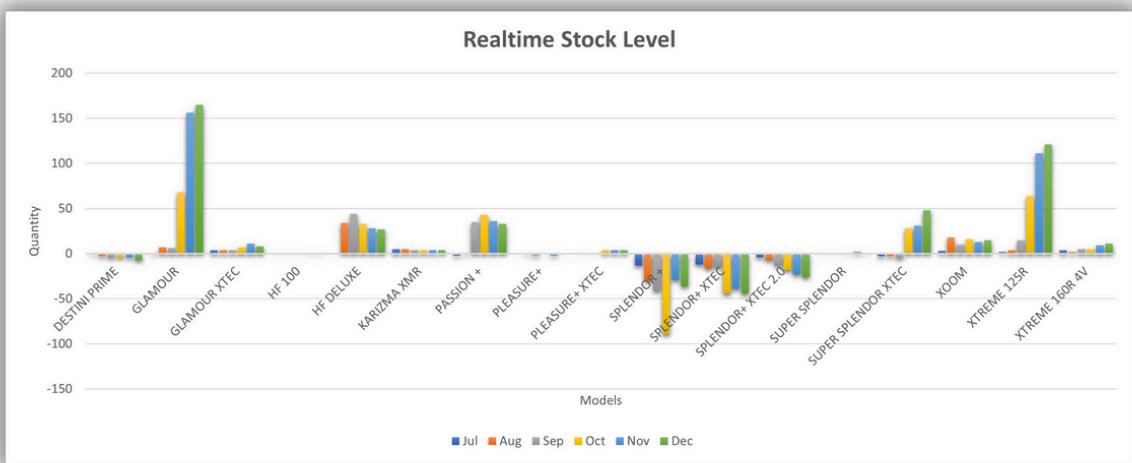
**Figure 6: Inventory Growth Over Time**

- The inventory count shows a consistent upward trend from July to November, culminating in a peak of 327 units by November. This sustained growth reflects a deliberate strategy to ramp up stock levels in anticipation of increased demand during the festive season. The company likely aimed to avoid stockouts and meet customer expectations during a critical sales period, leading to aggressive purchasing and inventory accumulation.
- The sharp rise in inventory, especially between October (118 units) and November (311 units), indicates a significant procurement push. This was likely driven by forecasts of heightened sales during the festive months, a common practice in many industries where seasonal demand spikes are anticipated. The intent was to ensure ample product availability and capitalize on potential revenue opportunities.
- Despite the proactive stocking, the inventory build-up exceeded the pace at which products were sold or absorbed by the market. This mismatch suggests that actual festive demand fell short of projections, or that replenishment was not closely aligned with real-time sales data. Overestimating demand, possibly influenced by optimistic sales forecasts, led to excess stock accumulating in the system.
- By December, the inventory count increased only slightly from 311 to 327 units, indicating a minor correction. This modest change suggests that much of the inventory remained unsold, becoming slow-moving stock.



**Figure 7: Inventory Level vs Time Chart**

- The data visualization clearly illustrates a dramatic increase in vehicle inventory levels over a six-month period, with the count rising from approximately 30 units in July to nearly 300 units in November before declining to about 100 units in December. Throughout this entire period of significant inventory fluctuation, the Reorder Point (ROP) remained unchanged at approximately 50 units. This static approach to inventory management demonstrates a fundamental disconnect between the replenishment trigger mechanism and the actual seasonal demand patterns.
- The fixed ROP functioned adequately during the early months when inventory levels were lower, but became increasingly problematic as vehicle counts surged beyond 150 units in September and continued climbing through November. This unchanging threshold failed to adjust to the dynamic market conditions, resulting in an inventory management system that couldn't effectively respond to the substantial seasonal variations experienced during this period.
- During high-demand months like October, when inventory levels reached approximately 250 units, the static ROP of 50 units proved severely insufficient for maintaining optimal stock levels. The chart demonstrates that a significant gap developed between actual inventory levels and the reorder trigger point. For fast-moving vehicle models experiencing higher sales velocity during these peak periods, the fixed ROP would have triggered replenishment orders too late in the sales cycle. This timing mismatch likely resulted in delayed procurement of popular models precisely when customer demand was highest. The static threshold failed to account for the accelerated depletion rates of inventory during these busy months, potentially leading to missed sales opportunities, extended customer wait times, and diminished customer satisfaction.



**Figure 8: Realtime Stock Level**

- The real-time stock level chart reveals a significant imbalance in inventory distribution across the product lineup. Two models-Glamour and Xtreme 125R-dominate the inventory count with substantially higher stock levels than all other models. Glamour shows peak inventory of approximately 160 units in December, following consistently high levels exceeding 150 units in earlier months.
- Similarly, Xtreme 125R maintains inventory levels around 100-120 units throughout November and December. This concentration aligns with actual market preferences, suggesting these models experience strong customer demand that justifies their disproportionate inventory allocation. Their prominent inventory position likely represents an appropriate resource allocation based on sales performance metrics and market share objectives.
- In stark contrast to the high-performing models, several product lines exhibit concerning inventory patterns that signal fundamental supply chain or demand issues. Pleasure+, Destini Prime, and HF 100 consistently show minimal or even negative stock levels across the six-month period. Negative inventory figures for Destini Prime across multiple months suggest serious reconciliation problems, potentially indicating unfulfilled backorders, accounting discrepancies, or returns exceeding available stock.
- Similarly, the near-zero inventory levels for Pleasure+ and HF 100 reflect either extreme supply constraints or, more likely, minimal customer interest that doesn't justify maintaining significant stock. Other models like Splendor and Splendor+ XTEC also display negative inventory during certain months, revealing systemic issues in inventory planning or demand forecasting.

- These patterns indicate either deliberate decisions to minimize investment in underperforming models or significant errors in stock management that require immediate attention.



*Figure 9: Purchase Amount Trend*

- The purchase amount chart reveals a consistent and increasingly aggressive procurement strategy from July through November 2024. Starting from approximately ₹3 million in July, purchases nearly doubled to ₹5.5 million in August, followed by another substantial jump to ₹9.5 million in September. This upward trajectory accelerated dramatically in October, reaching approximately ₹19 million, before peaking at over ₹22 million in November-representing a more than 600% increase from July's baseline.
- This strategic escalation in procurement spending was deliberately timed to coincide with India's major festive season (Dussehra, Diwali, and associated celebrations), when consumer spending typically surges. The progressive month-on-month increases reflect a calculated build-up approach, with spending intensifying as the core festive period approached. This front-loading strategy aimed to ensure optimal stock availability during peak consumer demand, preventing potential lost sales opportunities due to stockouts.
- The purchase amount graph illustrates a precipitous decline from the November peak of ₹22+ million to approximately ₹8 million in December-a reduction of nearly 64% in a single month.

- This dramatic correction signals a reactive response to diminishing sales momentum following the festive period, likely compounded by the recognition of significant overstocking across multiple product categories.
- The sharp procurement pullback indicates an emergency adjustment rather than a planned tapering, suggesting that anticipated sales volumes failed to materialize at projected levels. This misalignment between purchasing and actual market absorption rates has significant financial implications, with considerable working capital now locked into slow-moving or excess inventory.
- The graph visualizes a classic bullwhip effect in supply chain management, where demand signal distortions lead to increasingly exaggerated procurement responses upstream. Beyond the immediate financial impact, this situation potentially creates additional costs in terms of extended warehouse requirements, inventory management overhead, and potential future discounting necessary to move aging stock.



**Figure 10: Sales Price Distribution**

- The sales price distribution histogram reveals a striking concentration pattern with 471 units (81.3% of total sales) falling within the ₹60,000 to ₹75,000 price range. This overwhelming majority demonstrates a clear and decisive customer preference for more affordable two-wheeler options in KD Hero's market area. The strength of this entry-level to mid-segment category suggests several key market characteristics:
  - The local customer base likely consists predominantly of price-sensitive buyers who prioritize practical transportation over premium features.
  - The value proposition of vehicles in this price segment evidently resonates strongly with local customers' needs and expectations.

- This concentration also indicates a potential alignment with income levels in the region, where this price point represents an accessible purchase for the majority of prospective buyers.
- The data confirms that KD Hero has established a strong market position in the affordable segment, which serves as the backbone of their sales performance. This clustering pattern provides essential intelligence for product development, marketing strategies, and showroom display priorities going forward.
- The Figure 10 illustrates a pronounced drop-off in sales volume for higher-priced models, with only 59 units (approximately 10.2% of total sales) occurring above the ₹90,000 threshold. The premium segments show particularly weak performance:
  - Only 2 units sold in the ₹1,05,000 to ₹1,20,000 range.
  - Zero units in the ₹1,20,000 to ₹1,35,000 bracket.
  - A single unit in the highest ₹1,35,000 to ₹1,50,000 category.
- This distribution pattern strongly indicates limited local market capacity for premium two-wheeler models at KD Hero's location. The dramatic sales decline at higher price points reflects the regional economic reality - the purchasing power of the local customer base appears predominantly concentrated in more affordable product segments.
- This trend likely stems from factors including average household income levels, consumer financing accessibility, perceived value-for-money at different price points, and practical usage needs versus luxury preferences in the region. The data effectively establishes an upper price threshold beyond which sales potential diminishes substantially, suggesting that the dealership operates in a market where practical transportation solutions take precedence over premium features and brand prestige.

## **4. Interpretation of Results and Recommendation**

The analysis of KD Hero's operational data from July to December 2024 reveals several critical insights:

- **Sales Trends & Seasonality:** Sales increased steadily from July, peaked in October (high-demand festive season), and then declined sharply in November and December. This clear seasonality suggests inventory and marketing strategies must align closely with predictable sales cycles to maximize efficiency.
- **Top Selling Models:** Revenue is heavily concentrated among a few models - Splendor+, Splendor+ XTEC, Passion+, and Xtreme 125R. These should be prioritized in inventory and promotional strategies, as maintaining optimal stock levels for these models directly impacts customer satisfaction and revenue.
- **ABC Inventory Classification:** A small group of models (Category 'A') accounts for most sales. The 'B' and 'C' categories contribute less. This classification helps focus resources on high-performing models while managing lower-performing ones with caution.
- **Forecasting Accuracy:** Forecasts matched actual sales until September, but actual sales outpaced forecasts during the festive peak. This highlights the need for dynamic, responsive forecasting systems, especially during high-variance periods.
- **Procurement vs Sales:** Purchase volumes consistently exceeded sales, leading to inventory buildup, especially in October and November. This overstocking points to a need for tighter coordination between procurement and sales forecasts.
- **Inventory Management Flaws:** The Reorder Point (ROP) remained static despite sales fluctuations, causing both stockouts and overstocking. Implementing a dynamic ROP system, recalculating based on moving averages and supplier lead times, would address these inefficiencies.
- **Stock Level Imbalances:** High-selling models had healthy stock, but several low-selling models faced shortages or surpluses, with some even recording negative inventory. Dynamic inventory balancing, supported by live sales tracking, is needed to align stock with demand.

- **Purchase Spending Trends:** Purchase spending rose steadily until November, then dropped sharply in December, reflecting heavy pre-festive investments and a subsequent slowdown due to surplus realization.
- **Sales Price Distribution:** Most sales occurred in the ₹60,000–₹75,000 range, confirming KD Hero's affordability-driven customer base. Premium models sold poorly, indicating limited demand in this segment.

### **Recommendations:**

- Move to dynamic inventory management and procurement, adjusting based on real-time sales and updated forecasts.
- Prioritize stocking high-demand models and reduce investment in slow-movers.
- Evolve forecasting to include external factors and rolling updates.
- Align procurement more closely with expected sales, adopting just-in-time or min-max stock strategies.
- Strengthen data integration, monitoring, and reconciliation to eliminate stock inconsistencies.
- Regularly review key metrics (inventory turnover, carrying costs, stock-outs, lead times) and align procurement incentives with turnover, not just volume.
- Strategic Outlook: KD Hero is strong in the mass-market commuter segment but must modernize operational practices. Implementing dynamic forecasting, smarter inventory management, and better procurement planning will enhance profitability and customer service, ensuring sustainable growth.

KD Hero's growth potential is significant, but operational excellence in inventory and demand management is crucial. The analysis provides a roadmap for modernization, emphasizing data-driven decisions, dynamic systems, and strategic focus on high-performing models.