Data Analysis Report: Used Vehicle Sales

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June 7, 2024

Abstract

This report presents the analysis of a dataset related to the purchase and sale of used vehicles. The analysis includes calculating profit margins, evaluating inventory times, assessing market demand, and understanding buyer profiles. The goal is to derive actionable insights to aid in business decision-making.

Contents

1 Introduction

This report analyzes a dataset containing information about used vehicle sales. The purpose of this analysis is to evaluate the dataset, identify patterns, and present useful conclusions that can help in making informed business decisions.

2 Objectives and Methodologies

This section outlines the specific objectives of the analysis and the methodologies used to achieve them.

2.1 Profit Margin Analysis

Objective: Calculate the average profit margin for each vehicle.
Methodology:

1. Calculate the profit for each transaction by subtracting the purchase price from the sale price for each vehicle.

$$\text{Profit} = \text{Selling Price} - \text{Purchase Price} \tag{1}$$

2. Calculate the profit margin for each transaction.

$$\text{Profit Margin (\%)} = \left(\frac{\text{Profit}}{\text{Selling Price}}\right) \times 100 \tag{2}$$

3. Calculate the average profit margin across all transactions. This provides a benchmark for the business's profitability.

$$\text{Average Profit Margin (\%)} = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{\text{Profit}_i}{\text{Selling Price}_i}\right) \times 100 \tag{3}$$

Where:

- n: Total number of transactions.
- Profit_i: Profit for transaction i (equation 1).
- Selling Price_i: Selling price for transaction i.

4. Identify brands and models with the highest profit margins. This approach is achieved by breaking down the profit margin results in different segments as vehicle brand and model (figure 1). This helps in identifying which segments are more profitable.

2.2 Inventory Time Analysis

Objective: Determine which vehicles have the shortest and longest average inventory times.
Methodology:

1. Calculate the average inventory time for each brand and model.

$$\text{Average Inventory Time} = \frac{\sum_{i=1}^{n}\text{Inventory Time}_i}{n} \tag{4}$$

Where:

- n: Total number of transactions.

2. Identify which vehicles sell the fastest and which take the longest to sell (figure 3).

3 Analysis Based on Defined Objectives

Each analysis is implemented using Python, with each objective being addressed in its own dedicated folder within a structured GitHub repository. This directory structure ensures clarity, organization, and ease of navigation. The GitHub repository for the code is: `https://github.com/alexalcon/used_vehicle_sales_data_analysis`

3.1 Profit Margin Analysis

The profit margin analysis methodology is organized in a folder named `objective_analysis_1` within the Github repository. The profit (equation 1), profit margin (equation 2) and the average profit margin (equation 3) calculation are applied in the script `profit_and_profit_margin.py`, where it is obtained the results of the brands/models with the highest profit margins and the average profit margin (figure 1). Besides, a table (figure 2) of the profit and profit margin values for each brand/model is obtained in the script `profit_and_profit_margin_table.py`. These scripts apply the procedure described in the profit margin analysis objective methodology 2.1.

3.2 Inventory Time Analysis

The inventory time analysis methodology is organized in a folder named `objective_analysis_2` within the GitHub repository. The average inventory time calculation (equation 4) is applied in the script `inventory_time_analysis.py`, where it is obtained the results of the brands/models with the shortest and longest average inventory times (figure 3). Besides, a table (figure 4) of the average inventory time values for each brand/model is obtained in the script `inventory_time_table.py`. These scripts apply the procedure described in the inventory time analysis objective methodology 2.2.

4 Findings

This section presents the results of the analysis, supported by charts and tables.

4.1 Profit Margin Analysis

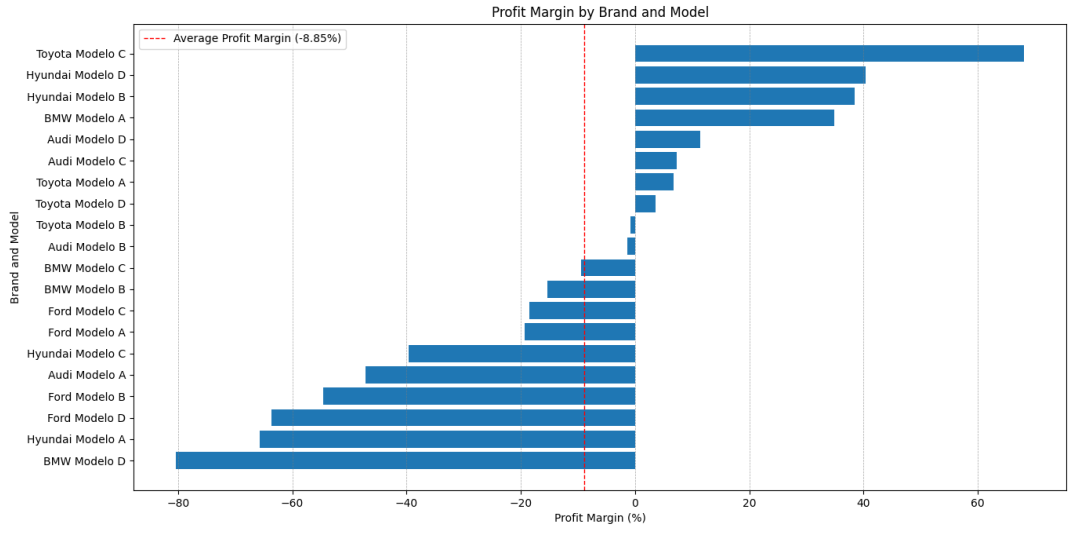

Figure 1: Profit Margins by Vehicle Brand and Model

The bar chart titled "Profit Margin by Brand and Model" (figure 1) displays the profit margins for various vehicle models across different brands. The x-axis represents the profit margin percentage (%), while the y-axis lists the specific vehicle brands and models. Each bar indicates the profit margin for a particular vehicle model, with positive values to the right and negative values to the left. Also the average profit margin (equation 3) is depicted.

Figure 2 shows the profit and profit margin percentages for various vehicle brands and models. It includes the calculated profit for each model, the corresponding profit margin, and the combined brand and model information. This table is useful for understanding the financial performance of different vehicle models, highlighting the most and least profitable models.

Profit by Brand and Model Table

Marca	Modelo	Profit	Profit Margin (%)	Brand and Model
Toyota	Modelo C	21471.8	68.13060100123032	Toyota Modelo C
Hyundai	Modelo D	9591.2	40.31793137416749	Hyundai Modelo D
Hyundai	Modelo B	6554.666666666667	38.42586772652137 5	Hyundai Modelo B
BMW	Modelo A	14405.25	34.94055107107441	BMW Modelo A
Audi	Modelo D	2861.714285714286	11.37088971726489	Audi Modelo D
Audi	Modelo C	1215.25	7.235495149744204	Audi Modelo C
Toyota	Modelo A	2509.5714285714284	6.778615917686763	Toyota Modelo A
Toyota	Modelo D	4298.8	3.629750320530795	Toyota Modelo D
Toyota	Modelo B	1373.6	-0.8347239352976572	Toyota Modelo B
Audi	Modelo B	2071.0	-1.3181299648710798	Audi Modelo B
BMW	Modelo C	5947.6	-9.418083539755836	BMW Modelo C
BMW	Modelo B	1291.0	-15.327902458515194	BMW Modelo B
Ford	Modelo C	-2767.333333333333	-18.527233070756317	Ford Modelo C
Ford	Modelo A	3295.25	-19.305589357592623	Ford Modelo A
Hyundai	Modelo C	168.71428571428572	-39.6067114167878	Hyundai Modelo C
Audi	Modelo A	1863.4	-47.16619739074108	Audi Modelo A
Ford	Modelo B	-6890.8	-54.61145784557594	Ford Modelo B
Ford	Modelo D	-1479.75	-63.63865149383236	Ford Modelo D
Hyundai	Modelo A	9643.75	-65.75703206498915	Hyundai Modelo A
BMW	Modelo D	7272.333333333333	-80.3821463386385	BMW Modelo D

Figure 2: Profit by Vehicle Brand and Model

4.2 Inventory Time Analysis

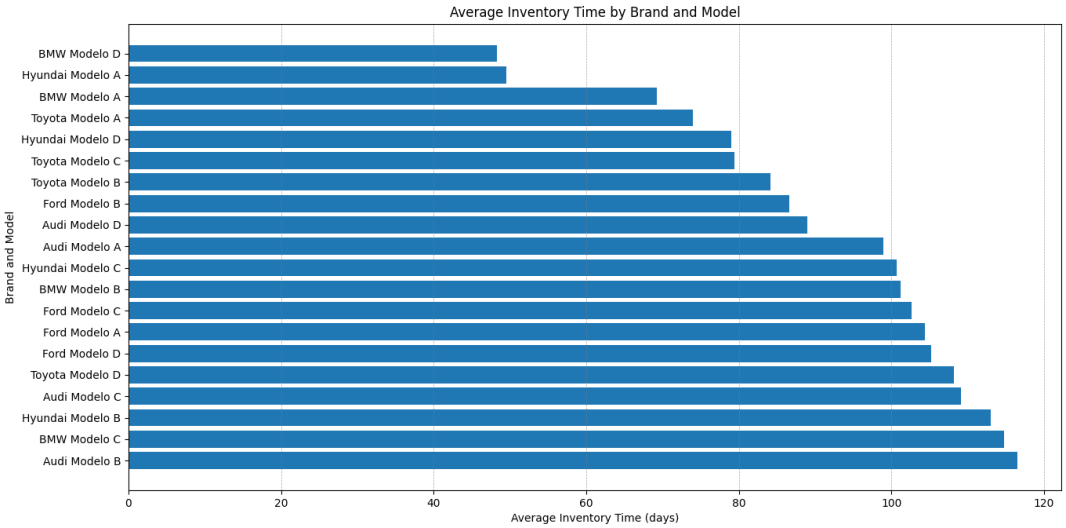

Figure 3: Average Inventory Time by Vehicle Brand and Model

Figure 3 displays the average inventory time in days for various vehicle brands and models. The horizontal bar chart highlights that BMW Modelo D has the shortest average inventory time, indicating it sells the fastest, while Audi Modelo B has the longest average inventory time, indicating it sells the slowest. This visualization provides a quick comparison of inventory turnover rates among different models.

Figure 4 shows the average inventory time in days for various vehicle brands and models. It provides detailed information on how long each model stays in inventory before being sold. The table helps identify which models have the shortest and longest average inventory times, aiding in inventory management and sales strategy development.

Profit by Brand and Model Table

Marca	Modelo	Average Inventory Time (days)
BMW	Modelo D	48.333333333333336
Hyundai	Modelo A	49.5
BMW	Modelo A	69.25
Toyota	Modelo A	74.0
Hyundai	Modelo D	79.0
Toyota	Modelo C	79.4
Toyota	Modelo B	84.2
Ford	Modelo B	86.6
Audi	Modelo D	89.0
Audi	Modelo A	99.0
Hyundai	Modelo C	100.71428571428572
BMW	Modelo B	101.2
Ford	Modelo C	102.66666666666669
Ford	Modelo A	104.375
Ford	Modelo D	105.25
Toyota	Modelo D	108.2
Audi	Modelo C	109.125
Hyundai	Modelo B	113.0
BMW	Modelo C	114.8
Audi	Modelo B	116.5

Figure 4: Average Inventory Time Values by Vehicle Brand and Model

5 Conclusions and Recommendations

This section summarizes the key findings of the analysis and offers recommendations for improving business decisions based on these findings.

5.1 Summary of Findings

The analysis of the used vehicle sales dataset has provided several key insights:

- **Profit Margin Analysis**:
  - The profit margins for various vehicle models show significant variation, with some models demonstrating high profitability while others result in losses.
  - Models like Toyota Modelo C and Hyundai Modelo D have high profit margins, making them the most profitable.
  - Conversely, models such as BMW Modelo C and Audi Modelo A have negative profit margins, indicating losses.
- **Inventory Time Analysis**:
  - The average inventory time for vehicle models varies, with some models selling much faster than others.
  - BMW Modelo D has the shortest average inventory time, indicating it is the fastest-selling model.
  - Audi Modelo B has the longest average inventory time, indicating it is the slowest-selling model.

5.2 Recommendations

Based on the findings, the following recommendations are proposed to improve business performance:

- **Optimize Inventory**:

  - Focus on stocking and promoting vehicle models with the shortest inventory times, such as BMW Modelo D, to improve turnover rates and reduce holding costs.
  - Reduce inventory levels of slow-selling models like Audi Modelo B to free up capital and storage space.

- **Enhance Marketing Efforts**:
  - Target marketing campaigns towards high-demand and high-profit models, such as Toyota Modelo C and Hyundai Modelo D, to maximize revenue and profitability.
  - Utilize customer satisfaction data to highlight positive aspects and features of these high-demand models in promotional materials.

- **Tailor Sales Strategies**:
  - Develop sales strategies that cater to the demographics of the most satisfied buyers, ensuring personalized and effective customer interactions.
  - Implement loyalty programs or special offers for repeat buyers of high-profit models to encourage brand loyalty and repeat purchases.