Analyzing the Impact of Car Features on Price and Profitability

Final Project-3

Kiruba Shankar S

Data Analytics Trainee

Description:

The automotive industry has seen significant transformation over the past few decades, with an increasing emphasis on fuel efficiency, environmental sustainability, and technological advancements. As competition among manufacturers intensifies and consumer preferences evolve, understanding the key drivers of car demand has become crucial.

Recently, there has been a noticeable shift towards electric and hybrid vehicles, alongside a growing interest in alternative fuels like hydrogen and natural gas. Despite these trends, traditional gasoline-powered vehicles continue to dominate the market, offering consumers a variety of fuel types and grades to choose from.

Approach:

- Data Exploration: Explored and cleaned dataset for accuracy and consistency.

- Descriptive Statistics: Summarized data using statistics and visualizations for insights.

- Regression Analysis: Analyzed feature-price relationships through multiple linear regression.

- Market Segmentation: Categorized cars into profitable segments based on features.

- Modeling and Challenges: Applied machine learning; addressed multicollinearity and data imbalance.
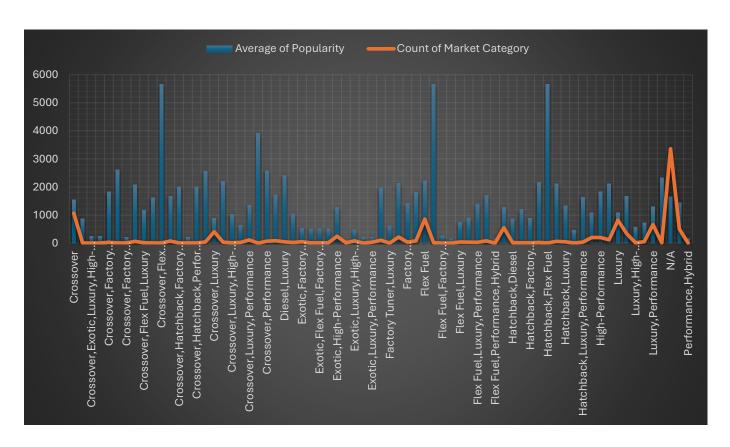
Tech_Stack Used:

- Excel

Data Cleaning:

- Cleared the duplicate values. Duplicate values 715.

- Used countA function to determine the missing values and identified the blank cells and deleted the sheet rows.
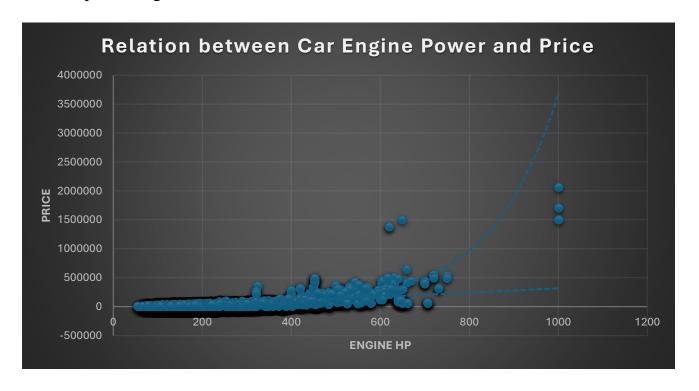
1. Task: Popularity of a car model vary across different market categories.

- The popularity of car models varies widely across different market categories. For example, "Crossover, Flex Fuel, Performance" has a very high average popularity (5657) but is only present in 6 instances, indicating a niche but highly popular category.

- Categories like "Flex Fuel" and "High-Performance" are generally more popular, especially when combined with "Factory Tuner" or "Performance".

- Some niche categories, such as "Crossover, Factory Tuner, Luxury, Performance" (2607), have high popularity but are less common, indicating potential for expansion in these segments.

- Categories like "Luxury" and "Hatchback" have many models but lower average popularity, showing broad appeal but less intense interest.

2. Task: The relationship between a car's engine power and its price.

- The graph shows a general positive correlation between engine power (HP) and car price. As engine power increases, the price tends to rise, especially noticeable after 600 HP.

- Cars with engine power above 600 HP experience a steep increase in price. This suggests that high-performance engines are significantly more expensive, possibly due to being part of luxury or high-performance car models.

- For cars with engine power below 600 HP, the price remains relatively stable with only slight increases.

- The sharp rise in price for engines with power above 800 HP suggests these are likely high-end or specialized vehicles, they are premium for their performance.

- A few data points at the extreme ends of the engine power scale (around 1000 HP) show prices significantly above the general trend, possibly representing exclusive, limited-edition, or exotic cars.
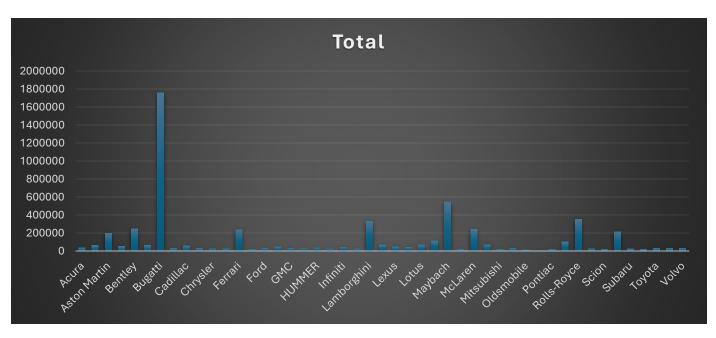

Relation between Car Engine Power and Price

3. Task: Important in determining a car's price.

- Intercept: The intercept has a significant negative value (-102,834.75). This suggests that if all other factors were zero, the base price would be significantly negative, which is theoretically impossible, indicating that this model likely includes base adjustments to account for omitted variables.

- Engine Cylinders: The coefficient for "Engine Cylinders" is the highest positive value (7483.33), implying that an increase in the number of cylinders leads to a considerable rise in the car's price.

- Engine HP: "Engine HP" has a positive coefficient (319.46), meaning higher horsepower contributes to a higher price, but its impact is less pronounced compared to the number of cylinders.

- Number of Doors: The "Number of Doors" has a negative coefficient (-4654.19), indicating that cars with more doors may be priced lower, possibly because two-door cars are often sports models, which tend to be more expensive.

- Fuel Efficiency (MPG): Both "Highway MPG" (540.56) and "City MPG" (1193.48) have positive coefficients, showing that better fuel efficiency slightly increases the car's price, with city MPG having a stronger impact than highway MPG. This suggests that consumers value fuel efficiency, especially in city driving.

Coefficients

	Intercept	Engine HP	Engine Cylinders	Number of Doors	highway MPG	city mpg
	-102834.7526	319.4607229	7483.325697	-4654.18699	540.5580602	1193.47926

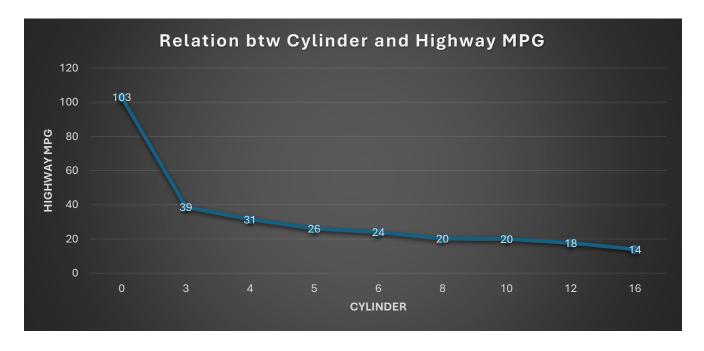## 4. Task: Average price of a car varies across different manufacturers.

- Luxury and High-End Brands: Brands like Bugatti, Rolls-Royce, and Lamborghini have significantly higher average prices, with Bugatti leading at approximately $1.76 million. These brands cater to a niche market with ultra-luxury and performance vehicles.

- Premium vs. Mass-Market: Premium brands such as BMW, Mercedes-Benz, and Porsche have average prices ranging from $62,000 to $101,000, indicating their positioning in the high-end segment. In contrast, mass-market brands like Chevrolet, Ford, and Honda have lower average prices, around $26,000 to $29,000.

- Ultra-Exclusive Brands: Maybach and Aston Martin also show very high average prices, reflecting their focus on exclusivity and luxury.

- Affordable Brands: Brands like FIAT, Mazda, and Mitsubishi have much lower average prices, ranging from $20,000 to $22,000. These brands cater to consumers seeking budget-friendly options.

- Mid-Range Brands: Brands like Volvo, Acura, and GMC fall into the mid-range price category, with averages around $29,000 to $35,000. These manufacturers balance between offering quality and affordability, appealing to a broader market segment.

5. Task: Relationship between fuel efficiency and the number of cylinders in a car's engine.

The data shows that cars with fewer cylinders are more fuel-efficient, while those with more cylinders tend to have lower fuel efficiency, likely due to increased fuel consumption for higher performance.

- Negative Correlation: There is a clear negative correlation between the number of cylinders and fuel efficiency. As the number of cylinders increases, the average highway MPG decreases. This suggests that cars with more cylinders generally consume more fuel.

- Low Cylinder Counts: Cars with fewer cylinders, such as those with 0 or 3 cylinders, show higher fuel efficiency.

- Increasing Cylinders: As the number of cylinders increases from 4 to 16, there is a noticeable drop in fuel efficiency. For example, cars with 4 cylinders have an average of 31 MPG, while those with 16 cylinders have only 14 MPG.

- Plateau at Higher Cylinders: The fuel efficiency seems to plateau at 20 MPG for cars with 8 and 10 cylinders. Beyond this point, even with an increase in cylinders (up to 16), the MPG does not significantly improve.

Result:

- Prices increase sharply with higher engine horsepower, particularly for vehicles exceeding 600 HP, indicating performance-driven pricing.

- Luxury brands like Bugatti and Rolls-Royce have much higher average prices compared to mass-market brands like Chevrolet.

- "Crossover" vehicles show diverse pricing, reflecting varied consumer preferences and feature offerings within this popular segment.

- Cars with more cylinders generally have lower fuel efficiency, highlighting a trade-off between performance and fuel economy.

- Better fuel efficiency, especially in city driving, tends to increase vehicle prices, reflecting consumer demand for cost savings.