Analyzing the Impact of Car Features on Price and Profitability

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Project Description

Objective:

- To analyze the relationship between car features, market categories, and pricing to identify popular and profitable features, optimizing pricing and product development decisions.

Key Outcomes:

- Understand consumer demand trends.
- Highlight features linked to profitability.
- Provide actionable recommendations for car manufacturers.

Dataset Overview

- Dataset: Car Features and MSRP
- Source: Kaggle (by Cooper Union)

Statistics:

- Observations: 11914
- Variables: 16

Key Variables:

- Make, Model, Year, Engine Fuel Type, Engine HP, Engine Cylinders, Transmission Type, Driven Wheels, Number of Doors, Market Category, Vehicle Size, Vehicle Style, Highway MPG, City MPG, Popularity, MSRP.

Tech Stack Used

Tools and Technologies:

- Microsoft Excel: Data Cleaning, Pivot Tables, Charts, and Dashboards
- Regression Analysis: Identifying key features affecting pricing
- Data Visualization: Scatter plots, bar charts, and line charts
- Interactive Dashboards: Slicers and filters for dynamic insights.

Data Cleaning and Preprocessing

Key Steps:

- Address missing values and duplicates.
- There are missing values in the following categories: Engine Fuel Type (3), Engine HP (69), Engine Cylinders (30), and Number of Doors (6).
- These rows were deleted as they were insignificant.

Outcome:

- The dataset is clean and well-structured, containing 11812 observations, making it suitable for advanced analysis.

Tasks Overview

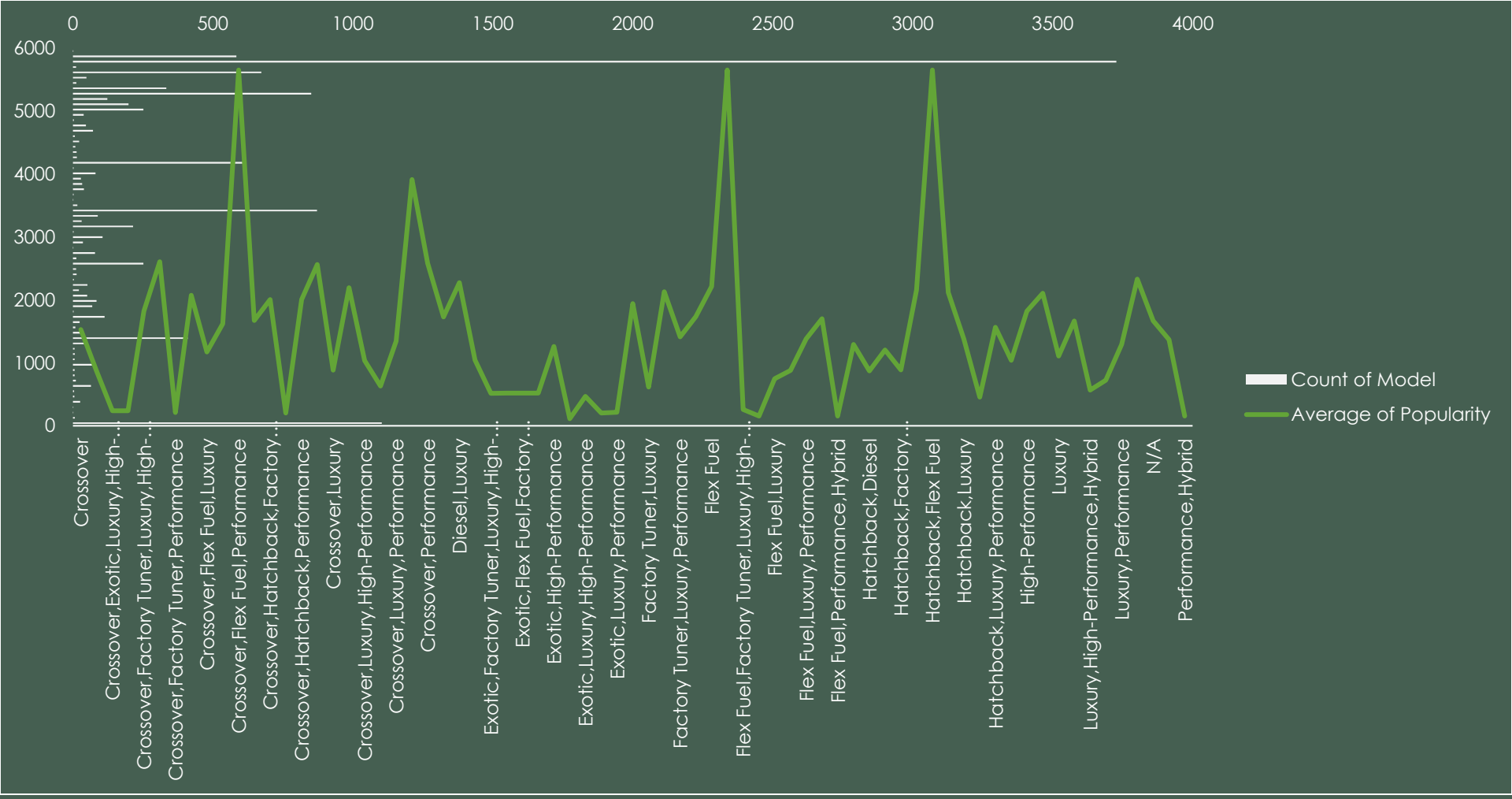
- Analyze popularity across market categories.
- Explore the relationship between engine power and price.
- Identify key features affecting price using regression analysis.
- Compare average prices across manufacturers.
- Examine the relationship between fuel efficiency and engine cylinders.
- Build an interactive dashboard to visualise insights dynamically.

Popularity Across Market Categories

Top 5 Most Popular Market Categories:
•Hatchback, Flex Fuel, Flex Fuel, Diesel, and Crossover categories with fuel-efficiency features are more popular, achieving higher popularity scores (~5657 on average).
•This suggests consumer preference for practical, fuel-efficient vehicles.

Top 5 Categories by Model Count:
•The "N/A" category dominates with the highest model count but has a moderate popularity score (1671.39).
•Crossover and Flex Fuel categories rank high in both model count and popularity, indicating their broad appeal.

Luxury Market Categories:
•Categories combining "Luxury" and "Performance" have a smaller number of models but maintain consistent popularity due to their niche target audience.

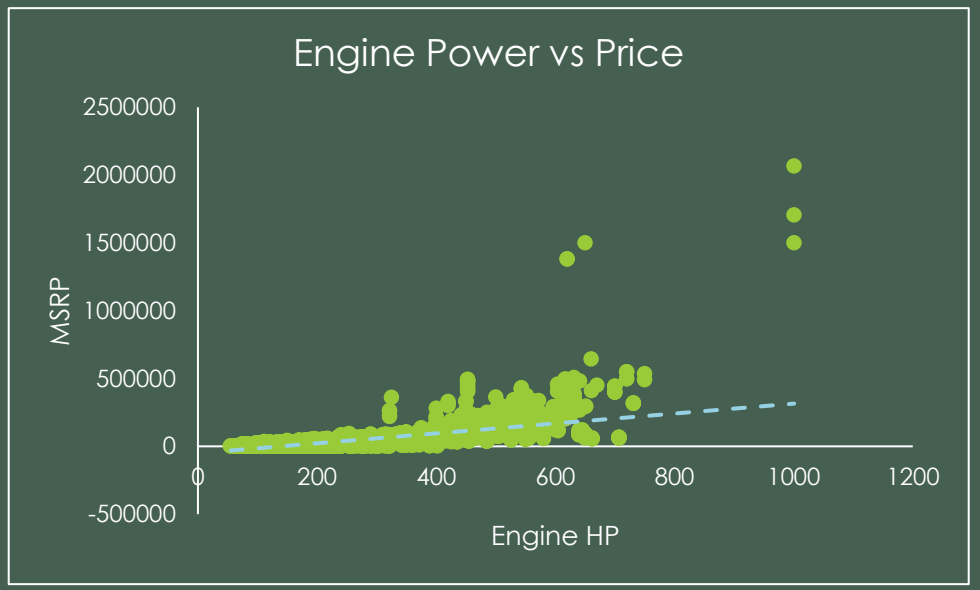


Conclusion

Market categories blending **flexibility (Flex Fuel)** or **performance (Luxury, Performance)** dominate in both volume and popularity, showing a balance between practicality and aspiration drives market success.

Analysing the Relationship Between Engine Power and Price

The scatter plot clearly illustrates the positive relationship between engine power and price, as indicated by the linear trendline. Vehicles with higher engine power, such as increased horsepower, generally tend to be more expensive. This can be attributed to factors like enhanced performance, premium features, and advanced engineering.



Key Car Features Influencing Price

Regression Analysis: Key Insights

- **Model Fit:**
  - **R-Square:** 0.47 — The model explains 47% of the variability in car price.
  - **Significance F:** 0 — The overall model is highly significant.

- **Key Influencers on Price:**
  1. **Engine HP (320.32)** and **Engine Cylinders (7211.85):** Strong positive impact on price (p-value = 0).
  2. **City MPG (1213.97)** and **Highway MPG (524.17):** Positive but smaller influence.
  3. **Number of Doors (-4816.18):** Negative impact, indicating fewer doors correlate with lower prices.
  4. **Popularity (-3.34):** Minimal negative effect.

- **Non-Significant Feature:**
  - **Year:** No meaningful relationship with price (p-value = 0.56).

Conclusion:

Engine power, number of engine cylinders, and fuel efficiency are the strongest predictors of price, whereas popularity and the number of doors have lesser yet notable effects. The year of the vehicle is not a significant factor.

Correlation Analysis: Key Insights

1.Strong Positive Correlations with Price (MSRP):

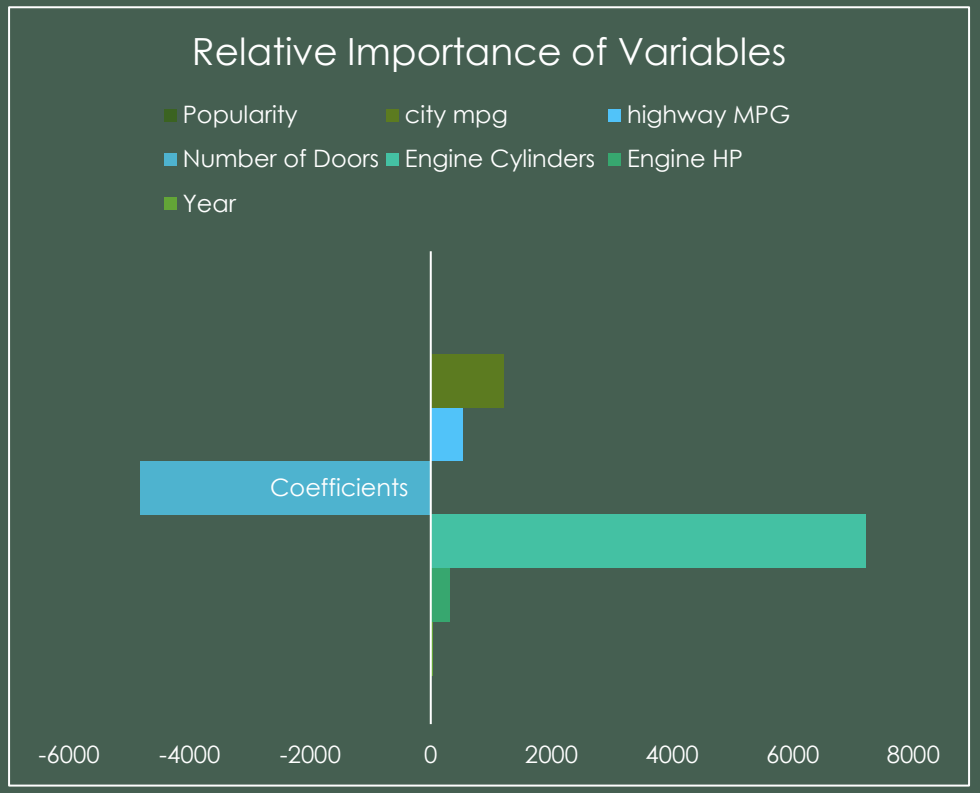
- **Engine HP (0.66)** and **Engine Cylinders (0.54):** They have the strongest positive relationship with price.

2.Moderate Negative Correlations:

- **City MPG (-0.23)** and **Highway MPG (-0.20):** Higher fuel efficiency slightly reduces the price.

3.Weak or Negligible Relationships:

- **Year (0.23):** Weak positive correlation.
- **Popularity (-0.05):** Almost no impact on price.
- **Number of Doors (-0.13):** Minimal negative effect.

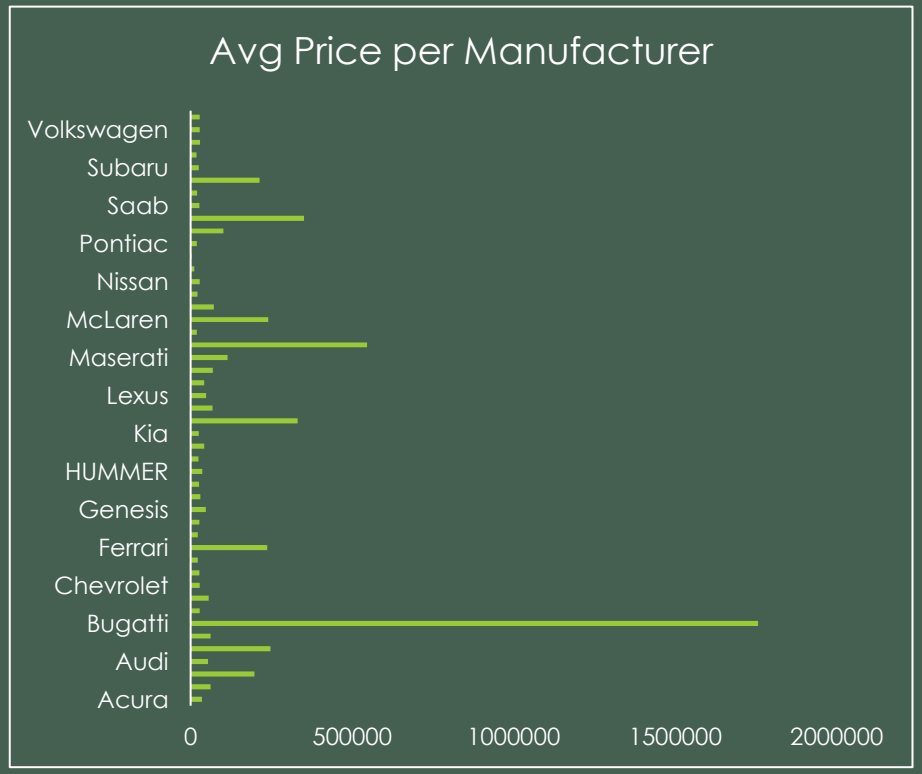


Conclusion:

Engine power and engine cylinders are key factors driving car price, while fuel efficiency shows a weak inverse effect. Other variables like popularity and year have negligible influence.

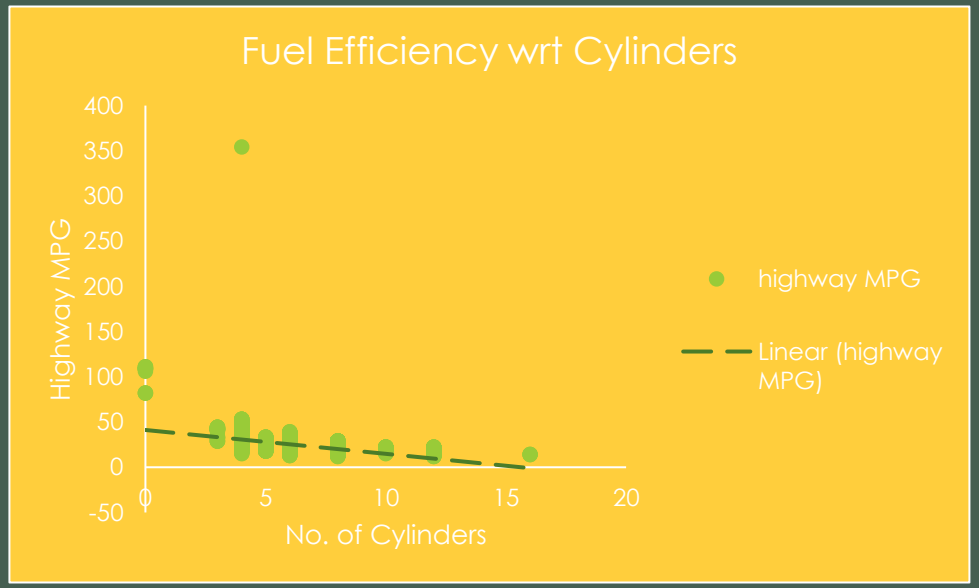
Analysis of Average Car Prices Across Various Manufacturers

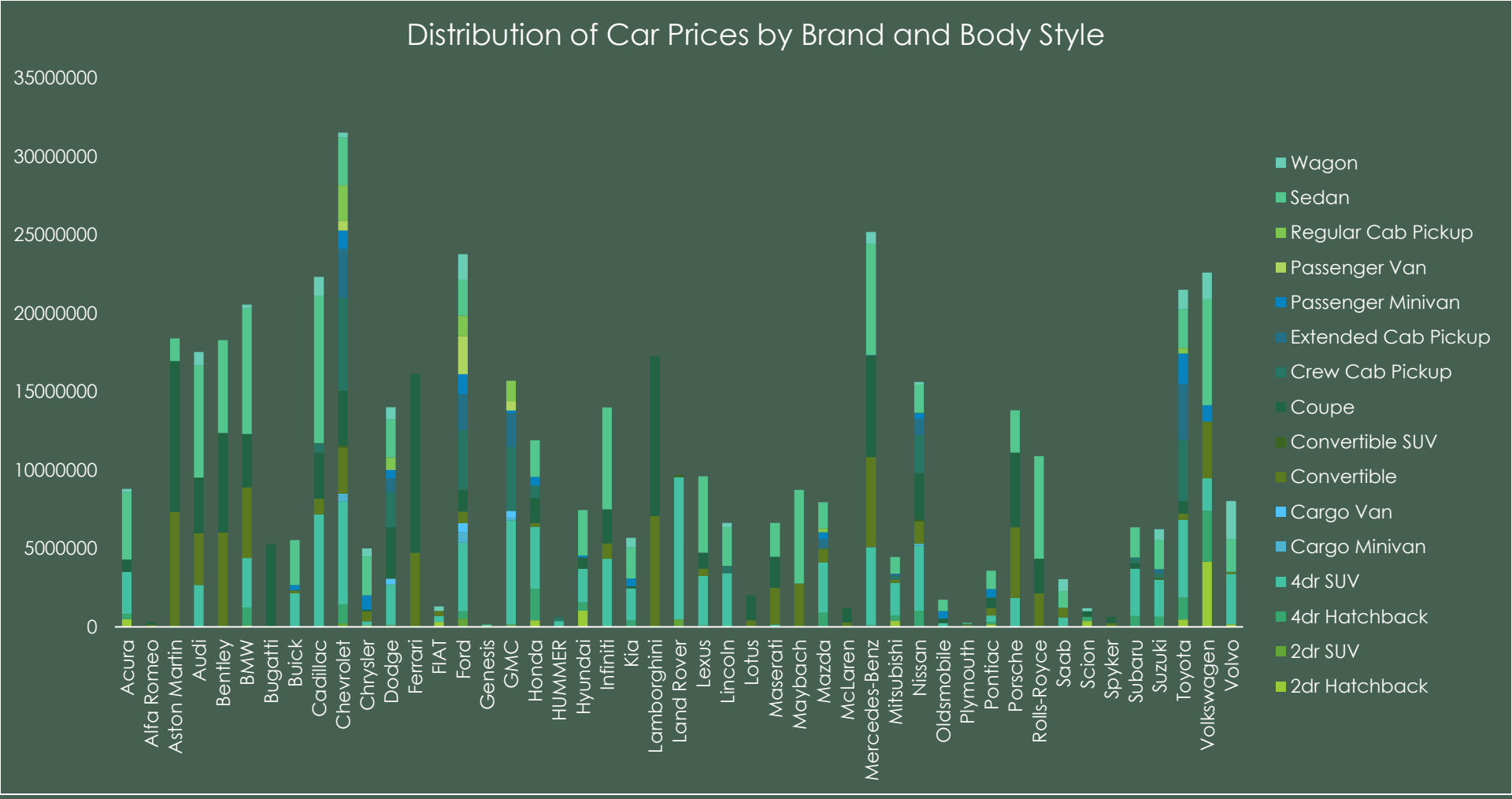
Top 5	
Manufacturers	Average of MSRP
Bugatti	1757223.667
Maybach	546221.875
Rolls-Royce	351130.6452
Lamborghini	331567.3077
Bentley	247169.3243



The relationship between a car's engine cylinder count and its fuel efficiency.

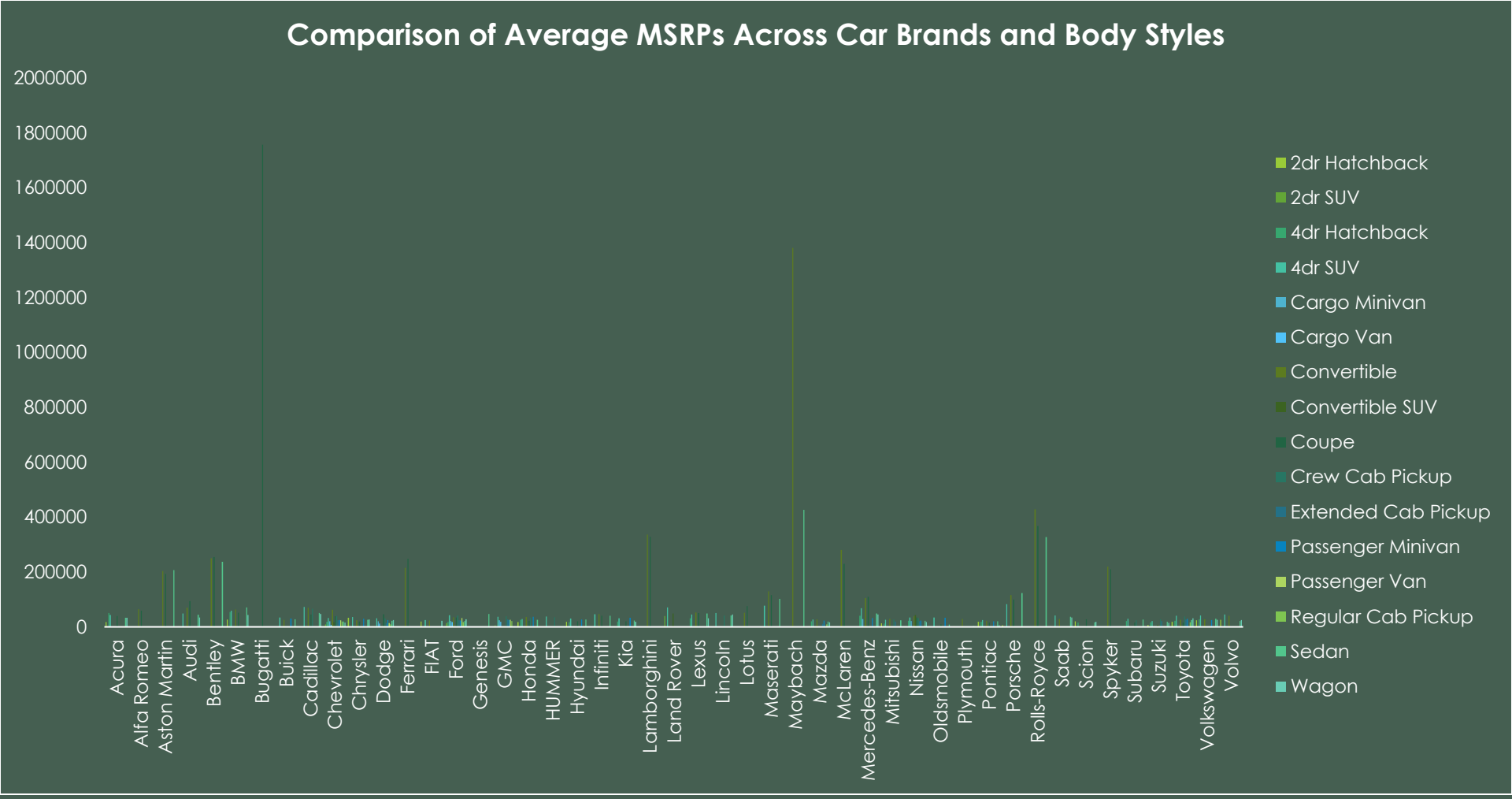
Correlation Coefficient = -0.62: Both the scatter plot and the correlation coefficient indicate a moderate negative relationship between the number of cylinders and highway MPG. As the number of cylinders increases, highway fuel efficiency tends to decrease.





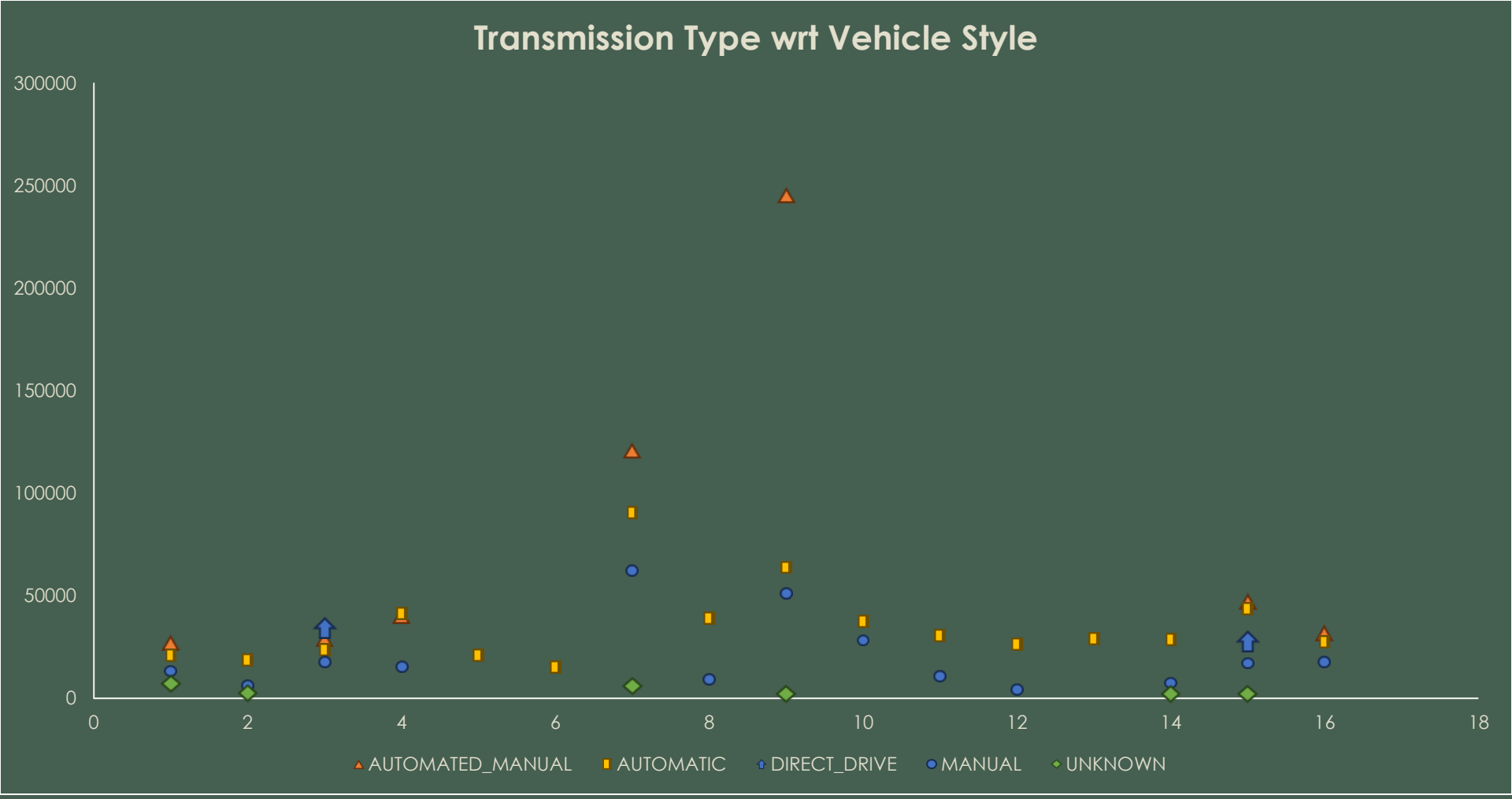
Distribution of Car Prices by Brand and Body Style

This chart highlights how the distribution of car prices varies across different brands and body styles. The total MSRP is broken down by body style within each brand, allowing us to compare price ranges within each segment.



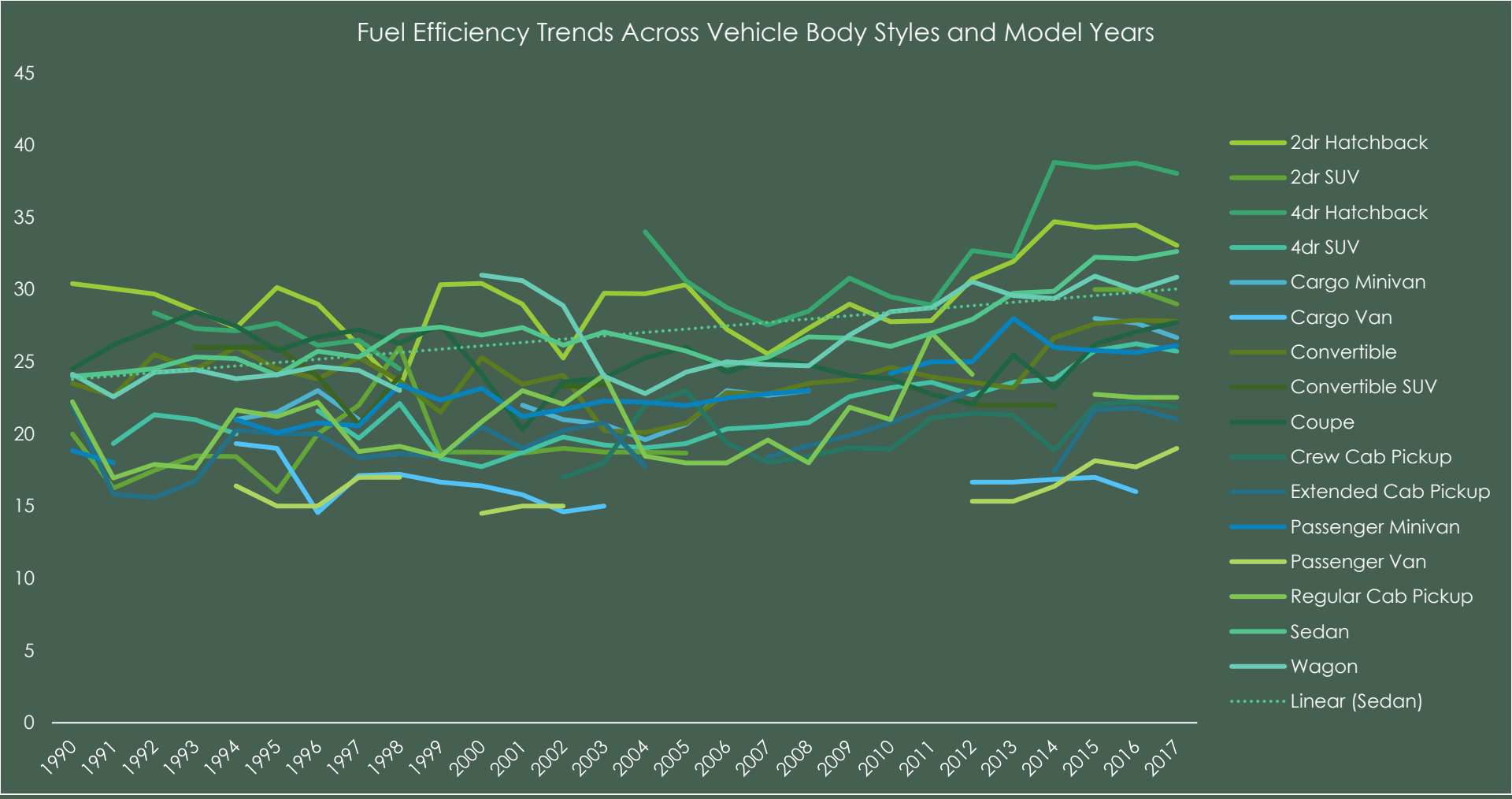
Comparison of Average MSRPs Across Car Brands and Body Styles

The analysis reveals that **Bugatti** has the **highest average MSRP** both **overall** and in the **Coupe** style, showcasing its position as a luxury brand. In contrast, **Plymouth** stands out with the **lowest average MSRP** both **overall** and in the **Sedan** style, emphasizing its affordability. This highlights a stark contrast between premium and budget-friendly car brands.



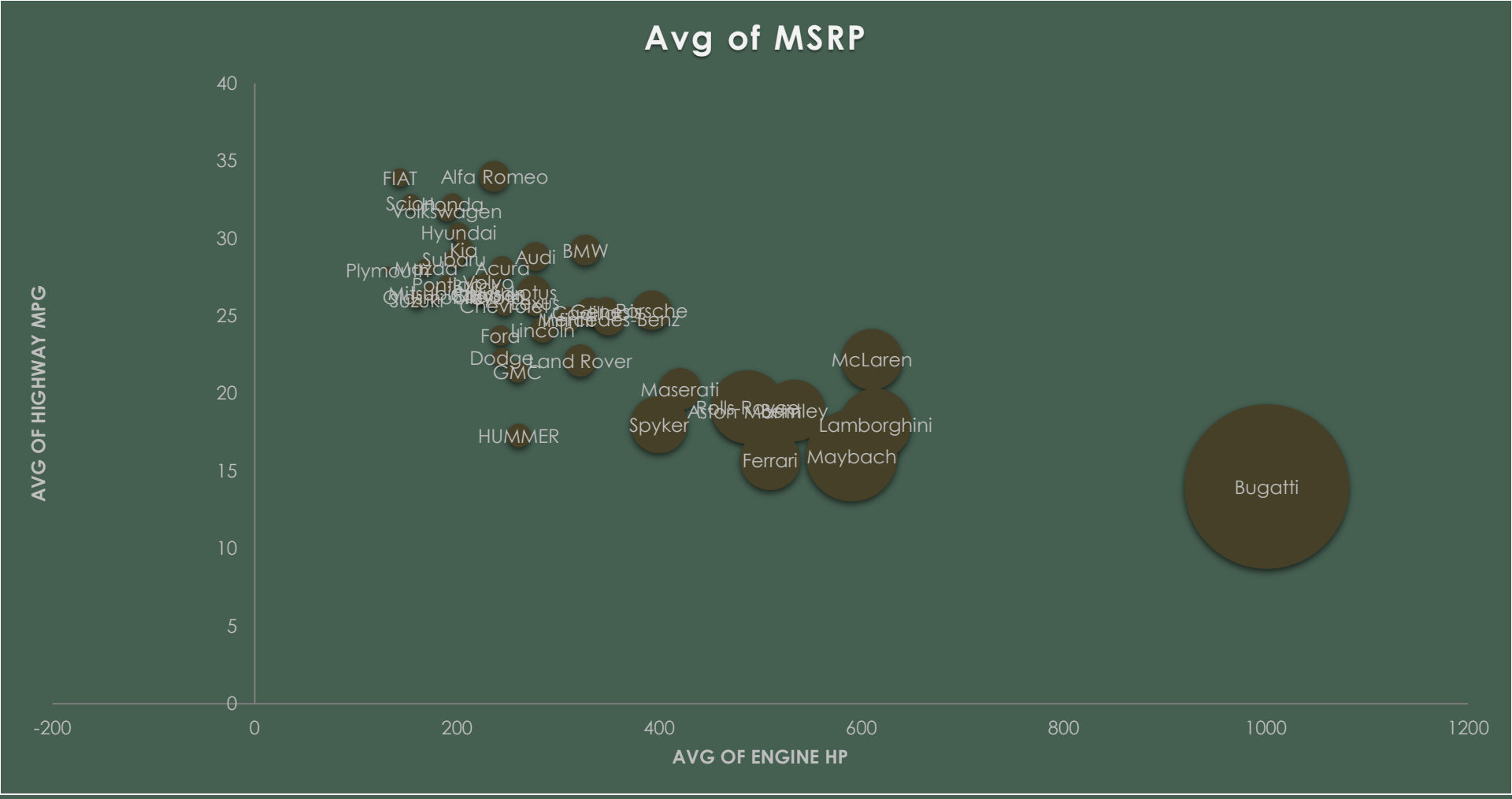
Impact of Transmission Type and Body Style on Car MSRP

AUTOMATED_MANUAL transmissions in luxury styles like Coupe have the highest average MSRP, while UNKNOWN and MANUAL transmissions are linked to lower-priced, economy vehicles. AUTOMATIC transmissions dominate across various body styles, offering a balance of cost and accessibility.



Fuel Efficiency Trends Across Vehicle Body Styles and Model Years

Fuel efficiency has steadily improved across most vehicle body styles over the years, with Sedans and Wagons consistently showcasing higher highway MPG averages. The trend highlights significant advancements in fuel-efficient technology, particularly post-2010, across various body styles.



Exploring the Relationship Between Horsepower, MPG, and Price Across Car Brands

The visualization highlights brand-specific trends, such as luxury brands having higher horsepower but lower MPG, and more economical brands balancing MPG and price.

Dashboard Overview

Interactive Dashboard Features:

- Filters and slicers for brand, body style, transmission type, market Category and model year.
- Stacked column charts for price distribution by brand and style.
- Scatter plots, line charts, and bubble charts for feature analysis.

Conclusion:

The analysis of the relationship between car features and their impact on price and profitability revealed key insights into the automotive market. Brands with higher horsepower and luxury features, such as Bugatti, Bentley, and Rolls-Royce, cater to niche, high-end consumers, offering premium pricing but sacrificing fuel efficiency (MPG). On the other hand, economical brands like Honda, Toyota, and Hyundai strike a balance between affordability, fuel efficiency, and moderate horsepower, targeting a broader market.

This study highlights that car features such as horsepower, MPG, and brand identity significantly influence pricing and profitability. Manufacturers can use these insights to position their products strategically based on market demand. For instance, balancing performance and fuel efficiency can appeal to mid-range buyers, while exclusive features and performance metrics cater to luxury segments. These findings are essential for businesses aiming to optimize product offerings and profitability in the competitive automotive industry.

Links for Excel and Video Presentation

- Excel
- Video Presentation