# Impact of Car Features on Price and Profitability

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## Project Description

This project focuses on analyzing car-related data to uncover insights about popularity, pricing, and features across market categories and manufacturers. It addresses business questions such as the variation in car model popularity, relationships between engine power and price, and the influence of features on pricing. The dataset includes attributes like model, market category, engine power, price, and MPG, which were cleaned and preprocessed for consistency and accuracy. Using descriptive statistics, regression analysis, and various visualizations, the project provides actionable insights while creating an interactive Excel dashboard to enable informed decision-making.

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## Approach

1. **Data Handling**
   Converted all blank values in the dataset by researching their Fuel Type, Horsepower (HP), Number of Cylinders, and Number of Doors.

2. **Descriptive Statistics**
   Used Pivot Tables to summarize car models and their characteristics across categories. Pivot Tables and Charts ensure clarity and interactivity for non-technical users.

3. **Visualization**
   Combo charts, scatter plots, line charts, and bubble charts for trend identification and relationship exploration.

4. **For Electric vehicles**
   **MPG** in the dataset likely refers to an **equivalent metric** called **MPGe** (Miles Per Gallon Equivalent). Electric kilowatt values have been converted into horsepower using the standard conversion factor (**1 kW ≈ 1.341 HP**) for uniformity in analysis.

# Tech-Stack Used

1. **Microsoft Excel**

   Data cleaning, analysis, and visualization.

2. **Excel Add-ins**

   Used for regression analysis and advanced charting.

3. **Operating System**

   Windows 10

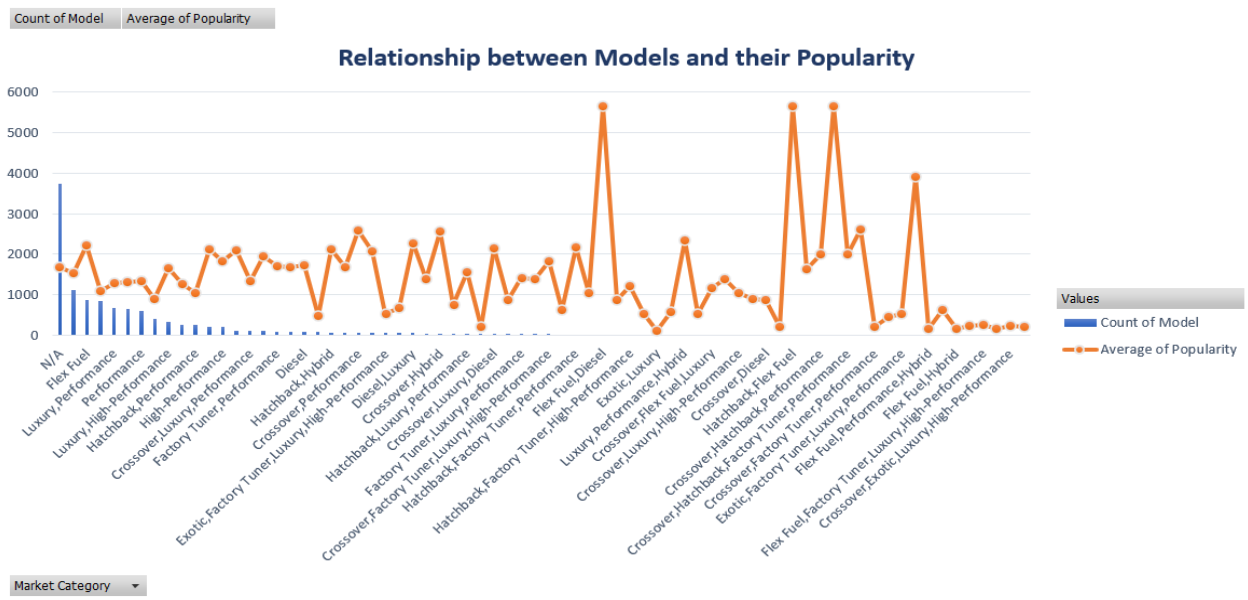
# Insights

## Task

### 1. Relationship between Models and their Popularity (Task 1.A, B)

| Row Labels | Count of Model | Average of Popularity |
|---|---|---|
| N/A | 3742 | 1676.9 |
| Crossover | 1110 | 1545.3 |
| Flex Fuel | 872 | 2217.3 |
| Luxury | 855 | 1102.7 |
| Luxury,Performance | 673 | 1292.6 |
| Hatchback | 641 | 1318.9 |
| Performance | 601 | 1348.9 |
| Crossover,Luxury | 410 | 884.5 |
| Luxury,High-Performance | 334 | 1668.0 |
| Exotic,High-Performance | 261 | 1271.3 |
| Hatchback,Performance | 252 | 1039.6 |
| Factory Tuner,Luxury,High-Performance | 215 | 2133.4 |
| High-Performance | 199 | 1821.4 |
| Hybrid | 123 | 2105.6 |
| Crossover,Luxury,Performance | 113 | 1344.8 |
| Factory Tuner,High-Performance | 106 | 1941.4 |
| Factory Tuner,Performance | 92 | 1695.7 |
| Flex Fuel,Performance | 87 | 1680.5 |
| Diesel | 84 | 1730.9 |
| Exotic,Luxury,High-Performance | 79 | 467.1 |
| Hatchback,Hybrid | 72 | 2121.3 |
| Crossover,Hatchback | 72 | 1675.7 |
| Crossover,Performance | 69 | 2586.0 |
| Crossover,Flex Fuel | 64 | 2073.8 |
| Exotic,Factory Tuner,Luxury,High-Performance | 52 | 517.5 |
| Luxury,Hybrid | 52 | 673.6 |
| Diesel,Luxury | 51 | 2275.0 |
| Hatchback,Luxury | 46 | 1379.5 |

| | | |
|---|---|---|
| Crossover,Hybrid | 42 | 2563.4 |
| Flex Fuel,Luxury | 39 | 746.5 |
| Hatchback,Luxury,Performance | 38 | 1566.1 |
| Exotic,Luxury,Performance | 36 | 217.0 |
| Crossover,Luxury,Diesel | 34 | 2149.4 |
| Flex Fuel,Luxury,High-Performance | 33 | 878.9 |
| Factory Tuner,Luxury,Performance | 31 | 1413.4 |
| Flex Fuel,Luxury,Performance | 28 | 1380.1 |
| Crossover,Factory Tuner,Luxury,High-Performance | 26 | 1823.5 |
| Crossover,Luxury,Hybrid | 24 | 630.9 |
| Hatchback,Factory Tuner,Performance | 22 | 2159.0 |
| Exotic,Factory Tuner,High-Performance | 21 | 1046.4 |
| Flex Fuel,Diesel | 16 | 5657.0 |
| Hatchback,Diesel | 14 | 873.0 |
| Hatchback,Factory Tuner,High-Performance | 13 | 1205.2 |
| Exotic,Flex Fuel,Factory Tuner,Luxury,High-Performance | 13 | 520.0 |
| Exotic,Luxury | 12 | 112.7 |
| Luxury,High-Performance,Hybrid | 12 | 568.8 |
| Luxury,Performance,Hybrid | 11 | 2333.2 |
| Exotic,Flex Fuel,Luxury,High-Performance | 11 | 520.0 |
| Crossover,Flex Fuel,Luxury | 10 | 1173.2 |
| Exotic,Performance | 10 | 1391.0 |
| Crossover,Luxury,High-Performance | 9 | 1037.2 |
| Hatchback,Factory Tuner,Luxury,Performance | 9 | 886.9 |
| Crossover,Diesel | 7 | 873.0 |
| Crossover,Hatchback,Luxury | 7 | 204.0 |
| Hatchback,Flex Fuel | 7 | 5657.0 |
| Crossover,Flex Fuel,Luxury,Performance | 6 | 1624.0 |
| Crossover,Hatchback,Performance | 6 | 2009.0 |
| Crossover,Hatchback,Performance | 6 | 2009.0 |
| Crossover,Flex Fuel,Performance | 6 | 5657.0 |
| Crossover,Hatchback,Factory Tuner,Performance | 6 | 2009.0 |
| Crossover,Factory Tuner,Luxury,Performance | 5 | 2607.4 |
| Crossover,Factory Tuner,Performance | 4 | 210.0 |
| Hatchback,Luxury,Hybrid | 3 | 454.0 |
| Exotic,Factory Tuner,Luxury,Performance | 3 | 520.0 |
| Crossover,Luxury,Performance,Hybrid | 2 | 3916.0 |
| Flex Fuel,Performance,Hybrid | 2 | 155.0 |
| Factory Tuner,Luxury | 2 | 617.0 |
| Flex Fuel,Hybrid | 2 | 155.0 |
| Crossover,Exotic,Luxury,Performance | 1 | 238.0 |
| Flex Fuel,Factory Tuner,Luxury,High-Performance | 1 | 258.0 |
| Performance,Hybrid | 1 | 155.0 |
| Crossover,Exotic,Luxury,High-Performance | 1 | 238.0 |
| Exotic,Luxury,High-Performance,Hybrid | 1 | 204.0 |
| **Grand Total** | **11914** | **1554.9** |



• **High Popularity of Flex Fuel and Hybrid Cars**: Categories like "Flex Fuel" (average popularity: 2,217.3) and "Hybrid" (average popularity: 2,105.6) show strong popularity scores, highlighting consumer interest in fuel-efficient technologies.

• **Luxury Cars Have Varied Popularity**: While "Luxury" (average popularity: 1,102.7) has a high count of models (855), its popularity is lower compared to other specific combinations like "Diesel, Luxury" (2,275.0).

• **Performance and High-Performance Cars Are Noteworthy**: Categories like "High-Performance" (1,821.4) and "Factory Tuner, High-Performance" (1,941.4) demonstrate significant popularity, emphasizing consumer interest in performance-oriented vehicles.

• **Combination Categories Exhibit Higher Popularity**: Specific combinations such as "Crossover, Factory Tuner, Luxury, Performance" (2,607.4) and "Luxury, Performance, Hybrid" (2,333.2) tend to have higher popularity scores despite fewer models, indicating niche but desirable market segments.

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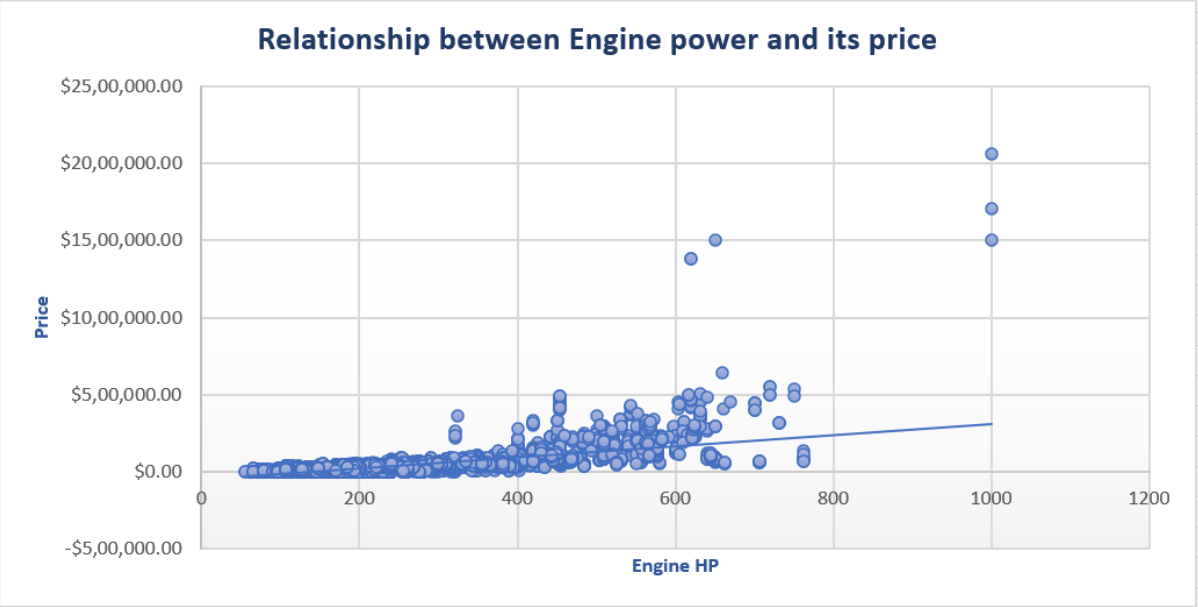
## 2. Relationship between Engine power and its price (Task 2)




Here, we can see as the price of the cars increases, the horsepower of the cars also increases. This indicates that higher-price cars often come with more powerful engines.

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## 3. Feature Importance in Determining Car Price (Task 3)

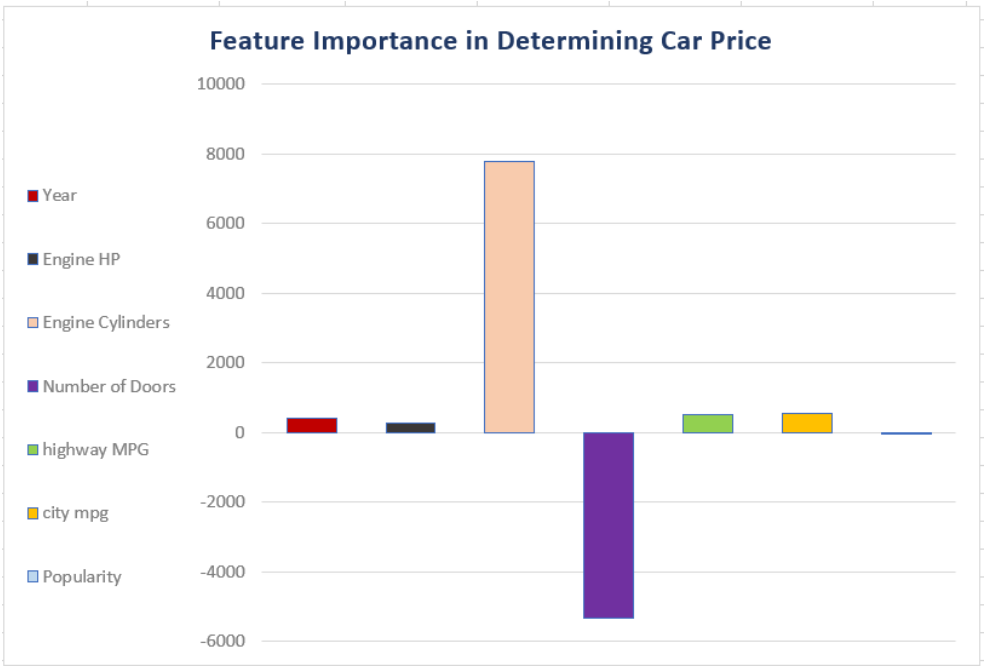
SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.678927443 |
| R Square | 0.460942473 |
| Adjusted R Square | 0.460625541 |
| Standard Error | 44145.39838 |
| Observations | 11914 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 7 | 1.98403E+13 | 2.83433E+12 | 1454.38522 | 0 |
| Residual | 11906 | 2.32026E+13 | 1948816198 | | |
| Total | 11913 | 4.30429E+13 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -856696.461 | 139891.0412 | -6.12402663 | 9.4115E-10 | -1130905.74 | -582487.182 | -1130905.74 | -582487.182 |
| Year | 389.6257578 | 70.09889544 | 5.558229631 | 2.7839E-08 | 252.2204788 | 527.0310368 | 252.2204788 | 527.0310368 |
| Engine HP | 280.001166 | 6.783256083 | 41.27828326 | 0 | 266.7048767 | 293.2974554 | 266.7048767 | 293.2974554 |
| Engine Cylinders | 7780.856492 | 438.8345789 | 17.73072785 | 1.8913E-69 | 6920.669075 | 8641.043908 | 6920.669075 | 8641.043908 |
| Number of Doors | -5331.16346 | 489.8194088 | -10.8839367 | 1.8516E-27 | -6291.28946 | -4371.03745 | -6291.28946 | -4371.03745 |
| highway MPG | 496.8050154 | 104.7178902 | 4.744222928 | 2.1174E-06 | 291.5408551 | 702.0691758 | 291.5408551 | 702.0691758 |
| city mpg | 546.5121152 | 98.4343985 | 5.552044036 | 2.884E-08 | 353.5646242 | 739.4596061 | 353.5646242 | 739.4596061 |
| Popularity | -3.41323582 | 0.283092034 | -12.0569829 | 2.784E-33 | -3.96814242 | -2.85832922 | -3.96814242 | -2.85832922 |

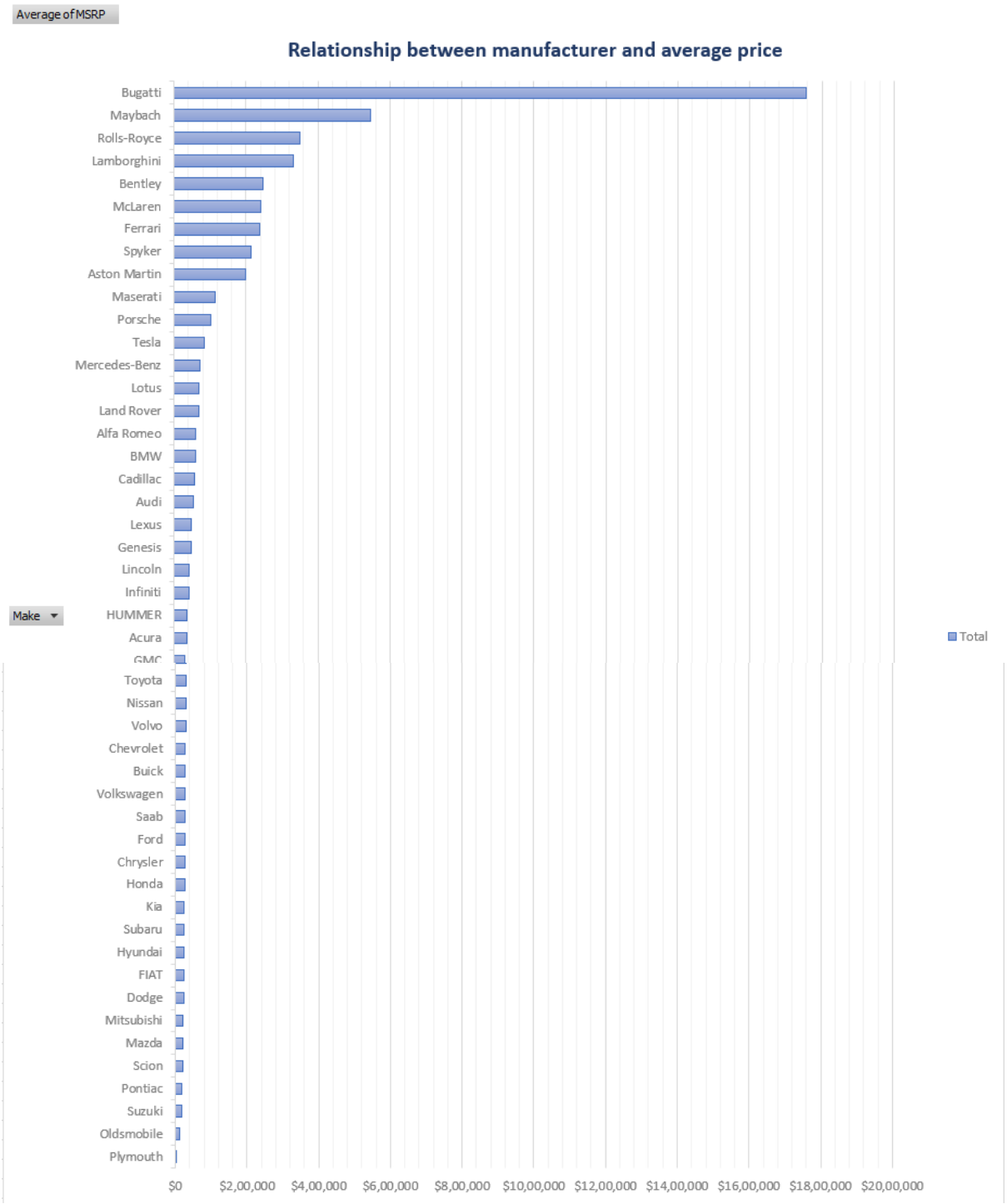



**Strong Positive Impact of Engine Cylinders**: The coefficient for "Engine Cylinders" (7,780.86) is the highest, indicating that the number of cylinders is the most influential factor in determining a car's price.

**Negative Impact of Number of Doors**: "Number of Doors" has a significant negative coefficient (-5,331.16), suggesting that cars with more doors might be associated with lower prices, potentially due to market segmentation.

## 4. Relationship between manufacturer and average price (Task 4.A, B)

| Row Labels | Average of MSRP |
|---|---|
| Plymouth | $3,123 |
| Oldsmobile | $11,543 |
| Suzuki | $17,907 |
| Pontiac | $19,322 |
| Scion | $19,933 |
| Mazda | $20,039 |
| Mitsubishi | $21,241 |
| Dodge | $22,390 |
| FIAT | $22,670 |
| Hyundai | $24,597 |
| Subaru | $24,828 |
| Kia | $25,310 |
| Honda | $26,674 |
| Chrysler | $26,723 |
| Ford | $27,399 |
| Saab | $27,414 |
| Volkswagen | $28,102 |
| Buick | $28,207 |
| Chevrolet | $28,350 |
| Volvo | $28,541 |
| Nissan | $28,583 |
| Toyota | $29,030 |
| GMC | $30,493 |
| Acura | $34,888 |
| HUMMER | $36,464 |
| Infiniti | $42,394 |
| Lincoln | $42,840 |
| Genesis | $46,617 |
| Lexus | $47,549 |
| Audi | $53,452 |
| Cadillac | $56,231 |
| BMW | $61,547 |
| Alfa Romeo | $61,600 |
| Land Rover | $67,823 |
| Lotus | $69,188 |
| Mercedes-Benz | $71,476 |
| Tesla | $85,256 |
| Porsche | $1,01,622 |
| Maserati | $1,14,208 |
| Aston Martin | $1,97,910 |
| Spyker | $2,13,323 |
| Ferrari | $2,38,219 |
| McLaren | $2,39,805 |
| Bentley | $2,47,169 |
| Lamborghini | $3,31,567 |
| Rolls-Royce | $3,51,131 |
| Maybach | $5,46,222 |
| Bugatti | $17,57,224 |
| **Grand Total** | **$40,595** |




**Economy Brands (Below $30,000)** - Brands like **Oldsmobile**, **Suzuki**, and **Pontiac** dominate the affordable segment.

**High-End and Exotic Luxury (Above $70,000)** -Brands like **Mercedes-Benz**, **Porsche**, and **Bentley** cater to the high-end luxury segment.

**Hyper-Luxury Dominance** - **Bugatti** leads the market with an average MSRP of $1,757,224, underscoring its exclusivity and engineering excellence.

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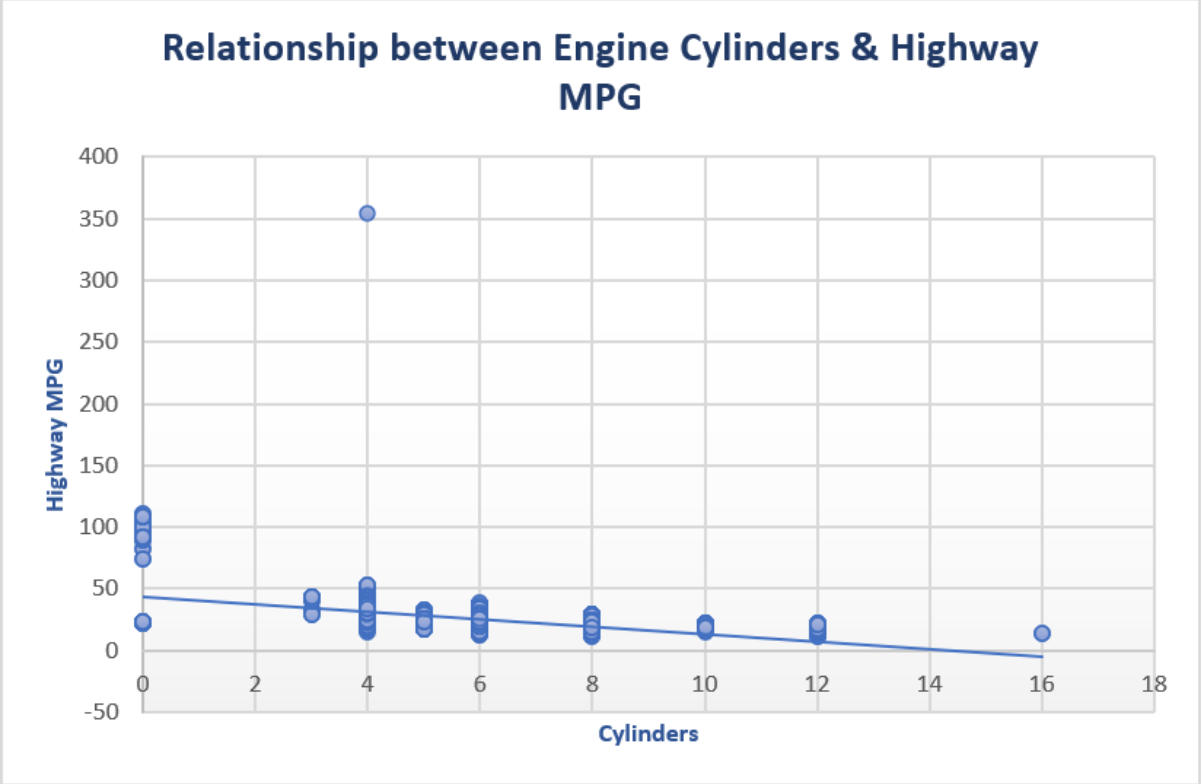
## 5. Relationship between Engine Cylinders & Highway MPG (Task 5.A, B)

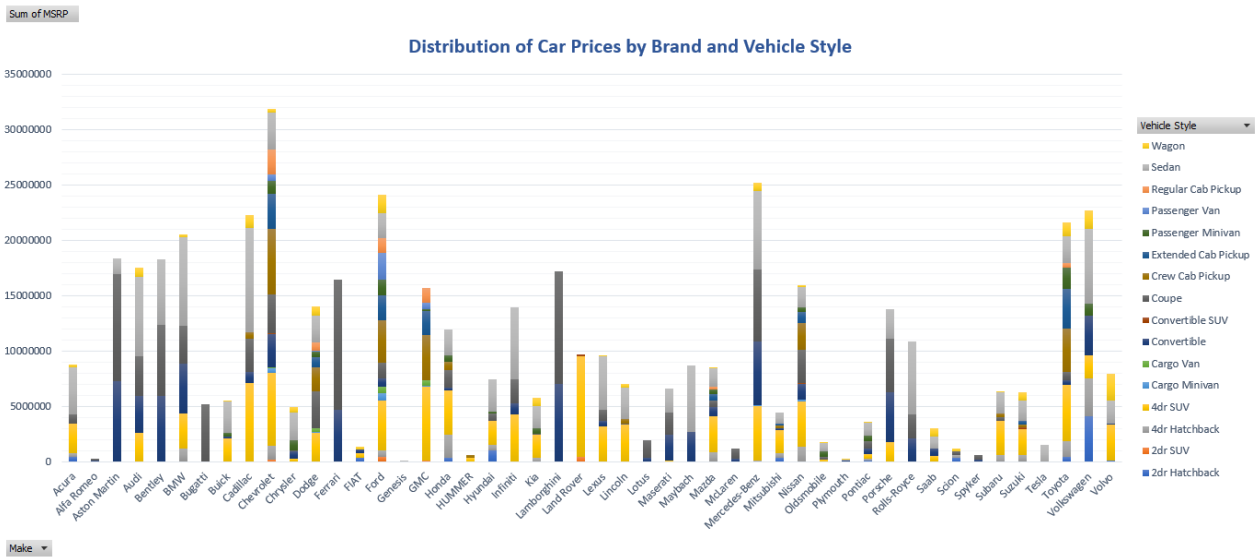



| Correlation Coefficient between Engine Cylinders and Highway MPG = | -0.61454 |
|---|---|

- Thers is a **Negative Correlation** between **Engine Cylinders** and **Highway MPG**.
- This indicates a moderate to strong negative relationship. As the number of engine cylinders increases, the highway MPG tends to decrease, likely due to larger engines consuming more fuel.

# Dashboard

1. **Distribution of Car Prices by Brand and Vehicle Style**




• **Luxury Segment**: Lamborghini and Rolls-Royce show their dominance in **Convertible** and **Coupe** categories.

• **Mass Market Leaders**: Toyota and Honda excel in **Passenger Vans** and **Sedans**, indicating family-oriented offerings.

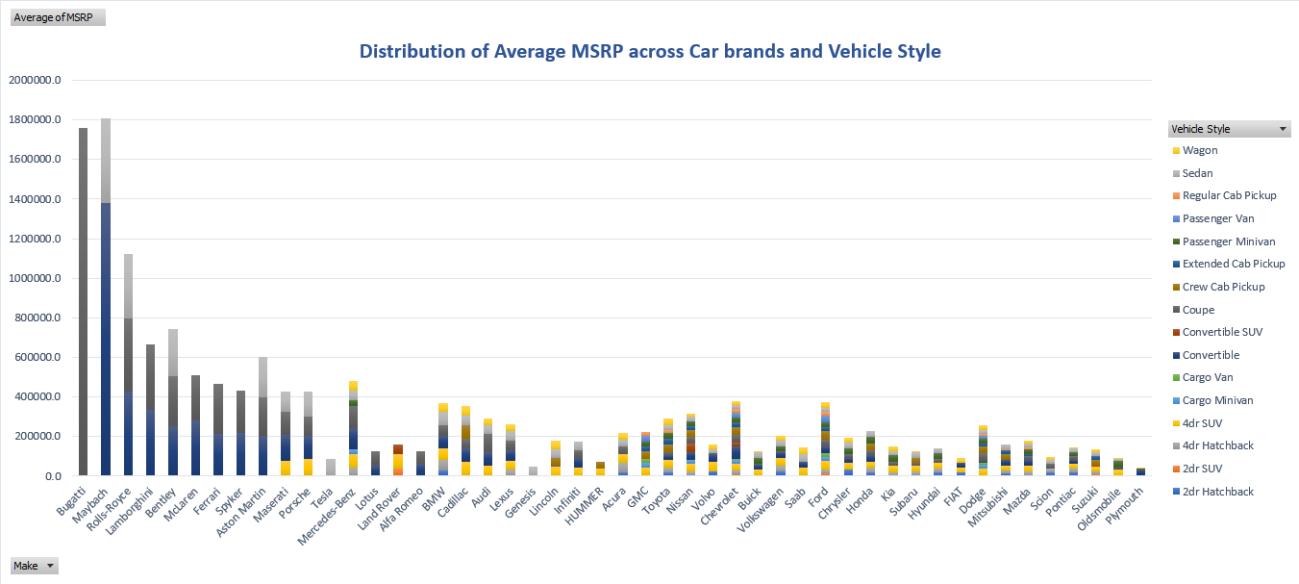
• **SUVs**: A major contributor to MSRP totals for brands like Toyota, Cadillac, and Chevrolet.

• **Sedans**: Dominated by Audi, BMW, and Mercedes-Benz in the luxury segment.

• **Sports Cars (Coupe & Convertible)**: Lamborghini, Ferrari, Porsche, and Rolls-Royce lead with high MSRP.

• **Niche Vehicles**: Brands like **Spyker** and **Lotus** specialize in high-end sports cars with small market shares.

## 2. Distribution of Average MSRP across Car brands and Vehicle Style




**Bugatti** has the highest average MSRP across its models, with a peak value of ₹1,757,223.70.

**Maybach**, **Rolls-Royce**, **Lamborghini**, and **Bentley** also dominate the luxury segment, with average MSRPs ranging from ₹247,169.30 to ₹1,381,375.00.

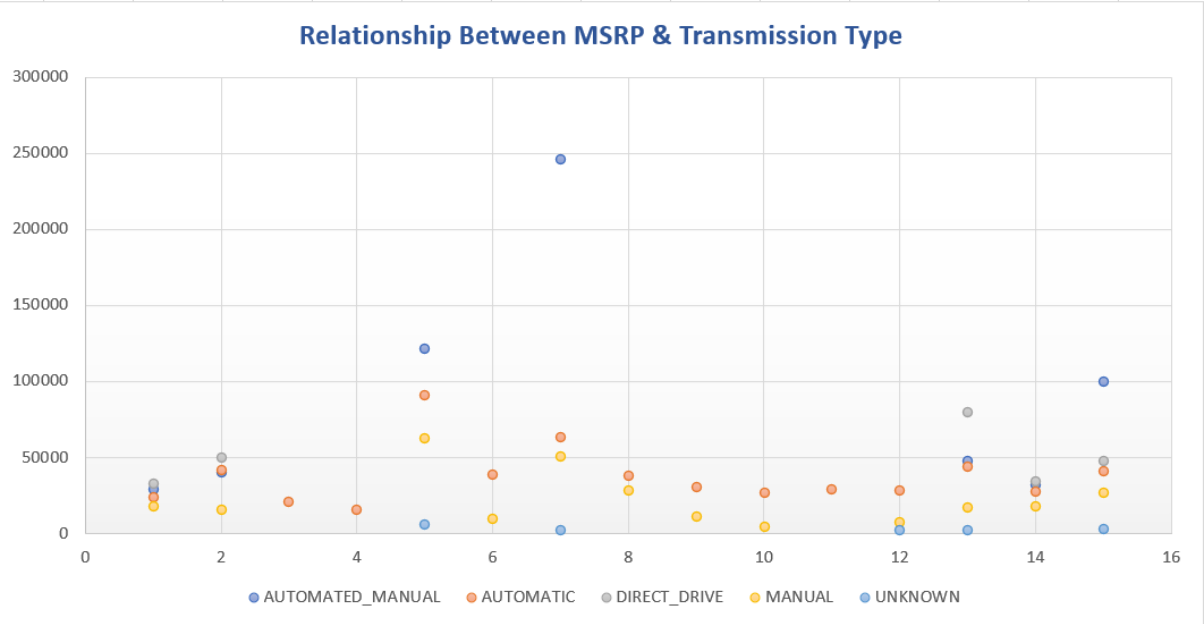
**Convertible and Coupe** models often have higher MSRPs across multiple brands.

Pickup trucks (e.g., Crew Cab and Extended Cab Pickups) show moderate MSRPs, with **Ford** and **Chevrolet** leading this category.

**Toyota**, **Nissan**, **Chevrolet**, and **Honda** dominate the more affordable segment, with average MSRPs mostly below ₹40,000.

Brands like **Kia**, **Hyundai**, and **Subaru** follow closely, focusing on affordability and specific vehicle types like SUVs and sedans.

### 3. Relationship Between MSRP & Transmission Type



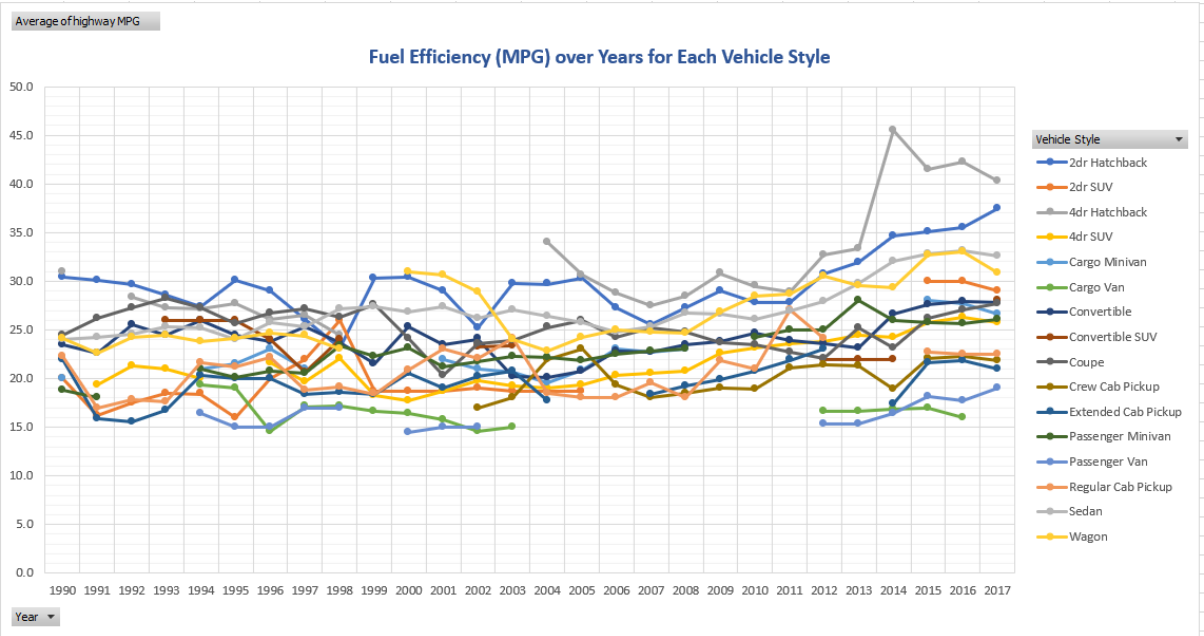

**Automated Manual** vehicles generally have the **highest MSRP** across most body styles, with notable peaks in **Passenger Van** (₹245,977.43) and **Cargo Van** (₹121,256.64).

**Manual** transmissions are the most affordable, with significantly lower MSRPs, especially in **Regular Cab Pickup** (₹4,405.33) and **Sedan** (₹17,119.23).

**Cargo Minivans and Passenger Vans** tend to have higher MSRPs across transmission types, particularly with **Automated Manual** and **Automatic** transmissions.

Sportier body styles like **Coupes** and **Convertibles** have moderate MSRPs, with **Automatic Coupes** at ₹63,371.81 and **Manual Convertibles** at ₹50,484.37.

## 4. Fuel Efficiency (MPG) over Years for Each Vehicle Style

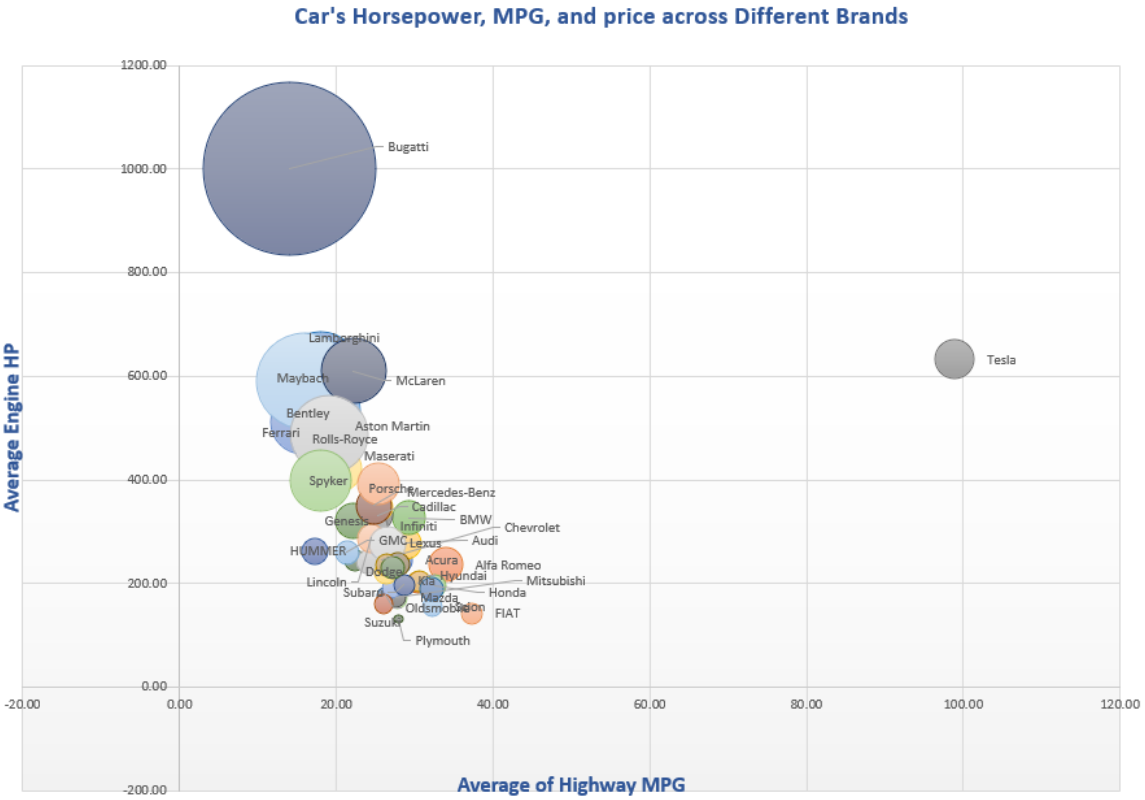



- There is a notable increase in average highway MPG for body styles like **Sedans** and **Wagons**, particularly in recent years (e.g., 2015–2017).

- Body styles such as **2dr Hatchbacks** and **4dr Hatchbacks** consistently show higher highway MPG averages.

- **Cargo Vans** and **Passenger Vans** exhibit the lowest MPG averages, remaining below **25 MPG** across most years.

5. **Car's horsepower, MPG, and price vary across different Brands**




**High-End Luxury Brands**: Brands like Bugatti, Rolls-Royce, and Lamborghini dominate in engine horsepower (e.g., Bugatti: 1001 HP) and MSRP (e.g., Bugatti: $1,757,223.67), with lower highway MPG reflecting performance over efficiency.

**Affordable & Efficient Segment**: Brands such as FIAT, Honda, and Scion exhibit high highway MPG (e.g., FIAT: 37.34 MPG) at lower MSRPs (e.g., Scion: $19,932.50), catering to budget-conscious consumers.

**Tesla's Unique Efficiency and Power**: Tesla stands out with exceptional highway MPG equivalent (98.94 MPGe) and high engine horsepower (633.22 HP approximately 472.19 kW), showcasing its dominance in the electric vehicle market with a competitive MSRP of $85,255.56.

**{***For electric vehicles,* ***MPG*** *in the dataset likely refers to an* ***equivalent metric*** *called* ***MPGe*** *(Miles Per Gallon Equivalent).***}**

# Result

This report outlines the project's key outcomes, emphasizing the substantial role of car features in determining price and profitability, and offers actionable recommendations derived from the findings. Key discoveries include:

- Cars with greater horsepower show a notable increase in price and profitability, with higher horsepower models commanding higher prices and delivering better profit margins.

- Fuel-efficient cars, although negatively correlated with price, attract a specific market segment focused on eco-friendliness and cost savings.

- Brand prestige proves to be the strongest determinant of price and profitability, as vehicles from prestigious brands tend to command significantly higher prices and yield better profit margins.

This project elevated my exploratory data analysis (EDA) skills to a new level and deepened my ability to extract valuable insights from data. It has also equipped me with the knowledge to make informed decisions that lead to meaningful and impactful outcomes.

*Link for the Excel file*

***Note:** If the Excel file is opened in Google Sheets, all the formatting and styling will be lost. Therefore, **I kindly request that you open this link in Excel rather than in Google Sheets. Thank you.***