Analyzing the Impact of Car Features on Price and Profitability

Excel file: Click Here
MS Excel Link:-
https://docs.google.com/spreadsheets/d/1ZMmdRHPdF8LcHfSZnIhftWn38QI1MEse/edit#gid=979314391

Description :-

The automotive industry has seen significant changes in recent years, driven by a stronger emphasis on fuel efficiency, sustainability, and technological advancements. Manufacturers face intense competition and must navigate a shifting consumer landscape, making it crucial to understand what influences car buyers.

A notable trend has been the rise in popularity of electric and hybrid vehicles, along with growing interest in alternative fuels like hydrogen and natural gas. Despite these developments, gasoline-powered cars still hold a major share of the market, offering consumers various fuel types and grades to choose from.

In this Project, the client has asked How can a car manufacturer optimize pricing and product development decisions to maximize profitability while meeting consumer demand? As a Data Analyst, our work is about analyzing patterns in the various Car features to understand the factors that drive consumer demands for Cars. These insights will be helpful for Car manufacturers, dealers and other stakeholders to determine the important factors to boost sales of Cars.

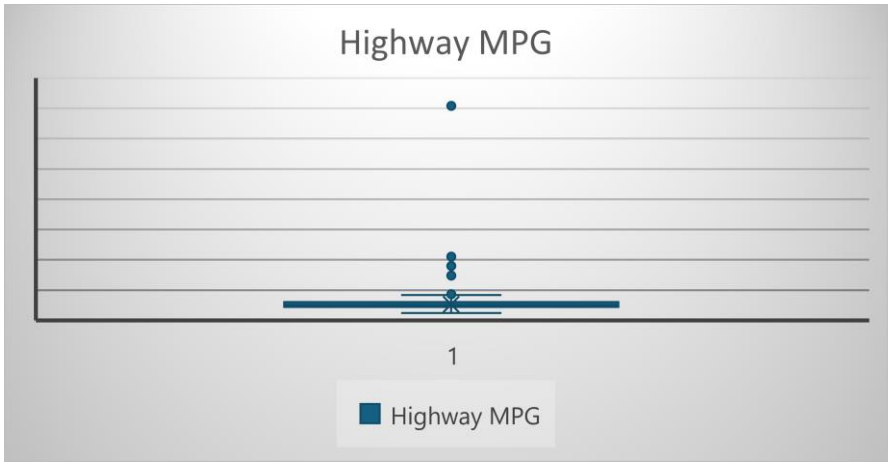
Tech Stack Used:-

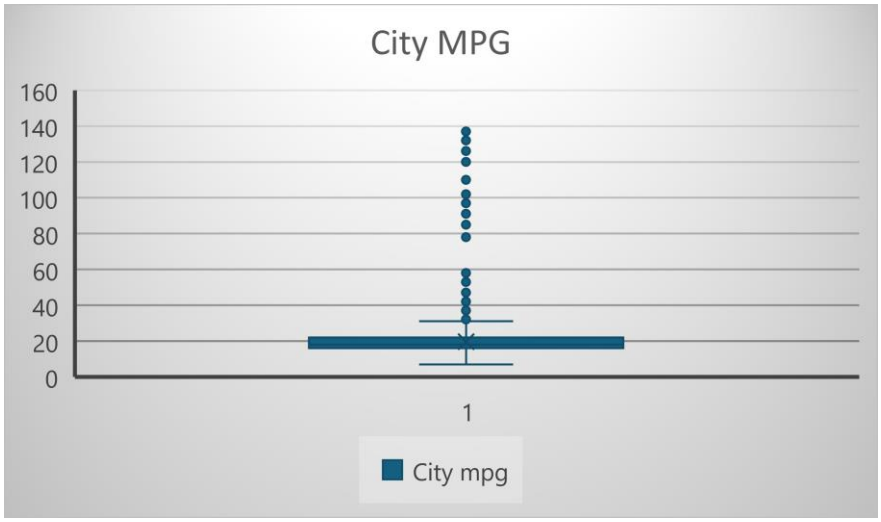
Microsoft Excel 365— A spreadsheet editor software used mainly by professionals to enter data in table format, perform computations, plot graphs etc, interpretation.

Exploratory Data Analysis:-

1. Engine Fuel Type in Suzuki Car had 3 blank space filled with the mode that is regular unleaded
2. Engine HP of 69 cars were not available which were filled using data from the website www.edmunds.com
3. 714 duplicates found in the data which have been removed.
4. There are no Engine cylinders in electric vehicles , so all blank columns are filled with 0.Mazda cars are filled with 2 and 4 cylinders respectively using the data www.autoevolution.com
5. Number of Doors in cars are filled using data from Wikipedia.com
6. 715 Duplicates found , hence the rows remaining for Analysis are 11199

Outliers:-



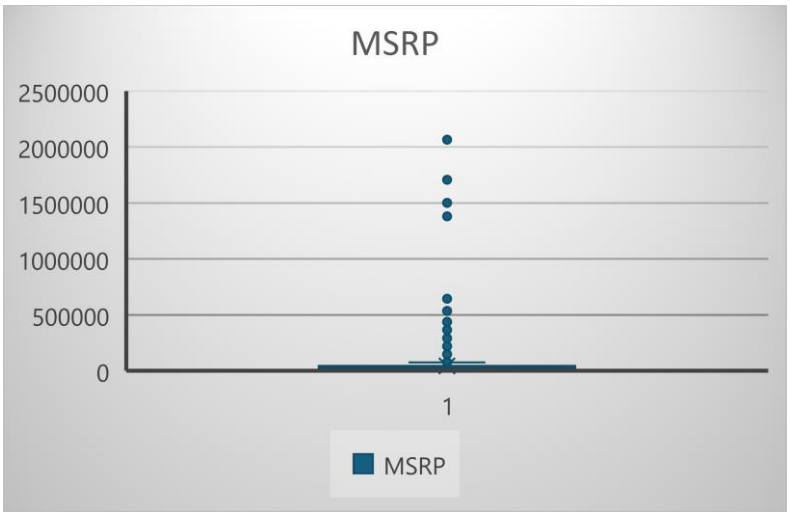


MSRP

Quartile Q1	21599
Quartile Q3	43035
IQR	21436

Upper Bound	Q3+1.5*IQR	75189
Lower Bound	Q1-1.5*IQR	-10555

Count of Outliers	960
Total Counts	11199
% of Outliers	8.57%



Task 1.A: Create a pivot table that shows the number of car models in each market category and their corresponding popularity scores.

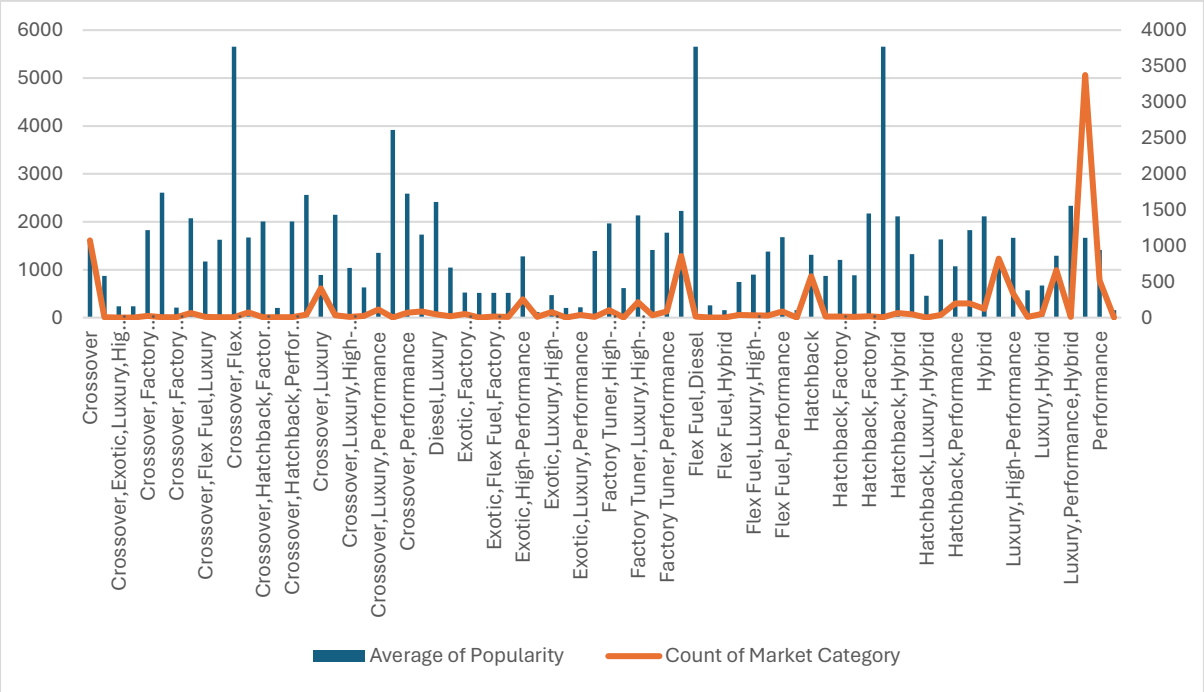
The entire Pivot table is created in Excel sheet.

Make, Model and their Market Category	Sum of Popularity
Acura	**50184**
CL	**1836**
Factory Tuner,Luxury,Performan	
Luxury	
ILX	**3264**
Luxury	3060
Luxury,Performance	204
ILX Hybrid	**408**
Luxury,Hybrid	408
Integra	**4896**
Hatchback,Factory Tuner,Luxury,Performance	408
Hatchback,Luxury	1632
Hatchback,Luxury,Performance	612
Luxury	1632
Luxury,Performance	612
Legend	**3264**
Luxury	1632
Luxury,Performance	1632
MDX	**6936**
Crossover,Luxury	6936
NSX	**1020**

Task 1.B: Create a combo chart that visualizes the relationship between market category and popularity.

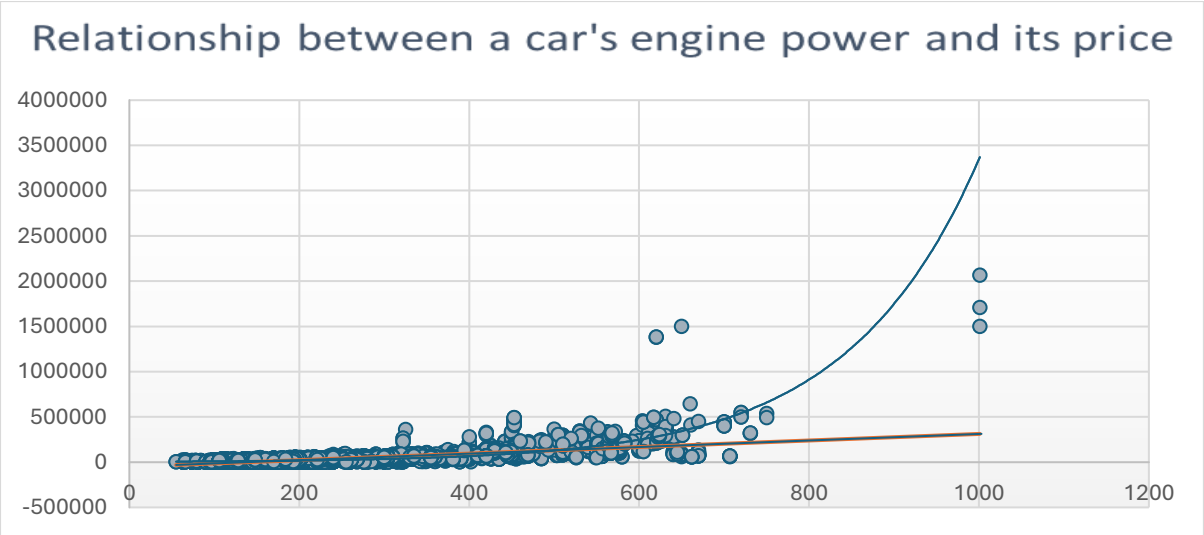
Market Category	Average of Popularity	Count of Market Category
Crossover	1556	1075
Crossover,Diesel	873	7
Crossover,Exotic,Luxury,High-Performance	238	1
Crossover,Exotic,Luxury,Performance	238	1
Crossover,Factory Tuner,Luxury,High-Performance	1823	26
Crossover,Factory Tuner,Luxury,Performance	2607	5
Crossover,Factory Tuner,Performance	210	4
Crossover,Flex Fuel	2074	64
Crossover,Flex Fuel,Luxury	1173	10
Crossover,Flex Fuel,Luxury,Performance	1624	6
Crossover,Flex Fuel,Performance	5657	6
Crossover,Hatchback	1676	72
Crossover,Hatchback,Factory Tuner,Performance	2009	6
Crossover,Hatchback,Luxury	204	7
Crossover,Hatchback,Performance	2009	6
Crossover,Hybrid	2563	42
Crossover,Luxury	889	406
Crossover,Luxury,Diesel	2149	34
Crossover,Luxury,High-Performance	1037	9
Crossover,Luxury,Hybrid	631	24
Crossover,Luxury,Performance	1349	112
Crossover,Luxury,Performance,Hybrid	3916	2
Crossover,Performance	2586	69
Diesel	1731	84
Diesel,Luxury	2416	47
Exotic,Factory Tuner,High-Performance	1046	21
Exotic,Factory Tuner,Luxury,High-Performance	523	51
Exotic,Factory Tuner,Luxury,Performance	520	3
Exotic,Flex Fuel,Factory Tuner,Luxury,High-Performance	520	13
Exotic,Flex Fuel,Luxury,High-Performance	520	11
Exotic,High-Performance	1280	254
Exotic,Luxury	113	12

Exotic,Luxury,High-Performance	473	77
Exotic,Luxury,High-Performance,Hybrid	204	1
Exotic,Luxury,Performance	217	36
Exotic,Performance	1391	10
Factory Tuner,High-Performance	1966	104
Factory Tuner,Luxury	617	2
Factory Tuner,Luxury,High-Performance	2133	215
Factory Tuner,Luxury,Performance	1413	31
Factory Tuner,Performance	1774	84
Flex Fuel	2226	855
Flex Fuel,Diesel	5657	16
Flex Fuel,Factory Tuner,Luxury,High-Performance	258	1
Flex Fuel,Hybrid	155	2
Flex Fuel,Luxury	747	39
Flex Fuel,Luxury,High-Performance	898	32
Flex Fuel,Luxury,Performance	1380	28
Flex Fuel,Performance	1680	87
Flex Fuel,Performance,Hybrid	155	2
Hatchback	1309	574
Hatchback,Diesel	873	14
Hatchback,Factory Tuner,High-Performance	1205	13
Hatchback,Factory Tuner,Luxury,Performance	887	9
Hatchback,Factory Tuner,Performance	2174	21
Hatchback,Flex Fuel	5657	7
Hatchback,Hybrid	2111	64
Hatchback,Luxury	1323	45
Hatchback,Luxury,Hybrid	454	3
Hatchback,Luxury,Performance	1632	36
Hatchback,Performance	1074	198
High-Performance	1823	198
Hybrid	2117	121
Luxury	1079	819
Luxury,High-Performance	1668	334
Luxury,High-Performance,Hybrid	569	12
Luxury,Hybrid	674	52
Luxury,Performance	1293	659
Luxury,Performance,Hybrid	2333	11
N/A	1665	3376
Performance	1415	520
Performance,Hybrid	155	1
Grand Total	**1558**	**11199**

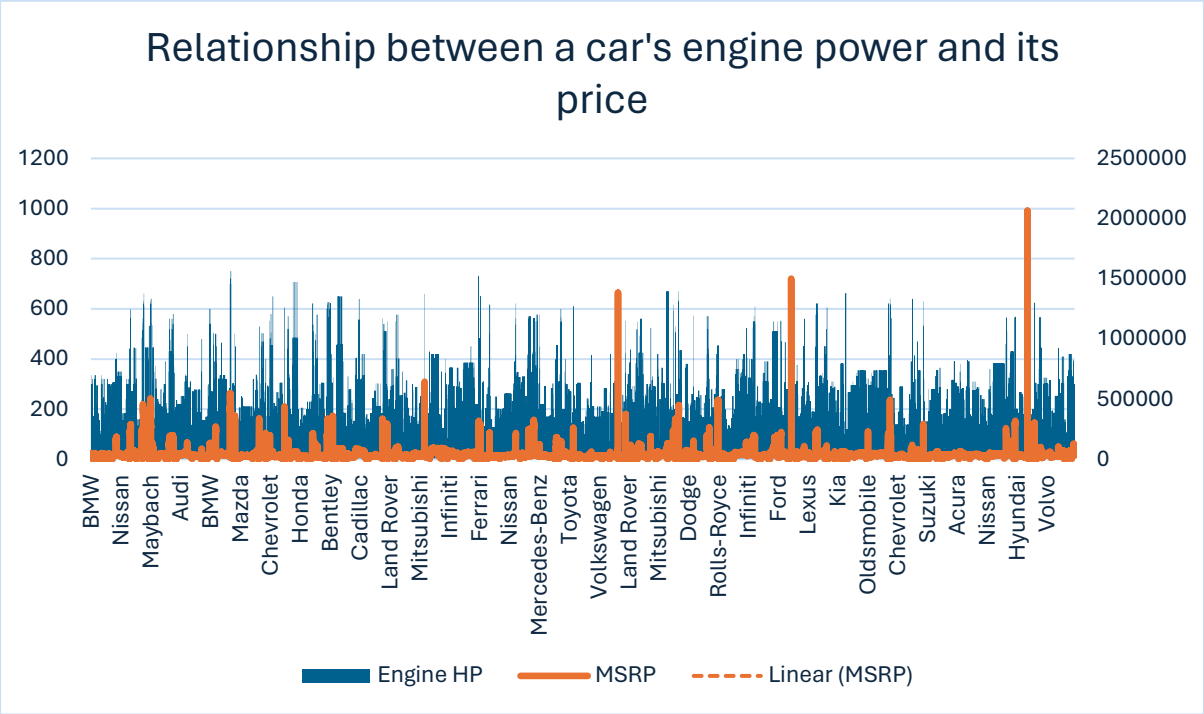


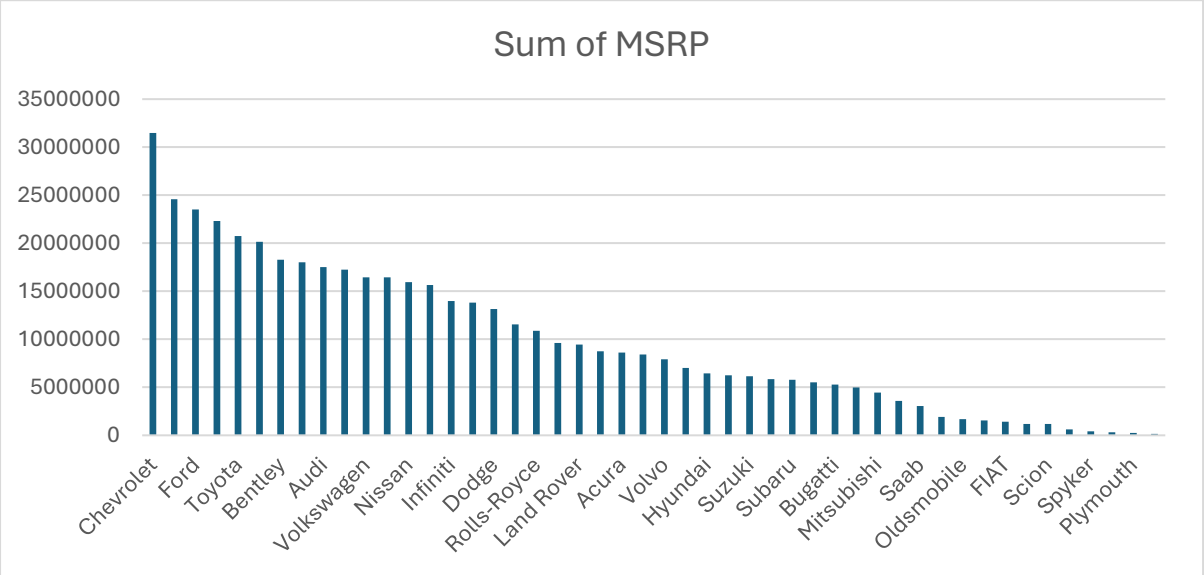
Insights:- The Crossover market category has the highest number of Car Models with the average Count of 1556 and average popularity of 1075. Some Market category like 1.Crossover,Flex Fuel,Performance 2.Flex Fuel,Diesel 3.Hatchback,Flex Fuel has highest average of Popularity but their count is very less.

Task 2: Create a scatter chart that plots engine power on the x-axis and price on the y-axis. Add a trendline to the chart to visualize the relationship between these variables.



Insights:- Car having Engine Power of 1001 has the highest MSRP. So MSRP is directly proportional to Engine HP. With increase in engine Hp ,the MSRP increases. If someone prefers to buy a car with Better car engine, he will end up paying more price.





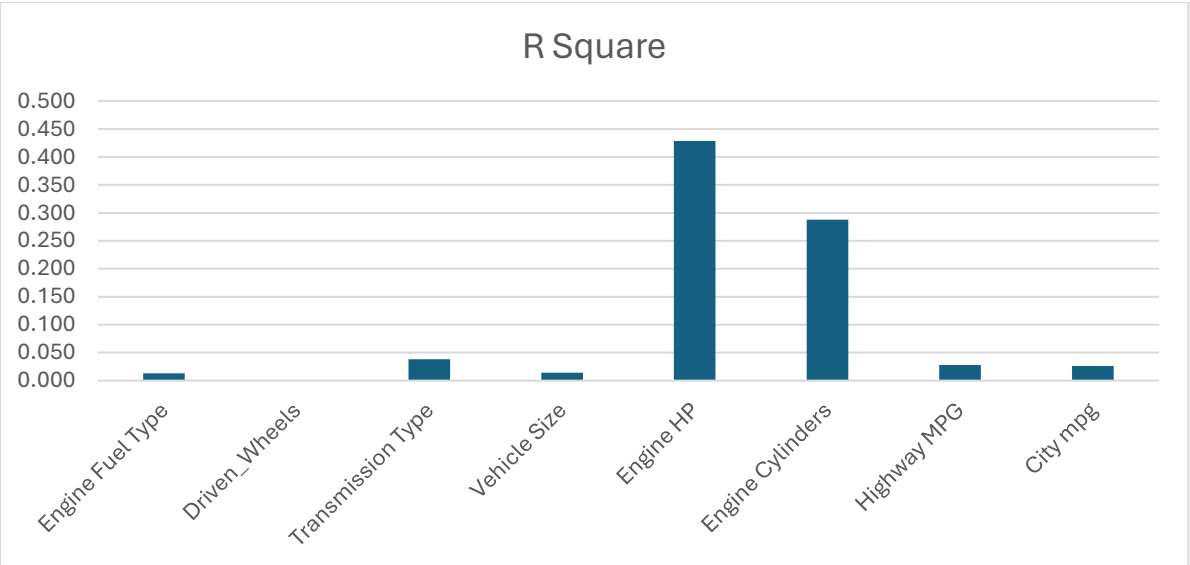
Insights :- Chevrolet Brand has the highest Sum of MSRP.

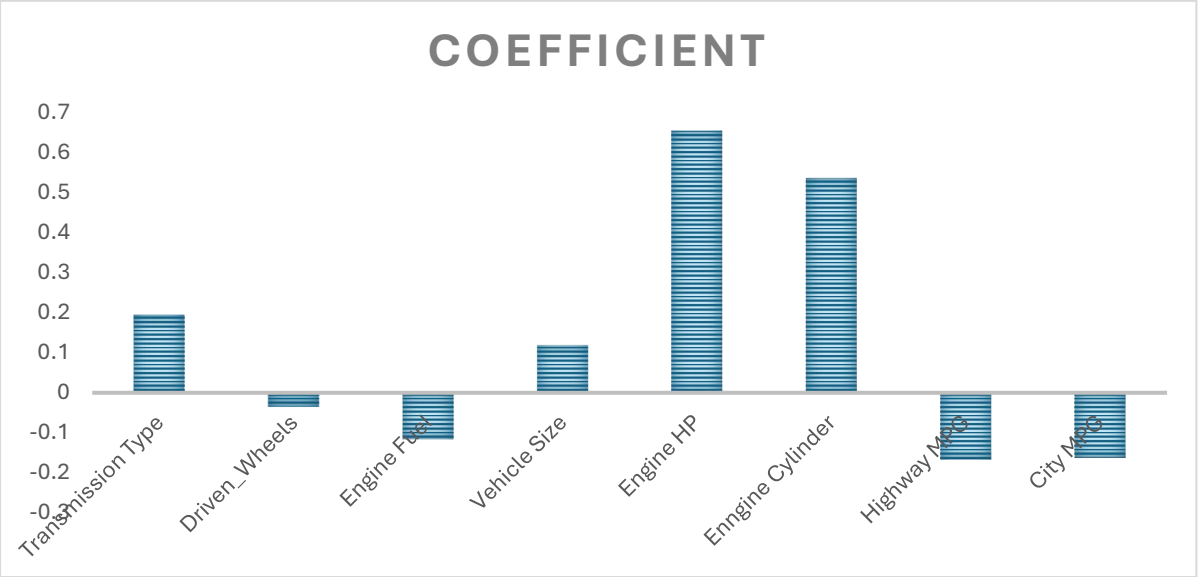
Task 3: Use regression analysis to identify the variables that have the strongest relationship with a car's price. Then create a bar chart that shows the coefficient values for each variable to visualize their relative importance.

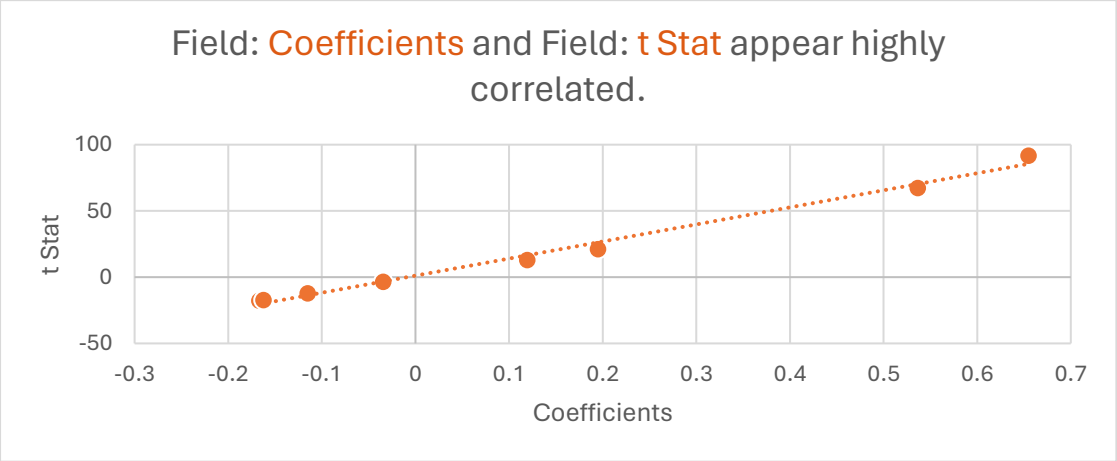
To find the regression analysis all the categorical data is changed to Numerical data **Reference: Encoding categorical values**. And then using the Z-score Method Normalization was done **Reference:Normalization**. Regression analysis of all the features with target MSRP was done using Excel 365 Data analysis. **Reference:Task3Regression Analysis**

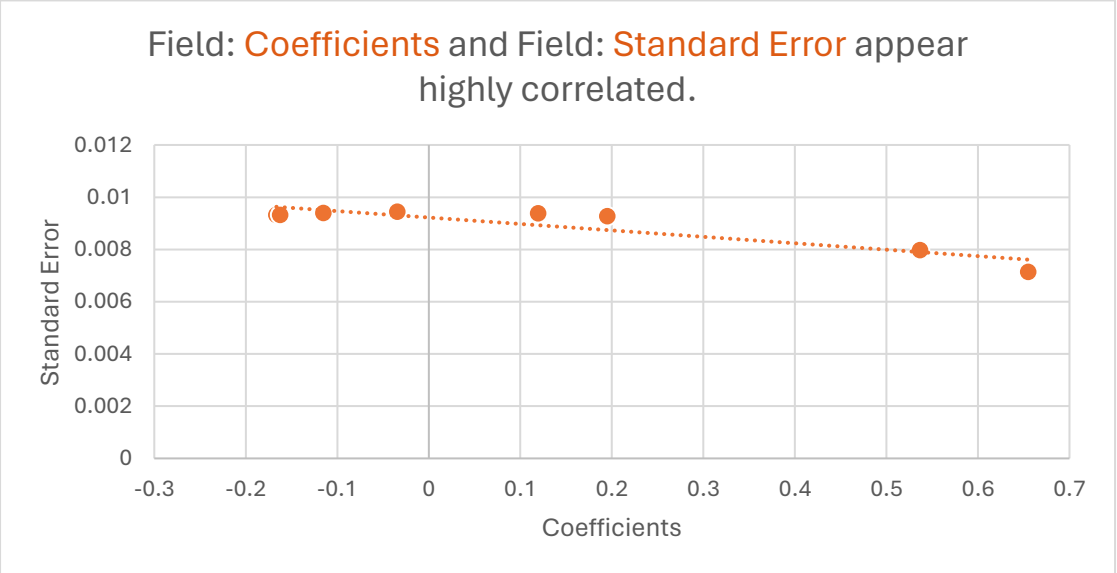
Regression	Engine Fuel Type	Driven_Wheels	Transmission Type	Vehicle Size	Engine HP	Engine Cylinders	Highway MPG	City mpg
Multiple R	0.115	0.034	0.195	0.119	0.655	0.537	0.167	0.162
R Square	0.013	0.001	0.038	0.014	0.429	0.288	0.028	0.026
Adjusted R Square	0.013	0.001	0.038	0.014	0.429	0.288	0.028	0.026
Standard Error	0.993	0.999	0.981	0.993	0.756	0.844	0.986	0.987
Observations	11198	11198	11198	11198	11198	11198	11198	11198

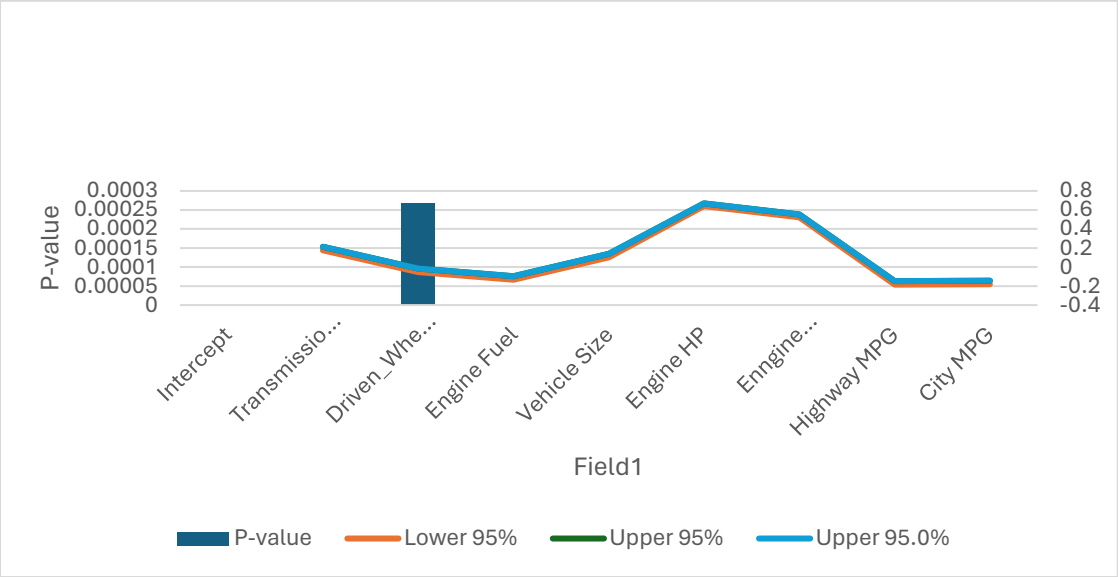
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Transmission Type	0.194988518	0.009270003	21.03435241	2.2939E-96	0.176818	0.213159355	0.176817681	0.21316
Driven_Wheels	-0.03444242	0.009445368	-3.646488089	0.00026705	-0.052957	-0.015927839	-0.052957002	-0.0159
Engine Fuel	-0.11520303	0.009388025	-12.27127435	2.1483E-34	-0.133605	-0.09680085	-0.13360521	-0.0968
Vehicle Size	0.11950598	0.00938315	12.73623192	6.7032E-37	0.101113	0.137898605	0.101113355	0.1379
Engine HP	0.654855107	0.00714246	91.68481705	0	0.640855	0.668855584	0.64085463	0.66886
Enngine Cylinder	0.536629131	0.007974416	67.29384376	0	0.520998	0.55226039	0.520997873	0.55226
Highway MPG	-0.166631148	0.009318255	-17.88222734	1.5462E-70	-0.184897	-0.14836573	-0.184896566	-0.1484
City MPG	-0.16234251	0.009325014	-17.40935829	5.3245E-67	-0.180621	-0.144063843	-0.180621177	-0.1441




COEFFICIENT
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
Transmission Type
Driven_Wheels
Engine Fuel
Vehicle Size
Engine HP
Enngine Cylinder
Highway MPG
City MPG


Field: Coefficients and Field: t Stat appear highly correlated.
t Stat
100
50
0
-50
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Coefficients


Field: Coefficients and Field: Standard Error appear highly correlated.
Standard Error
0.012
0.01
0.008
0.006
0.004
0.002
0
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Coefficients



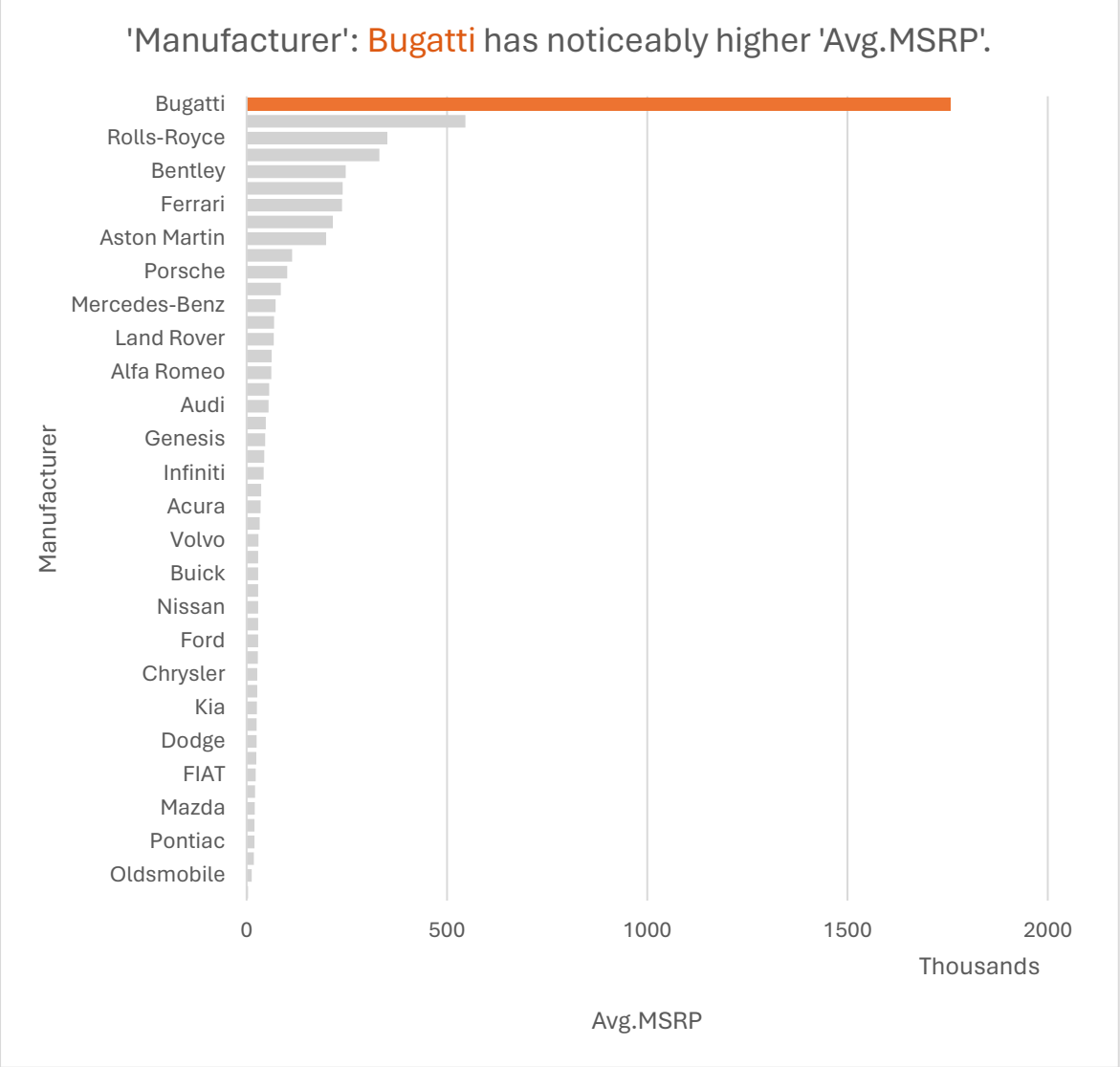
Insights:- To find the best suitable Feature we have to take into account R-square and Coefficient values. As per the observations engine HP has the strongest relationship with Price (target MSRP) followed by Engine cylinder. Hence we can say that Engine HP followed by Engine Cylinder are the most importance features to decide the Car price(MSRP).Coefficients and Standard Error appear highly correlated. Coefficients and t Stat appear highly correlated.

Task4.A: Create a pivot table that shows the average price of cars for each manufacturer.

Manufacturer	Average of MSRP
Acura	35087.49
Alfa Romeo	61600.00
Aston Martin	198123.46
Audi	54574.12
Bentley	247169.32
BMW	62162.56
Bugatti	1757223.67
Buick	29034.19
Cadillac	56368.27
Chevrolet	29074.73
Chrysler	26722.96
Dodge	24857.05
Ferrari	238218.84
FIAT	22670.24
Ford	28511.31
Genesis	46616.67
GMC	32444.09

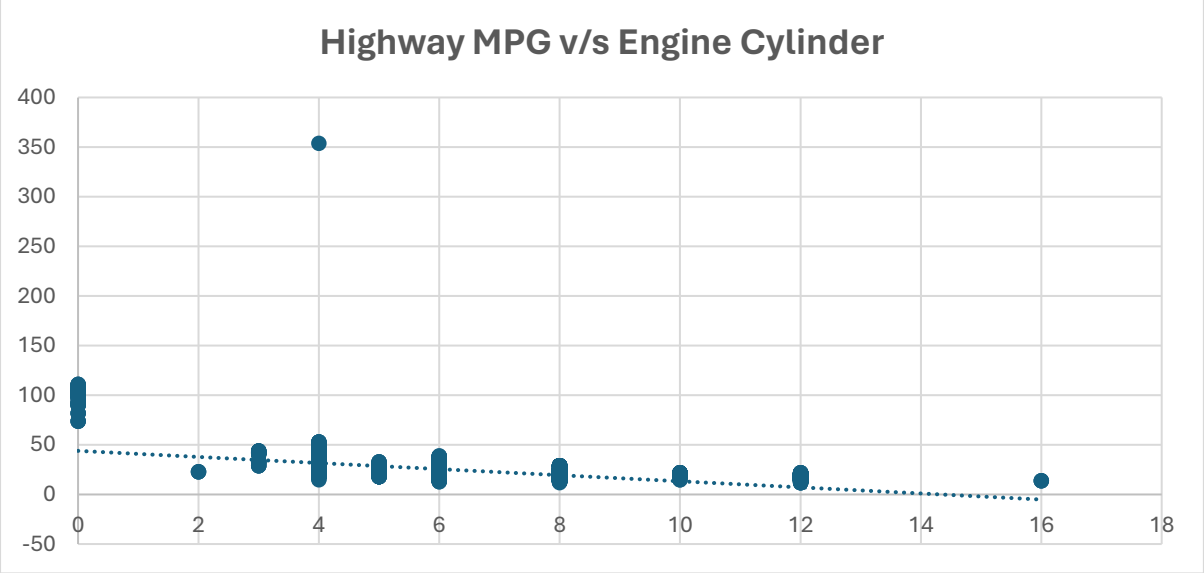
Honda	26655.15
HUMMER	36464.41
Hyundai	24926.26
Infiniti	42640.27
Kia	25513.76
Lamborghini	331567.31
Land Rover	68067.09
Lexus	47549.07
Lincoln	43860.83
Lotus	68377.14
Maserati	113684.49
Maybach	546221.88
Mazda	20416.62
McLaren	239805.00
Mercedes-Benz	72069.53
Mitsubishi	21340.56
Nissan	28921.15
Oldsmobile	12843.80
Plymouth	3296.87
Pontiac	19800.04
Porsche	101622.40
Rolls-Royce	351130.65
Saab	27879.81
Scion	19932.50
Spyker	214990.00
Subaru	24240.67
Suzuki	18026.42
Tesla	85255.56
Toyota	28846.56
Volkswagen	28978.52
Volvo	29724.68
Grand Total	**41925.92714**

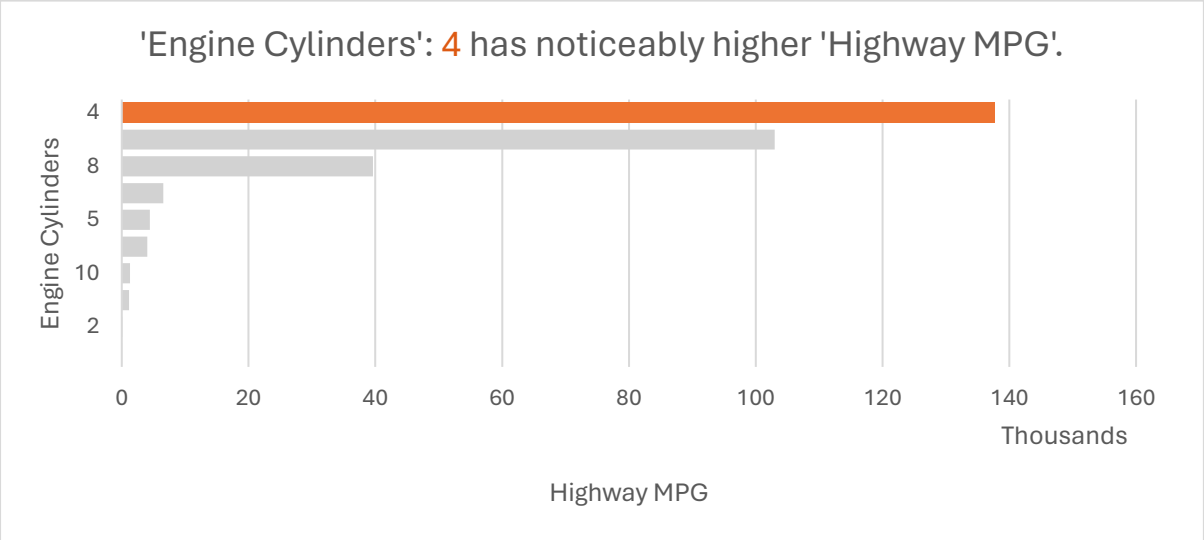
Task 4.B: Create a bar chart or a horizontal stacked bar chart that visualizes the relationship between manufacturer and average price.



Insights:- From the above Pivot Chart and Graph it is clear that Buggati has highest average price while Plymouth has the Lowest Price .

Task 5.A: Create a scatter plot with the number of cylinders on the x-axis and highway MPG on the y-axis. Then create a trendline on the scatter plot to visually estimate the slope of the relationship and assess its significance.

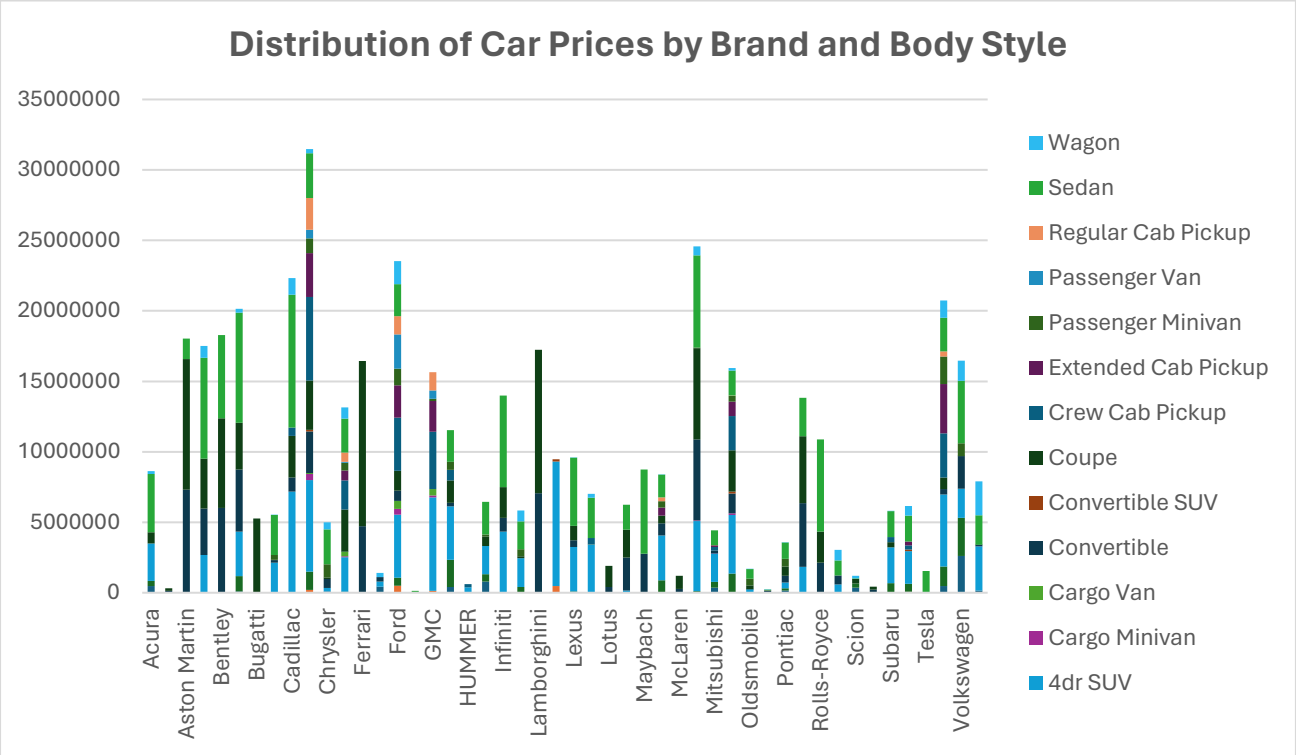




Insights:- We can observe that the plot between highway MPG and Engine Cylinders has a negative slope. The correlation coefficient is also Negative with a value of -0.6166.This is logical because as number of Engine Cylinders increases, the amount of fuel to be burnt also increases, thus decreasing the mileage (highway MPG).

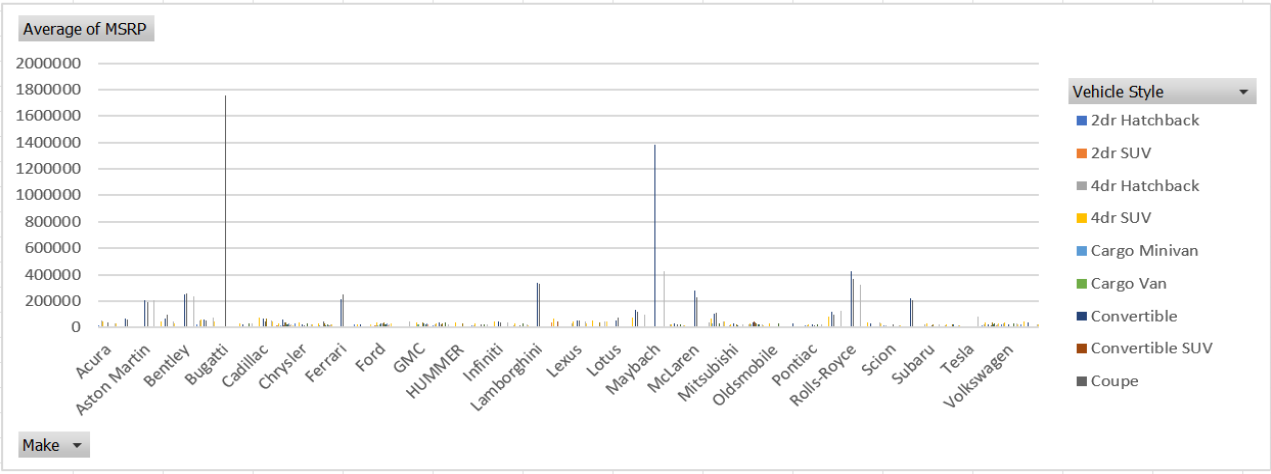
Building the Dashboard

Task 1: How does the distribution of car prices vary by brand and body style?

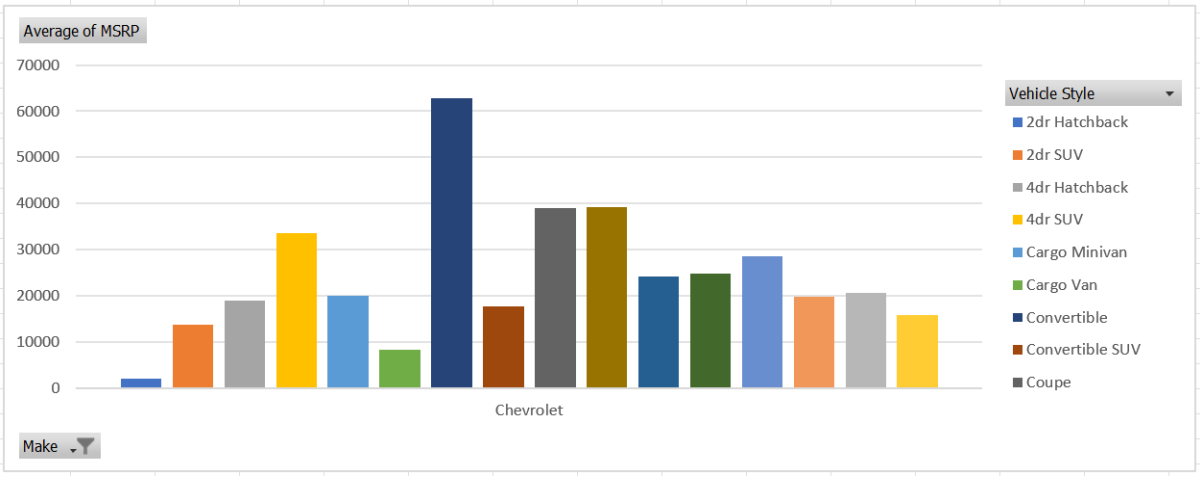


Insights: Pivot Table and stacked column chart is used to find out Distribution of Car Prices by Brand and Body Style. It is observed that Chevrolet has the highest sum of MSRP followed by Mercedes-Benz.

Task 2: Which car brands have the highest and lowest average MSRPs, and how does this vary by body style?



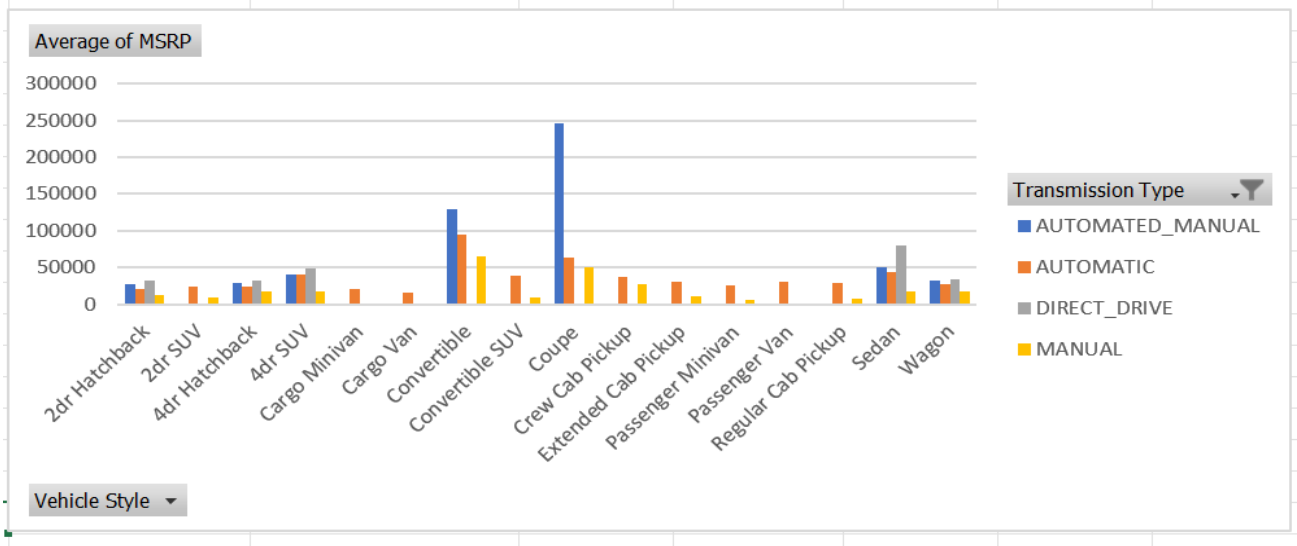
Insights:- Buggati has Highest Average MSRP of 1757223.667 and Plymouth has lowest Average MSRP 3296.87.

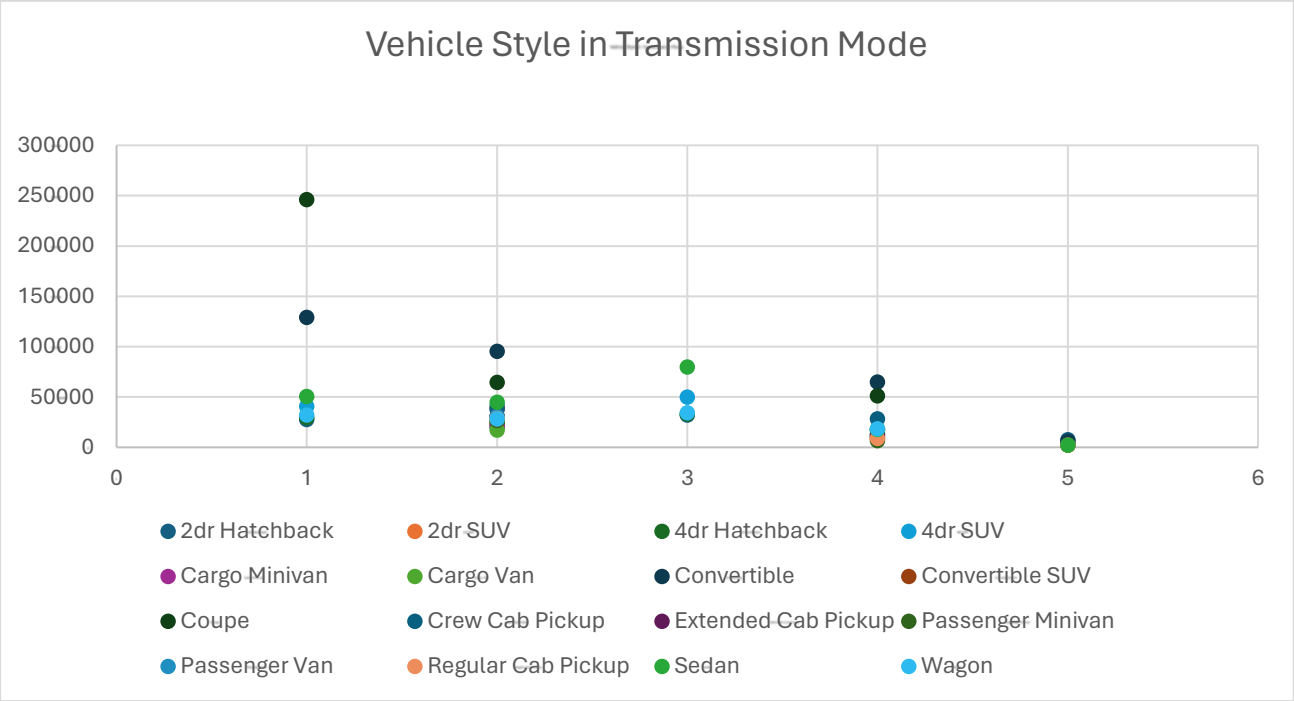


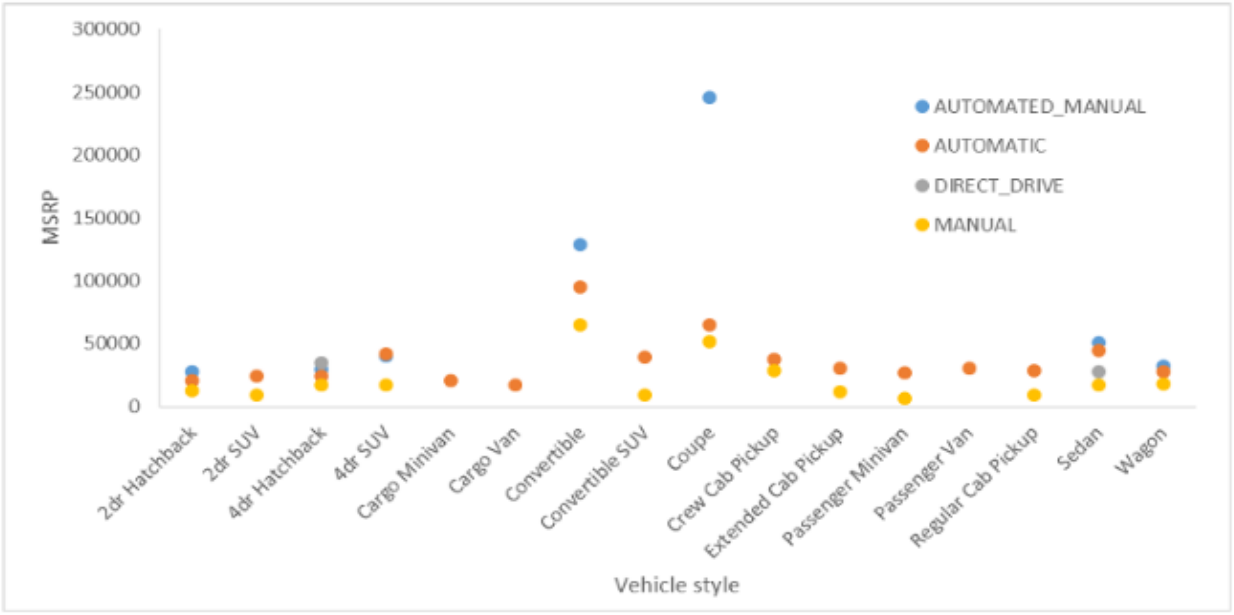
Clustered Chart to compare the average MSRPs across different car body styles. I have taken example of the Chevrolet Brand top explain the MSRP as per different styles. Filter option was used to choose one Brand and show variation.

Task 3: How do the different feature such as transmission type affect the MSRP, and how does this vary by body style?

Data for Unknown Transmission has been filtered out to get a proper analysis.

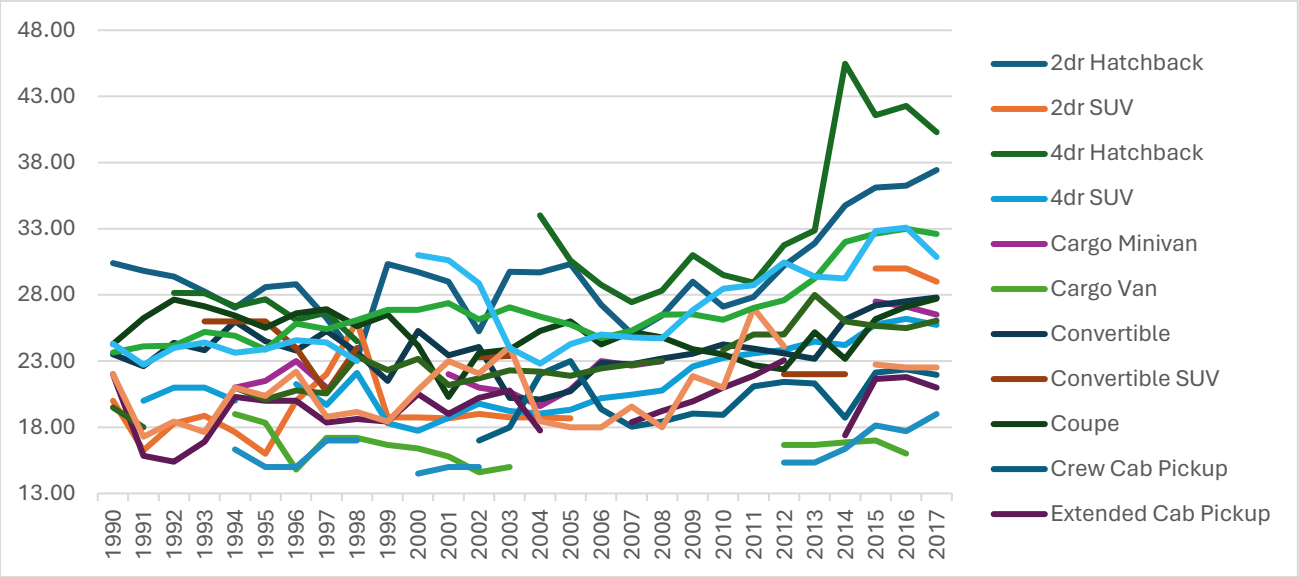


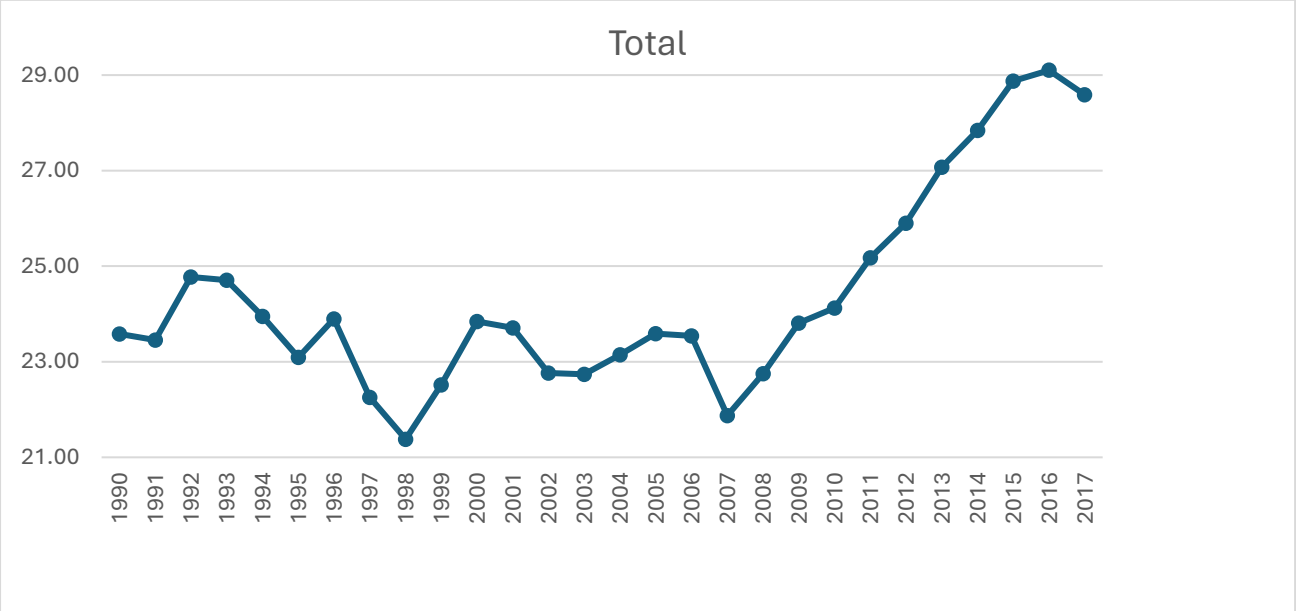




Insights:- Automated_Manual is the most saleable and MSRP making Transmission Mode. Coupe is the Vehicle Style which is mostly sold in Automated Manual Transmission.

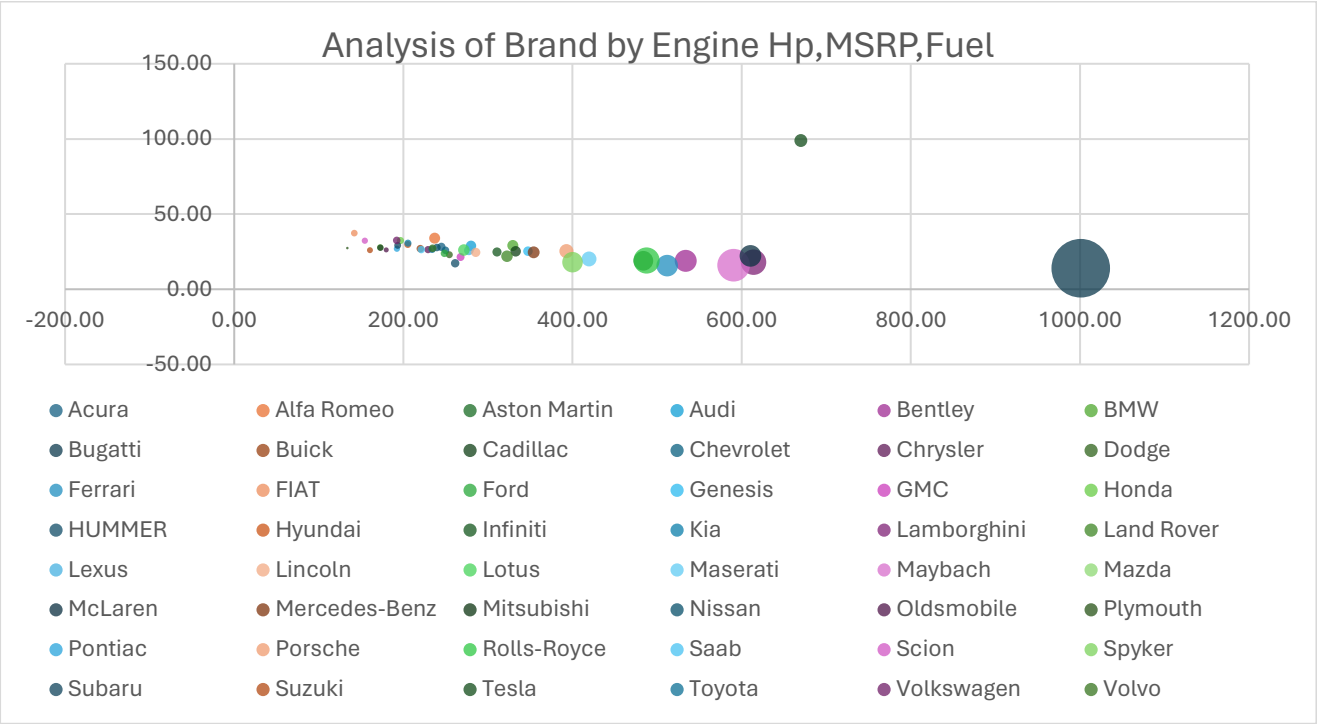
Task 4: How does the fuel efficiency of cars vary across different body styles and model years?

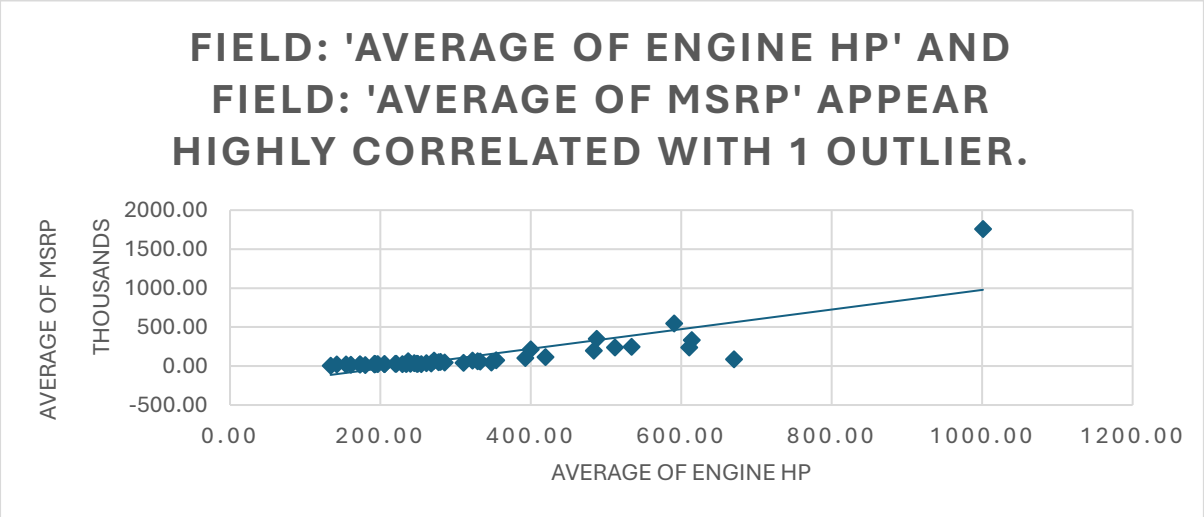




Insights:- We can understand from the graph that fuel efficiency has increased over the period of years for the Brands and Body Styles.

Task 5: How does the car's horsepower, MPG, and price vary across different Brands?





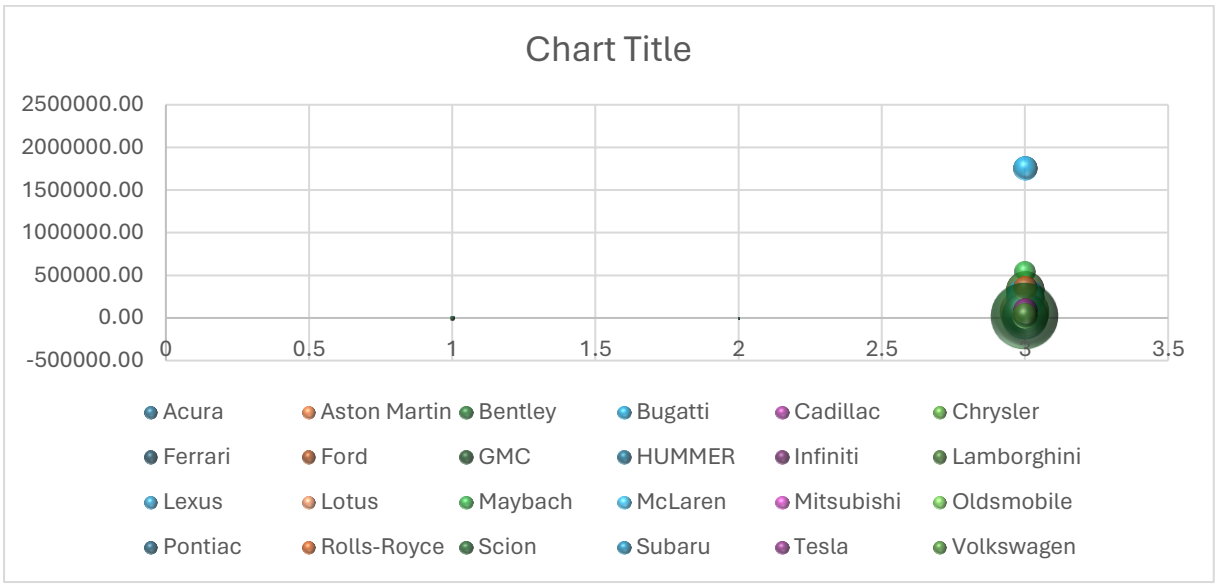


Chart Title
2500000.00
2000000.00
1500000.00
1000000.00
500000.00
0.00
-500000.00
0
0.5
1
1.5
2
2.5
3
3.5
Acura
Aston Martin
Bentley
Bugatti
Cadillac
Chrysler
Ferrari
Ford
GMC
HUMMER
Infiniti
Lamborghini
Lexus
Lotus
Maybach
McLaren
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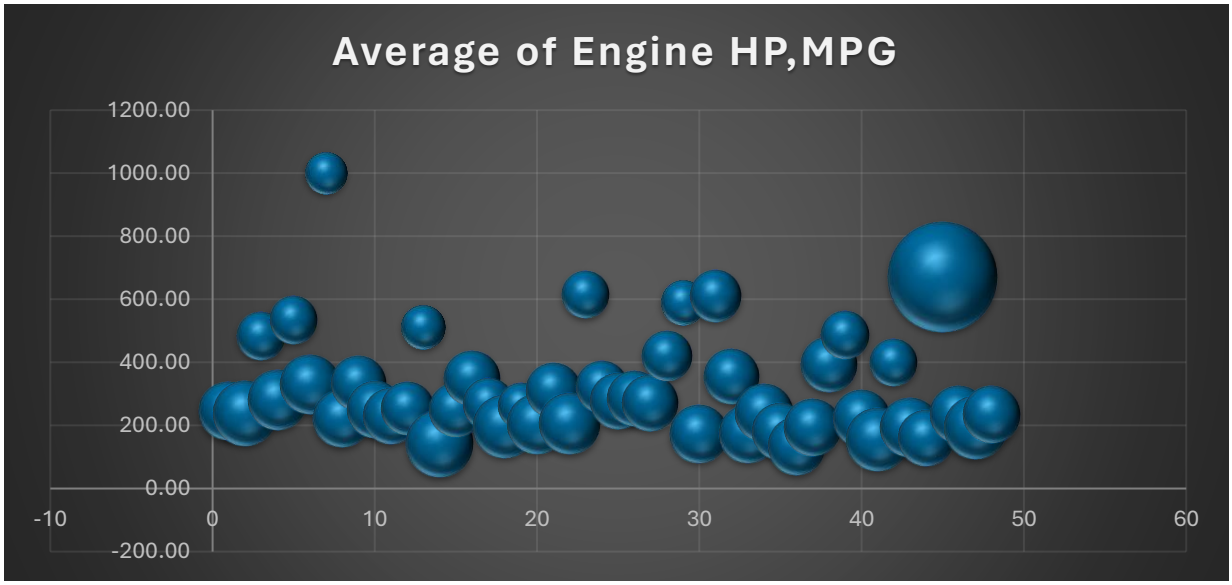
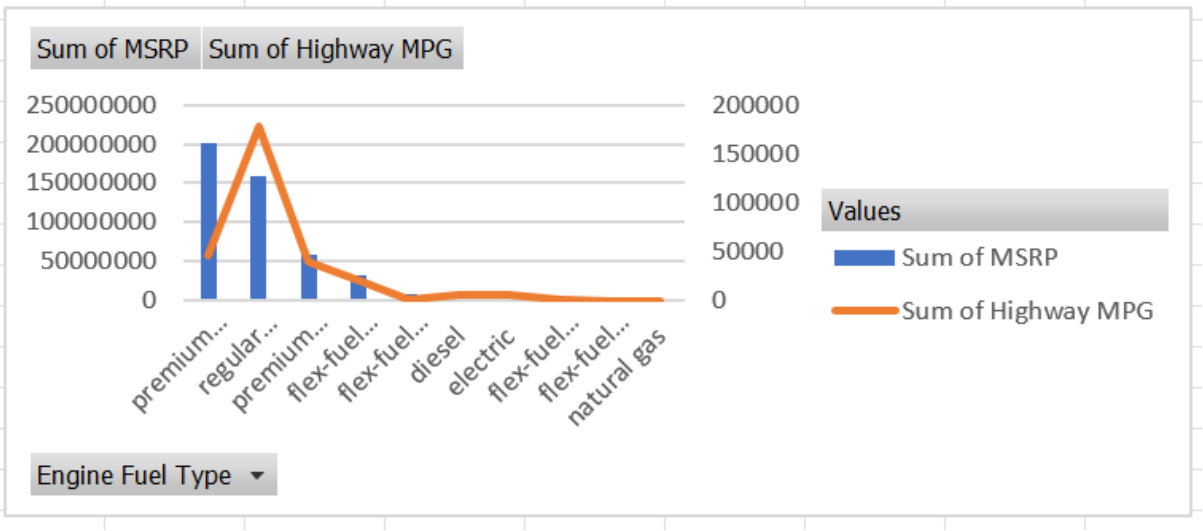
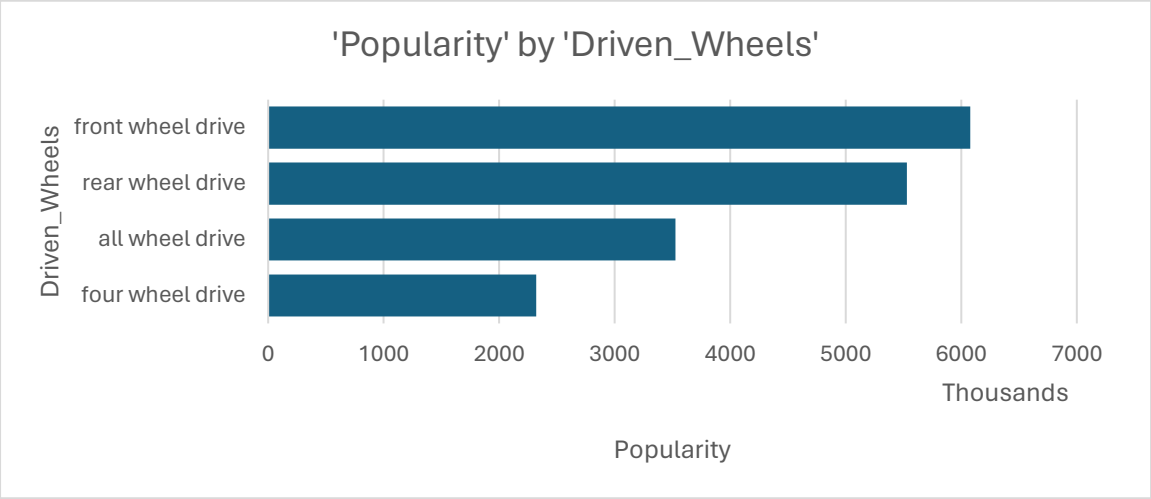
Oldsmobile
Pontiac
Rolls-Royce
Scion
Subaru
Tesla
Volkswagen


Average of Engine HP,MPG
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
-200.00
-10
0
10
20
30
40
50
60

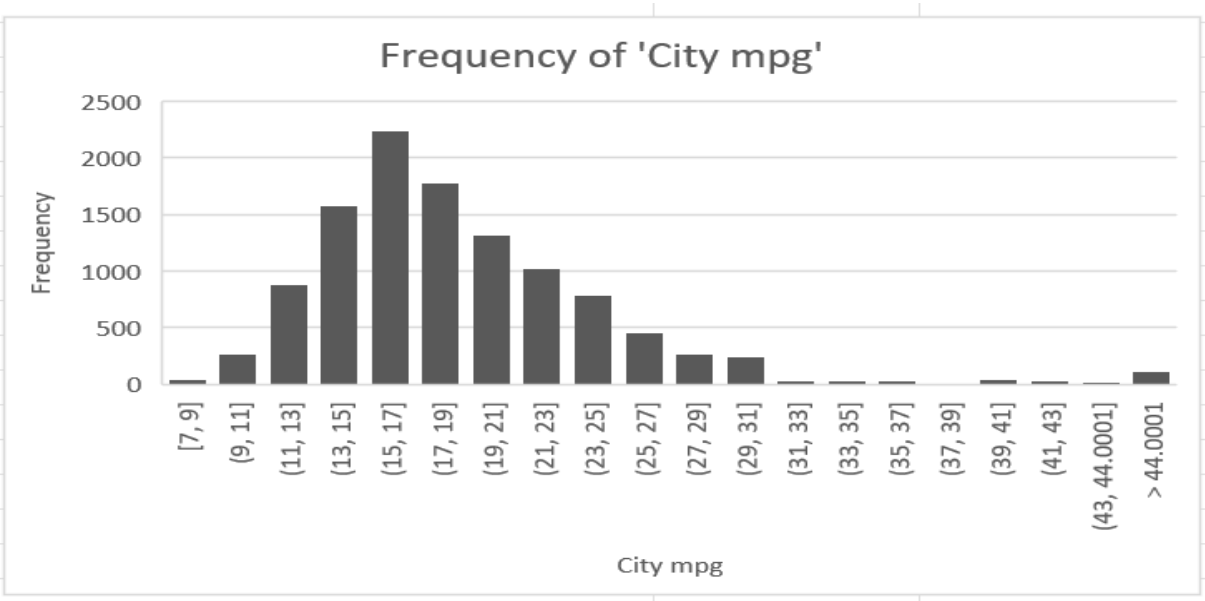
Some More Analysis:-



Regular Unleaded Engine Fuel Type has less MSRP than Premium Unleaded(required) but still its Sum of Highway MPG is more than other Engine Fuel type.



Cars with Front wheel Drive are more Popular than other Cars.



Majority of the cars bought gives average off 15-17 MPG.

To optimize pricing and product development decisions for maximizing profitability while meeting consumer demand, car manufacturers should:

Model Enhancement:

1. **Introduce New Models**: Develop luxury models at varied price points to attract a broader range of customers without diluting the brand's image. This can apply to high-end brands like Bugatti.
2. **Enhance Product Features**: Incorporate premium features and technological advancements in mid-range brands like Plymouth, Oldsmobile, and Suzuki to justify higher prices and appeal to discerning customers.
3. **Limited Editions**: Release limited edition models to create exclusivity and boost brand value, which can increase the willingness of consumers to pay more.

Price Enhancement:

1. **Competitive Pricing**: Set prices that balance profitability with market competitiveness. Use market research to understand the pricing strategies of competitors and adjust accordingly.
2. **Optimize Costs and Improve Efficiency**: Streamlining production processes, reducing waste, and leveraging economies of scale can significantly lower costs, enhancing profit margins.
3. **Monitor Market Trends**: Stay informed about changes in consumer preferences and market conditions. This allows for timely adjustments in pricing strategies to align with current demand.
4. **Customer Feedback**: Regularly gather and analyze customer feedback to understand their needs and preferences. Use this information to refine product features and pricing models.
5. **Product Differentiation**: Introduce unique features or limited edition models to justify higher prices and attract a specific segment of the market.

These strategies help align product offerings with market demands, thereby maximizing profitability.

Engine Cylinder:

Vehicles with fewer cylinders, such as 3-cylinder or 4-cylinder engines, can be marketed as more fuel-efficient and environmentally friendly options. These vehicles typically consume less fuel, making them appealing to eco-conscious consumers who are willing to pay a premium for green features. Highlighting the environmental benefits and potential fuel savings can attract this segment of buyers.

Market Category:

Manufacturers should focus on proving high-performance and hybrid models for the customer at relatively affordable prices as it is in demand and would be definitely purchased by the customers.

Conclusion:

Analyzing the impact of car features on pricing and profitability reveals that advanced features, cutting-edge technology, and high-quality materials significantly enhance a car's market value, resulting in higher pricing. These features attract consumers who are willing to pay a premium for enhanced performance, comfort, and safety. However, the inclusion of these advanced features also increases production costs, which can affect profitability.

To optimize profitability while meeting consumer demand, manufacturers should focus on:

1. **Identifying Key Features**: Determine which features are most valued by consumers and focus on incorporating those that provide the best return on investment.
2. **Cost Management**: Implement cost-effective production methods and materials to reduce the added costs of advanced features.
3. **Market Segmentation**: Tailor feature sets to different market segments to maximize appeal and pricing potential.
4. **Monitoring Trends**: Continuously track market trends and consumer preferences to adjust feature offerings and pricing strategies accordingly.

By balancing the incorporation of desirable features with efficient cost management, car manufacturers can maximize profitability while meeting consumer demand for advanced and high-quality vehicles.

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Thank You

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