

# Impact of Car Case Study

## Assessment 7

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#### Project Description

In the past few years, there has been a rise in interest in alternative fuels like hydrogen and natural gas, as well as electric and hybrid cars. At the same time, standard cars that run on gasoline are still the most popular on the market, and customers can choose from a variety of fuel types and grades.

How can a car manufacturer optimise pricing and product development decisions to maximise profitability while fulfilling consumer demand is the question the client asked as a data analyst for the given dataset.

#### Tech-Stack

This analytical study is conducted by employing Microsoft Excel, leveraging its extensive range of statistical functions including COUNT, Pivot Charts, and other advanced tools. Using methods like regression analysis and market segmentation to look at data, the manufacturer could come up with a pricing strategy that meets both customer needs and makes money, as well as figure out which product features to focus on when making new ones in the future. In the long run, this could help the company become more profitable and more competitive in the market.

#### Excel file



TRAINITY\_A7.xlsx

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## PART- 1

### A. TASK 1:

#### STATEMENT:

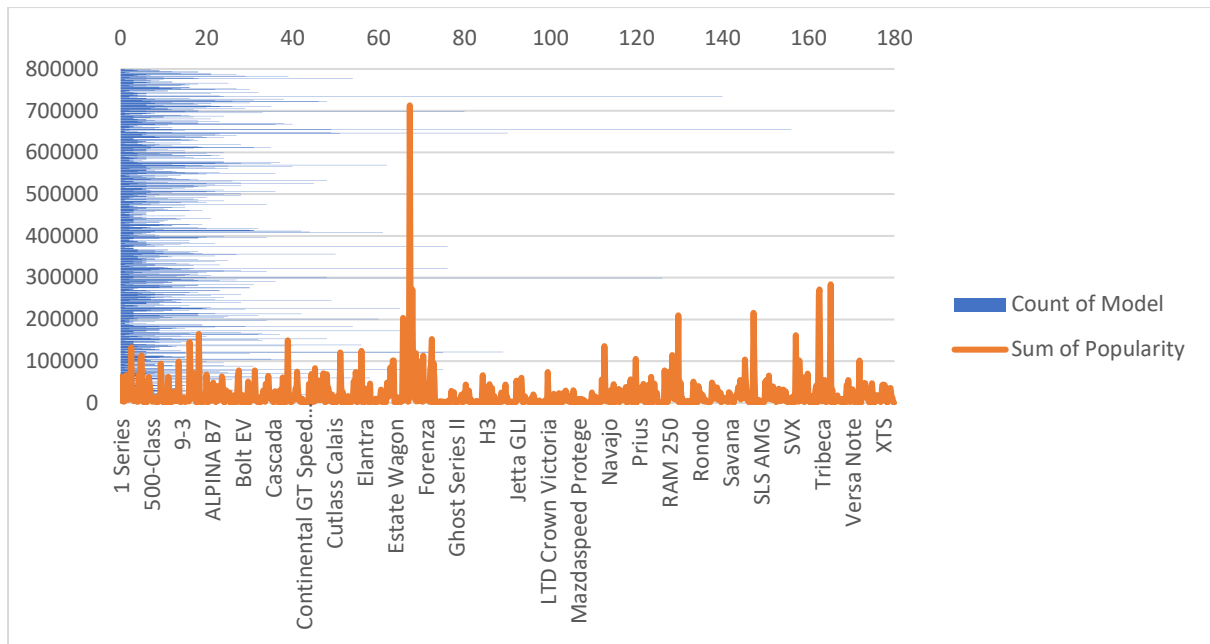
In what ways does the success of a car model change in different types of cars?

#### APPROACH:

A pivot table was made to show how many car models are in each market group and how popular each model is.

Relationship between Market Category and Popularity	Count of Model	Sum of Popularity
<b>1 Series</b>	<b>16</b>	<b>62656</b>
Luxury	4	15664
Luxury,High-Performance	5	19580
Luxury,Performance	7	27412
<b>1 Series M</b>	<b>1</b>	<b>3916</b>
Factory Tuner,Luxury,High-Performance	1	3916
<b>100</b>	<b>15</b>	<b>46575</b>
Luxury	15	46575
<b>124 Spider</b>	<b>3</b>	<b>2457</b>
Performance	3	2457
<b>190-Class</b>	<b>6</b>	<b>3702</b>
Luxury	6	3702
<b>2</b>	<b>12</b>	<b>7032</b>
Hatchback	12	7032
<b>2 Series</b>	<b>17</b>	<b>66572</b>
Factory Tuner,Luxury,High-Performance	8	31328
Luxury	3	11748
Luxury,Performance	6	23496
<b>200</b>	<b>29</b>	<b>41929</b>
Flex Fuel	15	15195
Flex Fuel,Performance	8	8104
Luxury	4	12420
Luxury,Performance	2	6210
<b>200SX</b>	<b>9</b>	<b>18081</b>
N/A	6	12054
Performance	3	6027
<b>240</b>	<b>8</b>	<b>6960</b>
Luxury	8	6960
<b>240SX</b>	<b>8</b>	<b>16072</b>

FIG 1 Relationship between Market Category and Popularity



**FIG 2 Visual representation of the relationship**

- Put together a combo chart that shows how market category and demand are related.

#### INTERPRETATION:

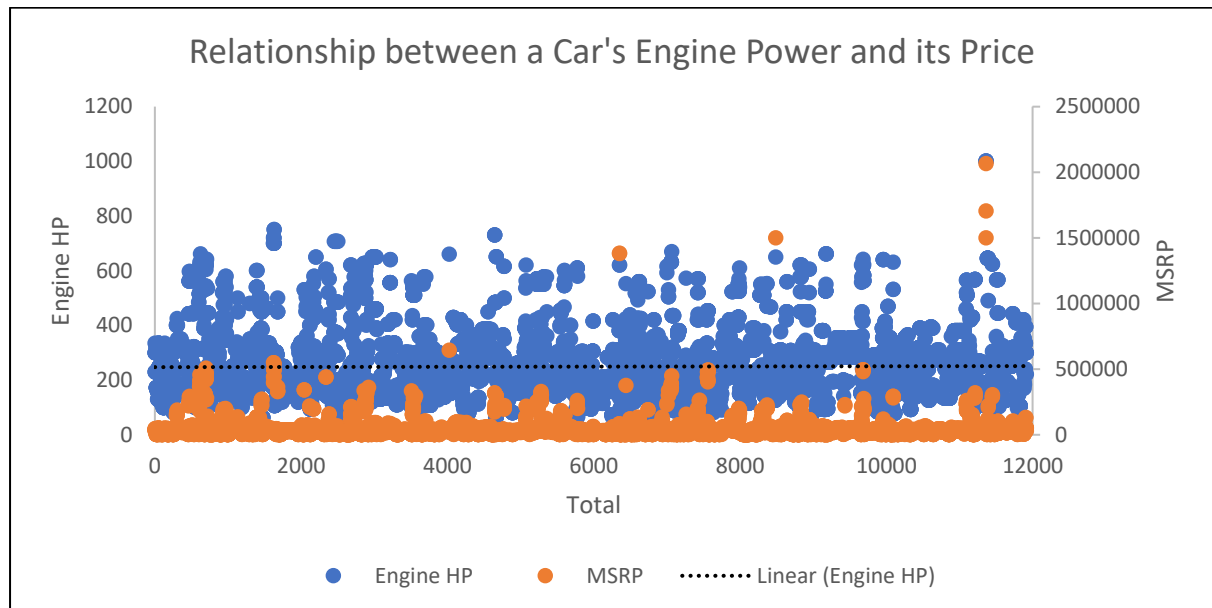
A favorable association was found while examining the relationship between an automobile's engine power and pricing. The price of a car usually rises in direct proportion to engine power, which is expressed in horsepower (HP). Regression study revealed a significant association between engine power and automobile pricing, which can be quantitatively estimated using the trendline's equation on the scatter chart.

## B. TASK 2:

### STATEMENT:

What does the price of a car have to do with how powerful its engine is?

### APPROACH:



**FIG 5 Relationship between a Car's Engine Power and its Price**

- I made a scatter chart with price on the y-axis and engine power on the x-axis.
- You can see how these factors are related by adding a trendline to the chart.

	<i>Engine HP</i>	<i>MSRP</i>
Engine HP	1	
MSRP	0.662007661	1

**FIG 6 Correlation between two variables**

### INTERPRETATION:

Many independent variables (such as engine cylinders, number of doors, highway and city mpg, engine horsepower, and popularity) that are statistically significant in predicting an automobile's price were found using multiple linear regression analysis. These variables' effects on car pricing were represented by their coefficients. While Number of Doors had a negative coefficient, indicating

a decrease in price with more doors, Engine HP had the largest positive coefficient, implying that it has the greatest impact on automobile prices.

### C. TASK 3:

#### STATEMENT:

What traits of a car tell you the most about its price?

#### APPROACH:

To examine the relationship between a dependent variable (in this case, car price) and several independent variables (in this case, Engine Cylinders, Number of Doors, highway MPG, city mpg, Engine HP, and Popularity), a multiple linear regression model is used. The results of the regression analysis are presented in the table below. Examining the main results of this regression study,

I	J	K	L	M	N	O	P	Q
<b>SUMMARY OUTPUT</b>								
<i>Regression Statistics</i>								
Multiple R	0.685306311							
R Square	0.46964474							
Adjusted R Square	0.46937525							
Standard Error	43908.53542							
Observations	11815							
<i>ANOVA</i>								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	6	2.01594E+13	3.35989E+12	1742.72	0			
Residual	11808	2.27653E+13	1927959483					
Total	11814	4.29247E+13						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-96512.01109	3687.749498	-26.17097803	8.3E-147	-103740.6082	-89283.41393	-103740.6082	-89283.41393
Engine Cylinders	7118.342131	437.0790222	16.28616742	5.43E-59	6261.59517	7975.089093	6261.59517	7975.089093
Number of Doors	-4721.527663	463.4140498	-10.18857254	2.81E-24	-5629.895621	-3813.159704	-5629.895621	-3813.159704
highway MPG	534.0108739	105.1984966	5.076221534	3.91E-07	327.8044724	740.2172754	327.8044724	740.2172754
city mpg	1219.711775	121.3635325	10.05006817	1.14E-23	981.819237	1457.604312	981.819237	1457.604312
Engine HP	323.0463366	5.979918896	54.02185919	0	311.3247094	334.7679638	311.3247094	334.7679638
Popularity	-3.324711821	0.281317034	-11.81838077	4.75E-32	-3.876139599	-2.773284044	-3.876139599	-2.773284044

**FIG 8 Regression Analysis**

#### Regression Statistics:

- Multiple R: 0.6853 - The multiple correlation coefficient (R), which assesses the magnitude and axis of the linear relationship between the independent factors and the dependent variable (vehicle price), is given here. It serves as a gauge for the overall effectiveness of the model fit.
- R Square: 0.4696 - The coefficient of determination (R<sup>2</sup>) is a measure of the amount of variance in the dependent variable (vehicle price) that can be accounted for by the independent variables. In this instance, the independent variables account for about 46.96% of the variation in automobile costs.
- Adjusted R Square: 0.4694, which is R Square but with the number of predictors considered. The complexity of the models is considered.
- The standard error of the estimate, which calculates the average difference between actual and expected automobile costs, is 43908.54.
- The total number of observations used in the analysis was 11,815 observations.

### Coefficients:

- The coefficients table contains details on the various predictor variables and how they affect car costs.
- This is the estimated intercept, often known as the constant term. When every other predictor variable is 0, it indicates the expected cost of an automobile.
- The coefficients for the corresponding independent variables are Engine Cylinders, Number of Doors, Highway MPG, City MPG, Engine HP, and Popularity.
  - Keeping all other variables fixed, they indicate the anticipated change in automobile price for a one-unit change in the relevant independent variable.
  - The significance of each coefficient is assessed using the t-statistic.
  - The p-value attached to each coefficient reflects the statistical significance of the variable in forecasting car pricing. All the predictor variables in this situation have p-values that are close to zero, indicating that they are highly significant.
  - The true coefficient value is expected to fall between the lower and upper 95% confidence ranges.

### INTERPRETATION:

- The regression model explains roughly 47% of the variation in car costs, demonstrating a modest predictive power for the independent variables that were included.
- Based on their low p-values, each predictor variable (engine cylinders, number of doors, highway and city mpg, engine horsepower, and popularity) is statistically significant in predicting automobile costs.
- The intensity and direction of the link are indicated by the coefficients. For instance, the engine horsepower has a positive coefficient, meaning that the price of cars tends to rise as engine horsepower rises. In contrast, Number of Doors has a negative coefficient, indicating that the price of an automobile tends to decrease as the number of doors rises.
- The intercept, which is a theoretical concept that might not have application in the actual world, is the predicted cost of an automobile when all the predictor variables are zero.



#### D. TASK 4:

##### STATEMENT:

How do different automakers' average prices differ from one another?

##### APPROACH:

A pivot table that displays the typical cost of cars for each manufacturer was created.

Name of the Manufacturer ▼	Average of MSRP
Acura	34,888
Alfa Romeo	61,600
Aston Martin	1,97,910
Audi	53,452
Bentley	2,47,169
BMW	61,547
Bugatti	17,57,224
Buick	28,207
Cadillac	56,231
Chevrolet	28,350
Chrysler	26,723
Dodge	22,390
Ferrari	2,38,219
FIAT	22,670
Ford	27,399
Genesis	46,617
GMC	30,493
Honda	26,674
HUMMER	36,464
Hyundai	24,597
Infiniti	42,394
Kia	25,310
Lamborghini	3,31,567
Land Rover	67,823
Lexus	47,549
Lincoln	42,840
Lotus	69,188
Maserati	1,14,208

**FIG 12 Pivot Table**

- The given information illustrates how the average Manufacturer's Suggested Retail Price (MSRP) for vehicles from various manufacturers varies depending on the manufacturer.
- The MSRP stands for the manufacturer's suggested retail price, which is the price at which an automobile is sold to dealers or consumers.

Made a bar graph to show the connection between the manufacturer and the typical pricing.

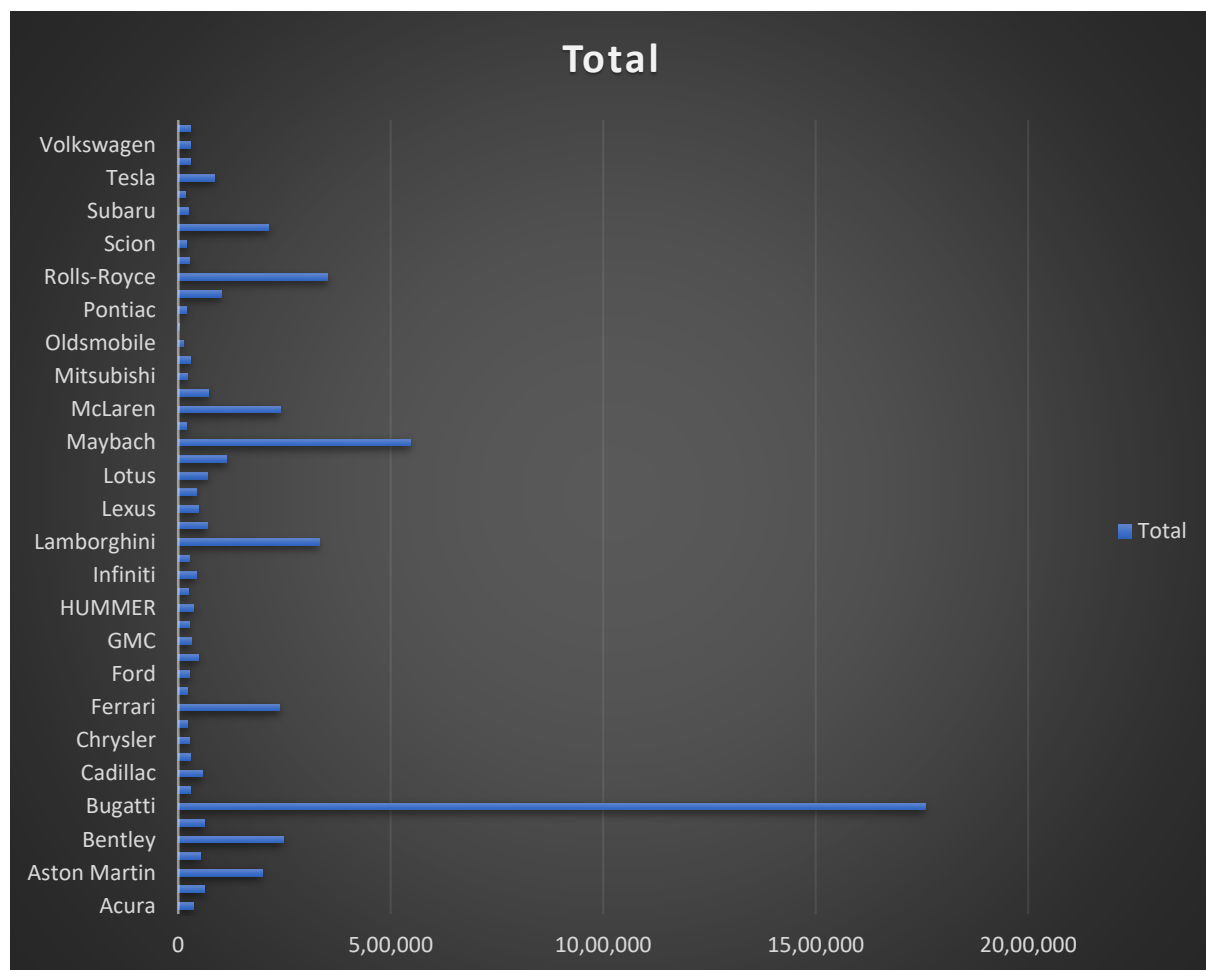


FIG 13 Visual Representation of Pivot Table

We can examine the data and note the following findings to comprehend the connection between the manufacturer and the typical MSRP:

1. Differing MSRP by Manufacturer: The data unmistakably demonstrates that various manufacturers have various average MSRPs. For instance, when compared to brands like Dodge, Pontiac, or Plymouth, the average MSRPs for Bugatti, Maybach, Lamborghini, and Rolls-Royce are much more.
2. Wide Price Range: The average MSRPs among manufacturers vary widely, indicating that the choice of automaker has a major impact on the cost of a car. For instance, while Dodge and Pontiac offer more affordable options, luxury automakers like Bugatti and Maybach offer high-end, pricey vehicles.
3. Market Segmentation: Based on their average MSRP, the data reveals that manufacturers target several market niches. While mainstream manufacturers provide more cheap options, luxury and high-performance manufacturers typically have substantially higher MSRPs.

4. Brand Reputation: The average MSRP is significantly influenced by a manufacturer's reputation and brand image. Higher pricing can be demanded from manufacturers who have a reputation for creating high-end or high-performance vehicles.

5. Model Variation: It's vital to remember that costs for a manufacturer's product line might still vary widely depending on the particular model and its characteristics.

6. Consumer Preferences: The average MSRP is also influenced by consumer preferences and how highly a manufacturer is thought to value their vehicles. Some consumers are prepared to pay more for specific brands or models because of things like brand recognition, dependability, or technological features.

#### INTERPRETATION:

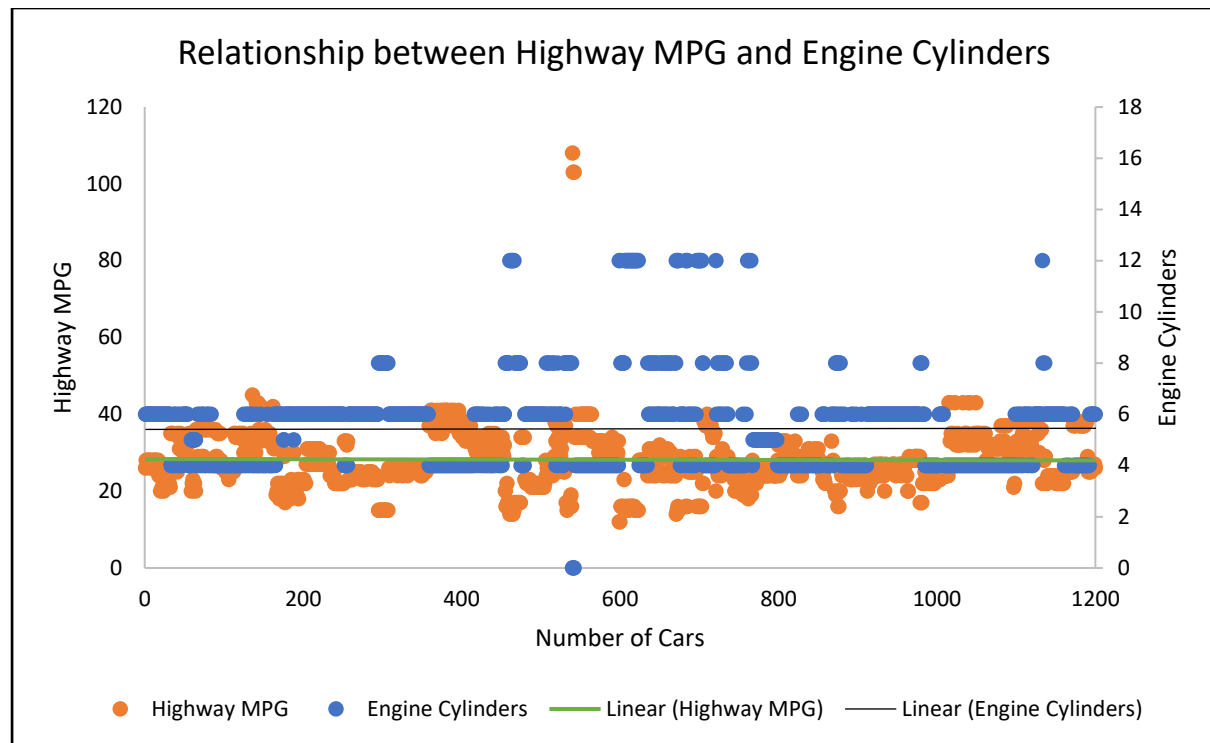
The average MSRP of cars is significantly influenced by the manufacturer. The price disparities are a result of the manufacturers' various market sectors, brand identities, and feature offerings. When selecting a car manufacturer, buyers should take their budget, demands, and tastes into account.

## E. TASK 5:

### STATEMENT:

What connection exists between a car's engine's cylinder count and fuel efficiency?

### APPROACH:



**FIG 19 Correlation matrices for loan approved Analysis**

- A scatter plot was made, with the cylinder count on the x-axis and the highway MPG on the y-axis.
- After that, draw a trendline on the scatter plot to visually determine the relationship's slope and determine its importance.

To measure the intensity and direction of the association between the number of cylinders and highway MPG, the correlation coefficient was calculated.

	Engine Cylinders	highway MPG
Engine Cylinders	1	
highway MPG	-0.621605733	1

**FIG 19 Correlation matrices**

- The numerical values within the matrix denote the correlation coefficients that quantify the relationship between pairs of variables. The correlation coefficient is bounded between -1

and 1, with a value of 1 indicating a perfect positive correlation, where both variables increase linearly.

- A value of -1 denotes a complete negative correlation, when an increase in one variable is accompanied by a linear drop in the other variable.
- A value of 0 denotes the absence of a linear correlation, indicating that the variables under consideration are not linearly related.

## INTERPRETATION

The number of cylinders in an automobile's engine and fuel economy (highway MPG) were found to be negatively correlated. Highway MPG typically declines as engine cylinder count increases. This negative trend was displayed in a scatter plot with a trendline, the direction and intensity of the association indicated by the trendline's slope. Furthermore, the correlation coefficient was computed to validate this inverse link and measure its magnitude.

## INSIGHTS:

- Regarding Buyers: Making Informed Auto Purchases: Buyers can select vehicles that best suit their performance and financial requirements.
- Fuel Efficiency: If fuel efficiency is vital to them, they can give it top priority.
- Brand Preferences: By being more aware of the price points connected to various automakers, consumers are better able to make decisions that are consistent with their preferred brands.
- Product Development: Automakers can customize their vehicles and advertising tactics to appeal to particular consumer demographics.
- Pricing Strategies: They are able to modify product portfolios and establish competitive prices.
- Efficiency Gains: Producers can investigate different powertrain options and increase fuel economy.
- Additional Research: Scholars are able to investigate the factors that underlie the associations that have been found.
- Industry Trend Analysis: Constant observation allows for the tracking of shifting customer preferences and industry trends.
- Policy and Regulation: Discussions regarding environmental rules and energy efficiency in the automotive sector can benefit from insights.

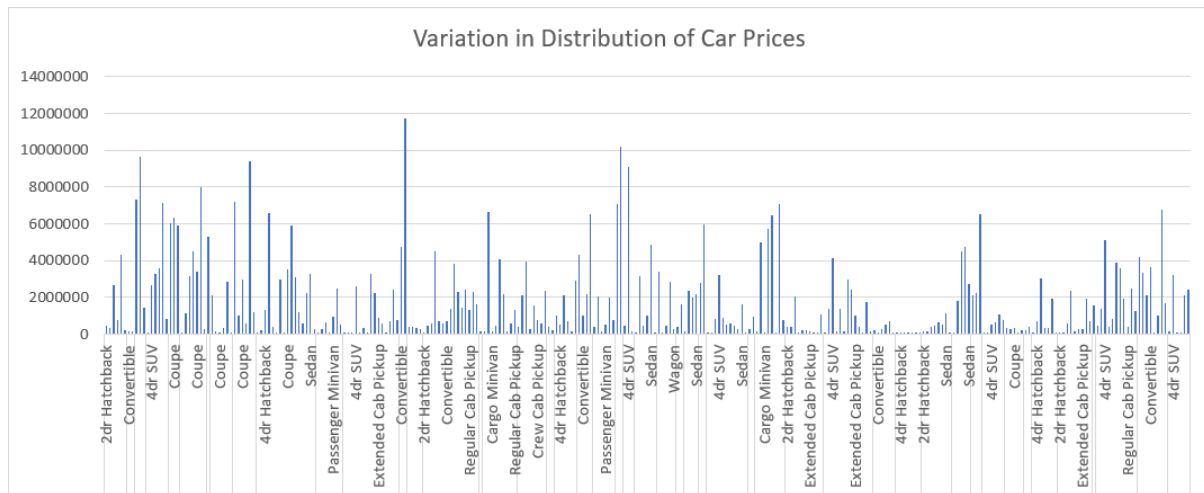
These acts support research and policy decisions, direct producers in product development and pricing, and assist customers in making educated judgments.

## PART – 2

### A. TASK 1 STATEMENT

#### APPROACH

Row Labels	Sum of MSRP
<b>Acura</b>	<b>8791672</b>
2dr Hatchback	480917
4dr Hatchback	357440
4dr SUV	2663505
Coupe	793748
Sedan	4294702
Wagon	201360
<b>Alfa Romeo</b>	<b>308000</b>
Convertible	129800
Coupe	178200
<b>Aston Martin</b>	<b>18405665</b>
Convertible	7321655
Coupe	9635275
Sedan	1448735
<b>Audi</b>	<b>17532293</b>
2dr Hatchback	4000
4dr SUV	2674900
Convertible	3291405
Coupe	3556290
Sedan	7158348
Wagon	847350
<b>Bentley</b>	<b>18290530</b>
Convertible	6012870
Coupe	6356760
Sedan	5920900
<b>BMW</b>	<b>20556619</b>
2dr Hatchback	80097
4dr Hatchback	1144950
4dr SUV	3160950



## INSIGHT

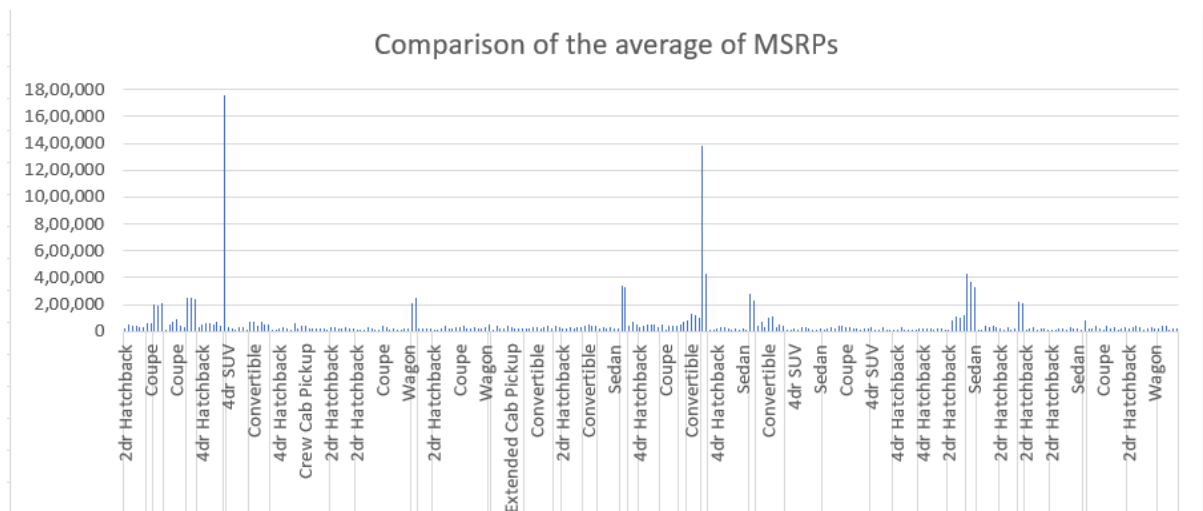
The Manufacturer's Suggested Retail Price (MSRP) for a variety of automobile manufacturers and vehicle types is displayed in the data. A few important lessons learned are:

1. The overall MSRPs of Cadillac, Chevrolet, Ford, Audi, BMW, Aston Martin, and Acura are noteworthy.
2. While convertibles and coupes are more typical of luxury brands, sedans are popular across brands.
3. High MSRPs are associated with luxury brands such as Bentley, Bugatti, Ferrari, Lamborghini, Maybach, McLaren, and Rolls-Royce.
4. Non-luxury brands offer a wider variety of vehicle types at high MSRPs.
5. The entire MSRP for all brands and designs comes to around \$483,645,697.

## B. TASK 2

### STATEMENT APPROACH

Row Labels	Average of MSRP
<b>Acura</b>	<b>34,888</b>
2dr Hatchback	17,176
4dr Hatchback	51,063
4dr SUV	42,960
Coupe	39,687
Sedan	33,292
Wagon	33,560
<b>Alfa Romeo</b>	<b>61,600</b>
Convertible	64,900
Coupe	59,400
<b>Aston Martin</b>	<b>1,97,910</b>
Convertible	2,03,379
Coupe	1,92,706
Sedan	2,06,962
<b>Audi</b>	<b>53,452</b>
2dr Hatchback	2,000
4dr SUV	48,635
Convertible	70,030
Coupe	93,587
Sedan	44,462
Wagon	33,894
<b>Bentley</b>	<b>2,47,169</b>
Convertible	2,50,536
Coupe	2,54,270
Sedan	2,36,836
<b>BMW</b>	<b>61,547</b>
2dr Hatchback	26,699
4dr Hatchback	54,521
4dr SUV	58,536





## INSIGHT

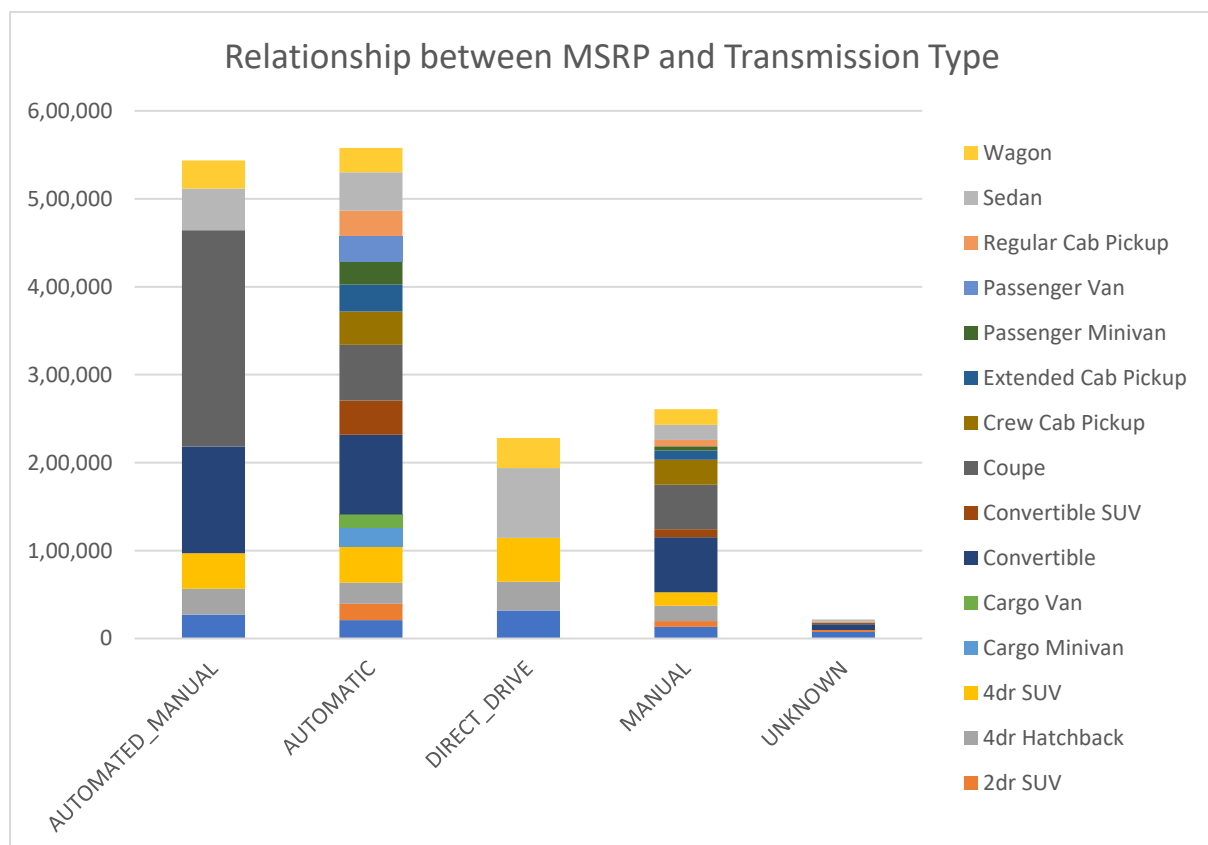
The information shows notable variations in typical MSRPs between auto brands. While companies like Dodge, Scion, and Plymouth offer more affordable options, luxury names like Bugatti, Lamborghini, and Maybach attract the greatest rates. Average MSRPs are also influenced by the type of vehicle selected, with convertibles frequently being the costliest alternative.

## C. TASK 3

### STATEMENT

### APPROACH

Average of MSRP	Column Labels												
Row Labels	2dr Hatchback	2dr SUV	4dr Hatchback	4dr SUV	Cargo Minivan	Cargo Van	Convertible	Convertible SUV	Coupe	Crew Cab Pickup	Extended Cab Pickup	Passenger Minivan	Passenger Van
AUTOMATED_MANUAL	27,181		29,249	40,451			1,21,257		2,45,977				
AUTOMATIC	20,926	18,615	23,834	41,536	20,921	15,280	90,637	38,926	63,372	37,744	30,637	26,413	29,015
DIRECT_DRIVE	31,800		32,800	49,800									
MANUAL	13,354	6,304	17,594	15,426			62,358	9,233	50,484	28,361	10,884	4,405	
UNKNOWN	7,362	2,371					5,784		2,000				
Grand Total	16,868	10,115	22,421	40,422	20,921	15,280	84,224	17,424	76,248	37,220	22,489	25,621	29,015



## INTERPRETATION

The average MSRP (Manufacturer's Suggested Retail Price) for various car body shapes and transmission types is shown in this data. Now let us examine the data:

Types of Transmission:

- AUTOMATED\_MANUAL: The typical MSRP for this transmission type varies depending on the body style, from 27,181 to 1,21,257.

- **AUTOMATIC:** The typical MSRP for an automatic transmission varies depending on the body style, from 18,615 to 43,769. In the dataset, it is the most prevalent transmission type.
- **DIRECT\_DRIVE:** The average MSRP for this transmission type is comparatively high, ranging from 31,800 to 79,512.
- **MANUAL:** The average MSRP of manual transmissions is typically lower, ranging from 4,405 to 62,358 for various body designs.

In the category of UNKNOWN, there is only one value, 7,362.

The data comprises a range of body styles, including Coupe, Crew Cab Pickup, Extended Cab Pickup, Passenger Minivan, Passenger Van, Regular Cab Pickup, Wagon, and 2dr Hatchback, 2dr SUV, 4dr Hatchback, 4dr SUV, Cargo Minivan, Cargo Van, Convertible, and Convertible SUV. The average MSRP varies significantly among these body styles, with the highest values typically associated with Convertible and Convertible SUV models. However, the average MSRP of 2dr Hatchback and cargo van versions is typically lower.

Overall Thoughts:

- The most popular transmission type, automatic, often has average MSRPs ranging from moderate to expensive for various body types.
- The average MSRP of manual transmissions is often lower, however this varies based on body type.
- The typical MSRP of Direct Drive transmissions is comparatively high.
- Based on the available data, the Unknown category seems to have a low average MSRP.

## INSIGHT

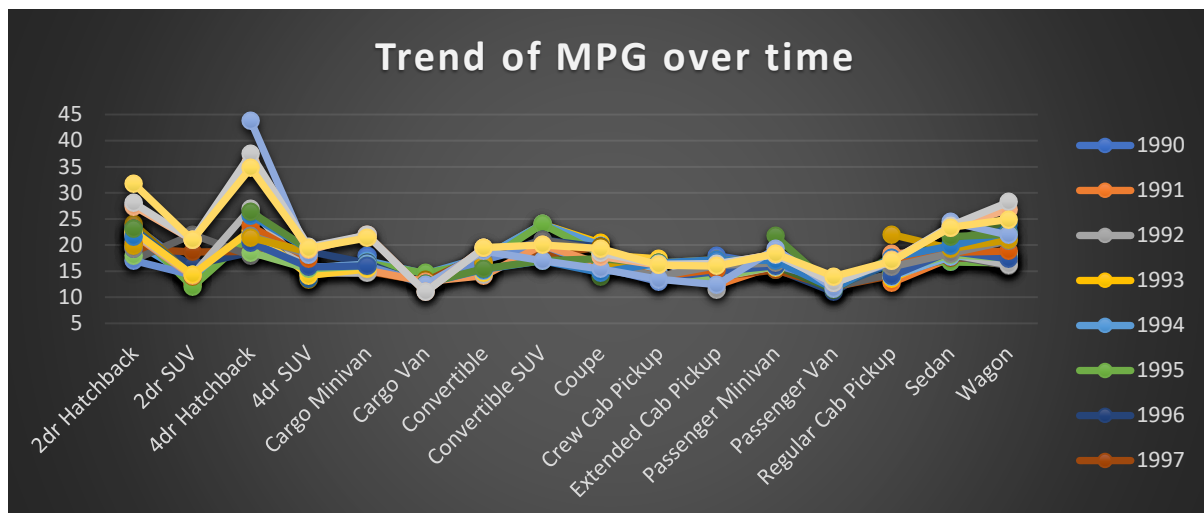
The average MSRP values for various body types and transmission types are shown by this analysis. Understanding how pricing fluctuates based on these aspects can help consumers, automakers, and dealerships make well-informed selections based on their preferences and financial constraints.

## D. TASK 4

### STATEMENT

### APPROACH

Average of city mpg	Column Labels																													
Row Labels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total	
2dr Hatchback	24	22	23	22	21	23	22	19	17	24	23	22	17	22	22	23	20	18	19	20	19	20	22	23	28	27	28	32	24	
2dr SUV	15	13	13	14	14	12	16	19	22	14	14	14	14	14	14	14											21	21	21	14
4dr Hatchback	22		22	21	21	22	19	19	18						27	23	21	19	21	24	22	21	26	26	44	36	37	35	32	
4dr SUV		14	16	16	15		19	16	18	13	14	14	16	15	15	14	16	15	16	17	18	19	19	19	18	19	20	19	18	
Cargo Minivan	18					17	17	17	15			16	16	15	15	15	16	16									22	22	21	19
Cargo Van					15	15	12	13	13	13	13	13	13	13									13	13	12	11	11		13	
Convertible	16	16	19	18	18	17	17	18	17	15	18	17	17	14	14	15	15	16	16	17	17	17	15	16	19	20	19	20	18	
Convertible SUV				24	24	24	21	18	21				20	20									17	17	17			20	20	
Coupe	17	18	19	20	20	18	20	20	19	20	17	14	16	16	18	18	16	18	17	17	16	16	15	17	15	18	18	19	18	
Crew Cab Pickup												13	14	17	17	15	14	14	14	14	14	17	17	17	13	16	16	16	16	
Extended Cab Pickup	18	12	11	13	16	16	16	14	14	14	16	14	15	16	14					14	15	15	16	17	17	12	16	16	15	
Passenger Minivan	16	16				17	15	15	15	17	16	16	16	16	16	16	16	16	16									18	18	17
Passenger Van					12	13	11	12	12		12	12	13										12	12	12	13	13	14	13	
Regular Cab Pickup	18	13	14	14	17	17	18	14	15	14	17	18	17	18	14	14	14	15	14	17	16	22	18				17	17	17	16
Sedan	17	18	18	19	18	17	18	18	18	19	20	20	18	19	18	19	18	18	19	19	18	19	20	22	24	23	24	23	22	
Wagon	17	16	18	18	17	17	17	17	16		24	25	22	18	16	18	18	18	17	19	21	21	22	22	22	27	28	25	22	
Grand Total	17	16	18	18	18	17	18	16	16	17	18	18	17	17	17	17	17	16	17	17	18	19	19	21	21	21	22	21	20	



## INTERPRETATION

We may identify some trends and insights by analyzing the given data, which displays the average city miles per gallon (MPG) for various body types across different model years:

Trends based on Form:

- The city MPG of sedans has been comparatively stable over the years, with a few exceptions during the 2012–2013 period when MPG saw an increase.
- The city MPG for wagon body styles is likewise very consistent, however there are minor variations, such as an increase in 2011.
- 2dr hatchbacks have changed over time, albeit they did get better in the early 2000s.
- MPG for 4-door hatchbacks increased in the middle of the 2000s and remained mostly stable after that.
- Variable-rate convertibles have varying city MPG ratings, however 2001 saw considerable improvement.
- In 2012, convertible SUVs had a poor MPG at first, but they gradually increased.
- The MPG of coupes fluctuated, peaking particularly in 2015.
- The MPG ratings of regular cab pickups are comparatively low.
- Over time, both crew cabin and extended cabin pickups have gotten better.
- In general, passenger minivans keep their MPG levels consistent.
- The MPG of passenger vans is continuously low.
- MPG has fluctuated for cargo minivans; MPG is low and stable for cargo vans.

General observations:

- For the majority of body types, the average city MPG appears to have increased over time. Fuel efficiency regulations and improvements in automobile technology are probably to blame for this.
- Cargo vans and pickup trucks typically have lower MPG than smaller vehicles, such as 2dr hatchbacks and compact cars.

- While some body types maintain a more consistent trajectory, others exhibit more notable annual variations in MPG.

### INSIGHT

The analysis could be improved by figuring out the general trend for each body style, figuring out which years saw major changes, and taking into account outside variables like modifications to fuel efficiency laws or advancements in engine technology that might have affected these trends.

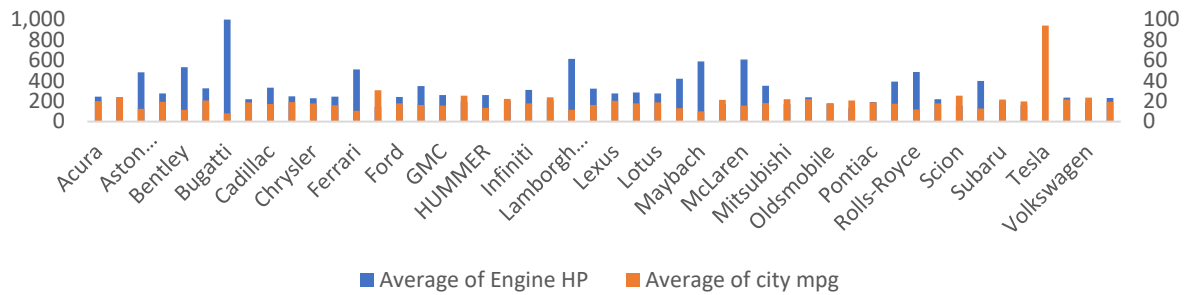
## E. TASK 5

### STATEMENT

### APPROACH

Row Labels	Average of Engine HP	Average of city mpg
<b>[-] Acura</b>	<b>245</b>	<b>20</b>
CL	237	17
ILX	191	25
ILX Hybrid	111	39
Integra	152	22
Legend	215	16
MDX	290	19
NSX	331	17
RDX	278	20
RL	300	17
RLX	321	21
RSX	167	22
SLX	203	13
TL	293	19
TLX	266	22
TSX	221	21
TSX Sport Wagon	201	22
Vigor	176	18
ZDX	300	16
<b>[-] Alfa Romeo</b>	<b>237</b>	<b>24</b>
4C	237	24
<b>[-] Aston Martin</b>	<b>484</b>	<b>13</b>
DB7	424	10
DB9	510	13
DB9 GT	540	13
DBS	510	12
Rapide	470	13
Rapide S	551	14

# Relationship between HP, MPG, and car brands



## DASHBOARD

### DASHBOARD for Impact of Car Features

