```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)


import seaborn as sns #visualisation
import matplotlib.pyplot as plt #visualisation
%matplotlib inline
sns.set(color_codes=True)
from scipy import stats
import warnings
warnings.filterwarnings("ignore")


df = pd.read_csv('./car_data.csv')


df.head()
```

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	
emium leaded quired)	335.0	6.0	MANUAL	rear wheel drive	2.0	Factory Tuner,Luxury,High-Performance	Compact	Coupe	26	19	3916	4
emium leaded quired)	300.0	6.0	MANUAL	rear wheel drive	2.0	Luxury,Performance	Compact	Convertible	28	19	3916	4
emium leaded quired)	300.0	6.0	MANUAL	rear wheel drive	2.0	Luxury,High-Performance	Compact	Coupe	28	20	3916	3
emium leaded quired)	230.0	6.0	MANUAL	rear wheel drive	2.0	Luxury,Performance	Compact	Coupe	28	18	3916	2
emium leaded quired)	230.0	6.0	MANUAL	rear wheel drive	2.0	Luxury	Compact	Convertible	28	18	3916	3

Next steps: Generate code with `df` View recommended plots

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11914 entries, 0 to 11913
Data columns (total 16 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Make               11914 non-null  object
 1   Model              11914 non-null  object
 2   Year               11914 non-null  int64
 3   Engine Fuel Type   11911 non-null  object
 4   Engine HP          11845 non-null  float64
 5   Engine Cylinders   11884 non-null  float64
```

```
 6   Transmission Type  11914 non-null  object
 7   Driven_Wheels      11914 non-null  object
 8   Number of Doors    11908 non-null  float64
 9   Market Category    8172 non-null   object
 10  Vehicle Size       11914 non-null  object
 11  Vehicle Style      11914 non-null  object
 12  highway MPG        11914 non-null  int64
 13  city mpg           11914 non-null  int64
 14  Popularity         11914 non-null  int64
 15  MSRP               11914 non-null  int64
dtypes: float64(3), int64(5), object(8)
memory usage: 1.5+ MB
```

```
df.drop(["Engine Fuel Type", "Market Category", "Vehicle Style", "Popularity", "Number of Doors", "Vehicle Size"], axis = 1, inplace =
```

```
df.head()
```

	Make	Model	Year	Engine HP	Engine Cylinders	Transmission Type	Driven_Wheels	highway MPG	city mpg	MSRP
0	BMW	1 Series M	2011	335.0	6.0	MANUAL	rear wheel drive	26	19	46135
1	BMW	1 Series	2011	300.0	6.0	MANUAL	rear wheel drive	28	19	40650
2	BMW	1 Series	2011	300.0	6.0	MANUAL	rear wheel drive	28	20	36350
3	BMW	1 Series	2011	230.0	6.0	MANUAL	rear wheel drive	28	18	29450
4	BMW	1 Series	2011	230.0	6.0	MANUAL	rear wheel drive	28	18	34500

Next steps: Generate code with `df` View recommended plots

```
df.columns = ['Make', 'Model', 'Year', 'Hp', 'Cylinders', 'Transmission', 'Drive_Mode', 'MPG_H', 'MPG_C', 'Price']
```

```
df.head()
```

	Make	Model	Year	Hp	Cylinders	Transmission	Drive_Mode	MPG_H	MPG_C	Price
0	BMW	1 Series M	2011	335.0	6.0	MANUAL	rear wheel drive	26	19	46135
1	BMW	1 Series	2011	300.0	6.0	MANUAL	rear wheel drive	28	19	40650
2	BMW	1 Series	2011	300.0	6.0	MANUAL	rear wheel drive	28	20	36350
3	BMW	1 Series	2011	230.0	6.0	MANUAL	rear wheel drive	28	18	29450
4	BMW	1 Series	2011	230.0	6.0	MANUAL	rear wheel drive	28	18	34500

Next steps: Generate code with `df` View recommended plots

```
df[df.duplicated()]
```

	Make	Model	Year	Hp	Cylinders	Transmission	Drive_Mode	MPG_H	MPG_C	Price
14	BMW	1 Series	2013	230.0	6.0	MANUAL	rear wheel drive	28	19	31500
18	Audi	100	1992	172.0	6.0	MANUAL	front wheel drive	24	17	2000
20	Audi	100	1992	172.0	6.0	MANUAL	front wheel drive	24	17	2000
24	Audi	100	1993	172.0	6.0	MANUAL	front wheel drive	24	17	2000
25	Audi	100	1993	172.0	6.0	MANUAL	front wheel drive	24	17	2000
...	...	...	...	...	...	...	...	...	...	...
11481	Suzuki	X-90	1998	95.0	4.0	MANUAL	four wheel drive	26	22	2000
11603	Volvo	XC60	2017	302.0	4.0	AUTOMATIC	all wheel drive	29	20	46350
11604	Volvo	XC60	2017	240.0	4.0	AUTOMATIC	front wheel drive	30	23	40950
11708	Suzuki	XL7	2008	252.0	6.0	AUTOMATIC	all wheel drive	22	15	29149
11717	Suzuki	XL7	2008	252.0	6.0	AUTOMATIC	front wheel drive	22	16	27499

989 rows × 10 columns

QUESTIONS

QUEST 1

Remove duplicates

```
df.drop_duplicates(inplace=True)
```

```
df.head()
```

	Make	Model	Year	Hp	Cylinders	Transmission	Drive_Mode	MPG_H	MPG_C	Price
0	BMW	1 Series M	2011	335.0	6.0	MANUAL	rear wheel drive	26	19	46135
1	BMW	1 Series	2011	300.0	6.0	MANUAL	rear wheel drive	28	19	40650
2	BMW	1 Series	2011	300.0	6.0	MANUAL	rear wheel drive	28	20	36350
3	BMW	1 Series	2011	230.0	6.0	MANUAL	rear wheel drive	28	18	29450
4	BMW	1 Series	2011	230.0	6.0	MANUAL	rear wheel drive	28	18	34500

Next steps: Generate code with `df` View recommended plots

Quest 2

Identify the categorical and the numerical features in the dataset

```
categorical_features = df.select_dtypes(include=['object', 'category']).columns.tolist()
numerical_features = df.select_dtypes(include=['int64', 'float64']).columns.tolist()

print("Categorical Features:", categorical_features)
print("Numerical Features:", numerical_features)
```

```
Categorical Features: ['Make', 'Model', 'Transmission', 'Drive_Mode']
Numerical Features: ['Year', 'Hp', 'Cylinders', 'MPG_H', 'MPG_C', 'Price']
```

Quest 3

Identify the columns which have missing values and impute them accordingly.

```
columns_with_missing_values = df.columns[df.isnull().any()].tolist()
print("Columns with missing values:", columns_with_missing_values)

# Impute missing values
for column in columns_with_missing_values:
    if df[column].dtype == 'category':
        # For categorical columns, fill missing values with the most frequent value
        df[column].fillna(df[column].mode()[0], inplace=True)
    else:
        # For numerical columns, fill missing values with the mean
        df[column].fillna(df[column].mean(), inplace=True)
```

```
Columns with missing values: []
```

Quest 4

Identify the outliers in the price column using IQR technique and create a column called is_outlier to clearly flag the outliers without dropping them from the dataset.

```
Q1 = df['Price'].quantile(0.25)
Q3 = df['Price'].quantile(0.75)
IQR = Q3 - Q1

#Lower and Upper bounds for outliers
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

#New column 'is_outlier' to flag outliers
df['is_outlier'] = ((df['Price'] < lower_bound) | (df['Price'] > upper_bound)).astype(int)

# Displaying the flagged outliers
outliers = df[df['is_outlier'] == 1]
print(outliers)

# Saving the modified DataFrame to a new CSV file
df.to_csv('car_data_with_outliers_flagged.csv', index=False)
```

```
           Make Model  Year     Hp  Cylinders      Transmission  \
294     Ferrari   360  2002  400.0        8.0            MANUAL
295     Ferrari   360  2002  400.0        8.0            MANUAL
296     Ferrari   360  2002  400.0        8.0  AUTOMATED_MANUAL
297     Ferrari   360  2002  400.0        8.0  AUTOMATED_MANUAL
298     Ferrari   360  2003  400.0        8.0            MANUAL
...         ...   ...   ...    ...        ...               ...
11736  Cadillac   XLR  2008  320.0        8.0         AUTOMATIC
11737  Cadillac   XLR  2009  320.0        8.0         AUTOMATIC
11903       BMW    Z8  2001  394.0        8.0            MANUAL
11904       BMW    Z8  2002  394.0        8.0            MANUAL
11905       BMW    Z8  2003  394.0        8.0            MANUAL

             Drive_Mode  MPG_H  MPG_C   Price  is_outlier
294    rear wheel drive     15     10  160829           1
295    rear wheel drive     15     10  140615           1
296    rear wheel drive     15     10  150694           1
297    rear wheel drive     15     10  170829           1
298    rear wheel drive     15     10  165986           1
```

```
...                 ...    ...    ...     ...         ...
11736  rear wheel drive     24     15   85650           1
11737  rear wheel drive     24     15   86215           1
11903  rear wheel drive     19     12  128000           1
11904  rear wheel drive     19     12  130000           1
11905  rear wheel drive     19     12  131500           1

[946 rows x 11 columns]
```

Quet 5

Standardize the numerical columns either using Min-Max or Standard scaling method.

```
#Min-Max
from sklearn.preprocessing import MinMaxScaler
numerical_columns = df.select_dtypes(include=['int64', 'float64']).columns.tolist()
scaler = MinMaxScaler()
df[numerical_columns] = scaler.fit_transform(df[numerical_columns])
print(df.head())
```

```
  Make       Model      Year        Hp  Cylinders Transmission  \
0  BMW  1 Series M  0.777778  0.295983      0.375       MANUAL
1  BMW    1 Series  0.777778  0.258985      0.375       MANUAL
2  BMW    1 Series  0.777778  0.258985      0.375       MANUAL
3  BMW    1 Series  0.777778  0.184989      0.375       MANUAL
4  BMW    1 Series  0.777778  0.184989      0.375       MANUAL

         Drive_Mode     MPG_H     MPG_C     Price  is_outlier
0  rear wheel drive  0.040936  0.092308  0.021384         0.0
1  rear wheel drive  0.046784  0.092308  0.018727         0.0
2  rear wheel drive  0.046784  0.100000  0.016643         0.0
3  rear wheel drive  0.046784  0.084615  0.013300         0.0
4  rear wheel drive  0.046784  0.084615  0.015747         0.0
```

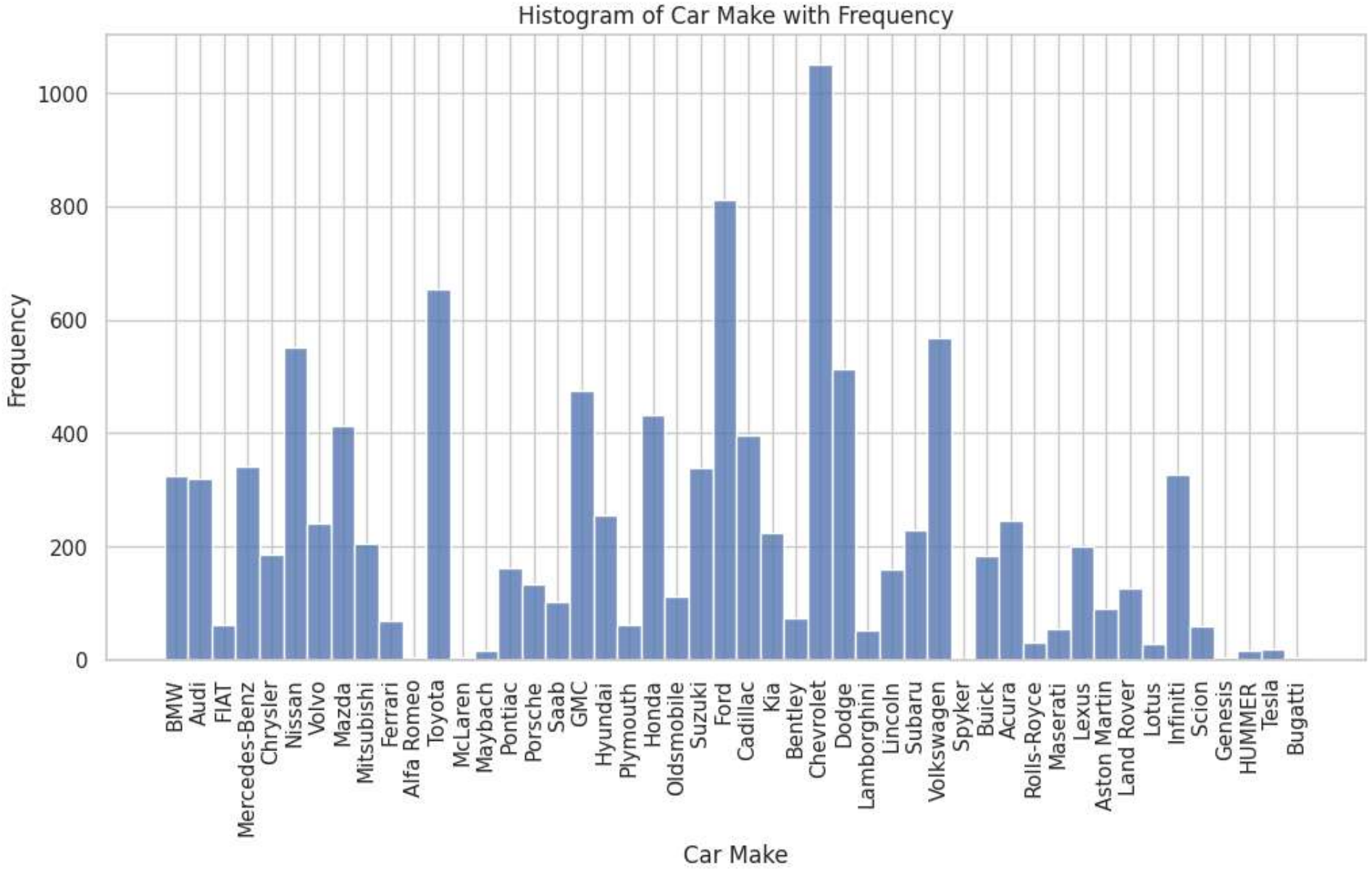
```
#Standard scaling
from sklearn.preprocessing import StandardScaler
numerical_columns = df.select_dtypes(include=['int64', 'float64']).columns.tolist()
scaler = StandardScaler()
df[numerical_columns] = scaler.fit_transform(df[numerical_columns])
print(df.head())
```

```
  Make       Model      Year        Hp  Cylinders Transmission  \
0  BMW  1 Series M  0.011703  0.736622   0.184652       MANUAL
1  BMW    1 Series  0.011703  0.416751   0.184652       MANUAL
2  BMW    1 Series  0.011703  0.416751   0.184652       MANUAL
3  BMW    1 Series  0.011703 -0.222991   0.184652       MANUAL
4  BMW    1 Series  0.011703 -0.222991   0.184652       MANUAL

          Drive_Mode     MPG_H     MPG_C     Price  is_outlier
0  rear wheel drive -0.072501 -0.083248  0.058636   -0.307895
1  rear wheel drive  0.148966 -0.083248 -0.029759   -0.307895
2  rear wheel drive  0.148966  0.024754 -0.099058   -0.307895
3  rear wheel drive  0.148966 -0.191250 -0.210257   -0.307895
4  rear wheel drive  0.148966 -0.191250 -0.128872   -0.307895
```

Quest 6

Plot histogram of Car make with its frequency

```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.histplot(data=df, x='Make', palette='viridis', discrete=True)
plt.xticks(rotation=90)
plt.title('Histogram of Car Make with Frequency')
plt.xlabel('Car Make')
plt.ylabel('Frequency')
plt.show()
```

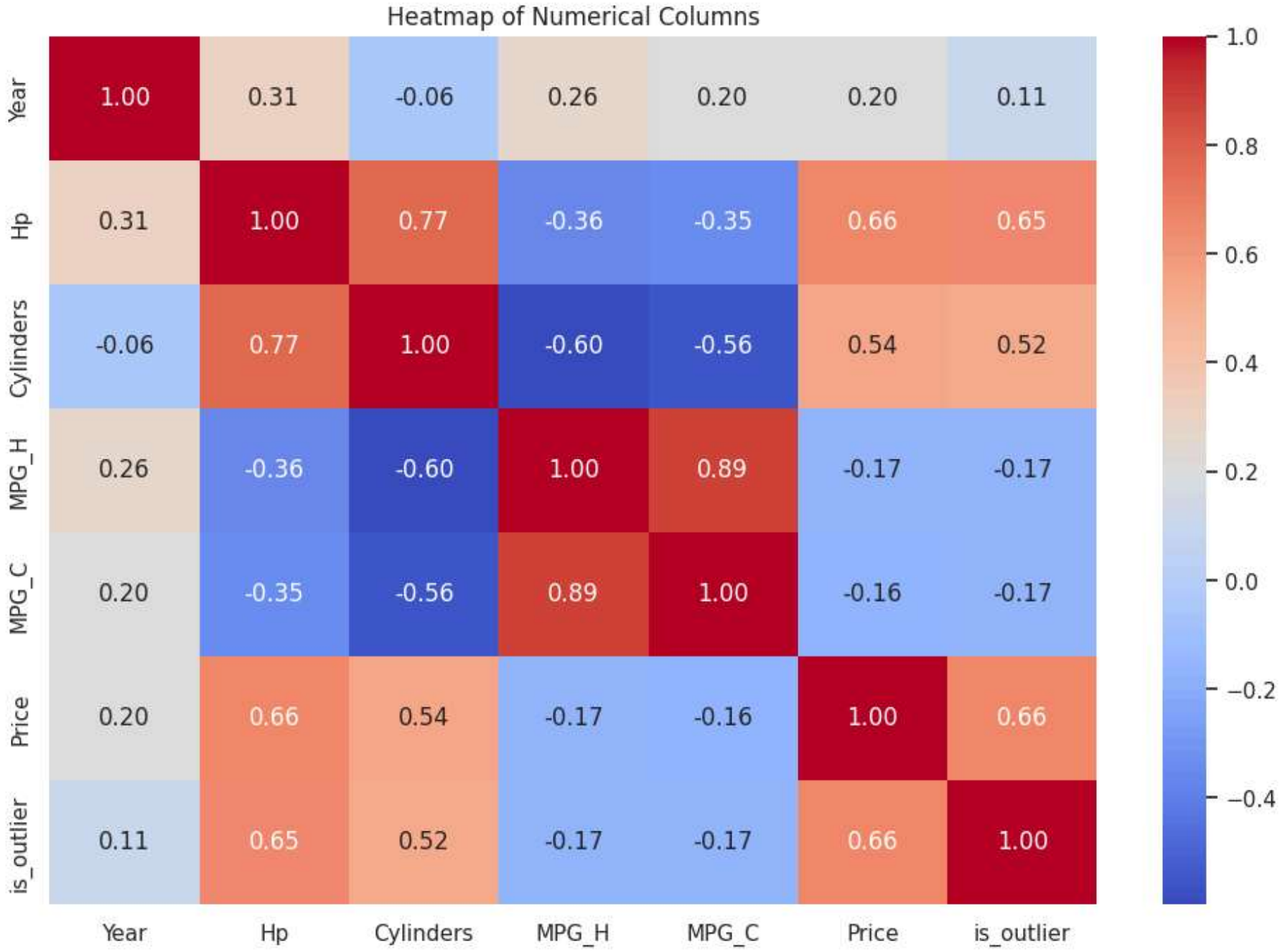


Heat Maps is a type of plot which is necessary when we need to find the dependent variables.

Quest 7

Create a heat map of all numerical columns

```
numerical_columns = df.select_dtypes(include=['int64', 'float64'])
correlation_matrix = numerical_columns.corr()

plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Heatmap of Numerical Columns')
plt.show()
```

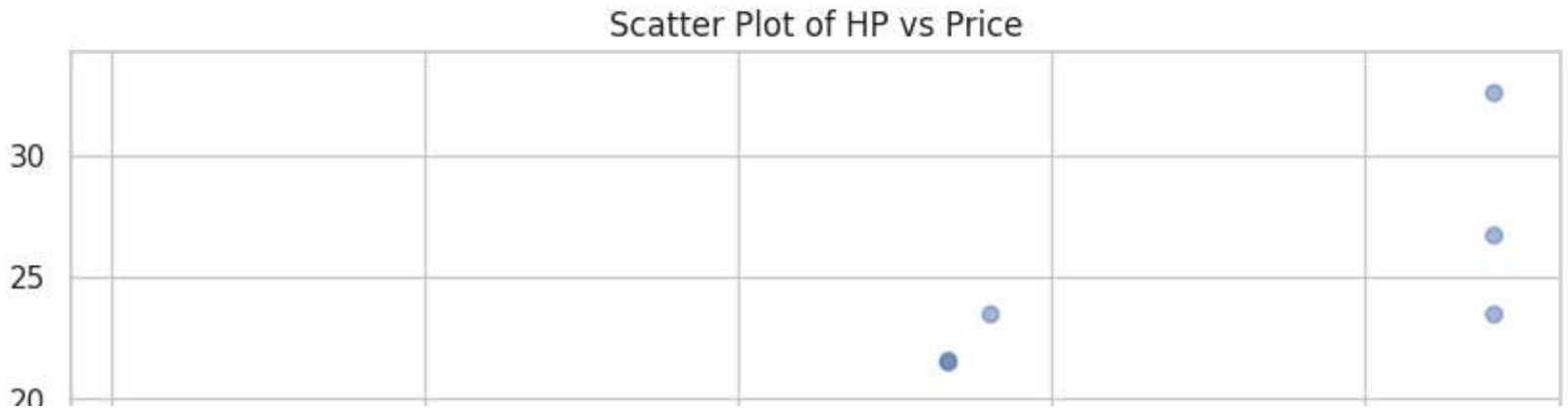

Heatmap of Numerical Columns
Year
Hp
Cylinders
MPG_H
MPG_C
Price
is_outlier
1.00 0.31 -0.06 0.26 0.20 0.20 0.11
0.31 1.00 0.77 -0.36 -0.35 0.66 0.65
-0.06 0.77 1.00 -0.60 -0.56 0.54 0.52
0.26 -0.36 -0.60 1.00 0.89 -0.17 -0.17
0.20 -0.35 -0.56 0.89 1.00 -0.16 -0.17
0.20 0.66 0.54 -0.17 -0.16 1.00 0.66
0.11 0.65 0.52 -0.17 -0.17 0.66 1.00
Year
Hp
Cylinders
MPG_H
MPG_C
Price
is_outlier
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

Scatterplot : We generally use scatter plots to find the correlation between two variables

Quest 8

Create scatterplot between HP and Price

```
import matplotlib.pyplot as plt

plt.figure(figsize=(10, 6))
plt.scatter(df['Hp'], df['Price'], alpha=0.5)
plt.title('Scatter Plot of HP vs Price')
plt.xlabel('Horsepower (HP)')
plt.ylabel('Price')
plt.grid(True)
plt.show()
```



Quest 6

Create new features by transforming the following columns -

Feature Transformation Feature type

1. price Log Numerical

2. city_mpg BoxCox Numerical

3. make One-hot encoding Categorical

```
import numpy as np

# Performing logarithmic transformation on 'Price' column
df['price_log'] = np.log(df['Price'])
```