Analyzing Selling Price of used Cars using Python

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Analyzing the selling price of used cars is essential for making informed decisions in the automotive market. Using Python, we can efficiently process and visualize data to uncover key factors influencing car prices. This analysis not only aids buyers and sellers but also enables predictive modeling for future price estimation. This article will explore how to analyze the selling price of used cars using Python.

Step 1: Understanding the Dataset

The dataset contains various attributes of used cars, including price, brand, color, horsepower and more. Our goal is to analyze these factors and determine their impact on selling price. To download the file used in this example, click here.

> ***Problem Statement:*** *Our friend Otis wants to sell his car but isn't sure about the price. He wants to maximize profit while ensuring a reasonable deal for buyers. To help Otis we will analyze the dataset and determine the factors affecting car prices.*

Step 2: Converting `.data` File to `.csv`

If the dataset is in `.data` format, follow these steps to convert it to `.csv`:

1. Open MS Excel.
2. Go to **Data** > **From Text**.
3. Select **Comma Delimiter**.
4. Save the file as `.csv`.

Now we can proceed with loading the dataset into Python.

To analyze the data install the following Python libraries using the command below:

pip install pandas numpy matplotlib seaborn scipy

Import the following python libraries: numpy, pandas, matplotlib, seaborn and scipy.

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy as sp
```

Step 4: Load the Dataset

Now, we load the dataset into a Pandas DataFrame and preview the first few rows. Let's check the first five entries of dataset.

```
df = pd.read_csv('output.csv')

df = df.iloc[: , 1:]

df.head()
```

Output:

	3	?	alfa-romero	gas	std	two	convertible	rwd	front	88.60	...	130	mpfi	3.47	2.68	9.00	111	5000	21	27	13495
0	3	?	alfa-romero	gas	std	two	convertible	rwd	front	88.6	...	130	mpfi	3.47	2.68	9.0	111	5000	21	27	16500
1	1	?	alfa-romero	gas	std	two	hatchback	rwd	front	94.5	...	152	mpfi	2.68	3.47	9.0	154	5000	19	26	16500
2	2	164	audi	gas	std	four	sedan	fwd	front	99.8	...	109	mpfi	3.19	3.40	10.0	102	5500	24	30	13950
3	2	164	audi	gas	std	four	sedan	4wd	front	99.4	...	136	mpfi	3.19	3.40	8.0	115	5500	18	22	17450
4	2	?	audi	gas	std	two	sedan	fwd	front	99.8	...	136	mpfi	3.19	3.40	8.5	110	5500	19	25	15250

5 rows × 26 columns

Dataset

Step 5: Assign Column Headers

To make our dataset more readable we assign column headers:

```
headers = ["symboling", "normalized-losses", "make",
           "fuel-type", "aspiration","num-of-doors",
           "body-style","drive-wheels", "engine-location",
```

```
            "horsepower", "peak-rpm","city-mpg","highway-
mpg","price"]

df.columns=headers
df.head()
```

Output:

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location	wheel-base	...	engine-size	fuel-system	bore	stroke	compression-ratio
0	3	?	alfa-romero	gas	std	two	convertible	rwd	front	88.6	...	130	mpfi	3.47	2.68	9.0
1	1	?	alfa-romero	gas	std	two	hatchback	rwd	front	94.5	...	152	mpfi	2.68	3.47	9.0
2	2	164	audi	gas	std	four	sedan	fwd	front	99.8	...	109	mpfi	3.19	3.40	10.0
3	2	164	audi	gas	std	four	sedan	4wd	front	99.4	...	136	mpfi	3.19	3.40	8.0
4	2	?	audi	gas	std	two	sedan	fwd	front	99.8	...	136	mpfi	3.19	3.40	8.5

5 rows × 26 columns

Column Header

Step 6: Check for Missing Values

Missing values can impact our analysis. Let's check if any columns contain missing values.

```
data = df

data.isna().any()

data.isnull().any()
```

Output:

	0
symboling	False
normalized-losses	False
make	False
fuel-type	False
aspiration	False
num-of-doors	False
body-style	False
drive-wheels	False
engine-location	False
wheel-base	False
length	False
width	False
height	False
curb-weight	False
engine-type	False
num-of-cylinders	False
engine-size	False
fuel-system	False

Missing Values

Since fuel consumption is measured differently in different regions, we convert miles per gallon (MPG) to liters per 100 kilometers (L/100km)

```
data['city-mpg'] = 235 / df['city-mpg']
data.rename(columns = {'city_mpg': "city-L / 100km"}, inplace = True)

print(data.columns)

data.dtypes
```

Output:

```
Index(['symboling', 'normalized-losses', 'make', 'fuel-type', 'aspiration',
       'num-of-doors', 'body-style', 'drive-wheels', 'engine-location',
       'wheel-base', 'length', 'width', 'height', 'curb-weight', 'engine-type',
       'num-of-cylinders', 'engine-size', 'fuel-system', 'bore', 'stroke',
       'compression-ratio', 'horsepower', 'peak-rpm', 'city-mpg',
       'highway-mpg', 'price'],
      dtype='object')
```

	0
symboling	int64
normalized-losses	object
make	object
fuel-type	object
aspiration	object
num-of-doors	object
body-style	object
drive-wheels	object
engine-location	object
wheel-base	float64
length	float64
width	float64
height	float64
curb-weight	int64

MPG

Step 8: Convert Price Column to Integer

The price column should be numerical, but it may contain string values like `?`. We need to clean and convert it:

```
data.price.unique()

data = data[data.price != '?']

data['price'] = data['price'].astype(int)

data.dtypes
```

Output:

```
<ipython-input-6-e3e67a236340>:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data['price'] = data['price'].astype(int)
```

	0
symboling	int64
normalized-losses	object
make	object
fuel-type	object
aspiration	object
num-of-doors	object
body-style	object
drive-wheels	object
engine-location	object
wheel-base	float64
length	float64
width	float64

Step 9: Normalize Features

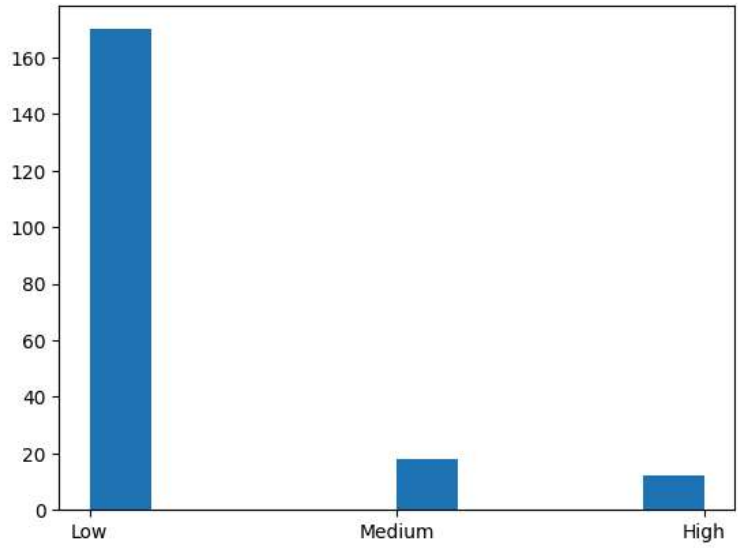
To ensure fair comparisons between different features, we normalize numerical columns. To categorize cars based on their price we divide the price range into three categories: Low, Medium and High.

```
data['length'] = data['length']/data['length'].max()
data['width'] = data['width']/data['width'].max()
data['height'] = data['height']/data['height'].max()

# binning- grouping values
bins = np.linspace(min(data['price']), max(data['price']), 4)
group_names = ['Low', 'Medium', 'High']
data['price-binned'] = pd.cut(data['price'], bins,
                              labels = group_names,
                              include_lowest = True)

print(data['price-binned'])
plt.hist(data['price-binned'])
plt.show()
```

Output:



Normalization Features

Step 10: Convert Categorical Data to Numerical

Machine learning models require numerical data. We convert categorical variables into numerical ones using one-hot encoding:

```
pd.get_dummies(data['fuel-type']).head()

data.describe()
```

Output:

	symboling	wheel-base	length	width	height	curb-weight	engine-size	compression-ratio	city-mpg	highway-mpg	price
count	200.000000	200.000000	200.000000	200.000000	200.000000	200.000000	200.000000	200.000000	200.000000	200.000000	200.000000
mean	0.830000	98.848000	0.837232	0.915250	0.899523	2555.705000	126.860000	10.170100	9.937914	30.705000	13205.690000
std	1.246557	6.038261	0.059333	0.029207	0.040610	518.594552	41.650501	4.014163	2.539415	6.827227	7966.982558
min	-2.000000	86.600000	0.678039	0.837500	0.799331	1488.000000	61.000000	7.000000	4.795918	16.000000	5118.000000
25%	0.000000	94.500000	0.809937	0.891319	0.869565	2163.000000	97.750000	8.575000	7.833333	25.000000	7775.000000
50%	1.000000	97.000000	0.832292	0.909722	0.904682	2414.000000	119.500000	9.000000	9.791667	30.000000	10270.000000
75%	2.000000	102.400000	0.881788	0.926042	0.928512	2926.250000	142.000000	9.400000	12.368421	34.000000	16500.750000
max	3.000000	120.900000	1.000000	1.000000	1.000000	4066.000000	326.000000	23.000000	18.075923	54.000000	45400.000000

Convert Categorical Data to Numerical

Step 11: Data Visualization

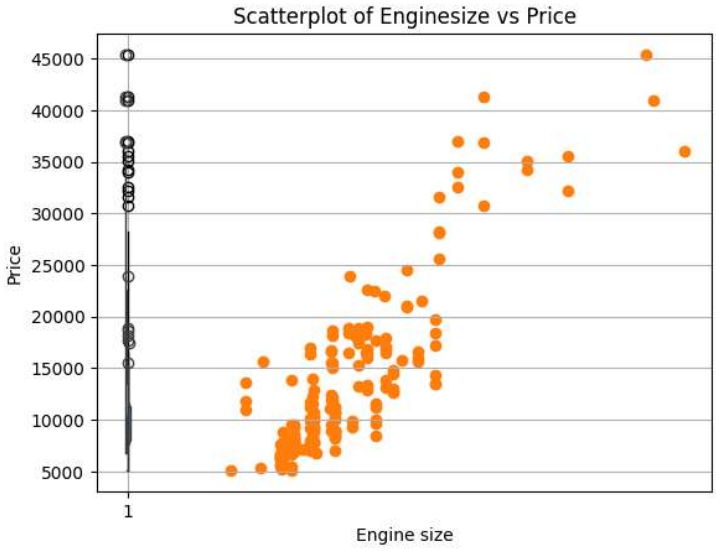
```
plt.boxplot(data['price'])

sns.boxplot(x ='drive-wheels', y ='price', data = data)

plt.scatter(data['engine-size'], data['price'])
```

```
plt.grid()
plt.show()
```

Output:



Engine Size

Step 12: Grouping Data by Drive-Wheels and Body-Style

Grouping data helps identify trends based on key variables:

```
test = data[['drive-wheels', 'body-style', 'price']]
data_grp = test.groupby(['drive-wheels', 'body-style'],
                        as_index = False).mean()

data_grp
```

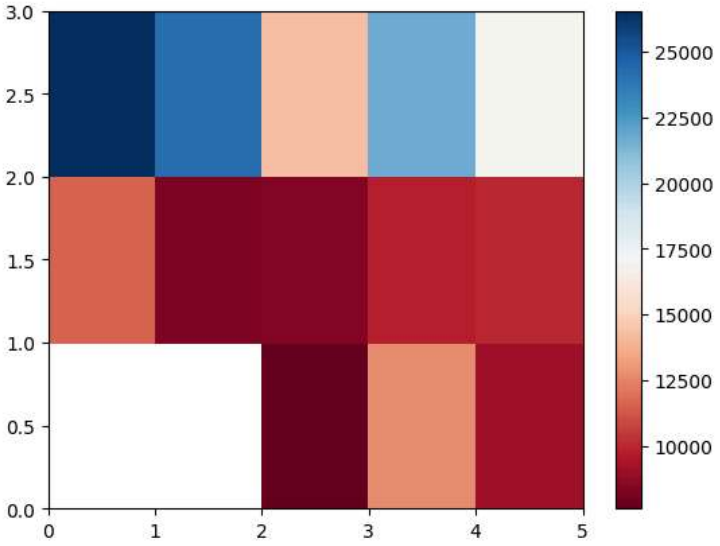
Output:

	drive-wheels	body-style	price
0	4wd	hatchback	7603.000000
1	4wd	sedan	12647.333333
2	4wd	wagon	9095.750000
3	fwd	convertible	11595.000000
4	fwd	hardtop	8249.000000
5	fwd	hatchback	8396.387755
6	fwd	sedan	9811.800000
7	fwd	wagon	9997.333333
8	rwd	convertible	26563.250000
9	rwd	hardtop	24202.714286
10	rwd	hatchback	14337.777778
11	rwd	sedan	21711.833333

```
data_pivot = data_grp.pivot(index = 'drive-wheels',
                            columns = 'body-style')
data_pivot

plt.pcolor(data_pivot, cmap ='RdBu')
plt.colorbar()
plt.show()
```

Output:



Pivot Table

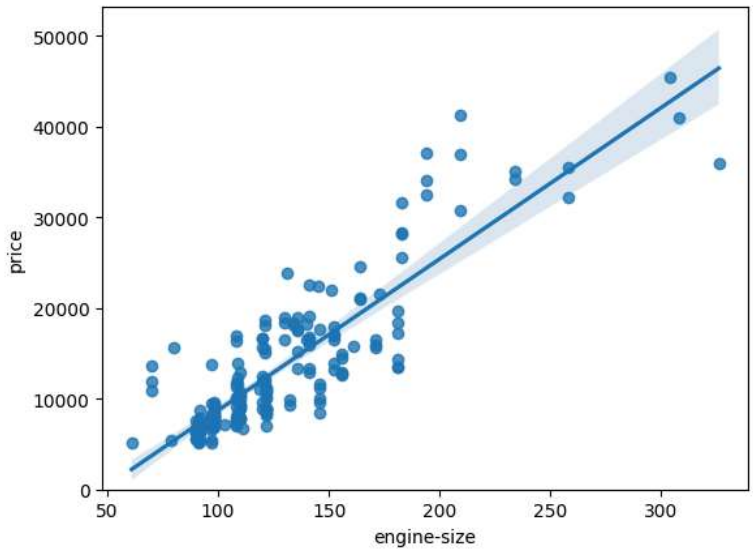
Step 14: Perform ANOVA Test

The Analysis of Variance (ANOVA) test helps determine if different groups have significantly different means.

```
data_annova = data[['make', 'price']]
grouped_annova = data_annova.groupby(['make'])
annova_results_l = sp.stats.f_oneway(
                            grouped_annova.get_group('honda')
['price'],
                            grouped_annova.get_group('subaru')
['price']
                                    )
print(annova_results_l)

sns.regplot(x ='engine-size', y ='price', data = data)
plt.ylim(0, )
```

Output:



ANOVA Test

This step-by-step analysis helps in understanding the key factors influencing the selling price of used cars. Proper data cleaning, visualization and statistical tests ensure that our findings are accurate and insightful.

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