hamid

February 20, 2024

[ ]:
```
!pip install numpy
!pip install pandas
!pip install matplotlib
!pip install seaborn
!pip install pandas scipy
```

```
Requirement already satisfied: numpy in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (1.26.3)
Requirement already satisfied: pandas in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (2.1.4)
Requirement already satisfied: numpy<2,>=1.23.2 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
pandas) (1.26.3)
Requirement already satisfied: python-dateutil>=2.8.2 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
pandas) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
pandas) (2023.4)
Requirement already satisfied: six>=1.5 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
python-dateutil>=2.8.2->pandas) (1.16.0)
Requirement already satisfied: matplotlib in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (3.8.2)
Requirement already satisfied: contourpy>=1.0.1 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (1.2.0)
Requirement already satisfied: cycler>=0.10 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (4.47.0)
Requirement already satisfied: kiwisolver>=1.3.1 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
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matplotlib) (1.4.5)
Requirement already satisfied: numpy<2,>=1.21 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (1.26.3)
Requirement already satisfied: packaging>=20.0 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (23.2)
Requirement already satisfied: pillow>=8 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
matplotlib) (3.1.1)
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Requirement already satisfied: six>=1.5 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
python-dateutil>=2.7->matplotlib) (1.16.0)
Requirement already satisfied: seaborn in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (0.13.1)
Requirement already satisfied: numpy!=1.24.0,>=1.20 in
/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
seaborn) (1.26.3)
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/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
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Requirement already satisfied: matplotlib!=3.6.1,>=3.4 in
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/Users/hamidhooshmandi/anaconda3/envs/USD/lib/python3.11/site-packages (from
python-dateutil>=2.8.2->pandas) (1.16.0)
```

[ ]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

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

[ ]:
```python
df.columns
```

[ ]:
```
Index(['product_id', 'product_name', 'category', 'discounted_price',
       'actual_price', 'discount_percentage', 'rating', 'rating_count',
       'about_product', 'user_id', 'user_name', 'review_id', 'review_title',
       'review_content', 'img_link', 'product_link'],
```

```
      dtype='object')
```

[ ]:
```
df.dtypes
```

[ ]:
```
product_id              object
product_name            object
category                object
discounted_price        object
actual_price            object
discount_percentage     object
rating                  object
rating_count            object
about_product           object
user_id                 object
user_name               object
review_id               object
review_title            object
review_content          object
img_link                object
product_link            object
dtype: object
```

[ ]:
```
print(df['category'])
```

```
0       Computers&Accessories|Accessories&Peripherals|…
1       Computers&Accessories|Accessories&Peripherals|…
2       Computers&Accessories|Accessories&Peripherals|…
3       Computers&Accessories|Accessories&Peripherals|…
4       Computers&Accessories|Accessories&Peripherals|…
                              …
1460    Home&Kitchen|Kitchen&HomeAppliances|WaterPurif…
1461    Home&Kitchen|Kitchen&HomeAppliances|SmallKitch…
1462    Home&Kitchen|Heating,Cooling&AirQuality|RoomHe…
1463    Home&Kitchen|Heating,Cooling&AirQuality|Fans|E…
1464    Home&Kitchen|Kitchen&HomeAppliances|SmallKitch…
Name: category, Length: 1465, dtype: object
```

[ ]:
```
# split category column into multiple columns on '|' delimiter.
catsplit = df['category'].str.split('|', expand=True)


# copy selected columns to a new dataframe df1.
df1 = df[['product_id', 'product_name', 'category', 'discounted_price',␣
 ↪'actual_price', 'discount_percentage', 'rating', 'rating_count']].copy()
catsplit = catsplit.rename(columns={0:'category_1', 1:'category_2', 2:
 ↪'category_3', 3:'category_4', 4:'category_5'})
```

```
# rename and assign split categories to df1 as category_1, category_2 etc.
df1['category_1'] = catsplit['category_1']
df1['category_2'] = catsplit['category_2']
df1['category_3'] = catsplit['category_3']
df1['category_4'] = catsplit['category_4']

# drop original category column from df1.
df1.drop(columns='category', inplace=True)
df1
```

[ ]:

	product_id	product_name	\
0	B07JW9H4J1	Wayona Nylon Braided USB to Lightning Fast Cha…	
1	B098NS6PVG	Ambrane Unbreakable 60W / 3A Fast Charging 1.5…	
2	B096MSW6CT	Sounce Fast Phone Charging Cable & Data Sync U…	
3	B08HDJ86NZ	boAt Deuce USB 300 2 in 1 Type-C & Micro USB S…	
4	B08CF3B7N1	Portronics Konnect L 1.2M Fast Charging 3A 8 P…	
…	…	…	
1460	B08L7J3T31	Noir Aqua - 5pcs PP Spun Filter + 1 Spanner | …	
1461	B01M6453MB	Prestige Delight PRWO Electric Rice Cooker (1 …	
1462	B009P2LIL4	Bajaj Majesty RX10 2000 Watts Heat Convector R…	
1463	B00J5DYCCA	Havells Ventil Air DSP 230mm Exhaust Fan (Pist…	
1464	B01486F4G6	Borosil Jumbo 1000-Watt Grill Sandwich Maker (…	

	discounted_price	actual_price	discount_percentage	rating	rating_count	\
0	399	1,099	64%	4.2	24,269	
1	199	349	43%	4.0	43,994	
2	199	1,899	90%	3.9	7,928	
3	329	699	53%	4.2	94,363	
4	154	399	61%	4.2	16,905	
…	…	…	…	…	…	
1460	379	919	59%	4	1,090	
1461	2,280	3,045	25%	4.1	4,118	
1462	2,219	3,080	28%	3.6	468	
1463	1,399	1,890	26%	4	8,031	
1464	2,863	3,690	22%	4.3	6,987	

	category_1	category_2	\
0	Computers&Accessories	Accessories&Peripherals	
1	Computers&Accessories	Accessories&Peripherals	
2	Computers&Accessories	Accessories&Peripherals	
3	Computers&Accessories	Accessories&Peripherals	
4	Computers&Accessories	Accessories&Peripherals	
…	…	…	
1460	Home&Kitchen	Kitchen&HomeAppliances	
1461	Home&Kitchen	Kitchen&HomeAppliances	
1462	Home&Kitchen	Heating,Cooling&AirQuality	
1463	Home&Kitchen	Heating,Cooling&AirQuality	

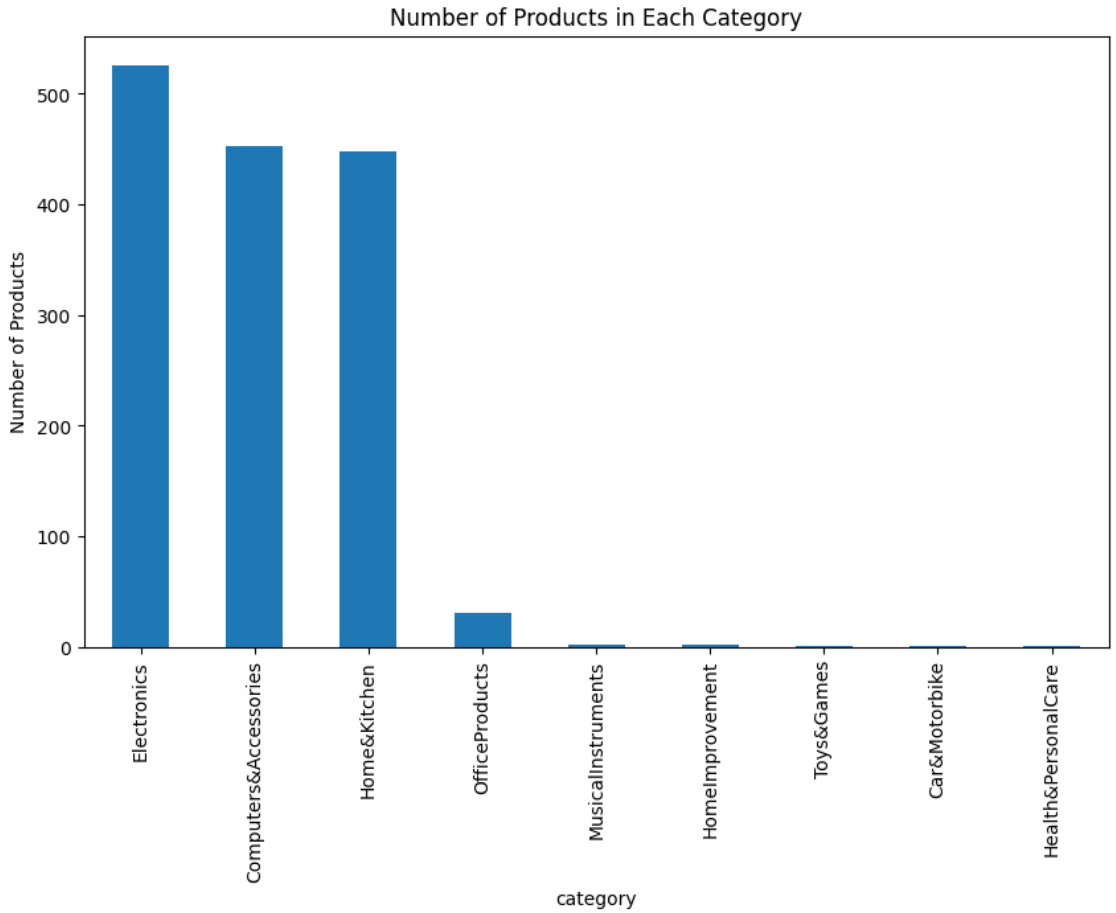
```
1464           Home&Kitchen      Kitchen&HomeAppliances

                        category_3                 category_4
0                Cables&Accessories                     Cables
1                Cables&Accessories                     Cables
2                Cables&Accessories                     Cables
3                Cables&Accessories                     Cables
4                Cables&Accessories                     Cables
…                               …                          …
1460  WaterPurifiers&Accessories  WaterPurifierAccessories
1461       SmallKitchenAppliances         Rice&PastaCookers
1462                   RoomHeaters            HeatConvectors
1463                          Fans               ExhaustFans
1464       SmallKitchenAppliances            SandwichMakers

[1465 rows x 11 columns]
```

[ ]:
```
print(df1['category_1'].value_counts())
print("-----------------------------------")
print(df1['category_2'].value_counts())
```

```
category_1
Electronics              526
Computers&Accessories    453
Home&Kitchen             448
OfficeProducts            31
MusicalInstruments         2
HomeImprovement            2
Toys&Games                 1
Car&Motorbike              1
Health&PersonalCare        1
Name: count, dtype: int64
-----------------------------------
category_2
Accessories&Peripherals                    381
Kitchen&HomeAppliances                     308
HomeTheater,TV&Video                       162
Mobiles&Accessories                        161
Heating,Cooling&AirQuality                 116
WearableTechnology                          76
Headphones,Earbuds&Accessories              66
NetworkingDevices                           34
OfficePaperProducts                         27
ExternalDevices&DataStorage                 18
Cameras&Photography                         16
HomeStorage&Organization                    16
HomeAudio                                   16
GeneralPurposeBatteries&BatteryChargers     14
```

```
Accessories                                  14
Printers,Inks&Accessories                    11
CraftMaterials                                7
Components                                    5
OfficeElectronics                             4
Electrical                                    2
Monitors                                      2
Microphones                                   2
Arts&Crafts                                   1
PowerAccessories                              1
Tablets                                       1
Laptops                                       1
Kitchen&Dining                                1
CarAccessories                                1
HomeMedicalSupplies&Equipment                 1
Name: count, dtype: int64
```

[ ]:
```python
import matplotlib.pyplot as plt

category_counts = df1['category_1'].value_counts()

category_counts.plot(kind='bar', figsize=(10, 6))

plt.title('Number of Products in Each Category')
plt.xlabel('category')
plt.ylabel('Number of Products')

plt.xticks(rotation='vertical')

plt.show()
```



[ ]:
```
df1['discount_percentage']
```

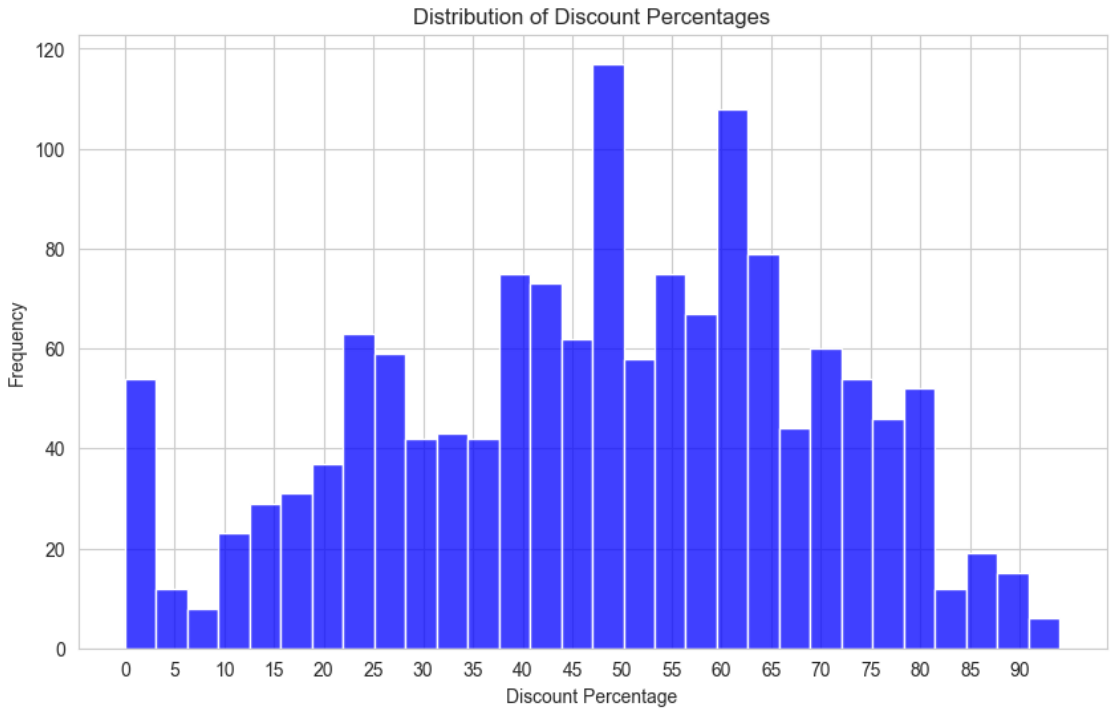
[ ]:
```
0        64%
1        43%
2        90%
3        53%
4        61%
        ...
1460     59%
1461     25%
1462     28%
1463     26%
1464     22%
Name: discount_percentage, Length: 1465, dtype: object
```

[ ]:
```
df1['discount_percentage'] = df1['discount_percentage'].astype(str).str.
  ↪replace('%', '')
```

```
df1['discount_percentage'] = pd.to_numeric(df1['discount_percentage'],␣
 ↪errors='coerce')
df1['discount_percentage'].mean()
```

[ ]: 47.69146757679181

[ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns

# Set the aesthetic style of the plots
sns.set_style("whitegrid")

# Create the histogram for the discount_percentage column
plt.figure(figsize=(10, 6))
sns.histplot(df1['discount_percentage'], kde=False, bins=30, color='blue')

plt.title('Distribution of Discount Percentages')
plt.xlabel('Discount Percentage')
plt.ylabel('Frequency')
plt.xticks(range(0, int(df1['discount_percentage'].max())+1, 5))

plt.show()
```



[ ]:
```
#Finding unusual string in the rating column

df1['rating'].value_counts()
```

[ ]:
```
rating
4.1    244
4.3    230
4.2    228
4.0    182
3.9    123
4.4    123
3.8     86
4.5     75
3.7     42
3.6     35
3.5     26
4.6     17
3.3     16
3.4     10
4.7      6
3.1      4
3.0      3
4.8      3
3.2      2
5.0      2
2.8      2
2.3      1
2.0      1
2.6      1
2.9      1
Name: count, dtype: int64
```

[ ]:
```
df1['rating_count'] = df1['rating_count'].astype(str).str.replace(',', '')
df1['rating_count'] = pd.to_numeric(df1['rating_count'], errors='coerce')
```

[ ]:
```
df1.query('rating == "|"')
```

[ ]:
```
Empty DataFrame
Columns: [product_id, product_name, discounted_price, actual_price,
discount_percentage, rating, rating_count, category_1, category_2, category_3,
category_4]
Index: []
```

[ ]:
```
# In Python, the float() function expects a dot (.) as the decimal separator.
df1['rating'] = df1['rating'].astype(str).str.replace(',', '')
df1['rating'] = pd.to_numeric(df1['rating'], errors='coerce')
```

[ ]:
```
nan_cols = df1.columns[df1.isnull().any()].tolist()
# print(nan_cols)

nan_rows = df1[df1['rating_count'].isnull()]

df1['rating_count']
nan_rating_count = df1[df1['rating_count'].isnull()]

df1 = df1.dropna(subset=['rating_count'])
```

[ ]:
```
#Changing the data type of discounted price and actual price
df1['discounted_price'] = df1['discounted_price'].astype(str).str.
 ↪replace("₹",'')
df1['discounted_price'] = df1['discounted_price'].astype('float64')

df1['actual_price'] = df1['actual_price'].astype(str).str.replace("₹",'')
df1['actual_price'] = df1['actual_price'].astype('float64')
```

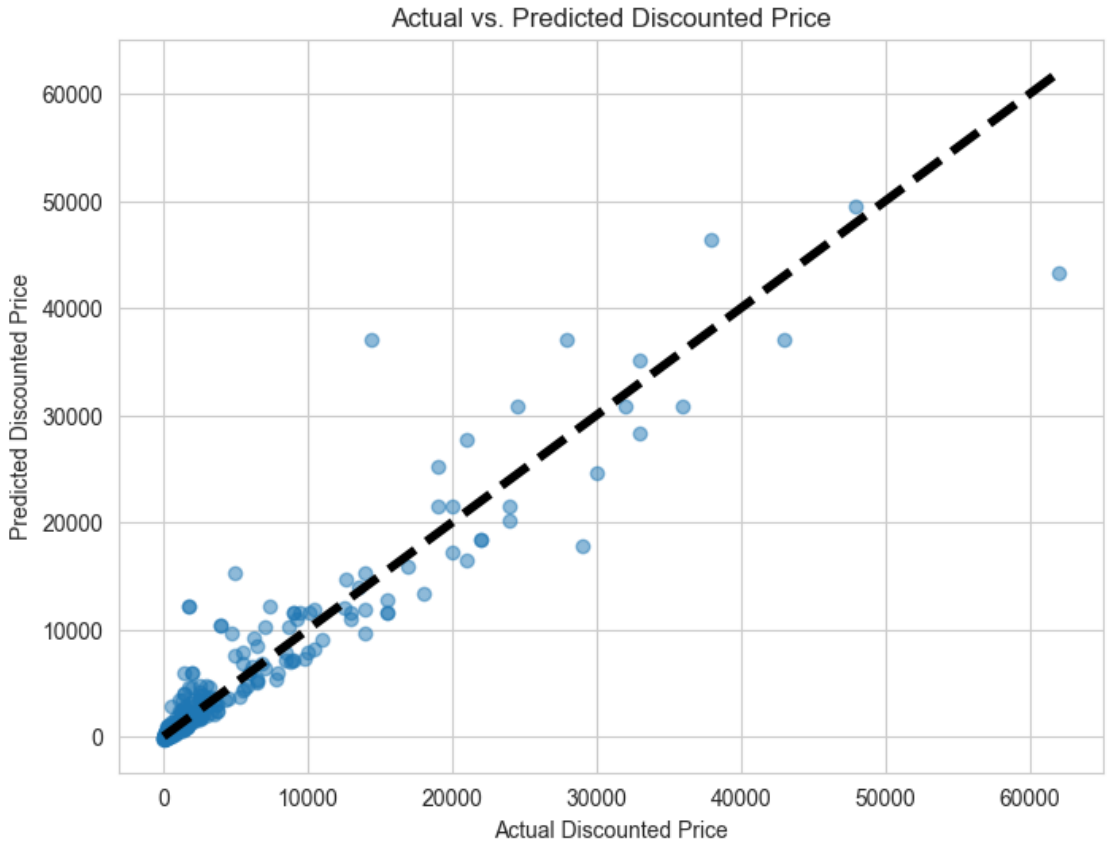
[ ]:
```
df['rating_count'] = df['rating_count'].astype(str).str.replace(',', '')
df['rating_count'] = pd.to_numeric(df['rating_count'], errors='coerce')
```

[ ]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
import pandas as pd

Xl = df1[['actual_price', 'rating', 'rating_count']]
yl = df1['discounted_price']

# Splitting the dataset into training and testing sets
Xl_train, Xl_test, yl_train, yl_test = train_test_split(Xl, yl,␣
 ↪random_state=21, test_size=0.3)


print("Number of rows in Xl_train: ", len(Xl_train))
print("Number of rows in Xl_test: ", len(Xl_test))
print("Number of rows in yl_train: ", len(yl_train))
print("Number of rows in yl_test: ", len(yl_test))

# Initializing and fitting the Linear Regression model
linear_model = LinearRegression()
linear_model.fit(Xl_train, yl_train)

linear_predict = linear_model.predict(Xl_test)

# Evaluating the model
linear_score = linear_model.score(Xl_test, yl_test)
print(f'Linear Regression score: {linear_score}')
```

```
print(f'Coefficients: {linear_model.coef_}')
```

```
Number of rows in Xl_train:  1024
Number of rows in Xl_test:  439
Number of rows in yl_train:  1024
Number of rows in yl_test:  439
Linear Regression score: 0.8975404541500936
Coefficients: [6.21644950e-01 1.16628328e+02 1.13744142e-03]
```

[ ]:
```
import matplotlib.pyplot as plt

plt.figure(figsize=(8, 6))
plt.scatter(yl_test, linear_predict, alpha=0.5)
plt.plot([yl_test.min(), yl_test.max()], [yl_test.min(), yl_test.max()], 'k--',␣
 ↪lw=4)
plt.xlabel('Actual Discounted Price')
plt.ylabel('Predicted Discounted Price')
plt.title('Actual vs. Predicted Discounted Price')
plt.show()
```



[ ]:
```
residuals = yl_test - linear_predict

plt.figure(figsize=(8, 6))
plt.scatter(linear_predict, residuals, alpha=0.5)
plt.hlines(y=0, xmin=linear_predict.min(), xmax=linear_predict.max(),␣
 ↪colors='red', linestyles='--')
plt.xlabel('Predicted Discounted Price')
plt.ylabel('Residuals')
plt.title('Residuals of Predicted Discounted Price')
plt.show()
```