AN ANALYSIS OF THE DISTRIBUTION OF JUMIA KENYA OFFERS ACROSS ITS PRODUCT CATEGORIES.

by

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This project will utilize the following data science concepts.

1. **Data mining and web scraping**
2. **Database management.**
3. **Data cleaning**
4. **Data Visualization**
5. **Data analysis- Regression analysis**

STEP 1: Mining Our Data

This section covers the following:

1. **Creating an sqlite3 database to store the scraped data.**
2. **Scraping data from our target website (www.jumia.co.ke) using Beautifulsoup**

In [ ]:
```
import numpy as np
import pandas as pd
import requests
from bs4 import BeautifulSoup
import sqlite3 as sql
```

In [ ]:
```
#creating an sqlite3 database to save the scrapped data
conn=sql.connect('Offers.db')
curs=conn.cursor()
curs.execute('''CREATE TABLE IF NOT EXISTS Jumia_products (Name VACHAR, Brand VARCHAR,
```

Out[ ]:
```
<sqlite3.Cursor at 0x24cadac7ea0>
```

In [ ]:
```
#creating a loop of all the urls containing offers.
'''Jumia has a total of 46 pages containing products on offer. We create a loop that fe
def url_fetcher():
    base_url='https://www.jumia.co.ke/catalog/?q=offers'
    for id in range (1,47,1):
        if id==1:
            url=base_url
        else:
            url='https://www.jumia.co.ke/catalog/?q=offers&page={}#catalog-listing'.for
        web_file=requests.get(url)
```

```
        soup=BeautifulSoup(web_file.text,'lxml')
        master=soup.find_all('a',class_='core')
        for product in master:
            try:
                name=product['data-name']
                brand=product['data-brand']
                category=product['data-category']
                img=product.find('img',class_='img')['data-src']
                shipping=product.find('div',class_='bdg _glb _xs').text
                offer=int(product.find('div',class_='prc').text.replace('KSh',' ').repl
                price=int(product.find('div',class_='old').text.replace('KSh',' ').repl
                discount=int(product.find('div',class_='bdg _dsct _sm').text.replace('%
                curs.execute('''INSERT INTO Jumia_products (Name,Brand,Category,Shippin
                #print(name,',  ',brand,' ,',category,' ,',img,',  ',shipping,',  ',offer,
            except Exception as e:
                pass
        if id <47:
            print(f'Scraping data from page {id}')
    conn.commit()
url_fetcher()
```

```
Scraping data from page 1
Scraping data from page 2
Scraping data from page 3
Scraping data from page 4
Scraping data from page 5
Scraping data from page 6
Scraping data from page 7
Scraping data from page 8
Scraping data from page 9
Scraping data from page 10
Scraping data from page 11
Scraping data from page 12
Scraping data from page 13
Scraping data from page 14
Scraping data from page 15
Scraping data from page 16
Scraping data from page 17
Scraping data from page 18
Scraping data from page 19
Scraping data from page 20
Scraping data from page 21
Scraping data from page 22
Scraping data from page 23
Scraping data from page 24
Scraping data from page 25
Scraping data from page 26
Scraping data from page 27
Scraping data from page 28
Scraping data from page 29
Scraping data from page 30
Scraping data from page 31
Scraping data from page 32
Scraping data from page 33
Scraping data from page 34
Scraping data from page 35
Scraping data from page 36
Scraping data from page 37
Scraping data from page 38
Scraping data from page 39
```

```
Scraping data from page 40
Scraping data from page 41
Scraping data from page 42
Scraping data from page 43
Scraping data from page 44
Scraping data from page 45
Scraping data from page 46
```

In [ ]:
```
results=curs.execute('''SELECT * FROM Jumia_products''').fetchall()
#print(results)
```

In [ ]:
```
#Loading the database into a pandas dataframe for analysis
conn=sql.connect('Offers.db')
df=pd.read_sql_query('SELECT * FROM Jumia_products',conn)
```

In [ ]:
```
# Creating a copy of the data frame for manipulation
jumia_offers=df.copy()
jumia_offers.drop_duplicates(inplace=True) #takes care of any duplicates that may arise
```

STEP 2: Exploratory Data Analysis

In this section we'll try to answer the following questions about our dataset.

1. **How many rows and columns does our dataset have?**
2. **How many unique product categories does our dataset have?**
3. **What is our dataset's statistical summary?**
4. **What data types does each column have?**

In [ ]:
```
#Checking for the number of rows and columns
jumia_offers.shape
#Our dataset has 1,533 row entries and 7 columns
```

Out[ ]:
```
(1115, 7)
```

In [ ]:
```
#Checking for columns and respective data types
jumia_offers.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1115 entries, 0 to 1539
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   Name      1115 non-null   object
 1   Brand     1115 non-null   object
 2   Category  1115 non-null   object
 3   Shipping  1115 non-null   object
 4   Price     1115 non-null   int64 
 5   Offer     1115 non-null   int64 
 6   Discount  1115 non-null   int64 
dtypes: int64(3), object(4)
memory usage: 69.7+ KB
```

In [ ]:
```
# Statistical summary
jumia_offers.describe()
```

Out[ ]:

	Price	Offer	Discount
count	1115.000000	1115.000000	1115.000000
mean	5939.849327	3760.712108	33.235874
std	8104.158760	4722.881014	12.225843
min	172.000000	86.000000	10.000000
25%	2042.000000	1475.000000	23.000000
50%	3545.000000	2289.000000	26.000000
75%	6148.000000	3971.500000	50.000000
max	78498.000000	39249.000000	50.000000

In [ ]:
```
# Checking for unique product categories
jumia_offers['Category'].nunique()
#our dataset has 161 unique product categogies
```

Out[ ]:
```
161
```

In [ ]:
```
#Checking how many times each category has been featured.
jumia_offers['Category'].value_counts()
```

Out[ ]:
```
Automobile/Motorcycle & Powersports/Accessories/Stands
192
Home & Office/Home & Kitchen/Home Decor/Home Décor Accents/Decorative Accessories/Decora
tive Bowls     97
Home & Office/Tools & Home Improvement/Power & Hand Tools/Gardening Tools
75
Toys & Games/Learning & Education/Reading & Writing/Diaries, Journals & Notebooks
36
Home & Office/Home & Kitchen/Kitchen & Dining/Bakeware/Bakers & Casseroles
26

...
Automobile/Replacement Parts/Belts, Hoses & Pulleys/Belts
1
Home & Office/Home & Kitchen/Kitchen & Dining/Kitchen Utensils & Gadgets
1
Home & Office/Home & Furniture/Lighting/Lighting Bulbs & Component
1
Toys & Games/Hobbies/Remote & App Controlled Vehicles & Parts
1
Home & Office/Arts, Crafts & Sewing/Needlework/Needle Felting Supplies/Tools
1
Name: Category, Length: 161, dtype: int64
```

Step 3: Cleaning Our Data

Under this section, we will check our dataset for;

1. **Missing values**
2. **Outliers**
3. **Structural errors**

a. Checking for nulls

In [ ]:
```
jumia_offers.isnull().sum()
#Our dataset has no missing values.
```

Out[ ]:
```
Name        0
Brand       0
Category    0
Shipping    0
Price       0
Offer       0
Discount    0
dtype: int64
```

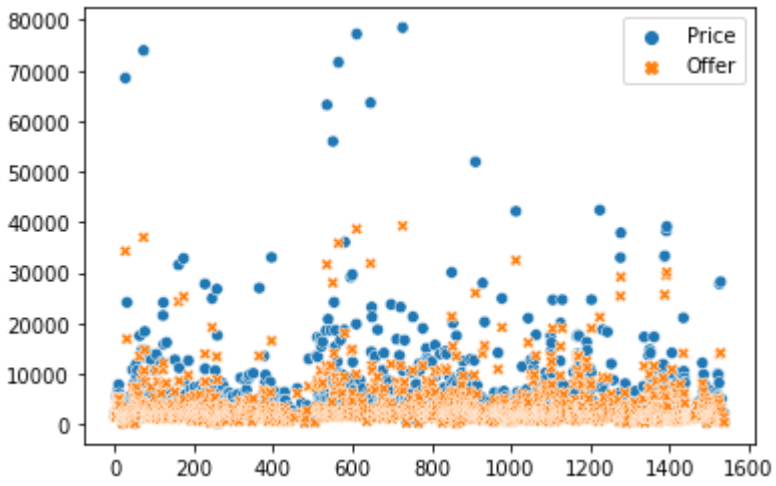
b. Plotting for outliers

We will utilize scatter plots and baxplots to check for outliers in the price and offer columns

In [ ]:
```
import seaborn
import matplotlib
%matplotlib inline
```

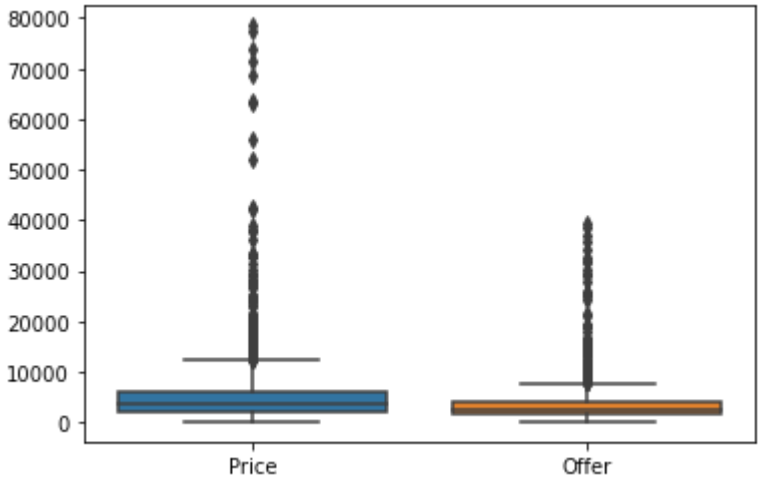
In [ ]:
```
#Scatterplot1
seaborn.scatterplot(data=jumia_offers[['Price','Offer']])
```

Out[ ]:
```
<AxesSubplot:>
```



In [ ]:
```
#Boxplot1
seaborn.boxplot(data=jumia_offers[['Price','Offer']])
```

Out[ ]:
```
<AxesSubplot:>
```



From the two plots above, we can tell that the two numerical columns (price & offer) contain outliers.

C. Cleaning Outliers

Under this section, we will utilize the standard deviation technique to remove outliers from our data.

In [ ]:
```
#Creating a custom function to check and filter out outliers from a given column
def std_outlier(df):
    avg=df.mean()
    std=df.std()
    upper_limit=avg+(3*std)
    lower_limit=avg-(3*std)
    clean_data=df[(df>lower_limit) & (df<upper_limit)]
    return clean_data
'''Our function calculates the series mean and standard deviation then uses them to set
In this case we utilize '3 standard deviations' from the mean on both bounds.'''
```

Out[ ]:
```
"\nOur function calculates the series mean and standard deviation then uses them to set
the upper and lower bounds in our data.\nIn this case we utilize '3 standard deviations'
from the mean on both bounds."
```

In [ ]:
```
clean_price=std_outlier(jumia_offers['Price'])

clean_offer=std_outlier(jumia_offers['Offer'])

#Running this cell once removes the least amount of outliers possible.
# If you want to increase the accuracy of 'cleaning' your data, you should run the cell
# Check the boxplots and scatter plots below to verify the changes in your dataset
```

In [ ]:
```
#Inserting the clean price and Offer values into our dataset
jumia_offers['Price']=clean_price
jumia_offers['Offer']=clean_offer
```

In [ ]:
```
# Checking to see if the two columns have introduced any nulls in our dataset.
jumia_offers.isnull().sum()
```

Out[ ]:
```
Name          0
Brand         0
Category      0
Shipping      0
Price        21
Offer        26
Discount      0
dtype: int64
```

In [ ]:
```
# Checking for entries whose values have been flagged as outliers.
jumia_offers[(jumia_offers['Price'].isnull()) | (jumia_offers['Offer'].isnull())]
```

Out[ ]:

	Name	Brand	Category	Shipping	Price	Offer	Discount
27	【Free Shp + R Deal + Limited Offer】800M Seah R...	Generic	Garden & Outdoors/Outdoor Power Tools/Metal De...	Shipped from abroad	NaN	NaN	50
73	【r Deal + Limited Offer】 Variable Frequency Dri...	Generic	Home & Office/Tools & Home Improvement/Electri...	Shipped from abroad	NaN	NaN	50
161	銆? + Super Deal + Limited Offer 銆?Green 4.3Inch...	Generic	Automobile/Motorcycle & Powersports/Accessorie...	Shipped from abroad	NaN	NaN	23
174	銆恣uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
246	140X Tibet Tibetan D Buddhist Copper Water Off...	Generic	Home & Office/Home & Kitchen/Home Decor/Home D...	Shipped from abroad	24885.0	NaN	23
396	銆? + Super Deal + Limited Offer 銆?DOT Approved ...	Generic	Automobile/Motorcycle & Powersports/Accessorie...	Shipped from abroad	NaN	16499.0	50
536	【r Deal + Limited Offer】 Variable Frequency Dri...	Generic	Home & Office/Tools & Home Improvement/Electri...	Shipped from abroad	NaN	NaN	50
551	銆愬ree Shipping + Super Deal + Limited Offer銆? D...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	50
565	【r Deal + Limited Offer】 Variable Frequency Dri...	Generic	Home & Office/Tools & Home Improvement/Electri...	Shipped from abroad	NaN	NaN	50

	Name	Brand	Category	Shipping	Price	Offer	Discount
581	Buddha Utensils Special S Offer Temple Ornamen...	Generic	Home & Office/Home & Kitchen/Kitchen & Dining/...	Shipped from abroad	NaN	NaN	50
611	【Free Shp + R Deal + Limited Offer】3reen Leve...	Generic	Home & Office/Tools & Home Improvement/Electri...	Shipped from abroad	NaN	NaN	50
646	【r Deal + Limited Offer】Variable Frequency Dri...	Generic	Home & Office/Tools & Home Improvement/Electri...	Shipped from abroad	NaN	NaN	50
727	350X Tibet Tibetan M Buddhist Copper Water Off...	Generic	Home & Office/Home & Kitchen/Home Decor/Home D...	Shipped from abroad	NaN	NaN	50
851	Pond Liner Special Offer Black Impermeable Mem...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	30034.0	NaN	29
911	AP9630 UPS Network Management Card 2 Offers	Generic	Computing/Computers & Accessories/Computer Com...	Shipped from abroad	NaN	NaN	50
978	140X Tibet Tibetan O Buddhist Copper Water Off...	Generic	Home & Office/Home & Kitchen/Home Decor/Home D...	Shipped from abroad	24885.0	NaN	23
1013	銆恇ree Shipping + Super Deal + Limited Offer銆?D...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
1106	銆? + Super Deal + Limited Offer 銆?DOT Approved ...	Generic	Automobile/Motorcycle & Powersports/Accessorie...	Shipped from abroad	24602.0	NaN	23
1130	140X Tibet Tibetan G Buddhist Copper Water Off...	Generic	Home & Office/Home & Kitchen/Home Decor/Home D...	Shipped from abroad	24631.0	NaN	23
1204	140X Tibet Tibetan P Buddhist Copper Water Off...	Generic	Home & Office/Home & Kitchen/Home Decor/Home D...	Shipped from abroad	24631.0	NaN	23
1225	銆? + Super Deal + Limited Offer 銆?Green 4.3Inch...	Generic	Automobile/Motorcycle & Powersports/Accessorie...	Shipped from abroad	NaN	NaN	50

	Name	Brand	Category	Shipping	Price	Offer	Discount
1277	銆恛uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
1278	銆恛uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
1388	銆恛uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
1389	銆恛uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
1393	銆恛uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23
1394	銆恛uper Deal + Limited Offer銆愩 ariable Frequency...	Generic	Home & Office/Tools & Home Improvement/Power &...	Shipped from abroad	NaN	NaN	23

In [ ]:
```
# Estimating the percentage of missing values
total_observations=np.product(jumia_offers.shape)
missing_observations=jumia_offers.isnull().sum().sum()
Null_ppercentage=(missing_observations/total_observations)*100
Null_ppercentage
#This percentage informs us on the technique to be used when handling nulls.
```

Out[ ]:
```
0.6021780909673287
```

d. Handling Missing values

In our case only 0.60% of our observations contains null values. This is a very small percentage and we can get away with dropping those values.

This percentage will vary depending on how many times you ran the outlier removal function.

If the percentage is significant, consider handling your missing values differently by filling them with column averages.

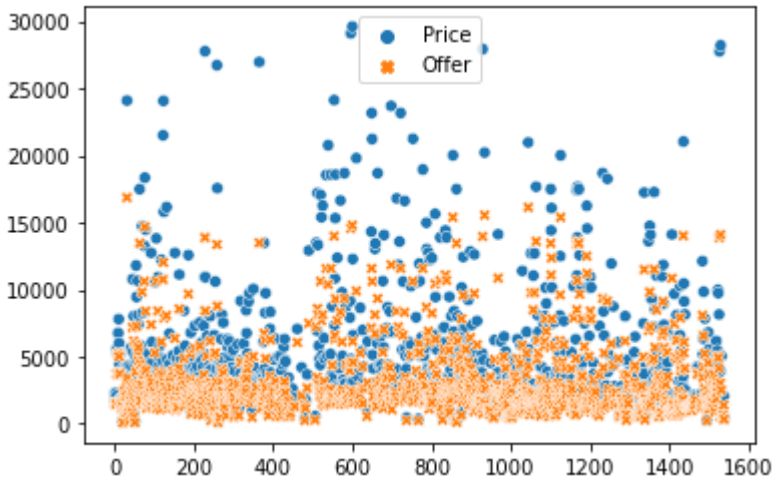
In [ ]:
```
# Lets create another copy of our data set containing null values for future reference
clean_data=jumia_offers.copy()
```

In [ ]:
```
# Dropping null values in our new dataset
```

```
clean_data.dropna(inplace=True)
```

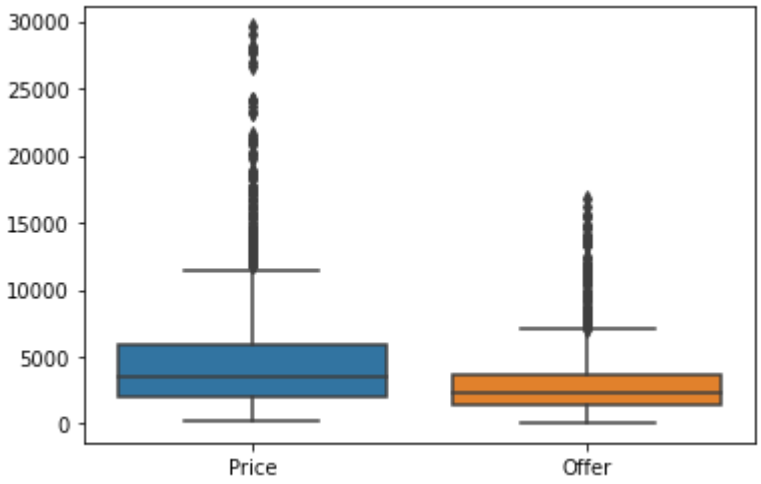
In [ ]:
```
seaborn.scatterplot(data=clean_data[['Price','Offer']])
```

Out[ ]:
```
<AxesSubplot:>
```



In [ ]:
```
seaborn.boxplot(data=clean_data[['Price','Offer']])
```

Out[ ]:
```
<AxesSubplot:>
```



In [ ]:
```
clean_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1088 entries, 0 to 1539
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   Name      1088 non-null   object 
 1   Brand     1088 non-null   object 
 2   Category  1088 non-null   object 
 3   Shipping  1088 non-null   object 
 4   Price     1088 non-null   float64
 5   Offer     1088 non-null   float64
 6   Discount  1088 non-null   int64  
```

```
dtypes: float64(2), int64(1), object(4)
memory usage: 68.0+ KB
```

From the two plots above, we can tell that some outliers have been removed from the dataset. The .info() method indicates that the new number of row entries is 1,126.

e. Fixing Structural errors in strings

In this section we will clean our dataset by fixing structural/format issues in columns containing string values.

In [ ]:
```
clean_data[['Name','Category']].tail()
```

Out[ ]:

	Name	Category
1535	Ast Deal + Limited Offerall Hooks Home Towel C...	Home & Office/Tools & Home Improvement/Hardwar...
1536	Ast Deal + Limited Offerall Hooks Home Towel C...	Home & Office/Tools & Home Improvement/Hardwar...
1537	Ast Deal + Limited Offerall Hooks Home Towel C...	Home & Office/Tools & Home Improvement/Hardwar...
1538	? + Super Deal Limited OfferGEHR1212-2 Externa...	Garden & Outdoors/Gardening & Lawn Care/Hand T...
1539	Ast Deal + Limited Offerall Hooks Home Towel C...	Home & Office/Tools & Home Improvement/Hardwar...

As you can see, the name column contains irrelevant strings and symbols that need to be removed. The category column also needs to be restructured from sub categories to main categories for analysis

In [ ]:
```
# We will utilize list expression to create a list of all the names and categories in t
clean_data['Name']=[name.split('+')[-1] for name in clean_data['Name']]
clean_data['Category']=[category.split('/')[0] for category in clean_data['Category']]
```

In [ ]:
```
clean_data[['Name','Category']].tail()
```

Out[ ]:

	Name	Category
1535	Limited Offerall Hooks Home Towel Clothe - Ho...	Home & Office
1536	Limited Offerall Hooks Home Towel Clothe - Co...	Home & Office
1537	Limited Offerall Hooks Home Towel Clothe - Co...	Home & Office
1538	Super Deal Limited OfferGEHR1212-2 External G...	Garden & Outdoors
1539	Limited Offerall Hooks Home Towel Clothe - Ho...	Home & Office

STEP 4: Performing Data Analysis

So far we have done the following;

1. **Mined data from jumia.co.ke by web scraping**
2. **Saved the mined data into an sqlite3 database**
3. **Created a pandas dataframe by reading the sqlite3 database**
4. **Performed EDA to understand the structure of our data**
5. **Performed data cleaning by:**

   . Plotting for outliers in numerical columns using seaborn (boxplot & scatterplot)

   . Removing Outliers using standard deviation outlier technique

   . Removing structural errors from strings

Our dataset is now ready for analysis

Research Questions

1. **Is there a correlation between the price of products and their offers? If yes, is it possible to predict offers given price?**
2. **How many product categories does jumia feature in offers?**
3. **What are the top 5 categories with the most number of items on offer?**
4. **What 5 categories have the least number of items on offer?**
5. **What is the min, max, avereage and standard deviation of offer prices?**
6. **How many products have the max and minimum discounts?**
7. **Plot for the distribution of discounts. Is it normally distributed?**
8. **Assuming there was only 1 item in stock when you ran this script;**

   . what is the value of all products on offer?

   . What is the value of products in their given categories?
9. **Split the dataset into train, validation and test groups and create a machine learning model to predict offers given prices.**
10. **What is the significance of this project?**

Q1. Is there a correlation between the price of products and their offers? If yes, is it possible to predict offers given price?

In [ ]:
```
clean_data['Price'].corr(clean_data['Offer'])
```

Out[ ]:
```
0.9592332188250519
```

There is a strong positive correlation of 0.9593. You can accurately predict the offer given a price of a product

Q2. How many product categories does jumia feature in offers?

In [ ]:
```
clean_data['Category'].nunique()
```

Out[ ]:
```
18
```

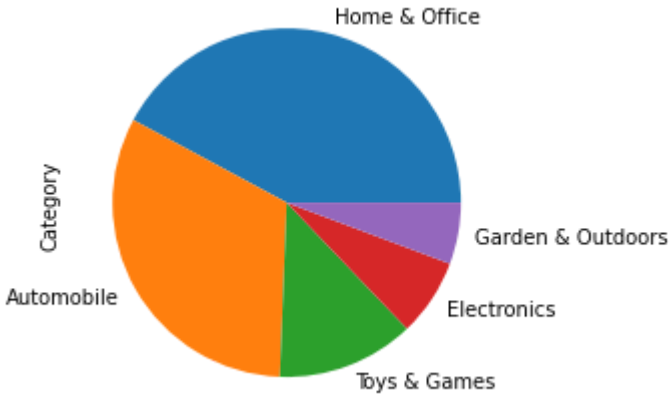
Q3. What are the top 5 categories with the most number of items on offer?

In [ ]:
```
clean_data['Category'].value_counts()[:5]
```

Out[ ]:
```
Home & Office        370
Automobile           283
Toys & Games         112
Electronics           63
Garden & Outdoors     50
Name: Category, dtype: int64
```

In [ ]:
```
#Plotting the 5 categories
clean_data['Category'].value_counts()[:5].plot(kind='pie')
```

Out[ ]:
```
<AxesSubplot:ylabel='Category'>
```



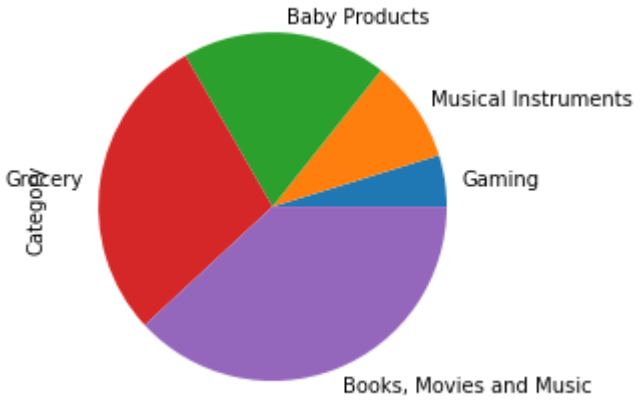
Q4. What 5 categories have the least number of items on offer?

In [ ]:
```
clean_data['Category'].value_counts(ascending=True)[:5]
#or
#clean_data['Category'].value_counts()[-5:]
```

Out[ ]:
```
Gaming                   1
Musical Instruments      2
Baby Products            4
Grocery                  6
Books, Movies and Music  8
Name: Category, dtype: int64
```

In [ ]:
```
# Plotting the 5 last categories
clean_data['Category'].value_counts(ascending=True)[:5].plot(kind='pie')
```

Out[ ]:
```
<AxesSubplot:ylabel='Category'>
```



Q5. What is the min, max, avereage and standard deviation of offer prices?

In [ ]:
```
clean_data[['Price','Offer']].describe()
```

Out[ ]:

	Price	Offer
count	1088.000000	1088.000000
mean	4992.936581	3191.073529
std	4736.983115	2888.252831
min	172.000000	86.000000
25%	1997.000000	1467.500000
50%	3495.500000	2240.500000
75%	5826.000000	3699.000000
max	29598.000000	16862.000000

Q6. How products has the max and minimum discounts?

In [ ]:
```
max_discount=clean_data[clean_data['Discount']==clean_data['Discount'].max()]['Name'].c
discount=clean_data['Discount'].max()
print(f'maximum discount: {discount}%\nNumber of products: {max_discount}')
```

```
maximum discount: 50%
Number of products: 300
```

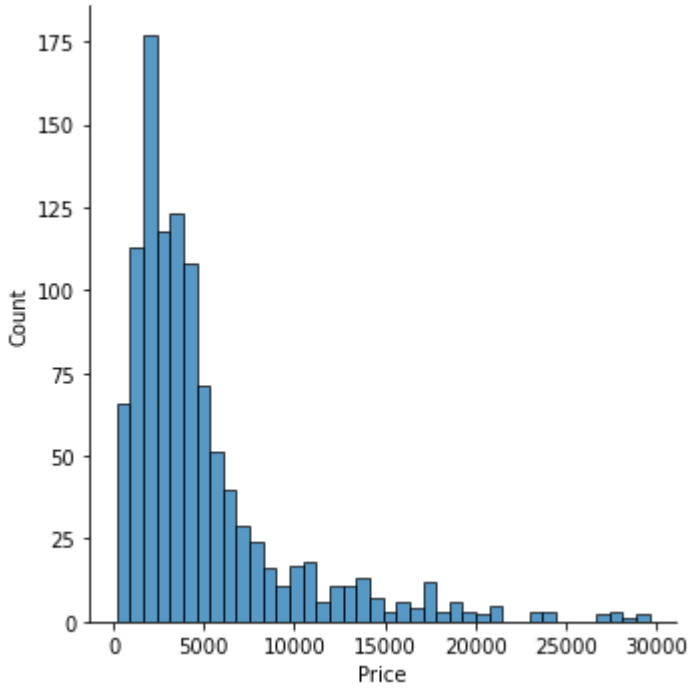
In [ ]:
```
min_discount=clean_data[clean_data['Discount']==clean_data['Discount'].min()]['Name'].c
minimumd=clean_data['Discount'].min()
print(f'minimum discount: {minimumd}%\nNumber of products: {min_discount}')
```

```
minimum discount: 10%
Number of products: 1
```

Q7. Plot for the distribution of discounts. Is it normally distributed?

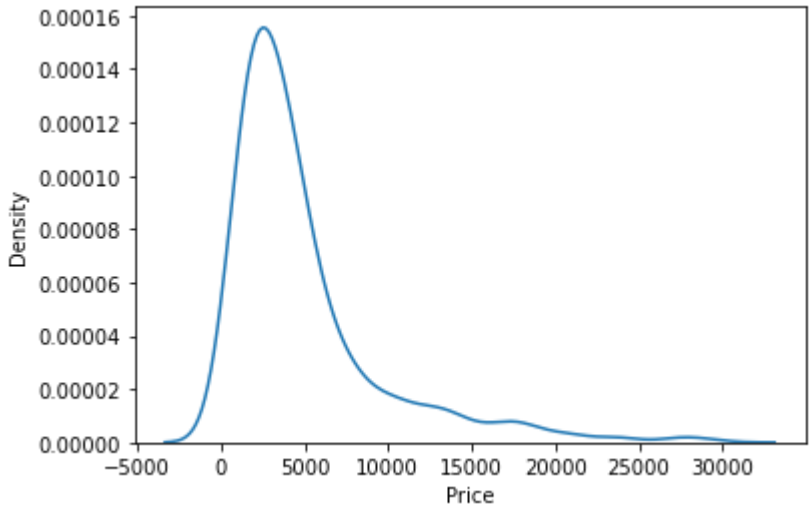
In [ ]:
```
seaborn.displot(data=clean_data['Price'])
```

Out[ ]:
```
<seaborn.axisgrid.FacetGrid at 0x24cafa06b20>
```



In [ ]:
```
seaborn.kdeplot(data=clean_data['Price'])
```

Out[ ]:
```
<AxesSubplot:xlabel='Price', ylabel='Density'>
```



In [ ]:
```
clean_data['Price'].mean()
```

Out[ ]:
```
4992.936580882353
```

The price of products in our data set is a random variable following a normal distribution with mean 4,955

Q8 a. what is the value of all products on offer?

In [ ]:
```
clean_data['Price'].sum()
```

Out[ ]:
```
5432315.0
```

Q8 b. What is the value of products in their given categories?

In [ ]:
```
clean_data.groupby('Category').sum()['Price']
```

Out[ ]:
```
Category
Automobile                1042482.0
Baby Products               33419.0
Books, Movies and Music     13802.0
Computing                   35507.0
Electronics                228526.0
Fashion                    135164.0
Gaming                       1967.0
Garden & Outdoors          467012.0
Grocery                     22358.0
Health & Beauty            198676.0
Home & Office             2375559.0
Industrial & Scientific     79353.0
Musical Instruments          6913.0
Pet Supplies                58084.0
Phones & Tablets           151122.0
Services                    72698.0
Sporting Goods             123018.0
Toys & Games               386655.0
Name: Price, dtype: float64
```

In [ ]:
```
clean_data.groupby('Category').sum()['Price'].plot(kind='bar')
```

Out[ ]:
```
<AxesSubplot:xlabel='Category'>
```