Data Science Project Presentation

Project Description

Your main objective is to develop an asset or group of assets that present the results of a data science project to the relevant stakeholders. The presentation will be based on the online retailer scenario that has been used throughout the Coursera Projects in the CDSP Specialization.

Your organization is an online retailer that sells a variety of different products. Each sale through the online storefront is recorded in a database with various characteristics, including customer name, customer address, sale price, quantity sold, and so on. The business leaders want to use this data to identify ways in which the business can cut down on wasteful spending in areas like product inventory, order fulfillment, and marketing.

A regression model that predicts how much money a customer will spend at the online store. By making this prediction, the business might be able to better project sales for a fiscal period for budgeting purposes, or better incentivize major customers to spend even more at the store.

Import Libraries

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import random

import sklearn

import shap
import eli5
from IPython.display import display
import statsmodels.api as sm

import datetime
from datetime import datetime, timedelta


import scipy.stats

#from sklearn.experimental import enable_hist_gradient_boosting
#from sklearn.linear_model import ElasticNet, Lasso, LinearRegression, LogisticRegression, Ridge
#from sklearn.ensemble import RandomForestClassifier, RandomForestRegressor, ExtraTreesClassifier, ExtraTreesRe
#from sklearn.ensemble import GradientBoostingClassifier, GradientBoostingRegressor, HistGradientBoostingClass


%matplotlib inline
#sets the default autosave frequency in seconds
%autosave 60
sns.set_style('dark')
sns.set(font_scale=1.2)

plt.rc('axes', labelsize=14)
plt.rc('xtick', labelsize=12)
plt.rc('ytick', labelsize=12)


from sklearn.model_selection import cross_val_score, train_test_split, GridSearchCV, RandomizedSearchCV
from sklearn.model_selection import cross_validate, KFold, RepeatedStratifiedKFold
from sklearn.preprocessing import LabelEncoder, StandardScaler, MinMaxScaler, OneHotEncoder


from sklearn.tree import export_graphviz, plot_tree
from sklearn.metrics import confusion_matrix, classification_report, mean_absolute_error, mean_squared_error,r2
from sklearn.metrics import plot_confusion_matrix, plot_precision_recall_curve, plot_roc_curve, accuracy_score
from sklearn.metrics import auc, f1_score, precision_score, recall_score, roc_auc_score


import warnings
warnings.filterwarnings('ignore')

from pycaret.regression import *

pd.set_option('display.max_columns',None)
#pd.set_option('display.max_rows',100)
pd.set_option('display.width', 1000)
pd.set_option('display.float_format','{:.2f}'.format)


random.seed(0)
np.random.seed(0)
np.set_printoptions(suppress=True)
```

```
Autosaving every 60 seconds
```

Exploratory Data Analysis

In [2]:

```
df = pd.read_csv("retail.csv")
```

In [3]:

```
df
```

Out[3]:

	Invoice	StockCode	Quantity	InvoiceDate	Price	CustomerID	Country	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT
0	536365	85123A	6	2010-12-01 08:26:00	2.55	u1785	United Kingdom	15.30	12	0
1	536373	85123A	6	2010-12-01 09:02:00	2.55	u1785	United Kingdom	15.30	12	0
2	536375	85123A	6	2010-12-01 09:32:00	2.55	u1785	United Kingdom	15.30	12	0
3	536378	20725	10	2010-12-01 09:37:00	1.65	u14688	United Kingdom	16.50	12	0
4	536392	84879	16	2010-12-01 10:29:00	1.69	u13705	United Kingdom	27.04	12	1
...	...	...	...	...	...	...	...	...	...	...
9128	581538	22197	4	2011-12-09 11:34:00	0.85	u14446	United Kingdom	3.40	12	0
9129	581538	20727	1	2011-12-09 11:34:00	1.65	u14446	United Kingdom	1.65	12	0
9130	581538	20725	1	2011-12-09 11:34:00	1.65	u14446	United Kingdom	1.65	12	0
9131	581579	22197	24	2011-12-09 12:19:00	0.85	u17581	United Kingdom	20.40	12	0
9132	581585	84879	16	2011-12-09 12:31:00	1.69	u15804	United Kingdom	27.04	12	1

9133 rows × 18 columns

In [4]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9133 entries, 0 to 9132
Data columns (total 18 columns):
 #   Column                                       Non-Null Count  Dtype
---  ------                                       --------------  -----
 0   Invoice                                      9133 non-null   int64
 1   StockCode                                    9133 non-null   object
 2   Quantity                                     9133 non-null   int64
 3   InvoiceDate                                  9133 non-null   object
 4   Price                                        9133 non-null   float64
 5   CustomerID                                   9133 non-null   object
 6   Country                                      9133 non-null   object
 7   TotalAmount                                  9133 non-null   float64
 8   Month                                        9133 non-null   int64
 9   Description_ASSORTED COLOUR BIRD ORNAMENT    9133 non-null   int64
 10  Description_CREAM HANGING HEART T-LIGHT HOLDER  9133 non-null   int64
 11  Description_JUMBO BAG RED RETROSPOT          9133 non-null   int64
 12  Description_LUNCH BAG  BLACK SKULL.          9133 non-null   int64
 13  Description_LUNCH BAG RED RETROSPOT          9133 non-null   int64
 14  Description_PARTY BUNTING                    9133 non-null   int64
 15  Description_POPCORN HOLDER                   9133 non-null   int64
 16  Description_REGENCY CAKESTAND 3 TIER         9133 non-null   int64
 17  Description_SET OF 3 CAKE TINS PANTRY DESIGN   9133 non-null   int64
dtypes: float64(2), int64(12), object(4)
memory usage: 1.3+ MB
```

In [5]:

```
df.describe(include='all')
```

Out[5]:

	Invoice	StockCode	Quantity	InvoiceDate	Price	CustomerID	Country	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT
count	9133.00	9133	9133.00	9133	9133.00	9133	9133	9133.00	9133.00	9133.00
unique	NaN	10	NaN	5624	NaN	2130	1	NaN	NaN	NaN
top	NaN	85123A	NaN	2011-06-02 12:08:00	NaN	u17841	United Kingdom	NaN	NaN	NaN
freq	NaN	1533	NaN	9	NaN	161	9133	NaN	NaN	NaN
mean	558595.95	NaN	7.52	NaN	2.47	NaN	NaN	14.47	6.99	0.11
std	12299.54	NaN	6.15	NaN	1.46	NaN	NaN	9.31	3.36	0.31
min	536365.00	NaN	1.00	NaN	0.00	NaN	NaN	0.00	1.00	0.00
25%	548150.00	NaN	3.00	NaN	1.65	NaN	NaN	5.90	4.00	0.00
50%	558481.00	NaN	6.00	NaN	1.95	NaN	NaN	14.75	7.00	0.00
75%	568697.00	NaN	10.00	NaN	2.95	NaN	NaN	19.80	10.00	0.00
max	581585.00	NaN	30.00	NaN	5.79	NaN	NaN	40.00	12.00	1.00

In [6]:

```
df.shape
```

Out[6]:

```
(9133, 18)
```

In [7]:

```
df.columns
```

Out[7]:

```
Index(['Invoice', 'StockCode', 'Quantity', 'InvoiceDate', 'Price', 'CustomerID', 'Country', 'TotalAmount', 'Mon
th', 'Description_ASSORTED COLOUR BIRD ORNAMENT', 'Description_CREAM HANGING HEART T-LIGHT HOLDER', 'Descriptio
n_JUMBO BAG RED RETROSPOT', 'Description_LUNCH BAG  BLACK SKULL.', 'Description_LUNCH BAG RED RETROSPOT', 'Desc
ription_PARTY BUNTING', 'Description_POPCORN HOLDER', 'Description_REGENCY CAKESTAND 3 TIER', 'Description_SET
OF 3 CAKE TINS PANTRY DESIGN '], dtype='object')
```

Groupby Function

In [8]:

```
df.groupby(['CustomerID']).sum()
```

Out[8]:

	Invoice	Quantity	Price	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER	Description_JUMBO BAG RED RETROSPOT
CustomerID								
u12747	5607527	126	22.33	262.20	83	5	4	1
u12748	47869871	306	174.08	496.98	758	4	6	11
u12749	2281611	20	16.54	72.92	39	1	0	0
u1282	541283	6	2.95	17.70	1	0	1	0
u12822	566580	10	1.65	16.50	9	0	0	0
...	...	...	...	...	...	...	...	...
u18265	2255134	40	12.14	66.32	32	1	0	0
u18272	1675000	51	6.05	41.25	19	0	0	0
u18274	575485	3	4.95	14.85	11	0	0	0
u18277	570859	8	1.69	13.52	10	1	0	0
u18283	25879653	86	80.37	149.75	333	0	4	10

2130 rows × 14 columns

In [9]:

```
df.groupby(['CustomerID']).mean()
```

Out[9]:

	Invoice	Quantity	Price	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER	Description_JUMBO BAG RED RETROSPOT
CustomerID								
u12747	560752.70	12.60	2.23	26.22	8.30	0.50	0.40	0.10
u12748	563174.95	3.60	2.05	5.85	8.92	0.05	0.07	0.13
u12749	570402.75	5.00	4.13	18.23	9.75	0.25	0.00	0.00
u1282	541283.00	6.00	2.95	17.70	1.00	0.00	1.00	0.00
u12822	566580.00	10.00	1.65	16.50	9.00	0.00	0.00	0.00
...	...	...	...	...	...	...	...	...
u18265	563783.50	10.00	3.04	16.58	8.00	0.25	0.00	0.00
u18272	558333.33	17.00	2.02	13.75	6.33	0.00	0.00	0.00
u18274	575485.00	3.00	4.95	14.85	11.00	0.00	0.00	0.00
u18277	570859.00	8.00	1.69	13.52	10.00	1.00	0.00	0.00
u18283	562601.15	1.87	1.75	3.26	7.24	0.00	0.09	0.22

2130 rows × 14 columns

In [10]:

```
df.groupby(['CustomerID']).median()
```

Out[10]:

	Invoice	Quantity	Price	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER	Description_JUMBO BAG RED RETROSPOT
CustomerID								
u12747	561973.00	14.00	1.89	27.04	10.00	0.50	0.00	0.00
u12748	564534.00	3.00	1.65	4.65	11.00	0.00	0.00	0.00
u12749	569467.50	4.50	4.95	14.85	9.50	0.00	0.00	0.00
u1282	541283.00	6.00	2.95	17.70	1.00	0.00	1.00	0.00
u12822	566580.00	10.00	1.65	16.50	9.00	0.00	0.00	0.00
...	...	...	...	...	...	...	...	...
u18265	563783.50	6.00	3.32	16.66	8.00	0.00	0.00	0.00
u18272	559813.00	24.00	0.55	13.20	7.00	0.00	0.00	0.00
u18274	575485.00	3.00	4.95	14.85	11.00	0.00	0.00	0.00
u18277	570859.00	8.00	1.69	13.52	10.00	1.00	0.00	0.00
u18283	558990.50	2.00	1.65	3.30	6.50	0.00	0.00	0.00

2130 rows × 14 columns

In [11]:

```
df.groupby(['CustomerID']).count()
```

Out[11]:

	Invoice	StockCode	Quantity	InvoiceDate	Price	Country	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER
CustomerID										
u12747	10	10	10	10	10	10	10	10	10	10
u12748	85	85	85	85	85	85	85	85	85	85
u12749	4	4	4	4	4	4	4	4	4	4
u1282	1	1	1	1	1	1	1	1	1	1
u12822	1	1	1	1	1	1	1	1	1	1
...	...	...	...	...	...	...	...	...	...	...
u18265	4	4	4	4	4	4	4	4	4	4
u18272	3	3	3	3	3	3	3	3	3	3
u18274	1	1	1	1	1	1	1	1	1	1
u18277	1	1	1	1	1	1	1	1	1	1
u18283	46	46	46	46	46	46	46	46	46	46

2130 rows × 17 columns

In [12]:

```
df2 = pd.DataFrame(df.groupby(['CustomerID']).sum())
```

In [13]:

```
df2
```

Out[13]:

	Invoice	Quantity	Price	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER	Description_JUMBO BAG RED RETROSPOT
CustomerID								
u12747	5607527	126	22.33	262.20	83	5	4	1
u12748	47869871	306	174.08	496.98	758	4	6	11
u12749	2281611	20	16.54	72.92	39	1	0	0
u1282	541283	6	2.95	17.70	1	0	1	0
u12822	566580	10	1.65	16.50	9	0	0	0
...	...	...	...	...	...	...	...	...
u18265	2255134	40	12.14	66.32	32	1	0	0
u18272	1675000	51	6.05	41.25	19	0	0	0
u18274	575485	3	4.95	14.85	11	0	0	0
u18277	570859	8	1.69	13.52	10	1	0	0
u18283	25879653	86	80.37	149.75	333	0	4	10

2130 rows × 14 columns

In [14]:

```
df2_new = df2[["Quantity","TotalAmount"]]
```

In [15]:

```
df2_new
```

Out[15]:

	Quantity	TotalAmount
CustomerID		
u12747	126	262.20
u12748	306	496.98
u12749	20	72.92
u1282	6	17.70
u12822	10	16.50
...	...	...
u18265	40	66.32
u18272	51	41.25
u18274	3	14.85
u18277	8	13.52
u18283	86	149.75

2130 rows × 2 columns

In [16]:

```
df3 = pd.DataFrame(df.groupby(['CustomerID']).count())
```

In [17]:

```
df3
```

Out[17]:

	Invoice	StockCode	Quantity	InvoiceDate	Price	Country	TotalAmount	Month	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER
CustomerID										
u12747	10	10	10	10	10	10	10	10	10	10
u12748	85	85	85	85	85	85	85	85	85	85
u12749	4	4	4	4	4	4	4	4	4	4
u1282	1	1	1	1	1	1	1	1	1	1
u12822	1	1	1	1	1	1	1	1	1	1
...	...	...	...	...	...	...	...	...	...	...
u18265	4	4	4	4	4	4	4	4	4	4
u18272	3	3	3	3	3	3	3	3	3	3
u18274	1	1	1	1	1	1	1	1	1	1
u18277	1	1	1	1	1	1	1	1	1	1
u18283	46	46	46	46	46	46	46	46	46	46

2130 rows × 17 columns

In [18]:

```
df3.columns
```

Out[18]:

```
Index(['Invoice', 'StockCode', 'Quantity', 'InvoiceDate', 'Price', 'Country', 'TotalAmount', 'Month', 'Descript
ion_ASSORTED COLOUR BIRD ORNAMENT', 'Description_CREAM HANGING HEART T-LIGHT HOLDER', 'Description_JUMBO BAG RE
D RETROSPOT', 'Description_LUNCH BAG  BLACK SKULL.', 'Description_LUNCH BAG RED RETROSPOT', 'Description_PARTY
BUNTING', 'Description_POPCORN HOLDER', 'Description_REGENCY CAKESTAND 3 TIER', 'Description_SET OF 3 CAKE TINS
PANTRY DESIGN '], dtype='object')
```

In [19]:

```
df3_new = df3[['Description_ASSORTED COLOUR BIRD ORNAMENT', 'Description_CREAM HANGING HEART T-LIGHT HOLDER',
              'Description_JUMBO BAG RED RETROSPOT', 'Description_LUNCH BAG  BLACK SKULL.',
              'Description_LUNCH BAG RED RETROSPOT', 'Description_PARTY BUNTING',
              'Description_POPCORN HOLDER', 'Description_REGENCY CAKESTAND 3 TIER',
              'Description_SET OF 3 CAKE TINS PANTRY DESIGN ']]
```

In [20]:

```
df3_new
```

Out[20]:

	Description_ASSORTED COLOUR BIRD ORNAMENT	Description_CREAM HANGING HEART T-LIGHT HOLDER	Description_JUMBO BAG RED RETROSPOT	Description_LUNCH BAG BLACK SKULL.	Description_LUNCH BAG RED RETROSPOT	Description_PARTY BUNTING
CustomerID						
u12747	10	10	10	10	10	10
u12748	85	85	85	85	85	85
u12749	4	4	4	4	4	4
u1282	1	1	1	1	1	1
u12822	1	1	1	1	1	1
...	...	...	...	...	...	...
u18265	4	4	4	4	4	4
u18272	3	3	3	3	3	3
u18274	1	1	1	1	1	1
u18277	1	1	1	1	1	1
u18283	46	46	46	46	46	46

2130 rows × 9 columns

In [21]:

```
df3_new.columns = ['birdorna', 'creamholder', 'jumbobag', 'lunchbagblack', 'lunchbagred', 'party', 'popcorn', '
```

In [22]:

```
df3_new
```

Out[22]:

	birdorna	creamholder	jumbobag	lunchbagblack	lunchbagred	party	popcorn	cakestand	caketins
CustomerID									
u12747	10	10	10	10	10	10	10	10	10
u12748	85	85	85	85	85	85	85	85	85
u12749	4	4	4	4	4	4	4	4	4
u1282	1	1	1	1	1	1	1	1	1
u12822	1	1	1	1	1	1	1	1	1
...	...	...	...	...	...	...	...	...	...
u18265	4	4	4	4	4	4	4	4	4
u18272	3	3	3	3	3	3	3	3	3
u18274	1	1	1	1	1	1	1	1	1
u18277	1	1	1	1	1	1	1	1	1
u18283	46	46	46	46	46	46	46	46	46

2130 rows × 9 columns

In [23]:

```
df4 = pd.concat([df2_new,df3_new],axis=1)
```

In [24]:

```
df4
```

Out[24]:

	Quantity	TotalAmount	birdorna	creamholder	jumbobag	lunchbagblack	lunchbagred	party	popcorn	cakestand	caketins
CustomerID											
u12747	126	262.20	10	10	10	10	10	10	10	10	10
u12748	306	496.98	85	85	85	85	85	85	85	85	85
u12749	20	72.92	4	4	4	4	4	4	4	4	4
u1282	6	17.70	1	1	1	1	1	1	1	1	1
u12822	10	16.50	1	1	1	1	1	1	1	1	1
...	...	...	...	...	...	...	...	...	...	...	...
u18265	40	66.32	4	4	4	4	4	4	4	4	4
u18272	51	41.25	3	3	3	3	3	3	3	3	3
u18274	3	14.85	1	1	1	1	1	1	1	1	1
u18277	8	13.52	1	1	1	1	1	1	1	1	1
u18283	86	149.75	46	46	46	46	46	46	46	46	46

2130 rows × 11 columns

In [25]:

```
df4.reset_index(inplace=True, drop=True)
```

In [26]:

```
df4
```

Out[26]:

	Quantity	TotalAmount	birdorna	creamholder	jumbobag	lunchbagblack	lunchbagred	party	popcorn	cakestand	caketins
0	126	262.20	10	10	10	10	10	10	10	10	10
1	306	496.98	85	85	85	85	85	85	85	85	85
2	20	72.92	4	4	4	4	4	4	4	4	4
3	6	17.70	1	1	1	1	1	1	1	1	1
4	10	16.50	1	1	1	1	1	1	1	1	1
...	...	...	...	...	...	...	...	...	...	...	...
2125	40	66.32	4	4	4	4	4	4	4	4	4
2126	51	41.25	3	3	3	3	3	3	3	3	3
2127	3	14.85	1	1	1	1	1	1	1	1	1
2128	8	13.52	1	1	1	1	1	1	1	1	1
2129	86	149.75	46	46	46	46	46	46	46	46	46

2130 rows × 11 columns

In [27]:

```
df4.columns
```

Out[27]:

```
Index(['Quantity', 'TotalAmount', 'birdorna', 'creamholder', 'jumbobag', 'lunchbagblack', 'lunchbagred', 'part
y', 'popcorn', 'cakestand', 'caketins'], dtype='object')
```

In [28]:

```
df5 = df4[['birdorna', 'creamholder', 'jumbobag', 'lunchbagblack',
           'lunchbagred', 'party', 'popcorn', 'cakestand', 'caketins',
           'Quantity', 'TotalAmount']]
```

In [29]:

```
df5
```

Out[29]:

	birdorna	creamholder	jumbobag	lunchbagblack	lunchbagred	party	popcorn	cakestand	caketins	Quantity	TotalAmount
0	10	10	10	10	10	10	10	10	10	126	262.20
1	85	85	85	85	85	85	85	85	85	306	496.98
2	4	4	4	4	4	4	4	4	4	20	72.92
3	1	1	1	1	1	1	1	1	1	6	17.70
4	1	1	1	1	1	1	1	1	1	10	16.50
...	...	...	...	...	...	...	...	...	...	...	...
2125	4	4	4	4	4	4	4	4	4	40	66.32
2126	3	3	3	3	3	3	3	3	3	51	41.25
2127	1	1	1	1	1	1	1	1	1	3	14.85
2128	1	1	1	1	1	1	1	1	1	8	13.52
2129	46	46	46	46	46	46	46	46	46	86	149.75

2130 rows × 11 columns

In [30]:

```
#df5.to_csv("train.csv", index=False)
```

In [31]:

```
df = pd.read_csv("train.csv")
df
```

Out[31]:

	birdorna	creamholder	jumbobag	lunchbagblack	lunchbagred	party	popcorn	cakestand	caketins	Quantity	TotalAmount
0	10	10	10	10	10	10	10	10	10	126	262.20
1	85	85	85	85	85	85	85	85	85	306	496.98
2	4	4	4	4	4	4	4	4	4	20	72.92
3	1	1	1	1	1	1	1	1	1	6	17.70
4	1	1	1	1	1	1	1	1	1	10	16.50
...	...	...	...	...	...	...	...	...	...	...	...
2125	4	4	4	4	4	4	4	4	4	40	66.32
2126	3	3	3	3	3	3	3	3	3	51	41.25
2127	1	1	1	1	1	1	1	1	1	3	14.85
2128	1	1	1	1	1	1	1	1	1	8	13.52
2129	46	46	46	46	46	46	46	46	46	86	149.75

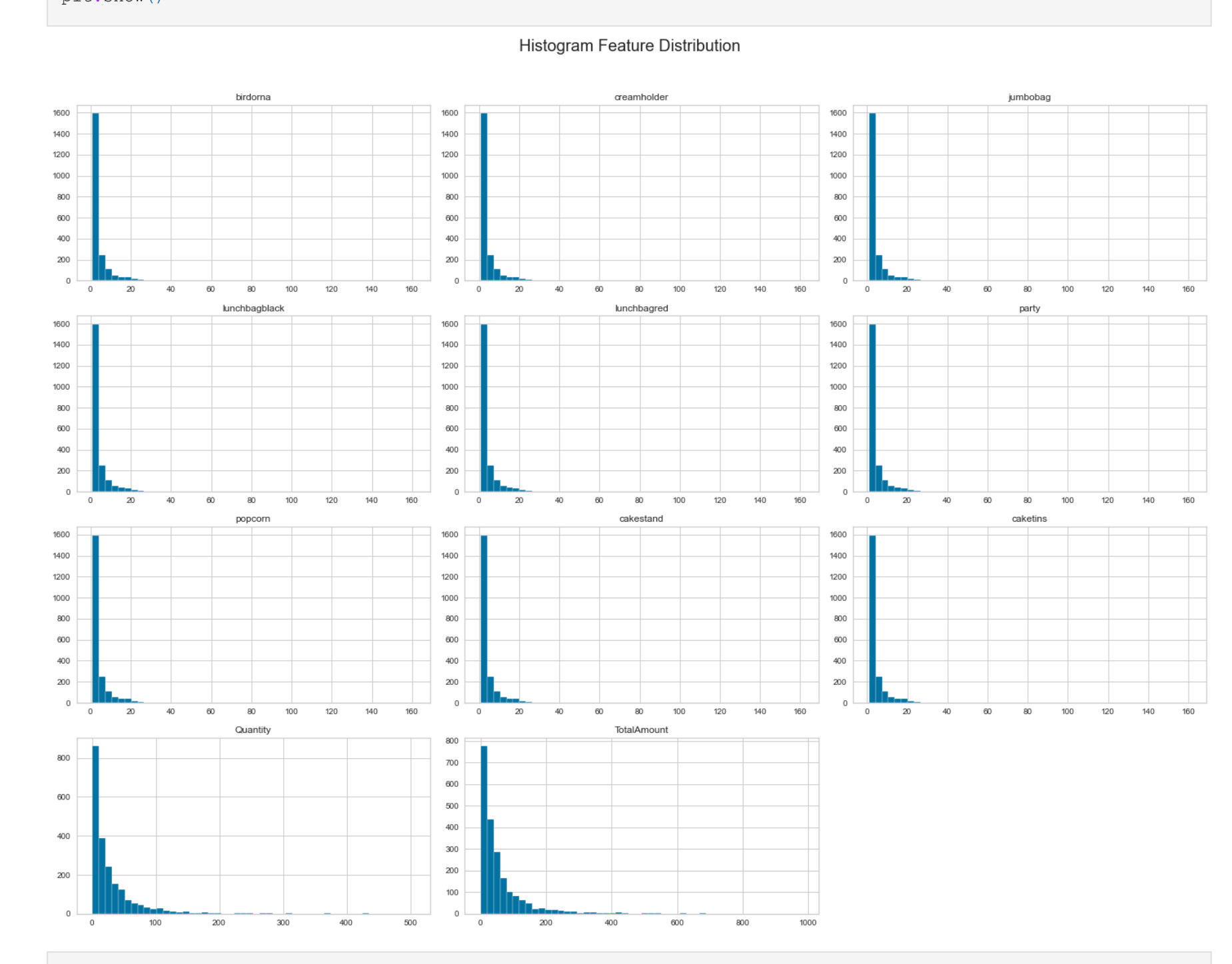
2130 rows × 11 columns

Data Visualization

Univariate Data Exploration

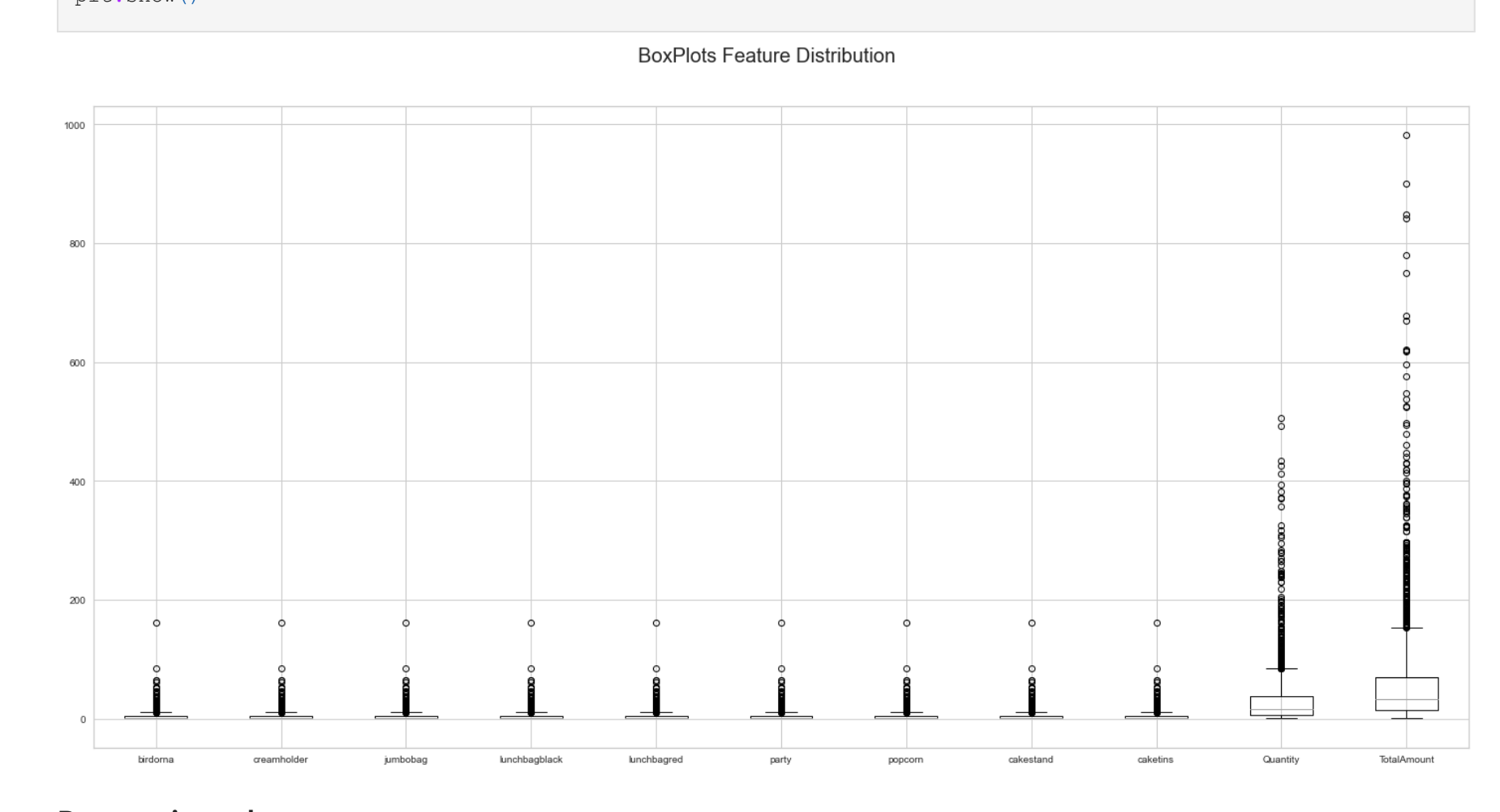
In [32]:

```
df.hist(bins=50, figsize=(20,15))
plt.suptitle('Histogram Feature Distribution', x=0.5, y=1.02, ha='center', fontsize=20)
plt.tight_layout()
plt.show()
```



In [33]:

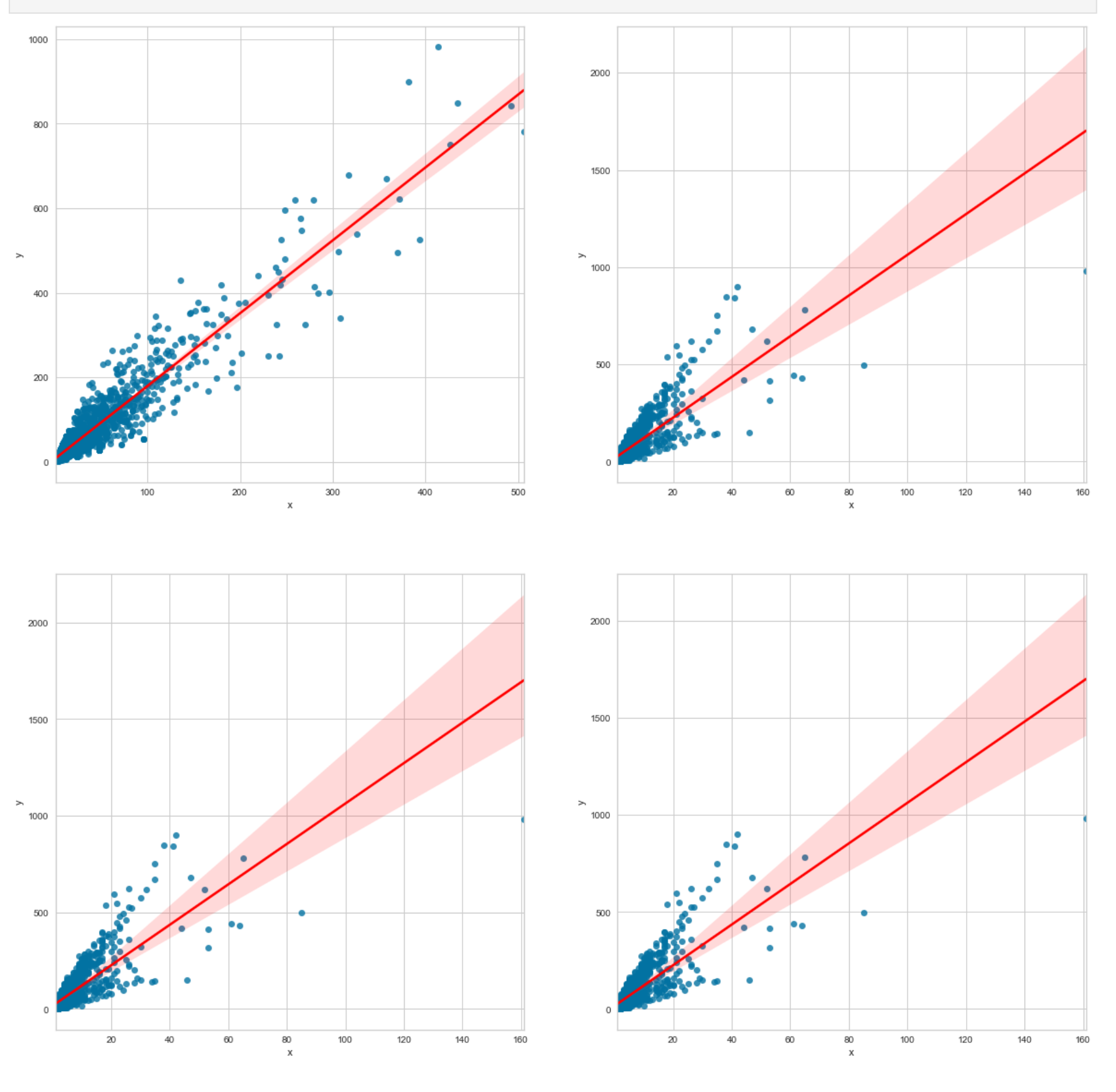
```
df.boxplot(figsize=(20,10))
plt.suptitle('BoxPlots Feature Distribution', x=0.5, y=1.02, ha='center', fontsize=20)
plt.tight_layout()
plt.show()
```



Regression plot

In [34]:

```
line_color = {'color': 'red'}
fig , ax = plt.subplots(2,2, figsize=(20,20))

#

ax1 = sns.regplot(x=df.Quantity, y=df.TotalAmount, line_kws=line_color, data=df, ax=ax[0,0])
ax1.set_xlabel("x")
ax1.set_ylabel("y")


#

ax2 = sns.regplot(x=df.caketins, y=df.TotalAmount, line_kws=line_color,  data=df, ax=ax[0,1])
ax2.set_xlabel("x")
ax2.set_ylabel("y")


#

ax3 = sns.regplot(x=df.party, y=df.TotalAmount, line_kws=line_color,  data=df, ax=ax[1,0])
ax3.set_xlabel("x")
ax3.set_ylabel("y")

#

ax4 = sns.regplot(x=df.jumbobag, y=df.TotalAmount, line_kws=line_color,  data=df, ax=ax[1,1])
ax4.set_xlabel("x")
ax4.set_ylabel("y")

plt.show()
```



Correlation

In [35]:

```
df.corr()
```

Out[35]:

	birdorna	creamholder	jumbobag	lunchbagblack	lunchbagred	party	popcorn	cakestand	caketins	Quantity	TotalAmount
birdorna	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
creamholder	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
jumbobag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
lunchbagblack	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
lunchbagred	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
party	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
popcorn	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
cakestand	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
caketins	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.82
Quantity	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	1.00	0.94
TotalAmount	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.94	1.00

In [36]:

```
df.corr()["TotalAmount"].sort_values()
```

Out[36]:

```
birdorna        0.82
creamholder     0.82
jumbobag        0.82
lunchbagblack   0.82
lunchbagred     0.82
party           0.82
popcorn         0.82
cakestand       0.82
caketins        0.82
Quantity        0.94
TotalAmount     1.00
Name: TotalAmount, dtype: float64
```

In [37]:

```
plt.figure(figsize=(16,9))
sns.heatmap(df.corr(),cmap="coolwarm",annot=True,fmt='.2f',linewidths=2)
plt.title("", fontsize=20)
plt.show()
```

Train Test Split

In [38]:
```
df.shape
```

Out[38]: (2130, 11)

In [39]:
```
X = df.iloc[:,:10]
y = df.iloc[:,10]
```

Train Test Split Cont'd

In [40]:
```
X.values, y.values
```

Out[40]:
```
(array([[ 10,  10,  10, ...,  10,  10, 126],
        [ 85,  85,  85, ...,  85,  85, 306],
        [  4,   4,   4, ...,   4,   4,  20],
        ...,
        [  1,   1,   1, ...,   1,   1,   3],
        [  1,   1,   1, ...,   1,   1,   8],
        [ 46,  46,  46, ...,  46,  46,  86]], dtype=int64),
 array([262.2 , 496.98,  72.92, ...,  14.85,  13.52, 149.75]))
```

In [41]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=0)
```

In [42]:
```
X_train.shape, X_test.shape, y_train.shape, y_test.shape
```

Out[42]: ((1704, 10), (426, 10), (1704,), (426,))

Model Training

Using PyCaret

In [43]:
```
exp_reg = setup(data = df, target = 'TotalAmount', session_id=0, normalize=True, train_size=0.8)
```

	Description	Value
0	session_id	0
1	Target	TotalAmount
2	Original Data	(2130, 11)
3	Missing Values	False
4	Numeric Features	10
5	Categorical Features	0
6	Ordinal Features	False
7	High Cardinality Features	False
8	High Cardinality Method	None
9	Transformed Train Set	(1704, 1)
10	Transformed Test Set	(426, 1)
11	Shuffle Train-Test	True
12	Stratify Train-Test	False
13	Fold Generator	KFold
14	Fold Number	10
15	CPU Jobs	-1
16	Use GPU	False
17	Log Experiment	False
18	Experiment Name	reg-default-name
19	USI	a776
20	Imputation Type	simple
21	Iterative Imputation Iteration	None
22	Numeric Imputer	mean
23	Iterative Imputation Numeric Model	None
24	Categorical Imputer	constant
25	Iterative Imputation Categorical Model	None
26	Unknown Categoricals Handling	least_frequent
27	Normalize	True
28	Normalize Method	zscore
29	Transformation	False
30	Transformation Method	None
31	PCA	False
32	PCA Method	None
33	PCA Components	None
34	Ignore Low Variance	False
35	Combine Rare Levels	False
36	Rare Level Threshold	None
37	Numeric Binning	False
38	Remove Outliers	False
39	Outliers Threshold	None
40	Remove Multicollinearity	False
41	Multicollinearity Threshold	None
42	Remove Perfect Collinearity	True
43	Clustering	False
44	Clustering Iteration	None
45	Polynomial Features	False
46	Polynomial Degree	None
47	Trignometry Features	False
48	Polynomial Threshold	None
49	Group Features	False
50	Feature Selection	False
51	Feature Selection Method	classic
52	Features Selection Threshold	None
53	Feature Interaction	False
54	Feature Ratio	False
55	Interaction Threshold	None
56	Transform Target	False
57	Transform Target Method	box-cox

In [44]:
```
compare_models(exclude=['omp','br','ard','par','ransac','tr','huber','kr',
                        'et','ada','gbr','mlp','xgboost','lightgbm','dummy'],fold=5) # For Regressor
```

	Model	MAE	MSE	RMSE	R2	RMSLE	MAPE	TT (Sec)
lr	Linear Regression	17.8544	947.2179	30.6364	0.8783	0.5063	0.6268	1.0380
ridge	Ridge Regression	17.8528	947.0163	30.6332	0.8783	0.5067	0.6282	0.0160
lar	Least Angle Regression	17.8544	947.2178	30.6364	0.8783	0.5063	0.6268	0.0120
lasso	Lasso Regression	17.8386	945.4307	30.6067	0.8782	0.5136	0.6506	0.0140
knn	K Neighbors Regressor	18.7626	1069.5026	32.3929	0.8655	0.4820	0.5074	0.0160
rf	Random Forest Regressor	18.9095	1320.4425	35.7696	0.8376	0.4547	0.4834	0.1520
dt	Decision Tree Regressor	19.8150	1551.9575	38.9230	0.8060	0.4593	0.4873	0.0160
en	Elastic Net	24.6143	1784.9168	41.8493	0.7769	0.7814	1.5256	0.0160
llar	Lasso Least Angle Regression	28.0081	2325.9701	47.7545	0.7105	0.8544	1.8134	0.0160

Out[44]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=-1, normalize=False)

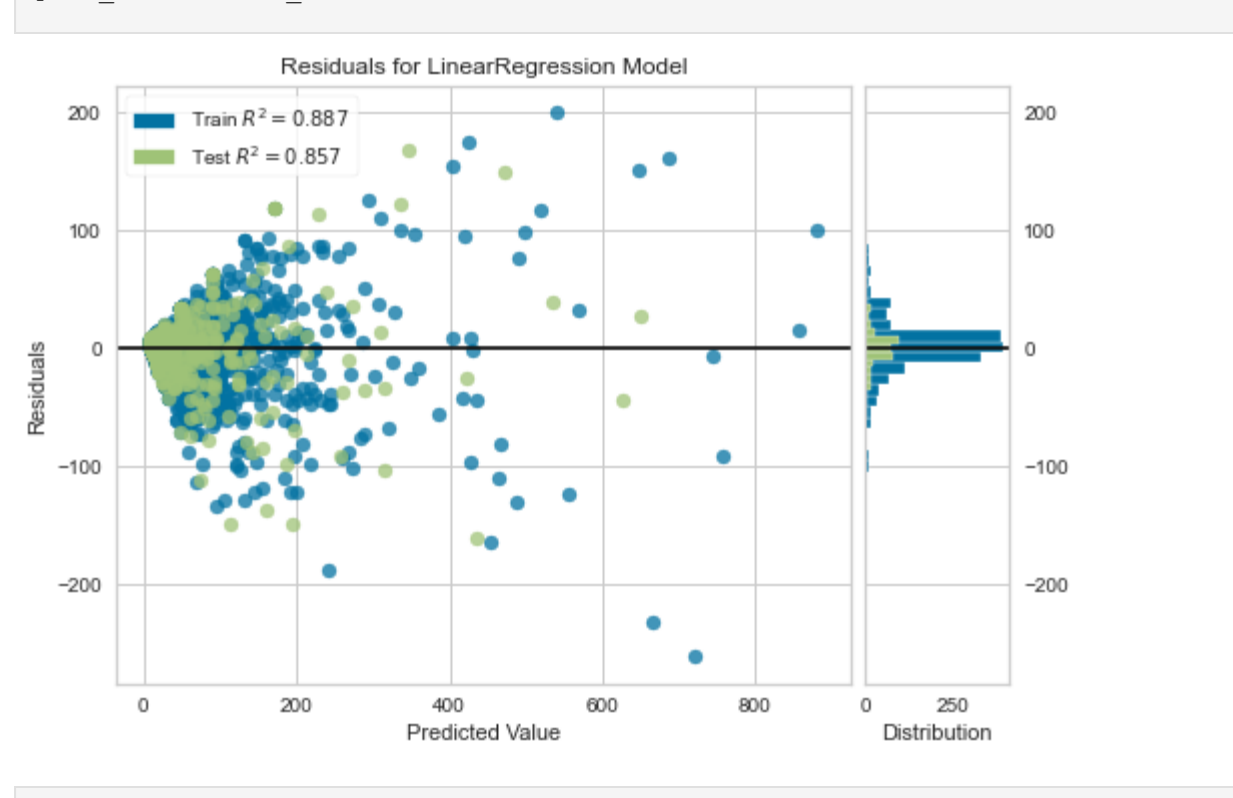
In [45]:
```
model_selected = create_model('lr')
```

	MAE	MSE	RMSE	R2	RMSLE	MAPE
0	15.1179	675.4857	25.9901	0.8989	0.4976	0.6126
1	18.1849	863.1987	29.3802	0.8657	0.4670	0.5386
2	20.6759	1448.6964	38.0617	0.8307	0.5069	0.6861
3	15.9946	710.1837	26.6493	0.8728	0.5201	0.6645
4	22.6746	1543.4596	39.2869	0.8911	0.4940	0.5404
5	15.8462	631.7058	25.1338	0.9371	0.4976	0.6352
6	15.3795	601.7423	24.5304	0.9108	0.5010	0.5899
7	17.3073	794.6956	28.1903	0.8642	0.5079	0.6291
8	19.0434	983.9913	31.3686	0.8548	0.5400	0.7465
9	17.8353	1130.3765	33.6211	0.8890	0.5376	0.6510
Mean	17.8060	938.3535	30.2212	0.8815	0.5070	0.6294
SD	2.3259	319.4285	5.0030	0.0288	0.0204	0.0606

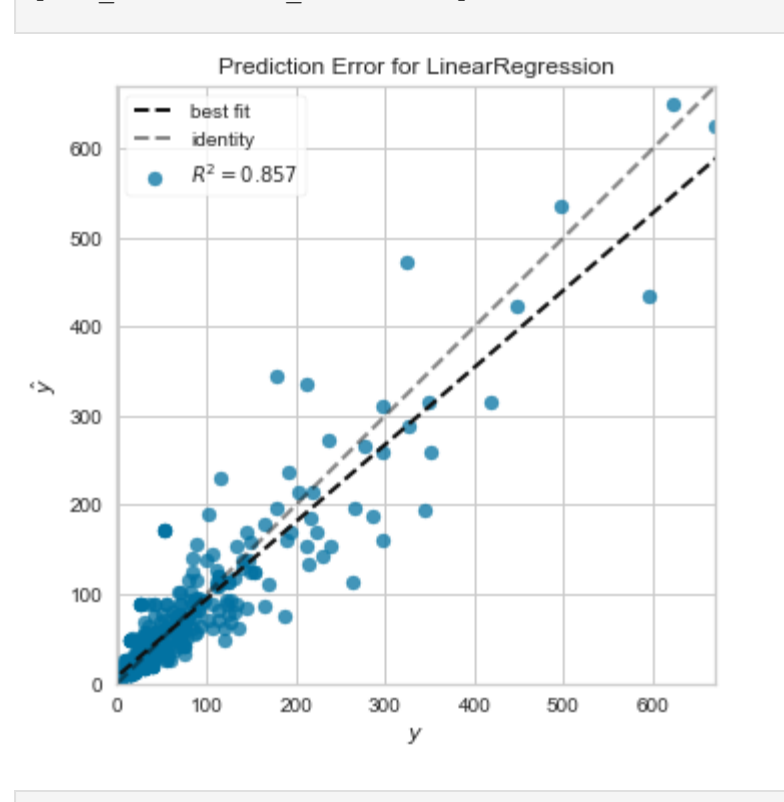
In [46]:
```
print(model_selected)
```

LinearRegression(copy_X=True, fit_intercept=True, n_jobs=-1, normalize=False)

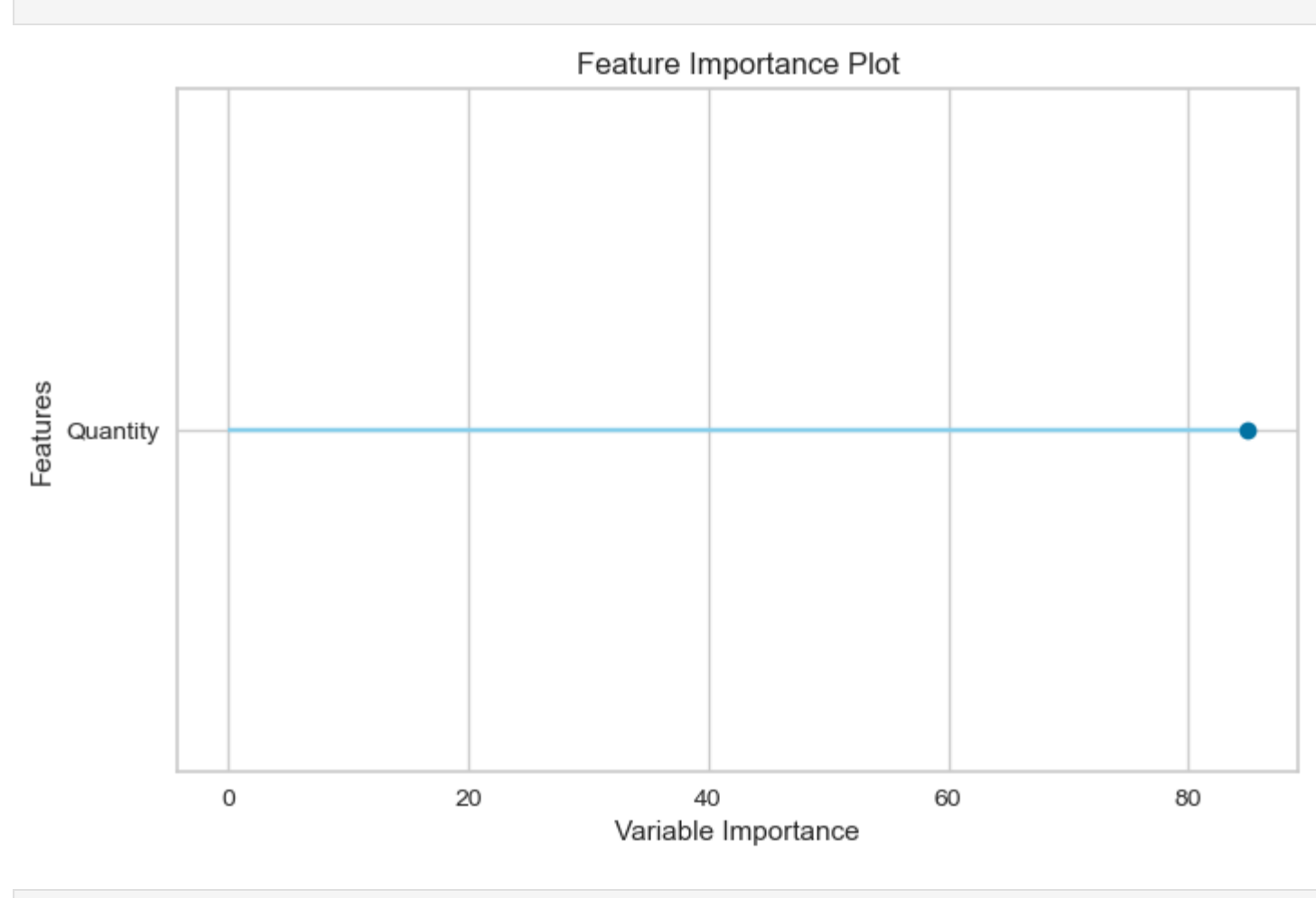
In [47]:
```
plot_model(model_selected)
```



In [48]:
```
plot_model(model_selected, plot = 'error')
```



In [49]:
```
plot_model(model_selected, plot='feature')
```



In [50]:
```
predict_model(model_selected)
```

	Model	MAE	MSE	RMSE	R2	RMSLE	MAPE
0	Linear Regression	19.0883	1077.0009	32.8177	0.8566	0.5374	0.7292

Out[50]:

	Quantity	TotalAmount	Label
0	1.51	102.40	189.45
1	-0.16	118.80	47.64
2	-0.61	9.90	9.59
3	0.73	154.50	123.73
4	0.85	214.20	134.11
...	...	...	...
421	-0.08	33.00	54.56
422	-0.51	34.65	18.24
423	1.59	266.40	196.37
424	-0.16	40.56	47.64
425	-0.33	27.04	33.81

426 rows × 3 columns

Python code done by Dennis Lam

In [ ]: