In [2]:
```python
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import pickle
from sklearn.preprocessing import StandardScaler, MinMaxScaler, OrdinalEncoder, PowerTransformer
from statsmodels.stats.outliers_influence import variance_inflation_factor
enc = OrdinalEncoder()
from sklearn.model_selection import train_test_split, GridSearchCV, cross_val_score, RandomizedSearchCV
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix, roc_curve, roc_auc_score
from sklearn import metrics

from sklearn.ensemble import RandomForestClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVR, SVC


import warnings
warnings.filterwarnings('ignore')
```

In [3]:
```python
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score, accuracy_score
from sklearn.linear_model import Ridge, Lasso, RidgeCV, LassoCV

from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import AdaBoostRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.svm import SVR
```

In [4]:
```python
df = pd.read_csv(r"C:\Users\Shrikant\OneDrive\Desktop\Black_Friday Project\blackFriday_train.csv")
df.tail(6)
```

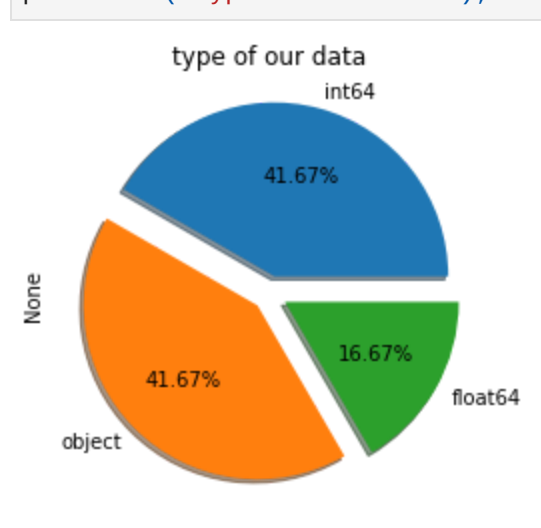
Out[4]:

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Product_Category_3	Purchase
550062	1006032	P00372445	M	46-50	7	A	3	0	20	NaN	NaN	473
550063	1006033	P00372445	M	51-55	13	B	1	1	20	NaN	NaN	368
550064	1006035	P00375436	F	26-35	1	C	3	0	20	NaN	NaN	371
550065	1006036	P00375436	F	26-35	15	B	4+	1	20	NaN	NaN	137
550066	1006038	P00375436	F	55+	1	C	2	0	20	NaN	NaN	365
550067	1006039	P00371644	F	46-50	0	B	4+	1	20	NaN	NaN	490

In [5]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 550068 entries, 0 to 550067
Data columns (total 12 columns):
 #   Column                      Non-Null Count   Dtype
---  ------                      --------------   -----
 0   User_ID                     550068 non-null  int64
 1   Product_ID                  550068 non-null  object
 2   Gender                      550068 non-null  object
 3   Age                         550068 non-null  object
 4   Occupation                  550068 non-null  int64
 5   City_Category               550068 non-null  object
 6   Stay_In_Current_City_Years  550068 non-null  object
 7   Marital_Status              550068 non-null  int64
 8   Product_Category_1          550068 non-null  int64
 9   Product_Category_2          376430 non-null  float64
 10  Product_Category_3          166821 non-null  float64
 11  Purchase                    550068 non-null  int64
dtypes: float64(2), int64(5), object(5)
memory usage: 50.4+ MB
```

In [6]:
```python
df.dtypes.value_counts().plot.pie(explode=[0.1,0.1,0.1],autopct='%1.2f%%',shadow=True)
plt.title('type of our data');
```



In [7]:
```python
for i in df.columns:
    a = df[i].isna().sum()
    if a > 0:
        print(i,'column has',a,'NaN values')
```

```
Product_Category_2 column has 173638 NaN values
Product_Category_3 column has 383247 NaN values
```

In [8]:
```python
for i in df.columns:
    a=df[i].value_counts()
    b=len(a.index)
    print(i,'column has',b,'categorical data counts\n')
```

```
User_ID column has 5891 categorical data counts

Product_ID column has 3631 categorical data counts

Gender column has 2 categorical data counts

Age column has 7 categorical data counts

Occupation column has 21 categorical data counts

City_Category column has 3 categorical data counts

Stay_In_Current_City_Years column has 5 categorical data counts

Marital_Status column has 2 categorical data counts

Product_Category_1 column has 20 categorical data counts

Product_Category_2 column has 17 categorical data counts

Product_Category_3 column has 15 categorical data counts

Purchase column has 18105 categorical data counts
```

In [9]:
```python
df.describe(include='all')
```

Out[9]:

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Product_Category_3	Purchas
count	5.500680e+05	550068	550068	550068	550068.000000	550068	550068	550068.000000	550068.000000	376430.000000	166821.000000	550068.0000
unique	NaN	3631	2	7	NaN	3	5	NaN	NaN	NaN	NaN	Na
top	NaN	P00265242	M	26-35	NaN	B	1	NaN	NaN	NaN	NaN	Na
freq	NaN	1880	414259	219587	NaN	231173	193821	NaN	NaN	NaN	NaN	Na
mean	1.003029e+06	NaN	NaN	NaN	8.076707	NaN	NaN	0.409653	5.404270	9.842329	12.668243	9263.9687
std	1.727592e+03	NaN	NaN	NaN	6.522660	NaN	NaN	0.491770	3.936211	5.086590	4.125338	5023.0653
min	1.000001e+06	NaN	NaN	NaN	0.000000	NaN	NaN	0.000000	1.000000	2.000000	3.000000	12.0000
25%	1.001516e+06	NaN	NaN	NaN	2.000000	NaN	NaN	0.000000	1.000000	5.000000	9.000000	5823.0000
50%	1.003077e+06	NaN	NaN	NaN	7.000000	NaN	NaN	0.000000	5.000000	9.000000	14.000000	8047.0000
75%	1.004478e+06	NaN	NaN	NaN	14.000000	NaN	NaN	1.000000	8.000000	15.000000	16.000000	12054.0000
max	1.006040e+06	NaN	NaN	NaN	20.000000	NaN	NaN	1.000000	20.000000	18.000000	18.000000	23961.0000

A basic observation is that:

Product P00265242 is the most popular product. Most of the transactions were made by men. Age group with most transactions was 26-35. City Category with most transactions was B

Their are lot amount of nan values present in columns (Product_Category_2 and Product_Category_3) need to replace it

In [10]:
```python
df
```

Out[10]:

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Product_Category_3	Purchase
0	1000001	P00069042	F	0-17	10	A	2	0	3	NaN	NaN	8370
1	1000001	P00248942	F	0-17	10	A	2	0	1	6.0	14.0	15200
2	1000001	P00087842	F	0-17	10	A	2	0	12	NaN	NaN	1422
3	1000001	P00085442	F	0-17	10	A	2	0	12	14.0	NaN	1057
4	1000002	P00285442	M	55+	16	C	4+	0	8	NaN	NaN	7969
...	...	...	...	...	...	...	...	...	...	...	...	...
550063	1006033	P00372445	M	51-55	13	B	1	1	20	NaN	NaN	368
550064	1006035	P00375436	F	26-35	1	C	3	0	20	NaN	NaN	371
550065	1006036	P00375436	F	26-35	15	B	4+	1	20	NaN	NaN	137
550066	1006038	P00375436	F	55+	1	C	2	0	20	NaN	NaN	365
550067	1006039	P00371644	F	46-50	0	B	4+	1	20	NaN	NaN	490

550068 rows × 12 columns

In [11]:
```python
df.Product_Category_2.value_counts()
```

Out[11]:
```
8.0     64088
14.0    55108
2.0     49217
16.0    43255
15.0    37855
5.0     26235
4.0     25677
6.0     16466
11.0    14134
17.0    13320
13.0    10531
9.0      5693
12.0     5528
10.0     3043
3.0      2884
18.0     2770
7.0       626
Name: Product_Category_2, dtype: int64
```

In [12]:
```python
#need to replace nan values
median = df['Product_Category_2'].median()
df['Product_Category_2'].fillna(median, inplace=True)
```

In [13]:
```python
df
```

Out[13]:

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Product_Category_3	Purchase
0	1000001	P00069042	F	0-17	10	A	2	0	3	9.0	NaN	8370
1	1000001	P00248942	F	0-17	10	A	2	0	1	6.0	14.0	15200
2	1000001	P00087842	F	0-17	10	A	2	0	12	9.0	NaN	1422
3	1000001	P00085442	F	0-17	10	A	2	0	12	14.0	NaN	1057
4	1000002	P00285442	M	55+	16	C	4+	0	8	9.0	NaN	7969
...	...	...	...	...	...	...	...	...	...	...	...	...
550063	1006033	P00372445	M	51-55	13	B	1	1	20	9.0	NaN	368
550064	1006035	P00375436	F	26-35	1	C	3	0	20	9.0	NaN	371
550065	1006036	P00375436	F	26-35	15	B	4+	1	20	9.0	NaN	137
550066	1006038	P00375436	F	55+	1	C	2	0	20	9.0	NaN	365
550067	1006039	P00371644	F	46-50	0	B	4+	1	20	9.0	NaN	490

550068 rows × 12 columns

In [14]:
```python
df.Product_Category_3.value_counts()
```

Out[14]:
```
16.0    32636
15.0    28013
14.0    18428
17.0    16702
5.0     16658
8.0     12562
9.0     11579
12.0     9246
13.0     5459
6.0      4890
18.0     4629
4.0      1875
11.0     1805
10.0     1726
3.0       613
Name: Product_Category_3, dtype: int64
```

we should drop Product_Category_3 because 68% values are missing

In [15]:
```python
df=df.drop('Product_Category_3',axis=1)
```

In [16]:
```python
df
```

Out[16]:

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Purchase
0	1000001	P00069042	F	0-17	10	A	2	0	3	9.0	8370
1	1000001	P00248942	F	0-17	10	A	2	0	1	6.0	15200
2	1000001	P00087842	F	0-17	10	A	2	0	12	9.0	1422
3	1000001	P00085442	F	0-17	10	A	2	0	12	14.0	1057
4	1000002	P00285442	M	55+	16	C	4+	0	8	9.0	7969
...	...	...	...	...	...	...	...	...	...	...	...
550063	1006033	P00372445	M	51-55	13	B	1	1	20	9.0	368
550064	1006035	P00375436	F	26-35	1	C	3	0	20	9.0	371
550065	1006036	P00375436	F	26-35	15	B	4+	1	20	9.0	137
550066	1006038	P00375436	F	55+	1	C	2	0	20	9.0	365
550067	1006039	P00371644	F	46-50	0	B	4+	1	20	9.0	490

550068 rows × 11 columns

In [17]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 550068 entries, 0 to 550067
Data columns (total 11 columns):
 #   Column                      Non-Null Count   Dtype
---  ------                      --------------   -----
 0   User_ID                     550068 non-null  int64
 1   Product_ID                  550068 non-null  object
 2   Gender                      550068 non-null  object
 3   Age                         550068 non-null  object
 4   Occupation                  550068 non-null  int64
 5   City_Category               550068 non-null  object
 6   Stay_In_Current_City_Years  550068 non-null  object
 7   Marital_Status              550068 non-null  int64
 8   Product_Category_1          550068 non-null  int64
 9   Product_Category_2          550068 non-null  float64
 10  Purchase                    550068 non-null  int64
dtypes: float64(1), int64(5), object(5)
memory usage: 46.2+ MB
```

All nan values have been replaced

we can drop user id and product id columns as it has no relation with target

In [18]:
```python
columns = []
for i in df.columns:
    if df[i].dtypes=='object':
        columns.append(i)
print('Below Columns have object datatype which needs to be converted to Int\n\n',columns)
```

```
Below Columns have object datatype which needs to be converted to Int

 ['Product_ID', 'Gender', 'Age', 'City_Category', 'Stay_In_Current_City_Years']
```

In [19]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 550068 entries, 0 to 550067
Data columns (total 11 columns):
 #   Column                      Non-Null Count   Dtype
---  ------                      --------------   -----
 0   User_ID                     550068 non-null  int64
 1   Product_ID                  550068 non-null  object
 2   Gender                      550068 non-null  object
 3   Age                         550068 non-null  object
 4   Occupation                  550068 non-null  int64
 5   City_Category               550068 non-null  object
 6   Stay_In_Current_City_Years  550068 non-null  object
 7   Marital_Status              550068 non-null  int64
 8   Product_Category_1          550068 non-null  int64
 9   Product_Category_2          550068 non-null  float64
 10  Purchase                    550068 non-null  int64
dtypes: float64(1), int64(5), object(5)
memory usage: 46.2+ MB
```

In [20]:
```python
df = df.drop(['Product_ID','User_ID'],axis=1)
```

In [21]:
```python
x = df.drop(['Purchase'],axis=1)
y = df['Purchase']
```

In [22]:
```python
df
```

Out[22]:

	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Purchase
0	F	0-17	10	A	2	0	3	9.0	8370
1	F	0-17	10	A	2	0	1	6.0	15200
2	F	0-17	10	A	2	0	12	9.0	1422
3	F	0-17	10	A	2	0	12	14.0	1057
4	M	55+	16	C	4+	0	8	9.0	7969
...	...	...	...	...	...	...	...	...	...
550063	M	51-55	13	B	1	1	20	9.0	368
550064	F	26-35	1	C	3	0	20	9.0	371
550065	F	26-35	15	B	4+	1	20	9.0	137
550066	F	55+	1	C	2	0	20	9.0	365
550067	F	46-50	0	B	4+	1	20	9.0	490

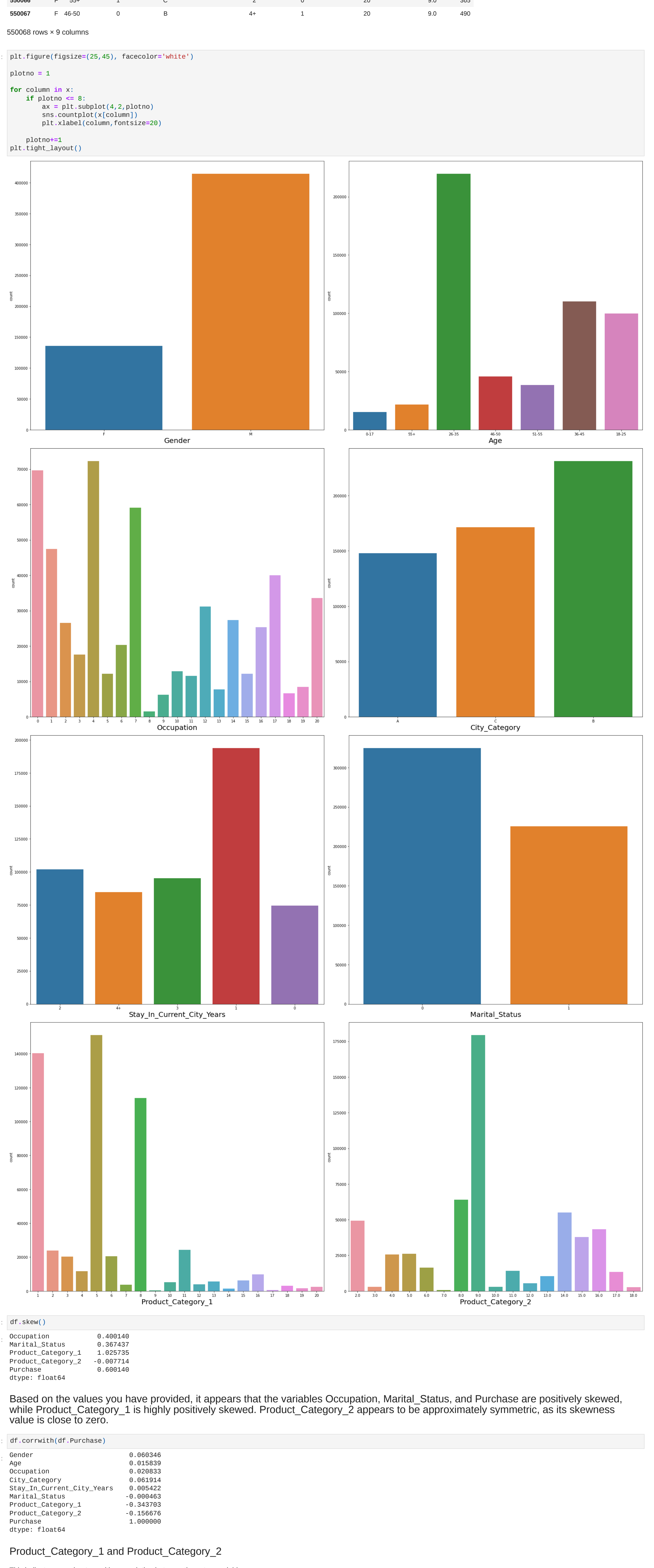
550068 rows × 9 columns

In [23]:
```python
plt.figure(figsize=(25,45), facecolor='white')

plotno = 1

for column in x:
    if plotno <= 8:
        ax = plt.subplot(4,2,plotno)
        sns.countplot(x[column])
        plt.xlabel(column,fontsize=20)

    plotno+=1
plt.tight_layout()
```



In [25]:
```python
df.skew()
```

Out[25]:
```
Occupation            0.400140
Marital_Status        0.367437
Product_Category_1    1.025735
Product_Category_2   -0.007714
Purchase              0.600140
dtype: float64
```

Based on the values you have provided, it appears that the variables Occupation, Marital_Status, and Purchase are positively skewed, while Product_Category_1 is highly positively skewed. Product_Category_2 appears to be approximately symmetric, as its skewness value is close to zero.

In [38]:
```python
df.corrwith(df.Purchase)
```

Out[38]:
```
Gender                        0.060346
Age                           0.015839
Occupation                    0.020833
City_Category                 0.061914
Stay_In_Current_City_Years    0.005422
Marital_Status               -0.000463
Product_Category_1           -0.343703
Product_Category_2           -0.156676
Purchase                      1.000000
dtype: float64
```

Product_Category_1 and Product_Category_2

This indicates a moderate positive correlation between these two variables.

In [39]:
```python
for i in df.columns:
    if df[i].dtypes=='object':
        df[i]=enc.fit_transform(df[i].values.reshape(-1,1))
```

In [41]:
```python
df
```

Out[41]:

	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_Category_2	Purchase
0	0.0	0.0	10	0.0	2.0	0	3	9.0	8370
1	0.0	0.0	10	0.0	2.0	0	1	6.0	15200
2	0.0	0.0	10	0.0	2.0	0	12	9.0	1422
3	0.0	0.0	10	0.0	2.0	0	12	14.0	1057
4	1.0	6.0	16	2.0	4.0	0	8	9.0	7969
...	...	...	...	...	...	...	...	...	...
550063	1.0	5.0	13	1.0	1.0	1	20	9.0	368
550064	0.0	2.0	1	2.0	3.0	0	20	9.0	371
550065	0.0	2.0	15	1.0	4.0	1	20	9.0	137
550066	0.0	6.0	1	2.0	2.0	0	20	9.0	365
550067	0.0	4.0	0	1.0	4.0	1	20	9.0	490

550068 rows × 9 columns

In [42]:
```python
plt.figure(figsize = (25,25))
sns.heatmap(df.corr(),annot=True, linewidths=0.5,linecolor='black',fmt = '.2f')
plt.show()
```