# Import Modules

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
%matplotlib inline
warnings.filterwarnings('ignore')
```

In [2]:
```
df = pd.read_csv('Black Friday Sales.csv')
```

In [3]:
```
# Descripotive analysis
```

In [4]:
```
df.head()
```

Out[4]:

|  | User_ID | Product_ID | Gender | Age | Occupation | City_Category | Stay_In_Current_City_Years | Marital_Status |
|---|---|---|---|---|---|---|---|---|
| **0** | 1000001 | P00069042 | F | 0-17 | 10 | A | 2 | 0 |
| **1** | 1000001 | P00248942 | F | 0-17 | 10 | A | 2 | 0 |
| **2** | 1000001 | P00087842 | F | 0-17 | 10 | A | 2 | 0 |
| **3** | 1000001 | P00085442 | F | 0-17 | 10 | A | 2 | 0 |
| **4** | 1000002 | P00285442 | M | 55+ | 16 | C | 4+ | 0 |

In [5]:
```
# Datatype info
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]:
```
# statistical info
df.describe()
```

Out[6]:

|  | User_ID | Occupation | Marital_Status | Product_Category_1 | Product_Category_2 | Product_Category |
|---|---|---|---|---|---|---|
| **count** | 5.500680e+05 | 550068.000000 | 550068.000000 | 550068.000000 | 376430.000000 | 166821.0000 |
| **mean** | 1.003029e+06 | 8.076707 | 0.409653 | 5.404270 | 9.842329 | 12.6682 |
| **std** | 1.727592e+03 | 6.522660 | 0.491770 | 3.936211 | 5.086590 | 4.1253 |
| **min** | 1.000001e+06 | 0.000000 | 0.000000 | 1.000000 | 2.000000 | 3.0000 |
| **25%** | 1.001516e+06 | 2.000000 | 0.000000 | 1.000000 | 5.000000 | 9.0000 |
| **50%** | 1.003077e+06 | 7.000000 | 0.000000 | 5.000000 | 9.000000 | 14.0000 |
| **75%** | 1.004478e+06 | 14.000000 | 1.000000 | 8.000000 | 15.000000 | 16.0000 |
| **max** | 1.006040e+06 | 20.000000 | 1.000000 | 20.000000 | 18.000000 | 18.0000 |

In [7]:

```
# Unique values
df.apply(lambda x: len(x.unique()))
```

Out[7]:

```
User_ID                       5891
Product_ID                    3631
Gender                           2
Age                              7
Occupation                      21
City_Category                    3
Stay_In_Current_City_Years       5
Marital_Status                   2
Product_Category_1              20
Product_Category_2              18
Product_Category_3              16
Purchase                     18105
dtype: int64
```

In [8]:

```
# Null values
df.isnull().sum()
```

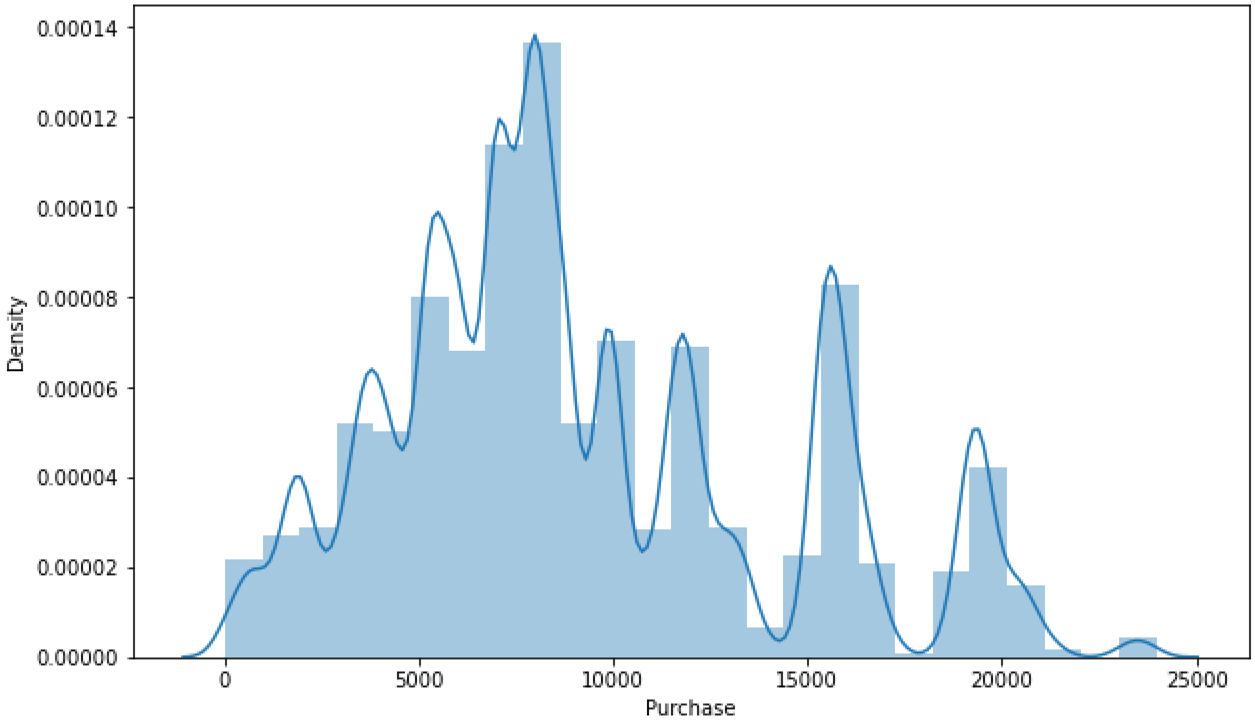
Out[8]:

```
User_ID                            0
Product_ID                         0
Gender                             0
Age                                0
Occupation                         0
City_Category                      0
Stay_In_Current_City_Years         0
Marital_Status                     0
Product_Category_1                 0
Product_Category_2            173638
Product_Category_3            383247
Purchase                           0
dtype: int64
```

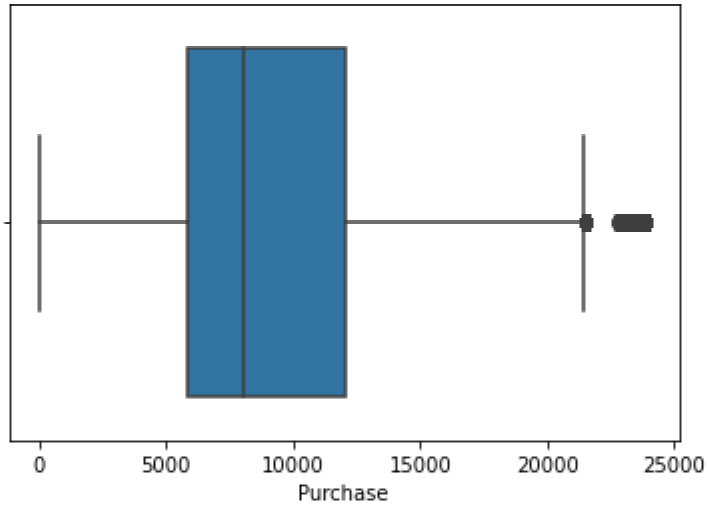
# Exploratory Data Ananalysis

In [9]:

```
plt.figure(figsize=(10,6))
sns.distplot(df['Purchase'] ,bins=25);
```

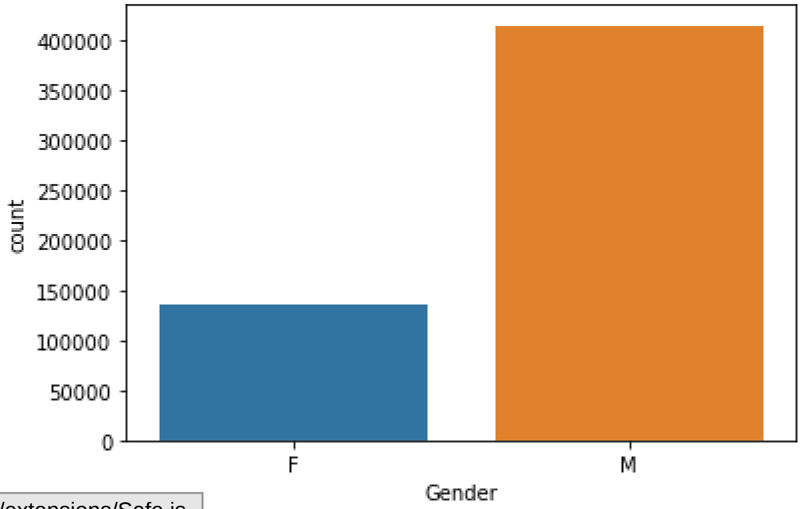


In [10]:
```
sns.boxplot(df['Purchase']);
```



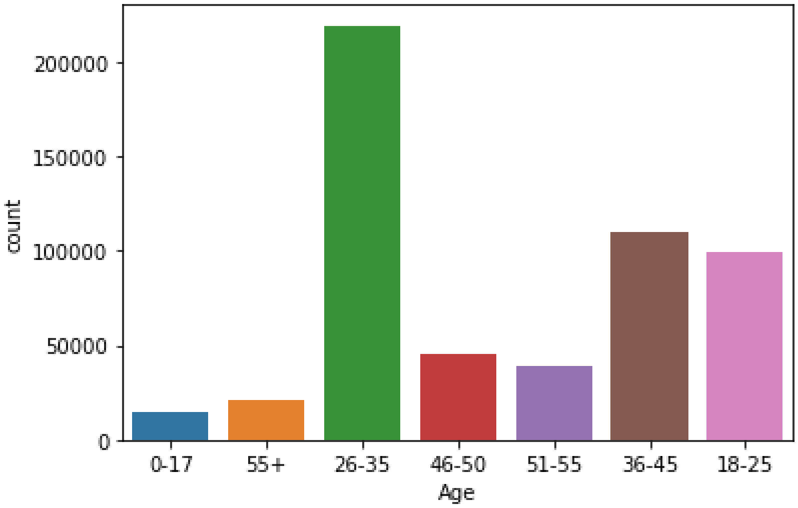
In [11]:
```
# We can see outliers in Purchase column
```

In [12]:
```
# dist of numeric variablres
sns.countplot(df.Gender);
```



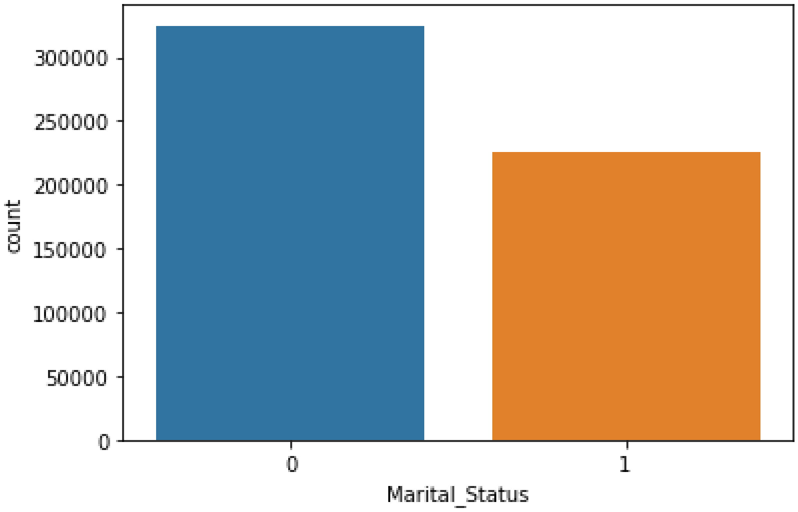
In [13]:

```
sns.countplot(df.Age);
```



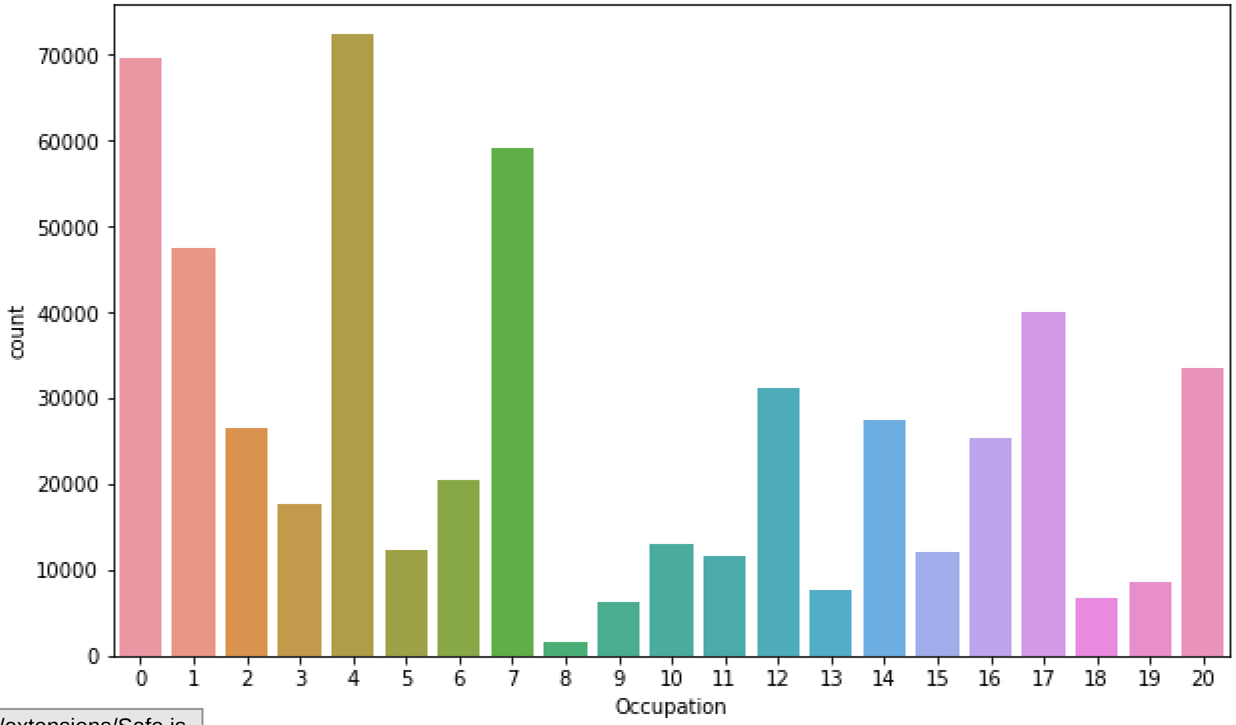
In [14]:

```
sns.countplot(df.Marital_Status);
```



In [15]:

```
plt.figure(figsize=(10,6))
sns.countplot(df.Occupation);
```



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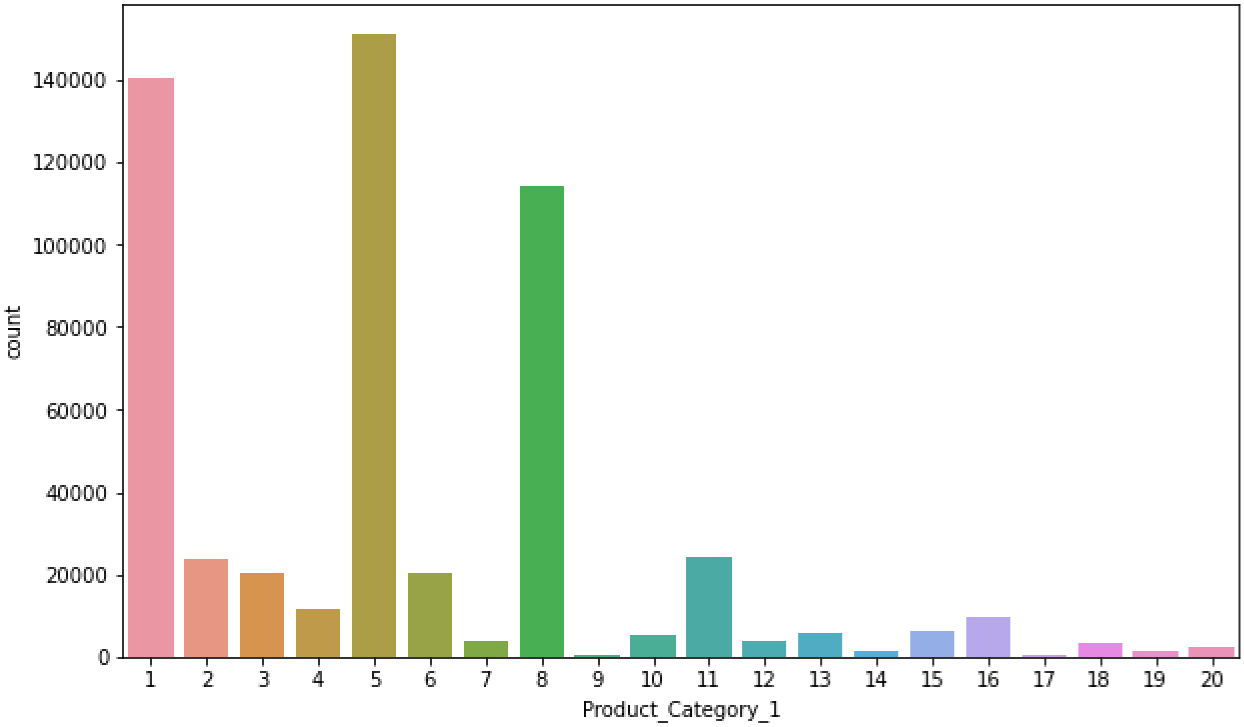
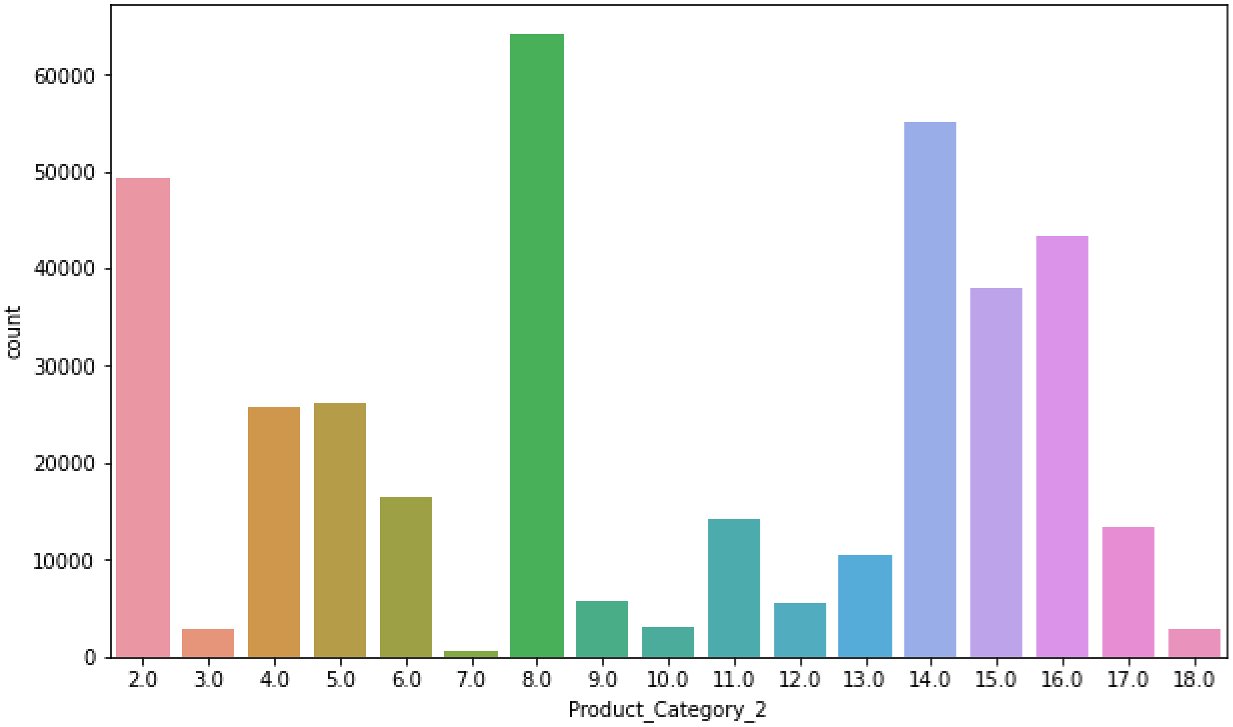
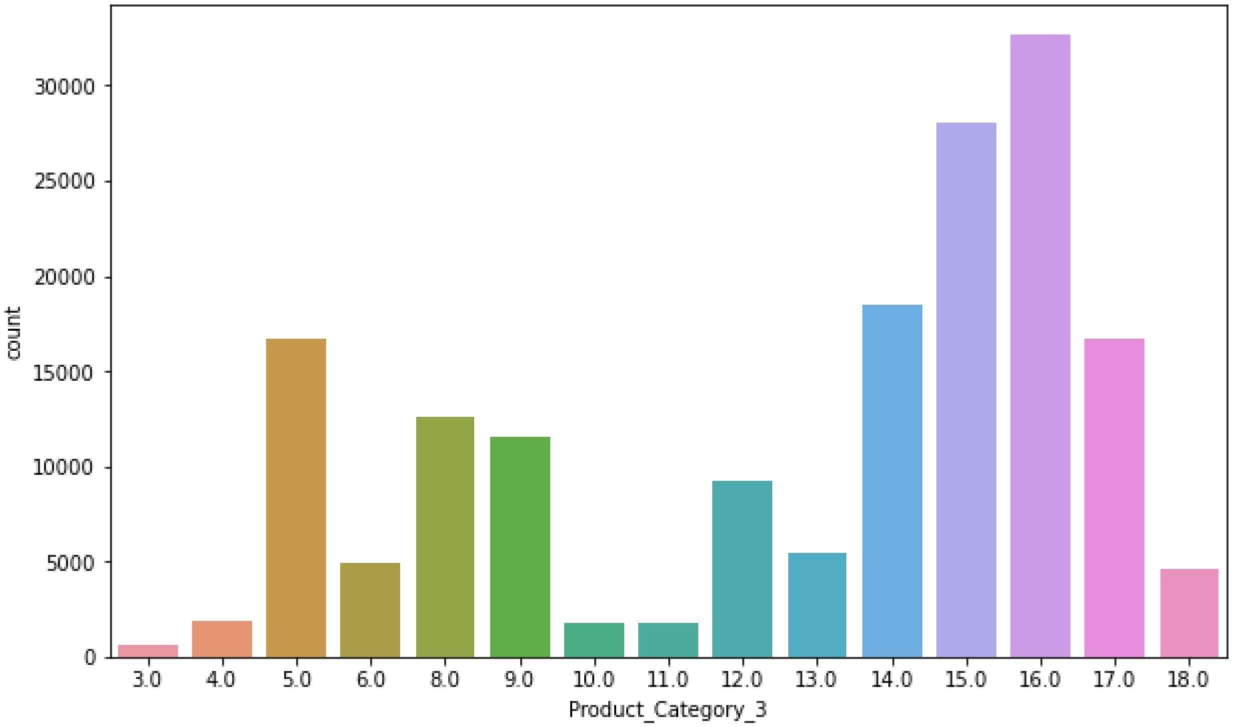
In [16]:
```
plt.figure(figsize=(10,6))
sns.countplot(df.Product_Category_1);
```



In [17]:
```
plt.figure(figsize=(10,6))
sns.countplot(df.Product_Category_2);
```

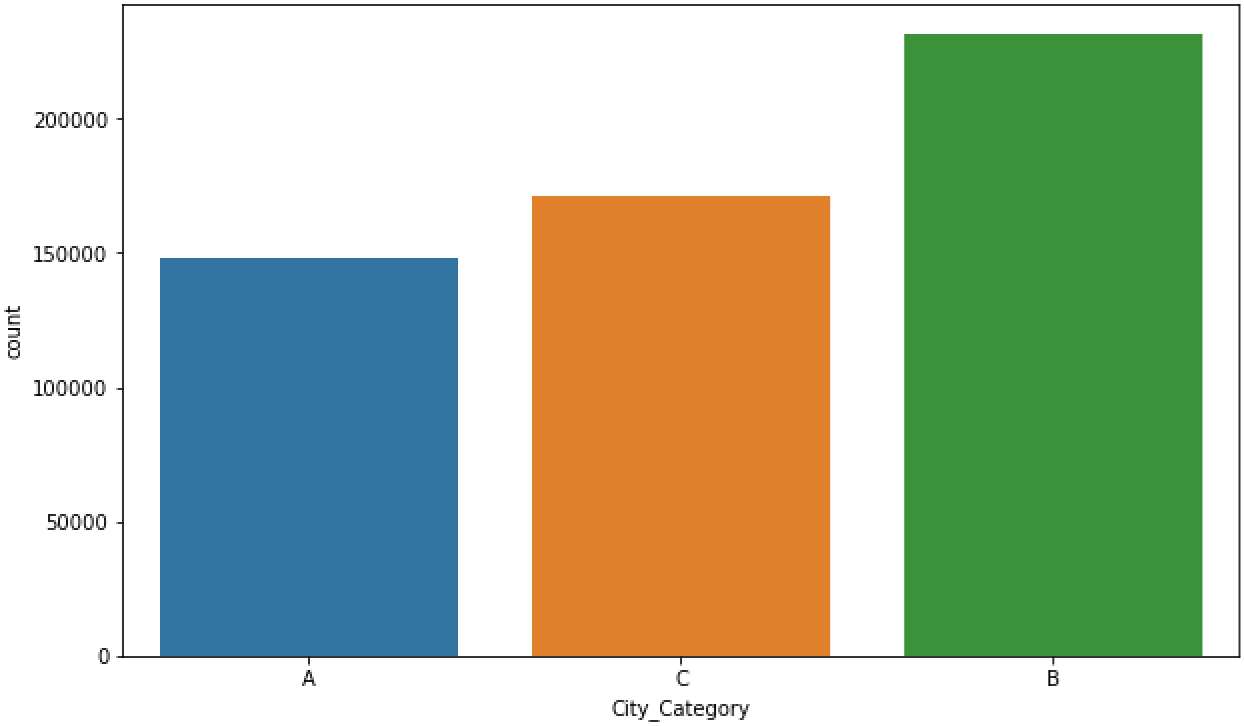


In [18]:
```
plt.figure(figsize=(10,6))
sns.countplot(df.Product_Category_3);
```



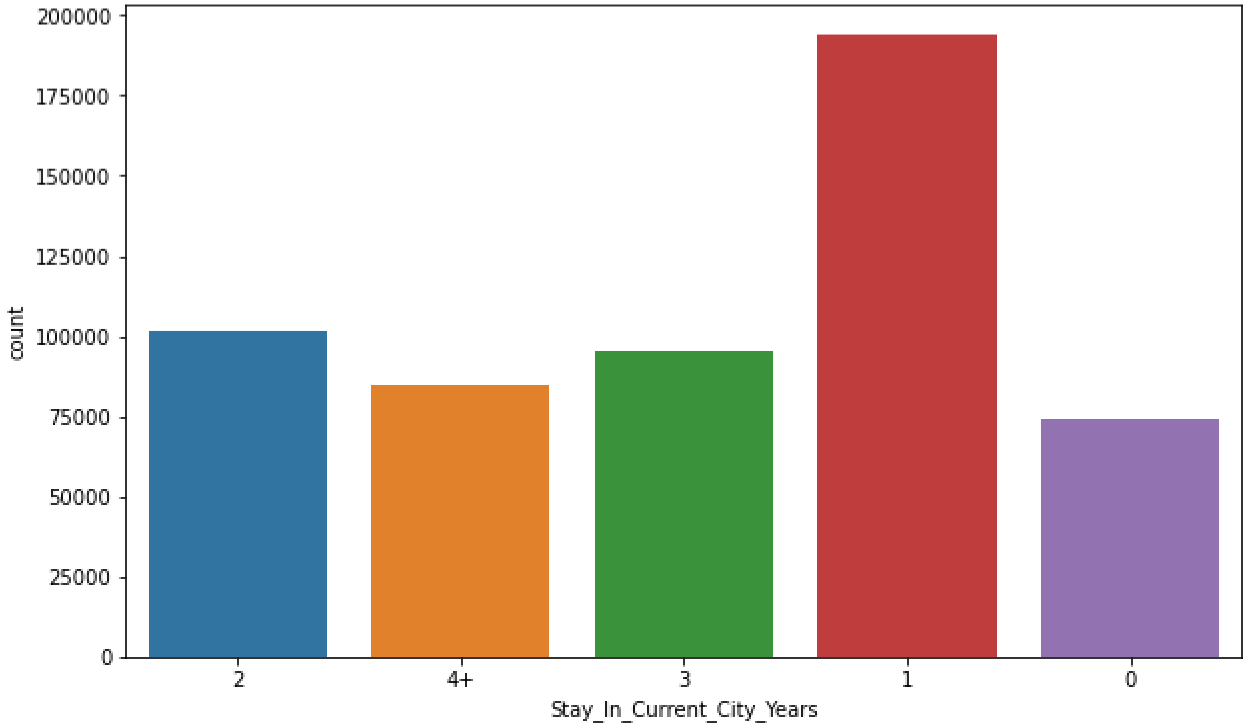
In [19]:

```
plt.figure(figsize=(10,6))
sns.countplot(df.City_Category);
```

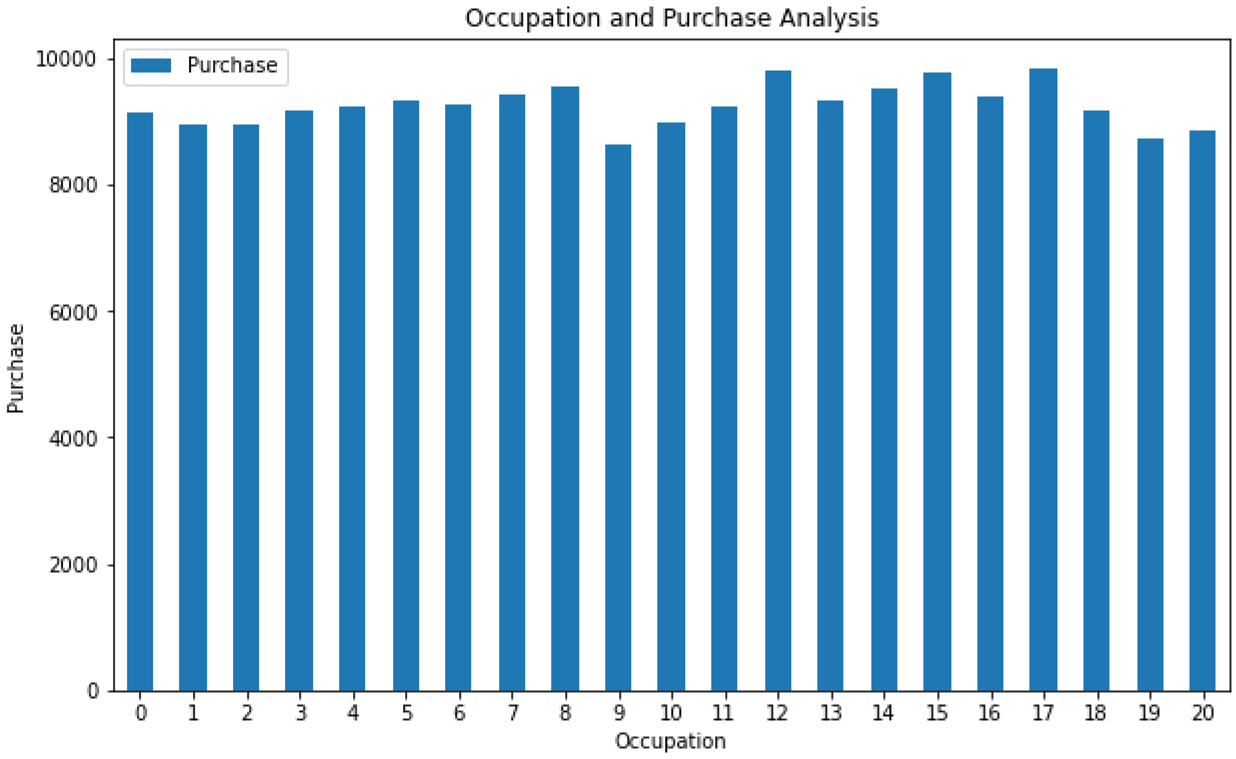


In [20]:

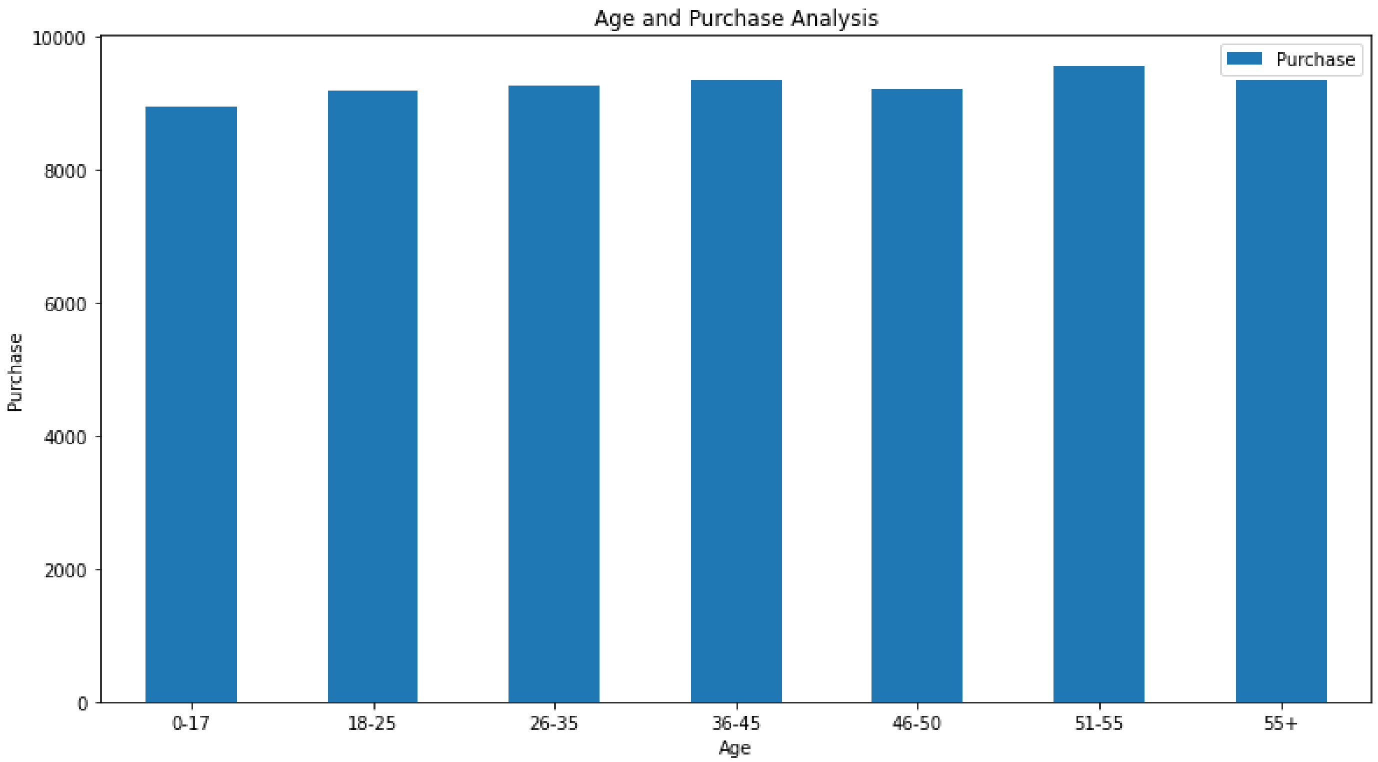
```
plt.figure(figsize=(10,6))
sns.countplot(df.Stay_In_Current_City_Years);
```



In [21]:
```
# Bivariate analysis
occupation_plot = df.pivot_table(index='Occupation', values='Purchase', aggfunc=np.mean)
occupation_plot.plot(kind='bar', figsize=(10, 6))
plt.xlabel('Occupation')
plt.ylabel("Purchase")
plt.title("Occupation and Purchase Analysis")
plt.xticks(rotation=0)
plt.show()
```

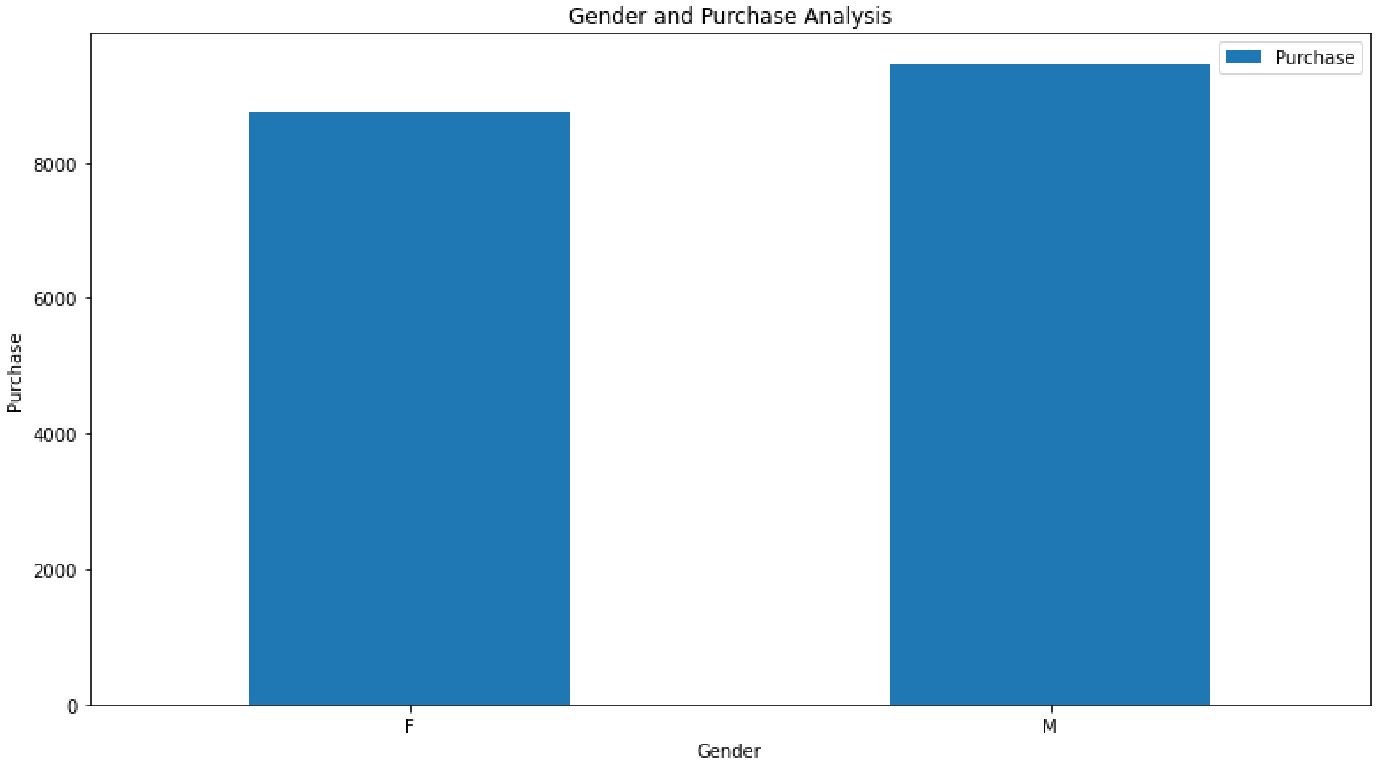


In [22]:
```
age_plot = df.pivot_table(index='Age', values='Purchase', aggfunc=np.mean)
age_plot.plot(kind='bar', figsize=(13, 7))
plt.xlabel('Age')
plt.ylabel("Purchase")
plt.title("Age and Purchase Analysis")
plt.xticks(rotation=0)
```



In [23]:

```
gender_plot = df.pivot_table(index='Gender', values='Purchase', aggfunc=np.mean)
gender_plot.plot(kind='bar', figsize=(13, 7))
plt.xlabel('Gender')
plt.ylabel("Purchase")
plt.title("Gender and Purchase Analysis")
plt.xticks(rotation=0)
plt.show()
```



In [24]:

```
df.head()
```

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Out[24]:

| | User_ID | Product_ID | Gender | Age | Occupation | City_Category | Stay_In_Current_City_Years | Marital_Status |
|---|---|---|---|---|---|---|---|---|
| **0** | 1000001 | P00069042 | F | 0-17 | 10 | A | 2 | 0 |
| **1** | 1000001 | P00248942 | F | 0-17 | 10 | A | 2 | 0 |
| **2** | 1000001 | P00087842 | F | 0-17 | 10 | A | 2 | 0 |
| **3** | 1000001 | P00085442 | F | 0-17 | 10 | A | 2 | 0 |
| **4** | 1000002 | P00285442 | M | 55+ | 16 | C | 4+ | 0 |

# Preprocessing the Dataset

In [25]:

```
df.isnull().sum()
```

Out[25]:

```
User_ID                            0
Product_ID                         0
Gender                             0
Age                                0
Occupation                         0
City_Category                      0
Stay_In_Current_City_Years         0
Marital_Status                     0
Product_Category_1                 0
Product_Category_2            173638
Product_Category_3            383247
Purchase                           0
dtype: int64
```

In [26]:

```
for i in df.columns:
    print(i," = " ,len(df[i].unique()))
```

```
User_ID  =  5891
Product_ID  =  3631
Gender  =  2
Age  =  7
Occupation  =  21
City_Category  =  3
Stay_In_Current_City_Years  =  5
Marital_Status  =  2
Product_Category_1  =  20
Product_Category_2  =  18
Product_Category_3  =  16
Purchase  =  18105
```

In [27]:

```
# Remove outliers using IQR technique
```

In [28]:

```
cols = ['Purchase']

Q1 = df[cols].quantile(0.25)
Q3 = df[cols].quantile(0.75)
IQR = Q3 - Q1

df = df[~((df[cols] < (Q1 - 1.5 * IQR)) |(df[cols] > (Q3 + 1.5 * IQR))).any(axis=1)]
```

In [ ]:

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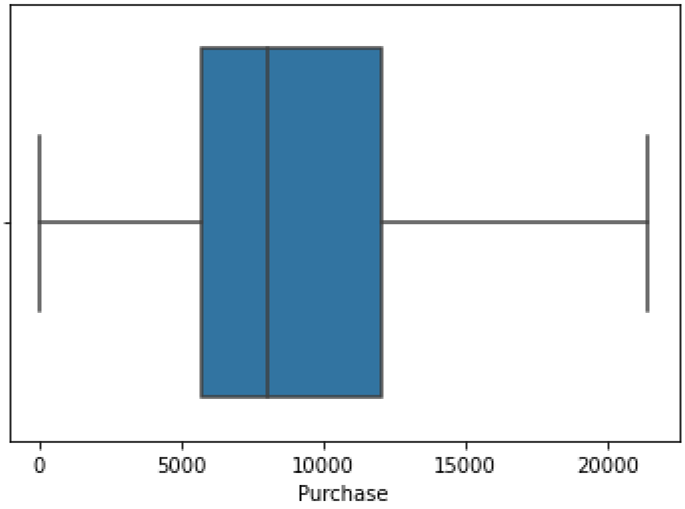
In [29]:

```
sns.boxplot(df['Purchase']);
```



In [30]:

```
# Droping columns
```

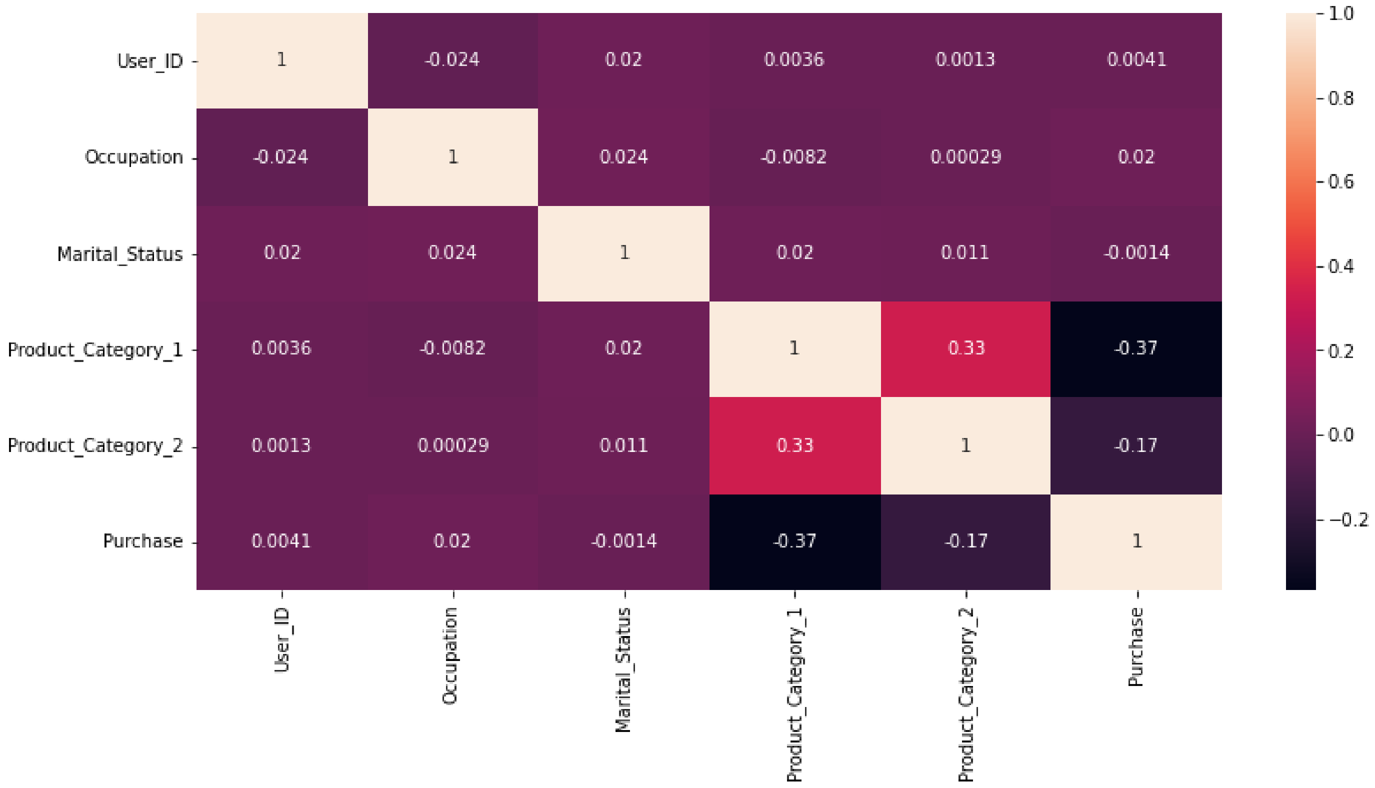
In [31]:

```
df['Product_Category_2'] = df['Product_Category_2'].fillna((df['Product_Category_2']).me
df.drop(['Product_Category_3'], axis=1, inplace=True)
```

# Corealtion Matrix

In [32]:

```
corr = df.corr()
plt.figure(figsize=(13,6))
sns.heatmap(corr, annot=True);
```



In [33]:

```
# df_Gender = pd.get_dummies(train['Gender'])
# df_Age = pd.get_dummies(train['Age'])
# df_City_Category = pd.get_dummies(train['City_Category'])
# df_Stay_In_Current_City_Years = pd.get_dummies(train['Stay_In_Current_City_Years'])
# data_final= pd.concat([train, df_Gender, df_Age, df_City_Category, df_Stay_In_Current_

# data_final.head()
```

In [34]:

```
# from sklearn.preprocessing import LabelEncoder
# LE= LabelEncoder()
```

In [35]:

```
# df['Gender'] = LE.fit_transform(df['Gender'])
# df['Age'] = LE.fit_transform(df['Age'])
# df['City_Category'] = LE.fit_transform(df['City_Category'])
# df['Stay_In_Current_City_Years'] = LE.fit_transform(df['Stay_In_Current_City_Years'])
```

In [36]:

```
df= pd.get_dummies(df, columns = ['Gender', 'Age','City_Category','Stay_In_Current_City_
```

In [37]:

```
df.head()
```

Out[37]:

| | User_ID | Product_ID | Marital_Status | Purchase | Gender_F | Gender_M | Age_0-17 | Age_18-25 | Age_26-35 | Age_36-45 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1000001 | P00069042 | 0 | 8370 | 1 | 0 | 1 | 0 | 0 | 0 |
| **1** | 1000001 | P00248942 | 0 | 15200 | 1 | 0 | 1 | 0 | 0 | 0 |
| **2** | 1000001 | P00087842 | 0 | 1422 | 1 | 0 | 1 | 0 | 0 | 0 |
| **3** | 1000001 | P00085442 | 0 | 1057 | 1 | 0 | 1 | 0 | 0 | 0 |
| **4** | 1000002 | P00285442 | 0 | 7969 | 0 | 1 | 0 | 0 | 0 | 0 |

5 rows × 79 columns

# Input Split

In [38]:

```
df.head()
```

Out[38]:

| | User_ID | Product_ID | Marital_Status | Purchase | Gender_F | Gender_M | Age_0-17 | Age_18-25 | Age_26-35 | Age_36-45 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1000001 | P00069042 | 0 | 8370 | 1 | 0 | 1 | 0 | 0 | 0 |
| **1** | 1000001 | P00248942 | 0 | 15200 | 1 | 0 | 1 | 0 | 0 | 0 |
| **2** | 1000001 | P00087842 | 0 | 1422 | 1 | 0 | 1 | 0 | 0 | 0 |
| **3** | 1000001 | P00085442 | 0 | 1057 | 1 | 0 | 1 | 0 | 0 | 0 |
| **4** | 1000002 | P00285442 | 0 | 7969 | 0 | 1 | 0 | 0 | 0 | 0 |

5 rows × 79 columns

In [39]:

```
X = df.drop(columns=['User_ID', 'Product_ID', 'Purchase'])
y = df['Purchase']
X.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 547391 entries, 0 to 550067
Data columns (total 76 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   Marital_Status                  547391 non-null  int64
 1   Gender_F                        547391 non-null  uint8
 2   Gender_M                        547391 non-null  uint8
 3   Age_0-17                        547391 non-null  uint8
 4   Age_18-25                       547391 non-null  uint8
 5   Age_26-35                       547391 non-null  uint8
 6   Age_36-45                       547391 non-null  uint8
 7   Age_46-50                       547391 non-null  uint8
 8   Age_51-55                       547391 non-null  uint8
 9   Age_55+                         547391 non-null  uint8
 10  City_Category_A                 547391 non-null  uint8
 11  City_Category_B                 547391 non-null  uint8
 12  City_Category_C                 547391 non-null  uint8
 13  Stay_In_Current_City_Years_0    547391 non-null  uint8
 14  Stay_In_Current_City_Years_1    547391 non-null  uint8
 15  Stay_In_Current_City_Years_2    547391 non-null  uint8
 16  Stay_In_Current_City_Years_3    547391 non-null  uint8
 17  Stay_In_Current_City_Years_4+   547391 non-null  uint8
 18  Occupation_0                    547391 non-null  uint8
 19  Occupation_1                    547391 non-null  uint8
 20  Occupation_2                    547391 non-null  uint8
 21  Occupation_3                    547391 non-null  uint8
 22  Occupation_4                    547391 non-null  uint8
 23  Occupation_5                    547391 non-null  uint8
 24  Occupation_6                    547391 non-null  uint8
 25  Occupation_7                    547391 non-null  uint8
 26  Occupation_8                    547391 non-null  uint8
 27  Occupation_9                    547391 non-null  uint8
 28  Occupation_10                   547391 non-null  uint8
 29  Occupation_11                   547391 non-null  uint8
 30  Occupation_12                   547391 non-null  uint8
 31  Occupation_13                   547391 non-null  uint8
 32  Occupation_14                   547391 non-null  uint8
 33  Occupation_15                   547391 non-null  uint8
 34  Occupation_16                   547391 non-null  uint8
 35  Occupation_17                   547391 non-null  uint8
 36  Occupation_18                   547391 non-null  uint8
 37  Occupation_19                   547391 non-null  uint8
 38  Occupation_20                   547391 non-null  uint8
 39  Product_Category_1_1            547391 non-null  uint8
 40  Product_Category_1_2            547391 non-null  uint8
 41  Product_Category_1_3            547391 non-null  uint8
 42  Product_Category_1_4            547391 non-null  uint8
 43  Product_Category_1_5            547391 non-null  uint8
 44  Product_Category_1_6            547391 non-null  uint8
 45  Product_Category_1_7            547391 non-null  uint8
 46  Product_Category_1_8            547391 non-null  uint8
 47  Product_Category_1_9            547391 non-null  uint8
 48  Product_Category_1_10           547391 non-null  uint8
 49  Product_Category_1_11           547391 non-null  uint8
 50  Product_Category_1_12           547391 non-null  uint8
 51  Product_Category_1_13           547391 non-null  uint8
 52  Product_Category_1_14           547391 non-null  uint8
 53  Product_Category_1_15           547391 non-null  uint8
 54  Product_Category_1_16           547391 non-null  uint8
 55  Product_Category_1_17           547391 non-null  uint8
 56  Product_Category_1_18           547391 non-null  uint8
 57  Product_Category_1_19           547391 non-null  uint8
 58  Product_Category_1_20           547391 non-null  uint8
```

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```
 59  Product_Category_2_2          547391 non-null  uint8
 60  Product_Category_2_3          547391 non-null  uint8
 61  Product_Category_2_4          547391 non-null  uint8
 62  Product_Category_2_5          547391 non-null  uint8
 63  Product_Category_2_6          547391 non-null  uint8
 64  Product_Category_2_7          547391 non-null  uint8
 65  Product_Category_2_8          547391 non-null  uint8
 66  Product_Category_2_9          547391 non-null  uint8
 67  Product_Category_2_10         547391 non-null  uint8
 68  Product_Category_2_11         547391 non-null  uint8
 69  Product_Category_2_12         547391 non-null  uint8
 70  Product_Category_2_13         547391 non-null  uint8
 71  Product_Category_2_14         547391 non-null  uint8
 72  Product_Category_2_15         547391 non-null  uint8
 73  Product_Category_2_16         547391 non-null  uint8
 74  Product_Category_2_17         547391 non-null  uint8
 75  Product_Category_2_18         547391 non-null  uint8
dtypes: int64(1), uint8(75)
memory usage: 47.5 MB
```

In [40]:

```
X.head()
```

Out[40]:

|  | Marital_Status | Gender_F | Gender_M | Age_0-17 | Age_18-25 | Age_26-35 | Age_36-45 | Age_46-50 | Age_51-55 | Age_55+ | ... |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | ... |
| **1** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | ... |
| **2** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | ... |
| **3** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | ... |
| **4** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | ... |

5 rows × 76 columns

In [ ]:

In [41]:

```
from sklearn.model_selection import train_test_split

X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.30,random_state=42)
```

In [42]:

```
print(X.shape)
print(y.shape)
print(X_train.shape)
print(y_train.shape)
print(X_test.shape)
print(y_test.shape)
```

```
(547391, 76)
(547391,)
(383173, 76)
(383173,)
(164218, 76)
(164218,)
```

In [43]:

```
from sklearn.preprocessing import StandardScaler
ss = StandardScaler()
X_train = ss.fit_transform(X_train)
X_test = ss.transform(X_test)
```

In [44]:

```
print(X.shape)
print(y.shape)
```

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```
print(X_train.shape)
print(y_train.shape)
print(X_test.shape)
print(y_test.shape)
```

```
(547391, 76)
(547391,)
(383173, 76)
(383173,)
(164218, 76)
(164218,)
```

In [45]:

```
# Training Model selection
```

In [46]:

```
from sklearn.linear_model import LinearRegression
LR=LinearRegression()
```

In [47]:

```
LR.fit(X_train,y_train)
```

Out[47]:

```
LinearRegression()
```

In [48]:

```
y_pred=LR.predict(X_test)
```

In [49]:

```
y_pred
```

Out[49]:

```
array([11073.22265906, 13913.72265906,  7403.22265906, ...,
        7768.22265906,  5842.22265906,  7215.22265906])
```

In [50]:

```
from sklearn.metrics import r2_score,mean_absolute_error,mean_squared_error
```

In [51]:

```
R2_score = r2_score(y_test,y_pred)
```

In [52]:

```
print("training score = ",LR.score(X_train, y_train))
print("Testing score = ",LR.score(X_test, y_test))
print("Mean Absolute error =",mean_absolute_error(y_test,y_pred))
print("Mean Squared error =",mean_squared_error(y_test,y_pred))
print("Root Mean Squared error=",np.sqrt(mean_squared_error(y_test,y_pred)))
print("R2score = " ,R2_score)
```

```
training score =  0.6347153750403496
Testing score =  0.6350016170765882
Mean Absolute error = 2260.2782310954826
Mean Squared error = 8934811.918436665
Root Mean Squared error= 2989.1155746201357
R2score =  0.6350016170765882
```

In [53]:

```
from sklearn.linear_model import Lasso
lasso = Lasso(alpha =0.0001)
lasso.fit(X_train, y_train)
y_pred = lasso.predict(X_test)
```

In [54]:

```
print("training score =", lasso.score(X_train, y_train))
print("Testing score =", lasso.score(X_test, y_test))
print("Mean Absolute error =",mean_absolute_error(y_test,y_pred))
print("Mean Squared error =",mean_squared_error(y_test,y_pred))
print("Root Mean Squared error=",np.sqrt(mean_squared_error(y_test,y_pred)))
print("R2score = " ,R2_score)
```

```
training score = 0.6347213760940762
Testing score = 0.6350018580884018
Mean Absolute error = 2260.399604181418
Mean Squared error = 8934806.018697584
Root Mean Squared error= 2989.1145877496206
R2score =  0.6350016170765882
```

In [55]:

```
from sklearn.linear_model import Ridge
Ridge = Ridge(alpha = 0.01)
Ridge.fit(X_train,y_train)
y_pred = Ridge.predict(X_test)
```

In [56]:

```
print("training score =", Ridge.score(X_train, y_train))
print("Testing score =", Ridge.score(X_test, y_test))
print("Mean Absolute error =",mean_absolute_error(y_test,y_pred))
print("Mean Squared error =",mean_squared_error(y_test,y_pred))
print("Root Mean Squared error=",np.sqrt(mean_squared_error(y_test,y_pred)))
print("R2score = " ,R2_score)
```

```
training score = 0.6347213760941086
Testing score = 0.635001857336509
Mean Absolute error = 2260.3995908922634
Mean Squared error = 8934806.037103202
Root Mean Squared error= 2989.1145908283947
R2score =  0.6350016170765882
```

In [57]:

```
from sklearn.ensemble import RandomForestRegressor
rf=RandomForestRegressor()
rf.fit(X_train,y_train)
```

Out[57]:

```
RandomForestRegressor()
```

In [58]:

```
print("training score =", rf.score(X_train, y_train))
print("Testing score =", rf.score(X_test, y_test))
print("Mean Absolute error =",mean_absolute_error(y_test,y_pred))
print("Mean Squared error =",mean_squared_error(y_test,y_pred))
print("Root Mean Squared error=",np.sqrt(mean_squared_error(y_test,y_pred)))
print("R2score = " ,R2_score)
```

```
training score = 0.7387019904768657
Testing score = 0.6314162482497752
Mean Absolute error = 2260.3995908922634
Mean Squared error = 8934806.037103202
Root Mean Squared error= 2989.1145908283947
R2score =  0.6350016170765882
```

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