IMPORTING LIBRARIES

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
```

```
df = pd.read_csv('/content/drive/MyDrive/Shopping dataset/superstore_data.csv')
df.head()
```

	Id	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	...	MntFish
0	1826	1970	Graduation	Divorced	84835.0	0	0	6/16/2014	0	189	...	
1	1	1961	Graduation	Single	57091.0	0	0	6/15/2014	0	464	...	
2	10476	1958	Graduation	Married	67267.0	0	1	5/13/2014	0	134	...	
3	1386	1967	Graduation	Together	32474.0	1	1	11/5/2014	0	10	...	
4	5371	1989	Graduation	Single	21474.0	1	0	8/4/2014	0	6	...	

5 rows × 22 columns

DATA PREPROCESSING

```
df.drop(columns='Id', inplace=True)
df.head()
```

	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	MntFruits	...	Mnt
0	1970	Graduation	Divorced	84835.0	0	0	6/16/2014	0	189	104	...	
1	1961	Graduation	Single	57091.0	0	0	6/15/2014	0	464	5	...	
2	1958	Graduation	Married	67267.0	0	1	5/13/2014	0	134	11	...	
3	1967	Graduation	Together	32474.0	1	1	11/5/2014	0	10	0	...	
4	1989	Graduation	Single	21474.0	1	0	8/4/2014	0	6	16	...	

5 rows × 21 columns

```
#Checking for the number of unique value from all of the object datatype
df.select_dtypes(include='object').nunique()
```

```
Education           5
Marital_Status      8
Dt_Customer       663
dtype: int64
```

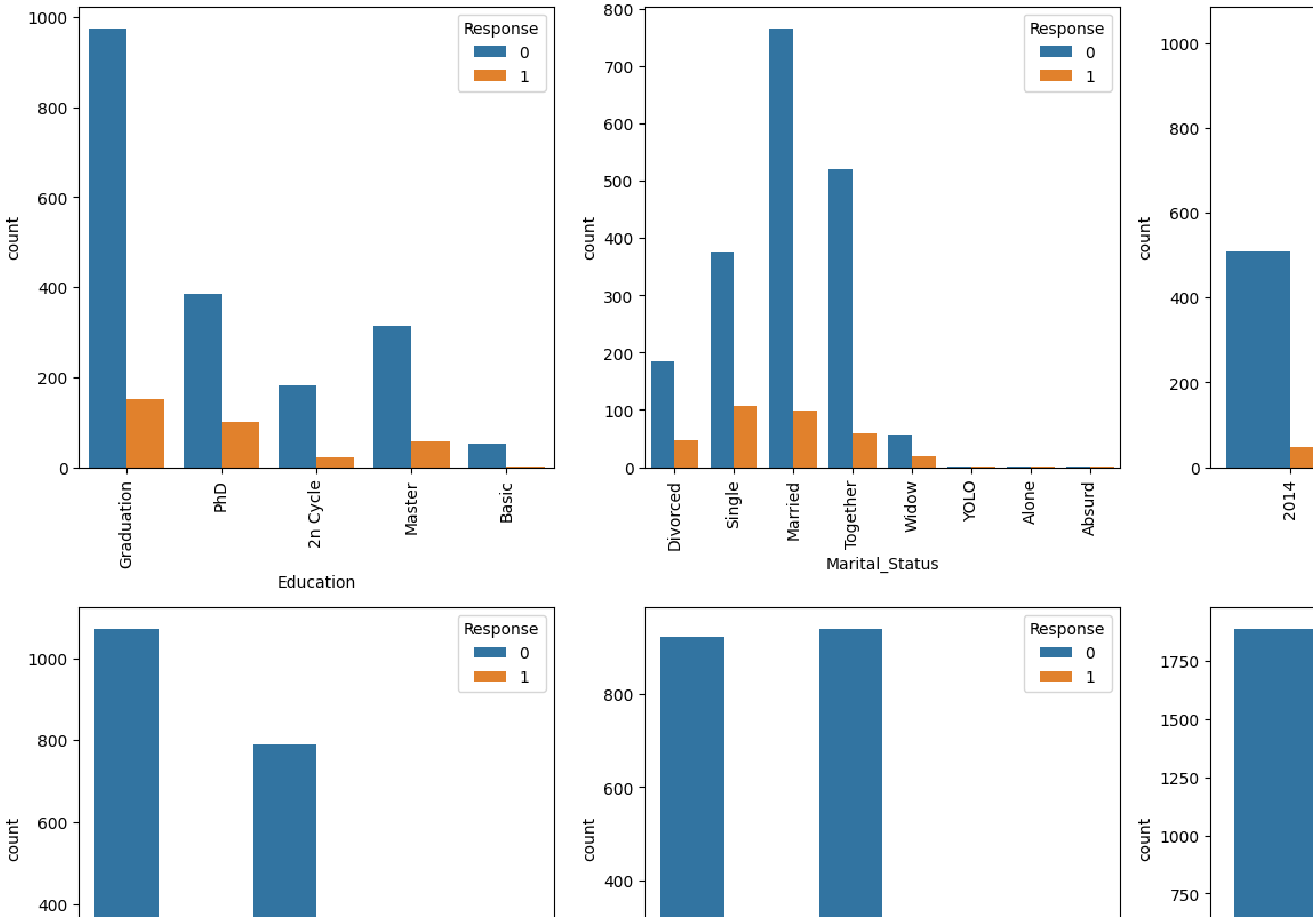
```
# Extract the last four digits from the date when the customer got enrolled with the company ie 'Dt_Customer' column
df['Dt_Customer'] = df['Dt_Customer'].str[-4:]
df.head()
```

	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	MntFruits	...	Mnt
0	1970	Graduation	Divorced	84835.0	0	0	2014	0	189	104	...	
1	1961	Graduation	Single	57091.0	0	0	2014	0	464	5	...	
2	1958	Graduation	Married	67267.0	0	1	2014	0	134	11	...	
3	1967	Graduation	Together	32474.0	1	1	2014	0	10	0	...	
4	1989	Graduation	Single	21474.0	1	0	2014	0	6	16	...	

5 rows × 21 columns

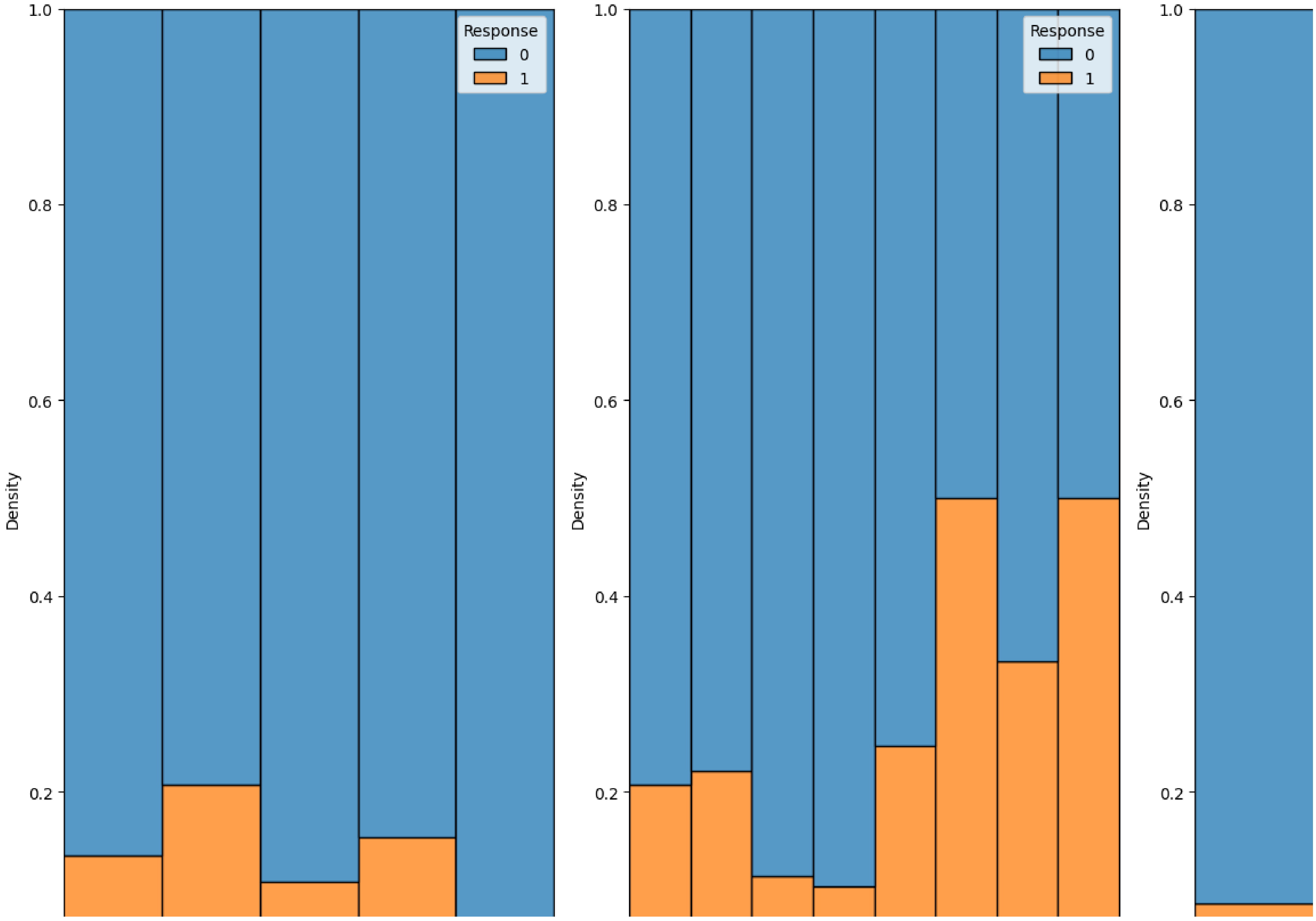
PERFORMING THE EXPLORATORY DATA ANALYSIS

```
# list of categorical variables to plot
cat_vars = ['Education', 'Marital_Status', 'Dt_Customer',
            'Kidhome', 'Teenhome', 'Complain']

# create figure with subplots
fig, axs = plt.subplots(nrows=2, ncols=3, figsize=(15, 10))
axs = axs.flatten()

# create barplot for each categorical variable
for i, var in enumerate(cat_vars):
    sns.countplot(x=var, hue='Response', data=df, ax=axs[i])
    axs[i].set_xticklabels(axs[i].get_xticklabels(), rotation=90)

# adjust spacing between subplots
fig.tight_layout()

# show plot
plt.show()
```

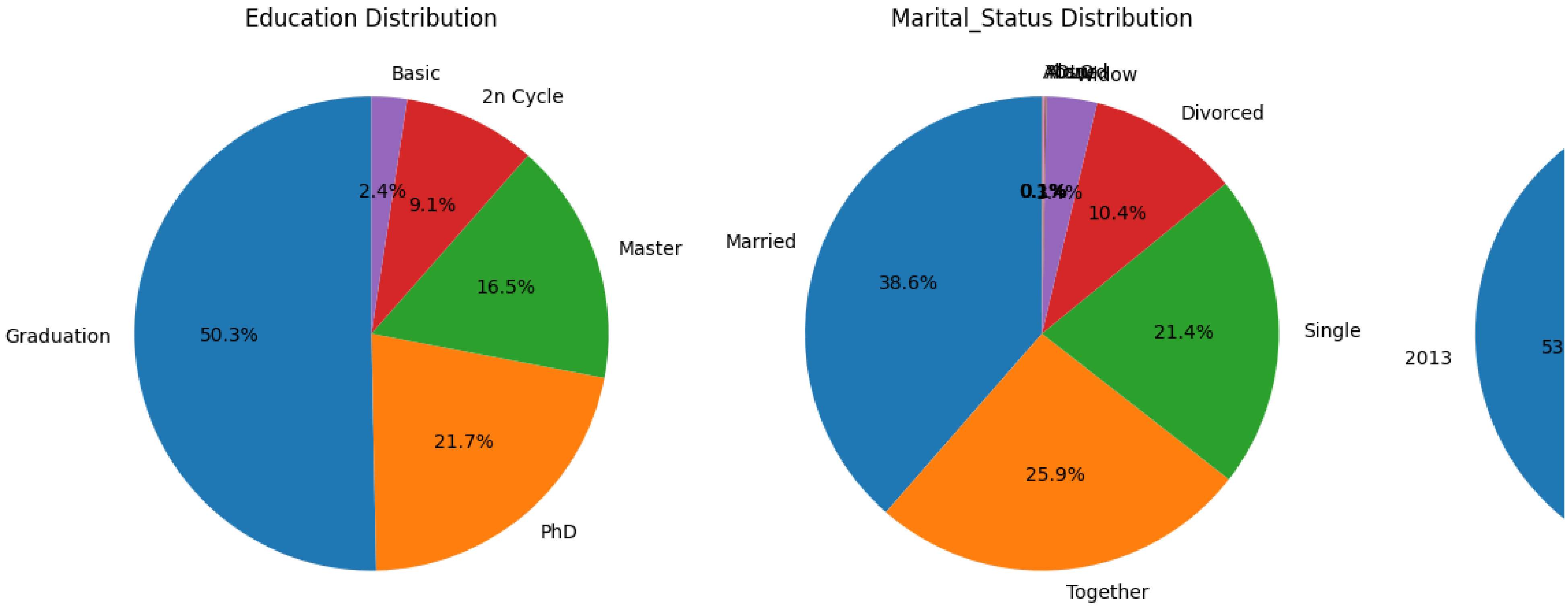



```
import warnings
warnings.filterwarnings("ignore")
# get list of categorical variables
cat_vars = ['Education', 'Marital_Status', 'Dt_Customer']

# create figure with subplots
fig, axs = plt.subplots(nrows=1, ncols=3, figsize=(15, 10))
axs = axs.flatten()

# create histplot for each categorical variable
for i, var in enumerate(cat_vars):
    sns.histplot(x=var, hue='Response', data=df, ax=axs[i], multiple="fill", kde=False, element="bars", fill=True, stat='c
    axs[i].set_xticklabels(df[var].unique(), rotation=90)
    axs[i].set_xlabel(var)

# adjust spacing between subplots
fig.tight_layout()
```

```
# show plot
plt.show()
```

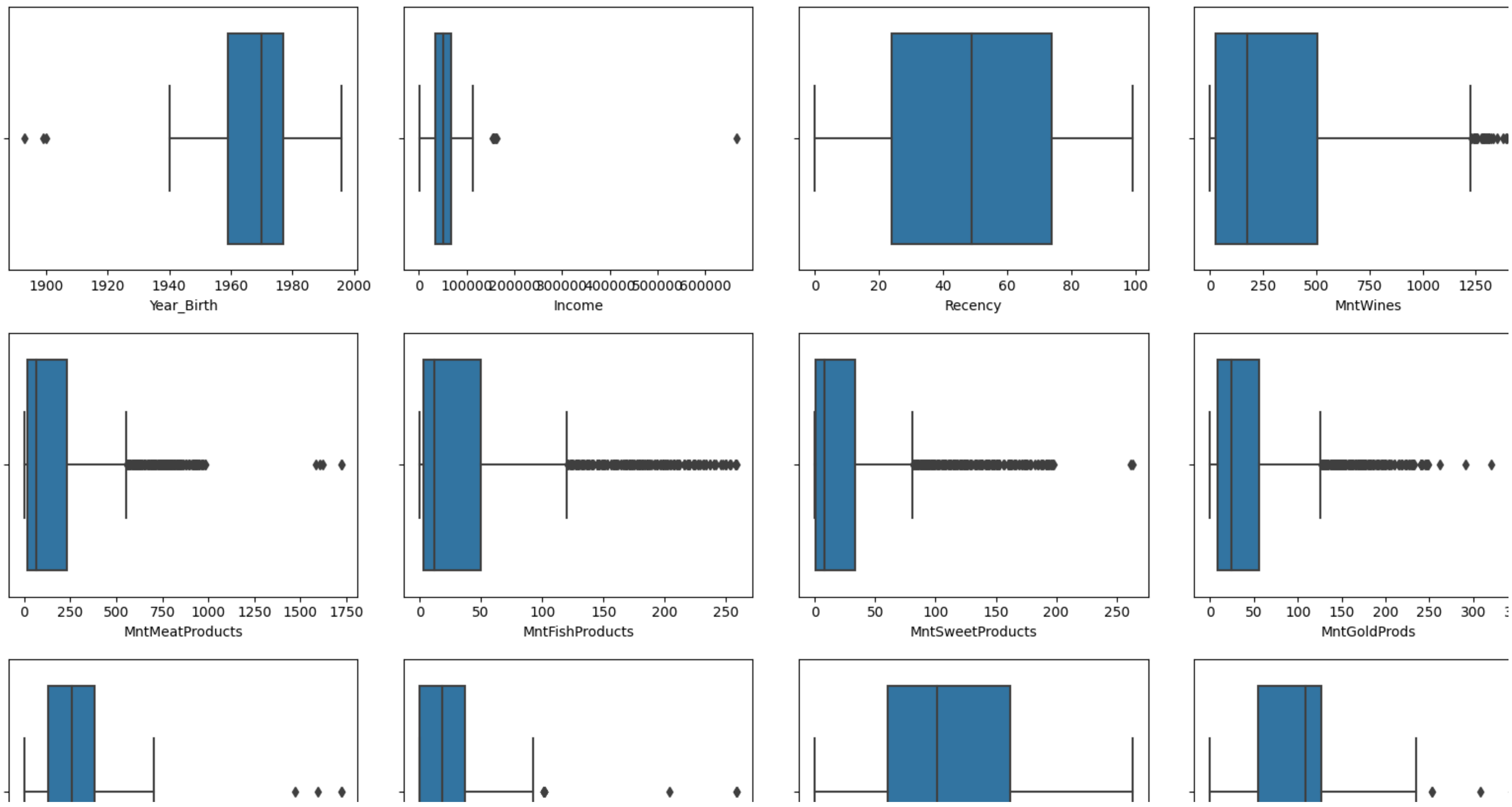



```
cat_vars = ['Education', 'Marital_Status', 'Dt_Customer',
            'Kidhome', 'Teenhome', 'Complain']

# create a figure and axes
fig, axs = plt.subplots(nrows=2, ncols=3, figsize=(15, 15))

# create a pie chart for each categorical variable
for i, var in enumerate(cat_vars):
    if i < len(axs.flat):
        # count the number of occurrences for each category
        cat_counts = df[var].value_counts()

        # create a pie chart
        axs.flat[i].pie(cat_counts, labels=cat_counts.index, autopct='%1.1f%%', startangle=90)

        # set a title for each subplot
        axs.flat[i].set_title(f'{var} Distribution')

# adjust spacing between subplots
fig.tight_layout()

# show the plot
plt.show()
```



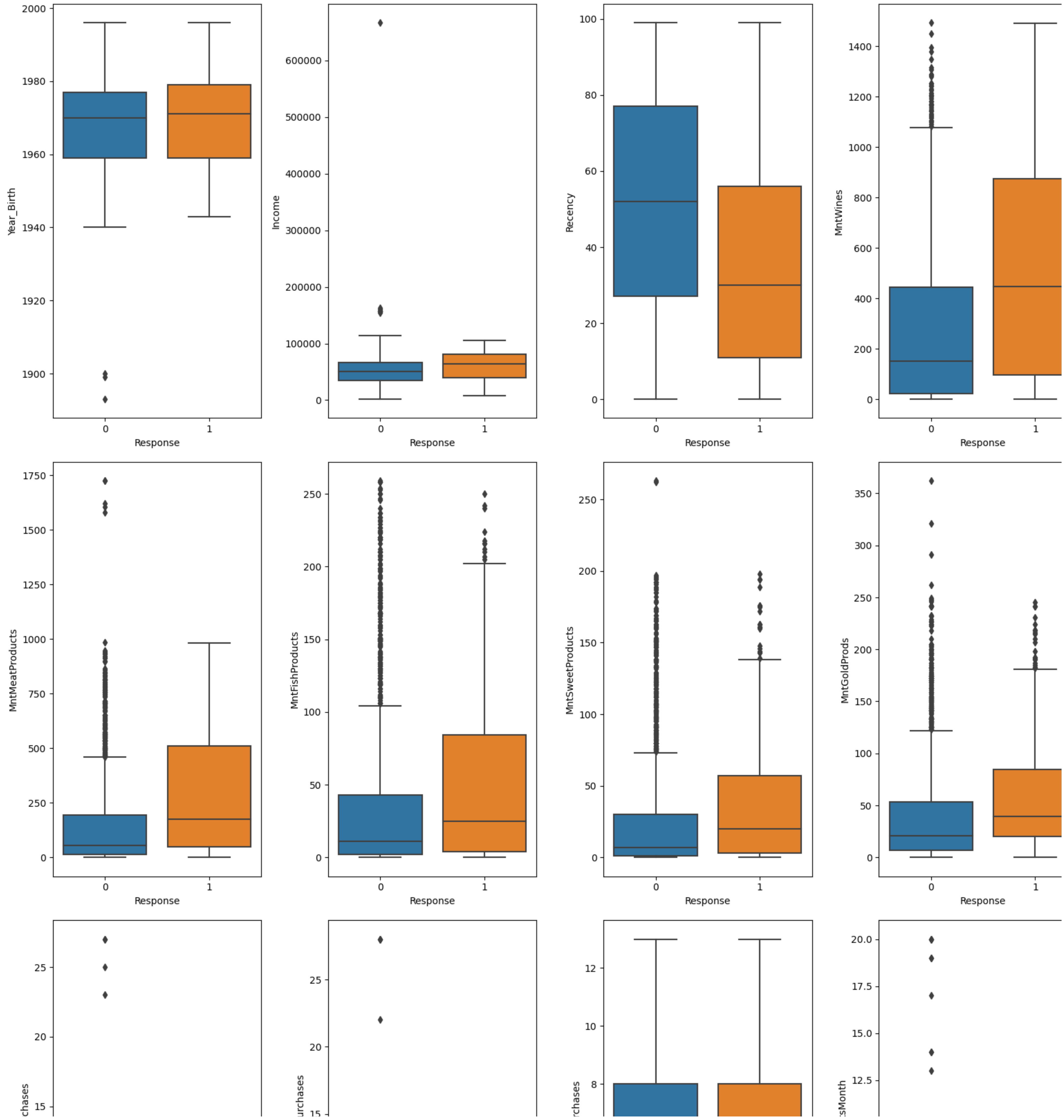
NOW FOCUSSING ON THE NUMERICAL FEATURES OF THE DATASET

```
num_vars = ['Year_Birth', 'Income', 'Recency', 'MntWines', 'MntFruits',
            'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
            'MntGoldProds', 'NumDealsPurchases', 'NumWebPurchases',
            'NumCatalogPurchases', 'NumStorePurchases', 'NumWebVisitsMonth']

fig, axs = plt.subplots(nrows=3, ncols=5, figsize=(20, 10))
axs = axs.flatten()

for i, var in enumerate(num_vars):
    sns.boxplot(x=var, data=df, ax=axs[i])

fig.tight_layout()

# remove the 15th subplot
fig.delaxes(axs[14])

plt.show()
```




```
num_vars = ['Year_Birth', 'Income', 'Recency', 'MntWines', 'MntFruits',
            'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
            'MntGoldProds', 'NumDealsPurchases', 'NumWebPurchases',
```

```
            'NumCatalogPurchases', 'NumStorePurchases', 'NumWebVisitsMonth']

fig, axs = plt.subplots(nrows=3, ncols=5, figsize=(20, 20))
axs = axs.flatten()

for i, var in enumerate(num_vars):
    sns.boxplot(y=var, x='Response', data=df, ax=axs[i])

fig.tight_layout()

# remove the 15th subplot
fig.delaxes(axs[14])

plt.show()
```



DATA PREPOROCESSING TO DEAL WITH MISSING AND NULL VALUES IF ANY

```
#Check missing value
check_missing = df.isnull().sum() * 100 / df.shape[0]
check_missing[check_missing > 0].sort_values(ascending=False)
```

```
Income    1.071429
dtype: float64
```

```
df.shape
```

```
(2240, 21)
```

```
# Drop null value because its only 1%
df.dropna(inplace=True)
df.shape
```

```
(2216, 21)
```

```
# Drop Complain column because its very  unbalanced
df.drop(columns='Complain', inplace=True)
df.shape
```

```
(2216, 20)
```

PERFORMING LABEL ENCODING FOR NON NUMERICAL COLUMNS

```
# Loop over each column in the DataFrame where dtype is 'object'
for col in df.select_dtypes(include=['object']).columns:

    # Print the column name and the unique values
    print(f"{col}: {df[col].unique()}")
```

```
Education: ['Graduation' 'PhD' '2n Cycle' 'Master' 'Basic']
Marital_Status: ['Divorced' 'Single' 'Married' 'Together' 'Widow' 'YOLO' 'Alone' 'Absurd']
Dt_Customer: ['2014' '2013' '2012']
```

```
#Replace 'YOLO' and 'Alone' with 'Single' in the 'Status' column
df['Marital_Status'] = df['Marital_Status'].replace(['YOLO', 'Alone'], 'Single')
df['Marital_Status'] = df['Marital_Status'].replace(['Together'], 'Married')
```

```
# Remove Dt_Customer because its irrelevant for prediction
df.drop(columns='Dt_Customer', inplace=True)
df.head()
```

	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	Mnt
0	1970	Graduation	Divorced	84835.0	0	0	0	189	104	379	
1	1961	Graduation	Single	57091.0	0	0	0	464	5	64	
2	1958	Graduation	Married	67267.0	0	1	0	134	11	59	
3	1967	Graduation	Married	32474.0	1	1	0	10	0	1	
4	1989	Graduation	Single	21474.0	1	0	0	6	16	24	

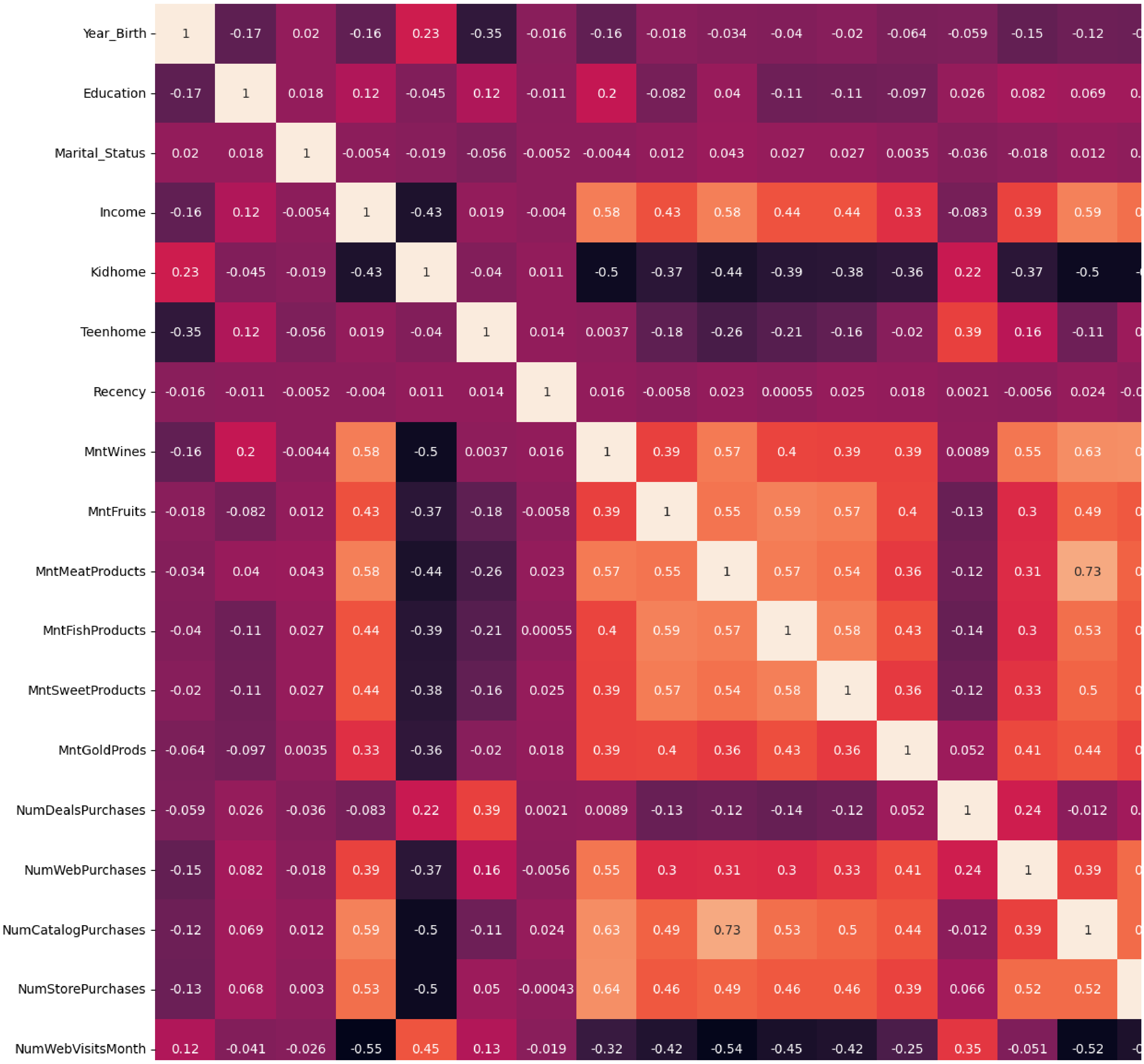
```
df1=df
```

```
from sklearn import preprocessing

# Loop over each column in the DataFrame where dtype is 'object'
for col in df.select_dtypes(include=['object']).columns:

    # Initialize a LabelEncoder object
    label_encoder = preprocessing.LabelEncoder()

    # Fit the encoder to the unique values in the column
    label_encoder.fit(df[col].unique())

    # Transform the column using the encoder
    df[col] = label_encoder.transform(df[col])

    # Print the column name and the unique encoded values
    print(f"{col}: {df[col].unique()}")
```

```
Education: [2 4 0 3 1]
Marital_Status: [1 3 2 4 0]
```

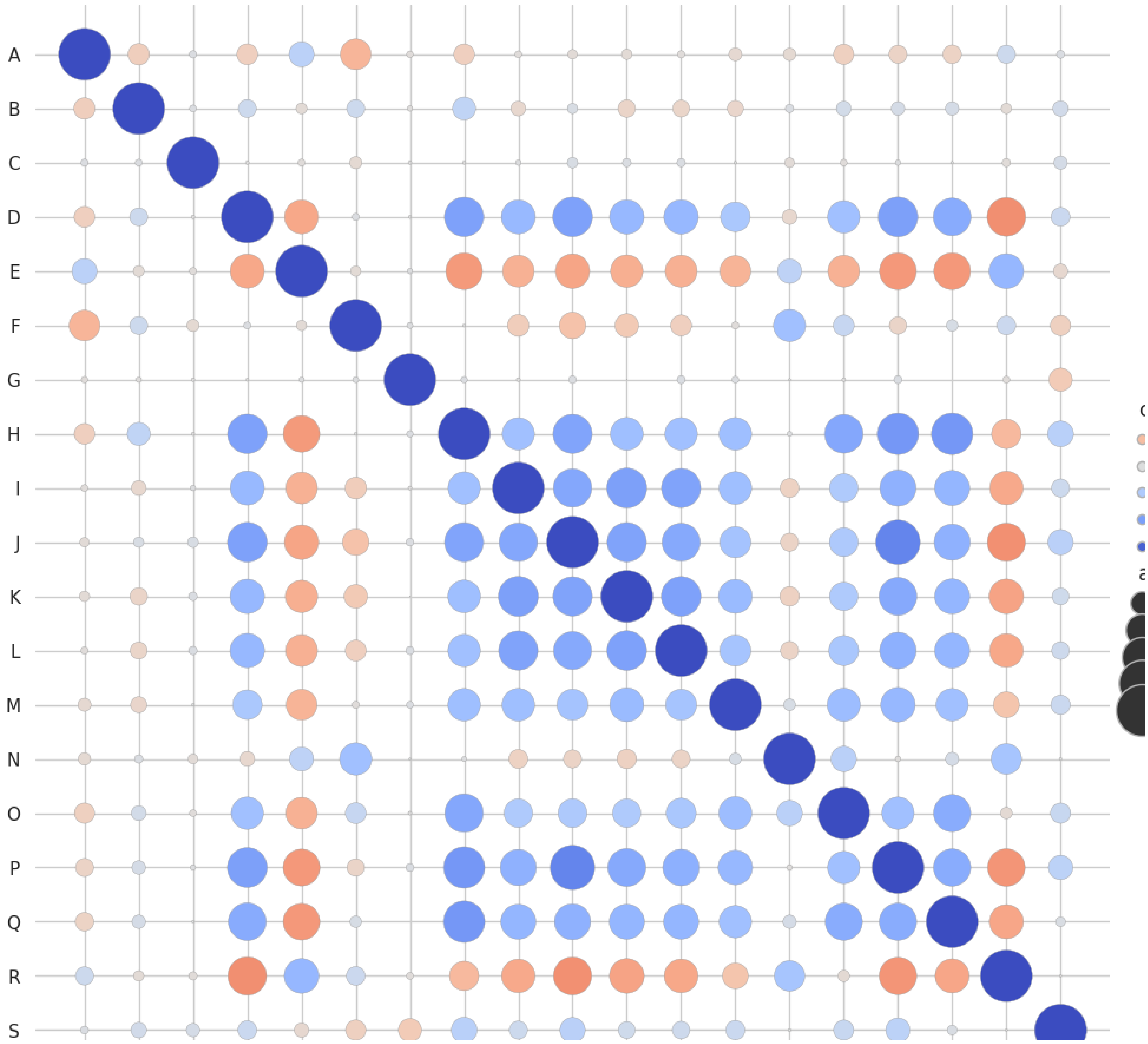
```
#Correlation Heatmap (print the correlation score each variables)
plt.figure(figsize=(20, 16))
sns.heatmap(df.corr(), fmt='.2g', annot=True)
```

```
<Axes: >
```




```
import string
import seaborn as sns
sns.set_theme(style="whitegrid")


values = np.array(df.corr())

corr_matrix = pd.DataFrame(values, columns = list(string.ascii_uppercase[:values.shape[1]]))
corr_matrix = corr_matrix.set_index(corr_matrix.columns)


# Compute a correlation matrix and convert to long-form
corr_mat = corr_matrix.stack().reset_index(name="correlation")
corr_mat["abs_correlation"] = abs(corr_mat["correlation"])


# Draw each cell as a scatter point with varying size and color
g = sns.relplot(
    data=corr_mat,
    x="level_0", y="level_1", hue="correlation", size="abs_correlation",
    palette="coolwarm_r", hue_norm=(-1, 1), edgecolor=".6",
    height=10, sizes=(0, 1000),
)

# Tweak the figure
g.set(xlabel="", ylabel="", aspect="equal")
```

```
g.despine(left=True, bottom=True)
for artist in g.legend.legendHandles:
    artist.set_edgecolor(".7")
```



SPLITTING THE TRAINING AND TESTING DATA

```
from sklearn.model_selection import train_test_split
# Select the features (X) and the target variable (y)
X = df.drop('Response', axis=1)
y = df['Response']

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=0)
```

REMOVING THE OUTLIER DATA FROM DATA USING Z SCORE

```
from scipy import stats

# Define the columns for which you want to remove outliers
selected_columns = ['Year_Birth', 'Income', 'MntFruits', 'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
           'MntGoldProds', 'NumDealsPurchases','NumCatalogPurchases']

# Calculate the Z-scores for the selected columns in the training data
z_scores = np.abs(stats.zscore(X_train[selected_columns]))

# Set a threshold value for outlier detection (e.g., 3)
threshold = 3

# Find the indices of outliers based on the threshold
```

```
outlier_indices = np.where(z_scores > threshold)[0]

# Remove the outliers from the training data
X_train = X_train.drop(X_train.index[outlier_indices])
y_train = y_train.drop(y_train.index[outlier_indices])
```

We provide data to 8 ML Classification Alghoritms and check which gives the best accuracy:

1. Logistic Regression
2. SVC
3. KNN
4. Gauss
5. Decision Tree
6. Random Forest
7. PassiveAggresive
8. GBM

```
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score
```

1. LOGISTIC REGRESSION

```
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression()
lr.fit(X_train,y_train)
y_pred = lr.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8490990990990991
```

2. SUPPORT VECTOR MACHINE

```
from sklearn.svm import SVC
svc = SVC().fit(X_train,y_train)
y_pred = svc.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8468468468468469
```

3. KNN

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier().fit(X_train,y_train)
y_pred = knn.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8468468468468469
```

4. GausNB

```
from sklearn.naive_bayes import GaussianNB
gb = GaussianNB().fit(X_train,y_train)
y_pred = gb.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.7207207207207207
```

5. DECISION TREE

```
from sklearn.tree import DecisionTreeClassifier
dt = DecisionTreeClassifier().fit(X_train,y_train)
y_pred = dt.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8108108108108109
```

6. RANDOM FOREST

```
from sklearn.ensemble import RandomForestClassifier
rf = RandomForestClassifier().fit(X_train,y_train)
y_pred = rf.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8536036036036037
```

7. PASSIVEAGGRESIVE

```
from sklearn.linear_model import PassiveAggressiveClassifier
pa = PassiveAggressiveClassifier().fit(X_train,y_train)
y_pred = pa.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.7567567567567568
```

GRADIENT BOOSTING MACHINE

```
from sklearn.ensemble import GradientBoostingClassifier
gbm = GradientBoostingClassifier().fit(X_train,y_train)
y_pred = gbm.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8603603603603603
```

WE SEE THAT GRADIENR BOOSTING MACHINE PROVIDES THE HIGHEST ACCURACY AMONGST ALL THESE ALGORITHMS

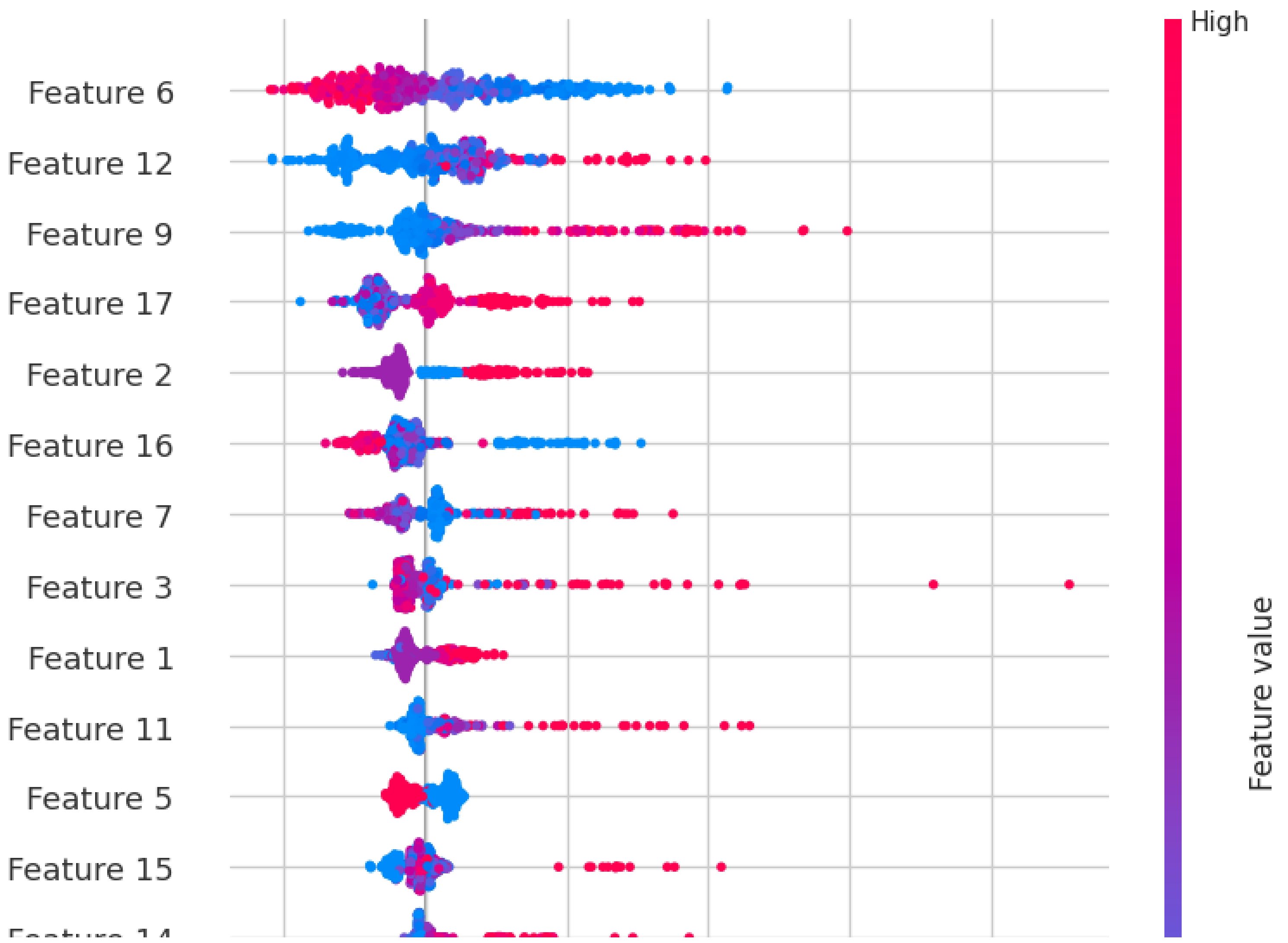
```
from sklearn.ensemble import GradientBoostingClassifier
gbm = GradientBoostingClassifier()
gbm.fit(X_train,y_train)
y_pred = gbm.predict(X_test)
accuracy_score(y_test,y_pred)
```

```
0.8626126126126126
```

```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score, jaccard_score, log_loss
print('F-1 Score : ',(f1_score(y_test, y_pred, average='micro')))
print('Precision Score : ',(precision_score(y_test, y_pred, average='micro')))
print('Recall Score : ',(recall_score(y_test, y_pred, average='micro')))
print('Jaccard Score : ',(jaccard_score(y_test, y_pred, average='micro')))
print('Log Loss : ',(log_loss(y_test, y_pred)))
```

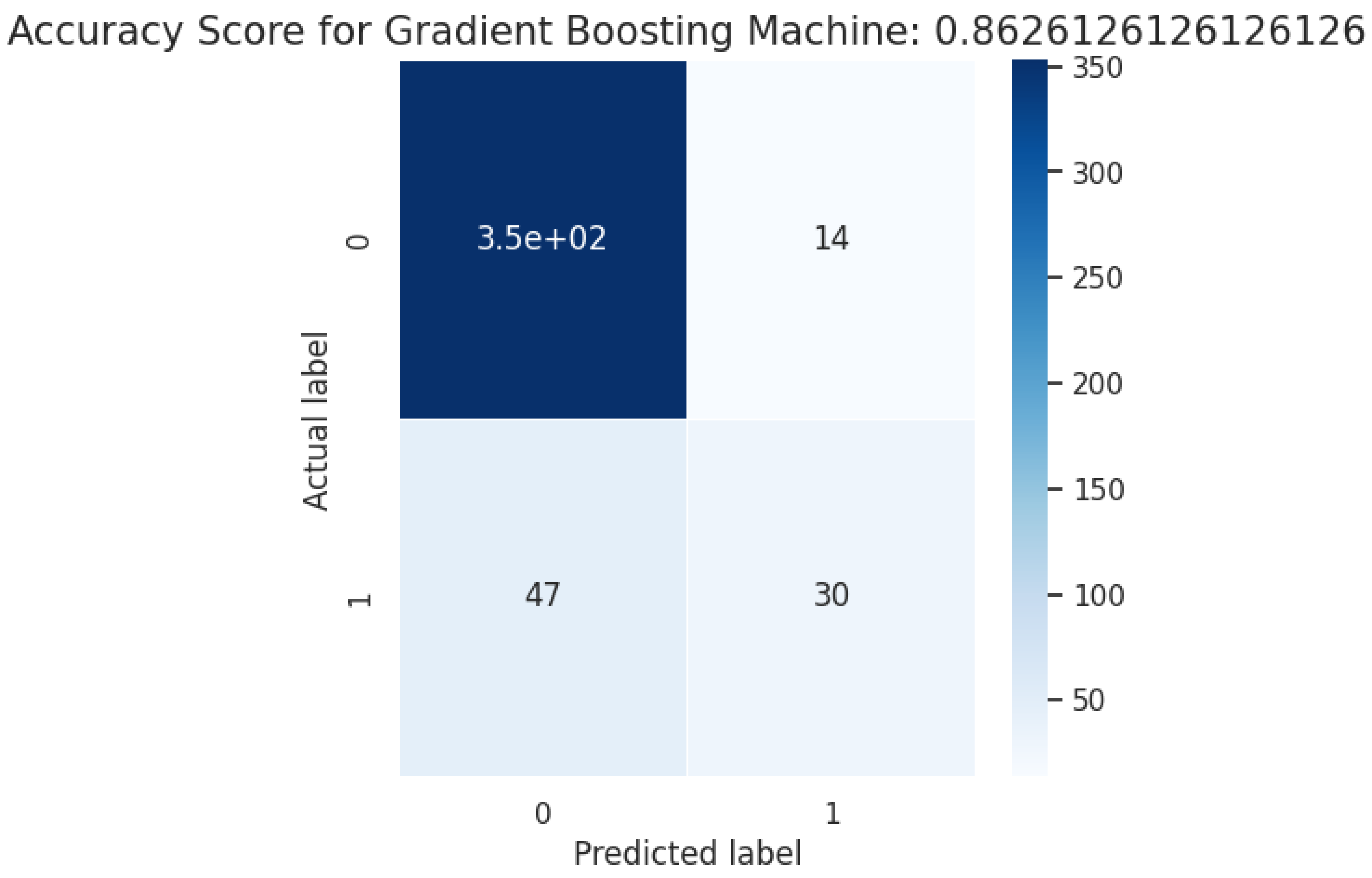
```
F-1 Score :  0.8626126126126126
Precision Score :  0.8626126126126126
Recall Score :  0.8626126126126126
Jaccard Score :  0.7584158415841584
Log Loss :  4.951943371027356
```

```
import shap
explainer = shap.TreeExplainer(gbm)
shap_values = explainer.shap_values(X_test)
shap.summary_plot(shap_values, X_test)
```




```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
all_sample_title = 'Accuracy Score for Gradient Boosting Machine: {0}'.format(gbm.score(X_test, y_test))
plt.title(all_sample_title, size = 15)
```

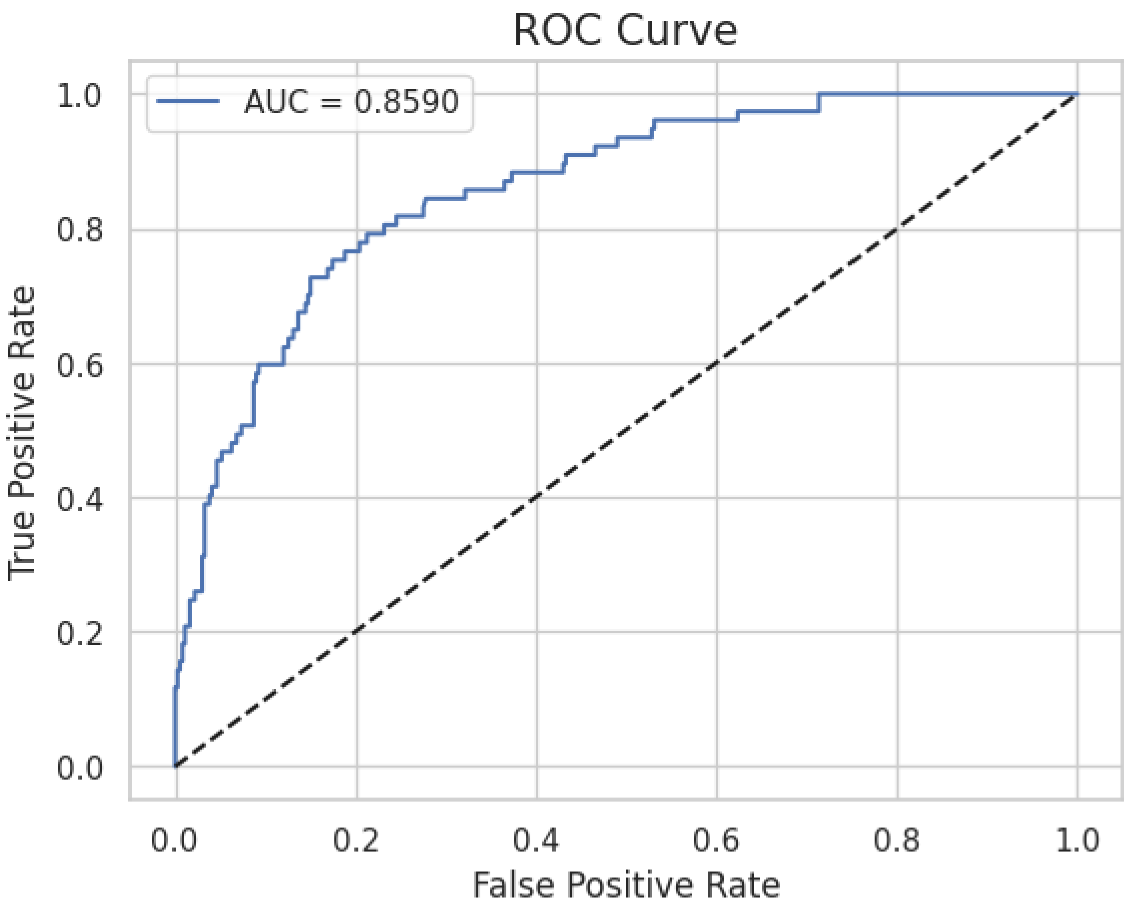
```
Text(0.5, 1.0, 'Accuracy Score for Gradient Boosting Machine: 0.8626126126126126')
```




```
from sklearn.metrics import roc_curve, roc_auc_score
y_pred_proba = gbm.predict_proba(X_test)[:][:,1]

df_actual_predicted = pd.concat([pd.DataFrame(np.array(y_test), columns=['y_actual']), pd.DataFrame(y_pred_proba, columns=
df_actual_predicted.index = y_test.index

fpr, tpr, tr = roc_curve(df_actual_predicted['y_actual'], df_actual_predicted['y_pred_proba'])
auc = roc_auc_score(df_actual_predicted['y_actual'], df_actual_predicted['y_pred_proba'])

plt.plot(fpr, tpr, label='AUC = %0.4f' %auc)
plt.plot(fpr, fpr, linestyle = '--', color='k')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
```

```
plt.title('ROC Curve', size = 15)
plt.legend()
```

<matplotlib.legend.Legend at 0x7f35cea50d30>



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