In [1]:
```
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
import numpy as np
sns.set_theme(color_codes=True)
```

In [2]:
```
df = pd.read_csv('Train.csv')
df.head()
```

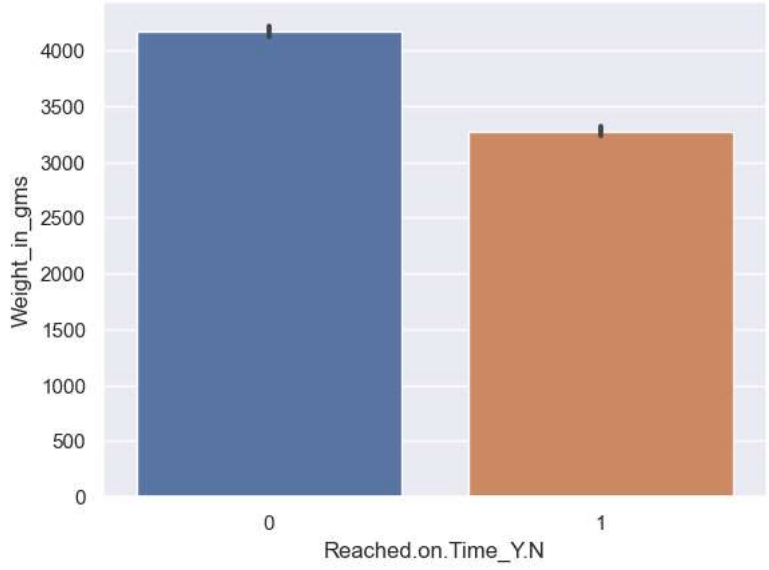
Out[2]:

	ID	Warehouse_block	Mode_of_Shipment	Customer_care_calls	Customer_rating	Cost_of_the_Product	Prior_purchases	Product_importance	Gender	Discou
0	1	D	Flight	4	2	177	3	low	F	
1	2	F	Flight	4	5	216	2	low	M	
2	3	A	Flight	2	2	183	4	low	M	
3	4	B	Flight	3	3	176	4	medium	M	
4	5	C	Flight	2	2	184	3	medium	F	

Exploratory Data Analysis

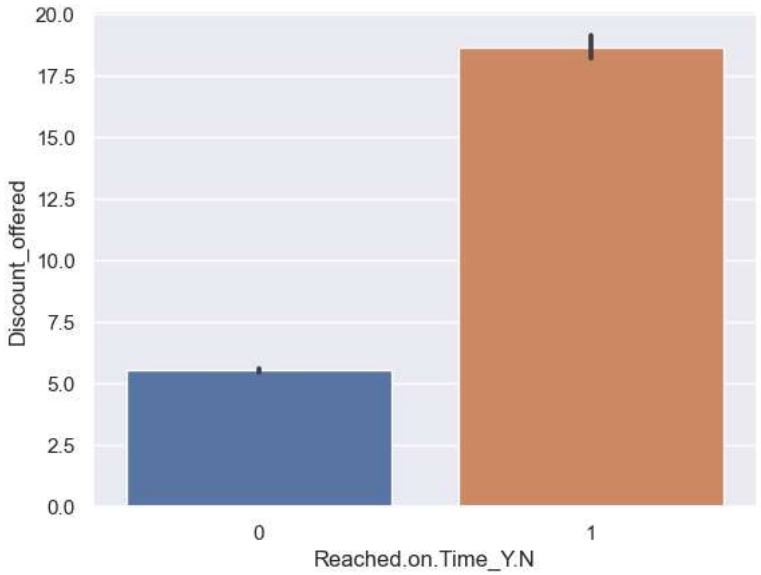
In [3]:
```
sns.barplot(data=df, x="Reached.on.Time_Y.N", y="Weight_in_gms")
#Heavy weight items are most likely to be late than light weight items
```

Out[3]:
```
<AxesSubplot:xlabel='Reached.on.Time_Y.N', ylabel='Weight_in_gms'>
```



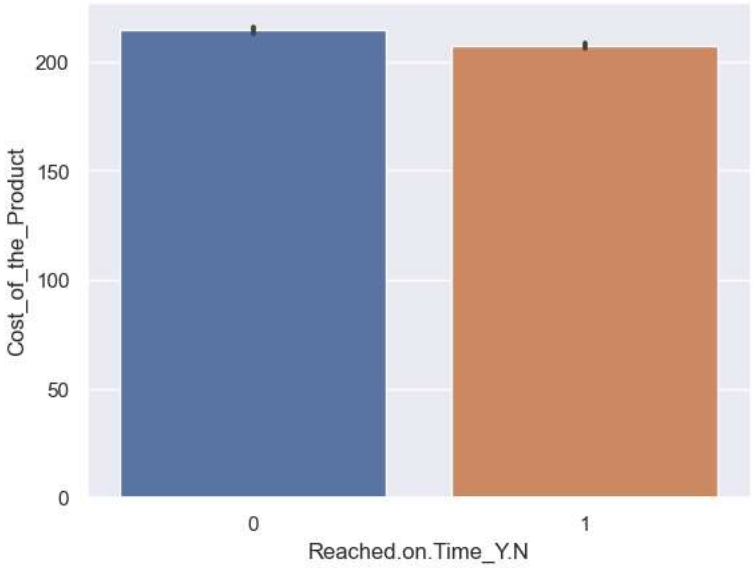
In [4]:
```
sns.barplot(data=df, x="Reached.on.Time_Y.N", y="Discount_offered")
#Because the huge discount offered are ontime, we have to make campaign to give more discount on product
```

Out[4]:
```
<AxesSubplot:xlabel='Reached.on.Time_Y.N', ylabel='Discount_offered'>
```



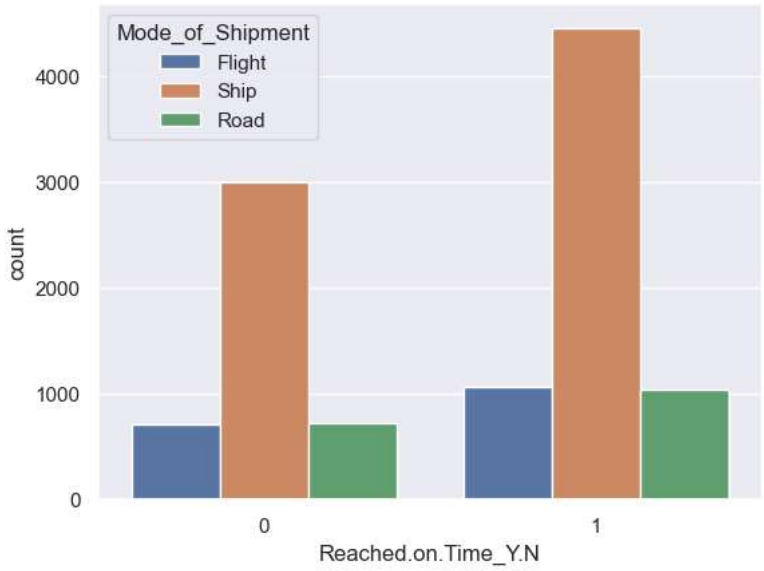
In [5]:
```
sns.barplot(data=df, x="Reached.on.Time_Y.N", y="Cost_of_the_Product")
```

Out[5]:
```
<AxesSubplot:xlabel='Reached.on.Time_Y.N', ylabel='Cost_of_the_Product'>
```



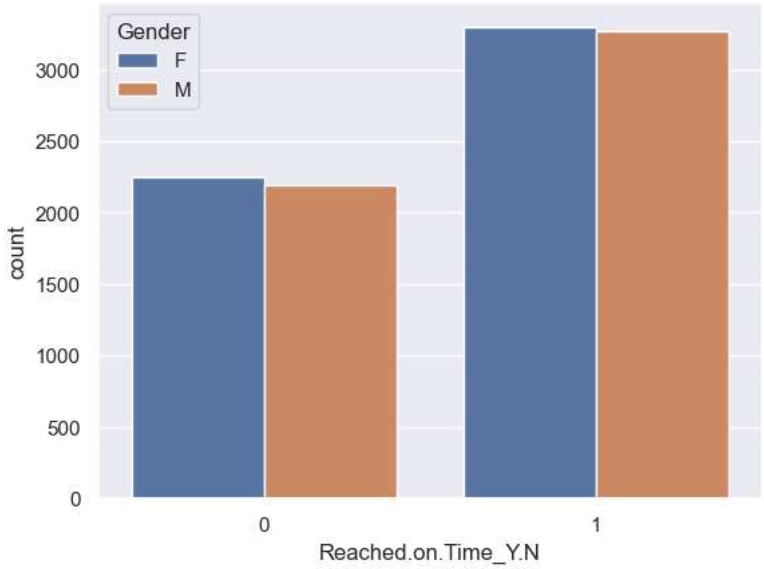
In [6]:
```
sns.countplot(data=df, x="Reached.on.Time_Y.N", hue="Mode_of_Shipment")
```

Out[6]: <AxesSubplot:xlabel='Reached.on.Time_Y.N', ylabel='count'>



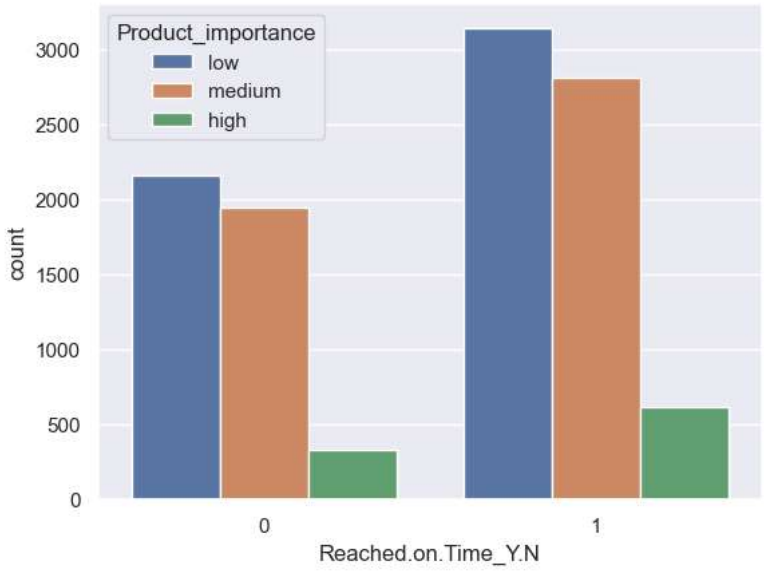
In [7]:
```
sns.countplot(data=df, x="Reached.on.Time_Y.N", hue="Gender")
```

Out[7]: <AxesSubplot:xlabel='Reached.on.Time_Y.N', ylabel='count'>



In [8]:
```
sns.countplot(data=df, x="Reached.on.Time_Y.N", hue="Product_importance")
```

Out[8]:
```
<AxesSubplot:xlabel='Reached.on.Time_Y.N', ylabel='count'>
```



Data Preprocessing

In [9]:
```
df['Warehouse_block'].unique()
```

Out[9]:
```
array(['D', 'F', 'A', 'B', 'C'], dtype=object)
```

In [10]:
```
df['Mode_of_Shipment'].unique()
```

Out[10]:
```
array(['Flight', 'Ship', 'Road'], dtype=object)
```

In [11]:
```
df['Product_importance'].unique()
```

Out[11]:
```
array(['low', 'medium', 'high'], dtype=object)
```

In [12]:
```
df['Gender'].unique()
```

Out[12]:
```
array(['F', 'M'], dtype=object)
```

In [13]:
```
from sklearn import preprocessing
label_encoder = preprocessing.LabelEncoder()
df['Warehouse_block']= label_encoder.fit_transform(df['Warehouse_block'])
df['Warehouse_block'].unique()
```

Out[13]:
```
array([3, 4, 0, 1, 2])
```

In [14]:
```
df['Mode_of_Shipment']= label_encoder.fit_transform(df['Mode_of_Shipment'])
df['Mode_of_Shipment'].unique()
```

Out[14]:
```
array([0, 2, 1])
```

In [15]:
```
df['Product_importance']= label_encoder.fit_transform(df['Product_importance'])
df['Product_importance'].unique()
```

Out[15]:
```
array([1, 2, 0])
```

In [16]:
```
df['Gender']= label_encoder.fit_transform(df['Gender'])
df['Gender'].unique()
```

Out[16]:
```
array([0, 1])
```

In [17]:
```
df.head()
```

Out[17]:

	ID	Warehouse_block	Mode_of_Shipment	Customer_care_calls	Customer_rating	Cost_of_the_Product	Prior_purchases	Product_importance	Gender	Discou
0	1	3	0	4	2	177	3	1	0	
1	2	4	0	4	5	216	2	1	1	
2	3	0	0	2	2	183	4	1	1	
3	4	1	0	3	3	176	4	2	1	
4	5	2	0	2	2	184	3	2	0	

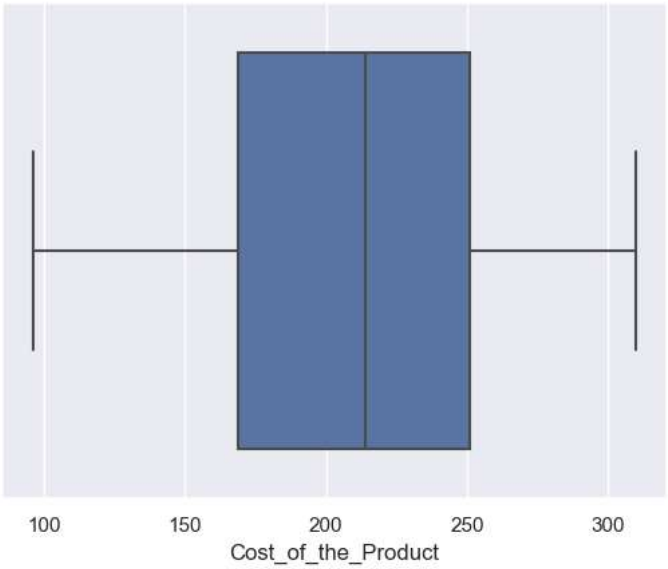
In [18]:
```
#convert object data types column to integer
df['Warehouse_block'] = pd.to_numeric(df['Warehouse_block'])
df['Mode_of_Shipment'] = pd.to_numeric(df['Mode_of_Shipment'])
df['Product_importance'] = pd.to_numeric(df['Product_importance'])
df['Gender'] = pd.to_numeric(df['Gender'])
df.dtypes
```

Out[18]:
```
ID                   int64
Warehouse_block      int32
Mode_of_Shipment     int32
Customer_care_calls  int64
Customer_rating      int64
Cost_of_the_Product  int64
Prior_purchases      int64
Product_importance   int32
Gender               int32
Discount_offered     int64
Weight_in_gms        int64
Reached.on.Time_Y.N  int64
dtype: object
```

Check the Outliers

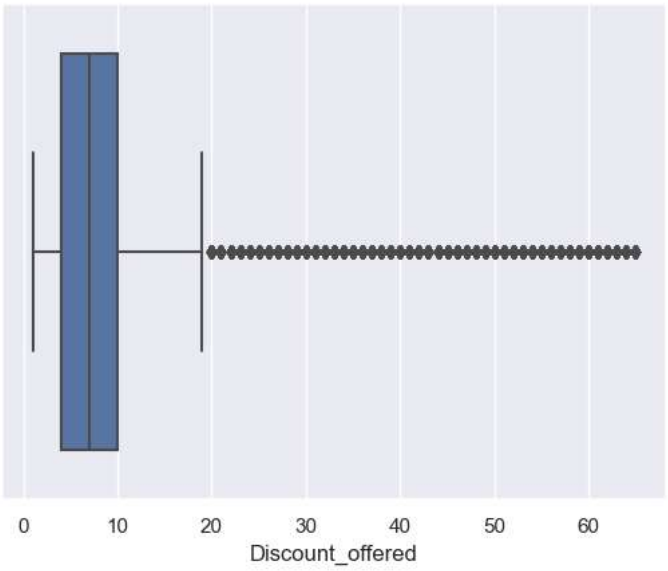
In [19]:
```
sns.boxplot(x=df["Cost_of_the_Product"])
```

Out[19]:
```
<AxesSubplot:xlabel='Cost_of_the_Product'>
```



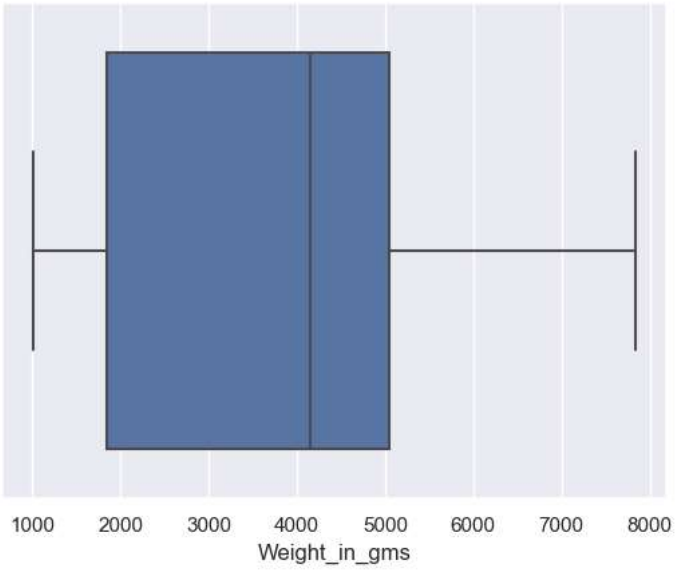
In [20]:
```
sns.boxplot(x=df["Discount_offered"])
```

Out[20]: <AxesSubplot:xlabel='Discount_offered'>



In [21]:
```
sns.boxplot(x=df["Weight_in_gms"])
```

Out[21]: <AxesSubplot:xlabel='Weight_in_gms'>



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

Out[22]:

	ID	Warehouse_block	Mode_of_Shipment	Customer_care_calls	Customer_rating	Cost_of_the_Product	Prior_purchases	Product_importance	Gender
0	1	3	0	4	2	177	3	1	0
1	2	4	0	4	5	216	2	1	1
2	3	0	0	2	2	183	4	1	1
3	4	1	0	3	3	176	4	2	1
4	5	2	0	2	2	184	3	2	0
...	...	...	...	...	...	...	...	...	...
10994	10995	0	2	4	1	252	5	2	0
10995	10996	1	2	4	1	232	5	2	0
10996	10997	2	2	5	4	242	5	1	0
10997	10998	4	2	5	2	223	6	2	1
10998	10999	3	2	2	5	155	5	1	0

10999 rows × 12 columns

Delete the Outlier Using Z-Score

In [23]:
```
import scipy.stats as stats
z = np.abs(stats.zscore(df))
data_clean = df[(z<3).all(axis = 1)]
data_clean.shape
```

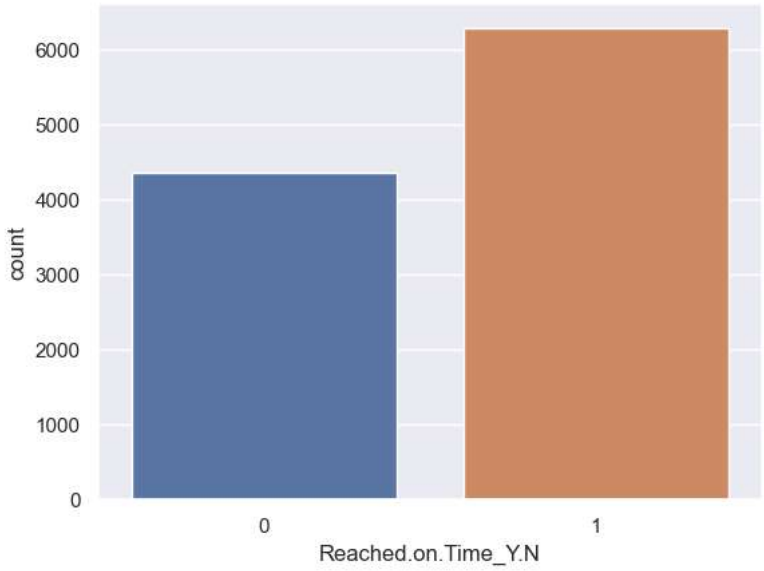
Out[23]:
```
(10642, 12)
```

Balance the Class Value

In [38]:
```
#Counting 1 and 0 Value in stroke column
sns.countplot(data_clean['Reached.on.Time_Y.N'])
data_clean['Reached.on.Time_Y.N'].value_counts()
```

```
D:\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From
version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will r
esult in an error or misinterpretation.
  warnings.warn(
```

Out[38]:
```
1    6282
0    4360
Name: Reached.on.Time_Y.N, dtype: int64
```

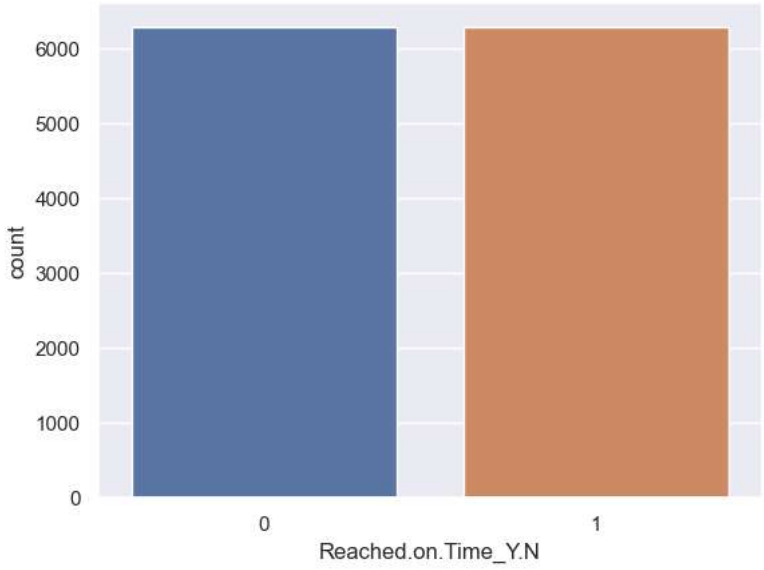


In [39]:
```
from sklearn.utils import resample
#create two different dataframe of majority and minority class
df_majority = data_clean[(data_clean['Reached.on.Time_Y.N']==1)]
df_minority = data_clean[(data_clean['Reached.on.Time_Y.N']==0)]
# upsample minority class
df_minority_upsampled = resample(df_minority,
                                 replace=True,    # sample with replacement
                                 n_samples= 6282, # to match majority class
                                 random_state=0)  # reproducible results
# Combine majority class with upsampled minority class
df_upsampled = pd.concat([df_minority_upsampled, df_majority])
```

In [40]:
```
sns.countplot(df_upsampled['Reached.on.Time_Y.N'])
df_upsampled['Reached.on.Time_Y.N'].value_counts()
```

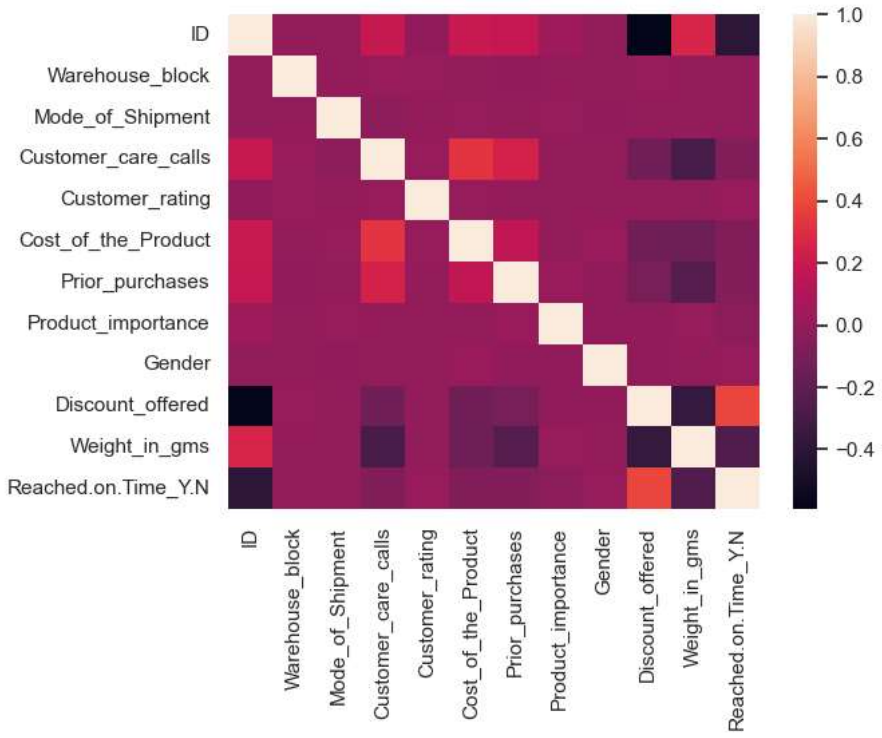
```
D:\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From
version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will r
esult in an error or misinterpretation.
  warnings.warn(
```

Out[40]:
```
0    6282
1    6282
Name: Reached.on.Time_Y.N, dtype: int64
```



In [25]:
```
sns.heatmap(data_clean.corr(), fmt='.2g')
```

Out[25]: <AxesSubplot:>



Machine Learning Model Building

In [41]:
```
X = df_upsampled.drop('Reached.on.Time_Y.N', axis=1)
y = df_upsampled['Reached.on.Time_Y.N']
```

In [42]:
```
#test size 20% and train size 80%
from sklearn.model_selection import train_test_split, cross_val_score, cross_val_predict
from sklearn.metrics import accuracy_score
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2,random_state=0)
```

Decision Tree Classifier

In [57]:
```
from sklearn.tree import DecisionTreeClassifier
dtree = DecisionTreeClassifier(random_state=0)
dtree.fit(X_train, y_train)
```

Out[57]:
```
DecisionTreeClassifier(random_state=0)
```

In [58]:
```
y_pred = dtree.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

```
Accuracy Score : 77.64 %
```

In [59]:
```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  0.7717303005686433
Precision Score :  0.818260120585702
Recall Score :  0.7302075326671791
```

Random Forest Classifier

In [54]:
```
from sklearn.ensemble import RandomForestClassifier
rfc = RandomForestClassifier(random_state=0)
rfc.fit(X_train, y_train)
```

Out[54]:
```
RandomForestClassifier(random_state=0)
```

In [55]:
```
y_pred = rfc.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

```
Accuracy Score : 74.81 %
```

In [56]:
```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  0.7097661623108666
Precision Score :  0.8795454545454545
Recall Score :  0.5949269792467333
```

Logistic Regression

In [49]:
```
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression(random_state=0)
lr.fit(X_train, y_train)
```

Out[49]:
```
LogisticRegression(random_state=0)
```

In [50]:
```
y_pred = lr.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

```
Accuracy Score : 68.52 %
```

In [51]:
```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score
print('F-1 Score : ',(f1_score(y_test, y_pred)))
print('Precision Score : ',(precision_score(y_test, y_pred)))
print('Recall Score : ',(recall_score(y_test, y_pred)))
```

```
F-1 Score :  0.6379862700228833
Precision Score :  0.7884615384615384
Recall Score :  0.5357417371252883
```