Mitul Joby - PES2UG20CS199

```
import pandas as pd
import sklearn as sk
import tensorflow as tf
import numpy as np
import seaborn as sns
```

```
df = pd.read_csv("/content/MI_Assignment1_2_Online Retail.csv",
encoding= 'unicode_escape')
df.head(5)
```

```
  InvoiceNo StockCode                          Description
Quantity  \
0    536365    85123A   WHITE HANGING HEART T-LIGHT HOLDER         6

1    536365     71053                  WHITE METAL LANTERN         6

2    536365    84406B       CREAM CUPID HEARTS COAT HANGER         8

3    536365    84029G  KNITTED UNION FLAG HOT WATER BOTTLE         6

4    536365    84029E       RED WOOLLY HOTTIE WHITE HEART.         6


     InvoiceDate  UnitPrice  CustomerID         Country
0  01-12-10 8:26       2.55     17850.0  United Kingdom
1  01-12-10 8:26       3.39     17850.0  United Kingdom
2  01-12-10 8:26       2.75     17850.0  United Kingdom
3  01-12-10 8:26       3.39     17850.0  United Kingdom
4  01-12-10 8:26       3.39     17850.0  United Kingdom
```

```
from time import time

df['InvoiceDate']=pd.to_datetime(df['InvoiceDate'])
df.count()
```

```
InvoiceNo      541909
StockCode      541909
Description    540455
Quantity       541909
InvoiceDate    541909
UnitPrice      541909
CustomerID     406829
Country        541909
dtype: int64
```

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

```
InvoiceNo           0
StockCode           0
```

```
Description      1454
Quantity            0
InvoiceDate         0
UnitPrice           0
CustomerID     135080
Country             0
dtype: int64
```

```
df=df[df['CustomerID'].notna()]
```

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

```
InvoiceNo      0
StockCode      0
Description    0
Quantity       0
InvoiceDate    0
UnitPrice      0
CustomerID     0
Country        0
dtype: int64
```

```
from datetime import datetime
from random import triangular
```

```
start_date=pd.Timestamp(2010,12,1)
end_date=pd.Timestamp(2011,8,31)
train_set=df[df['InvoiceDate']>=start_date]
train_set=train_set[train_set['InvoiceDate']<=end_date]
```

```
train_set.head()
```

```
      InvoiceNo StockCode                       Description
Quantity  \
25281    538365     22469            HEART OF WICKER SMALL         8

25282    538365    84030E    ENGLISH ROSE HOT WATER BOTTLE         1

25283    538365     22112       CHOCOLATE HOT WATER BOTTLE         3

25284    538365     22835  HOT WATER BOTTLE I AM SO POORLY         5

25285    538365    84029E   RED WOOLLY HOTTIE WHITE HEART.         4


              InvoiceDate  UnitPrice  CustomerID         Country
25281 2010-12-12 10:11:00       1.65     17243.0  United Kingdom
25282 2010-12-12 10:11:00       4.25     17243.0  United Kingdom
25283 2010-12-12 10:11:00       4.95     17243.0  United Kingdom
25284 2010-12-12 10:11:00       4.65     17243.0  United Kingdom
25285 2010-12-12 10:11:00       3.75     17243.0  United Kingdom
```

```
start=pd.Timestamp(2011,9,1)
end=pd.Timestamp(2011,12,31)
churn_set=df[df['InvoiceDate']>=start]
churn_set=churn_set[churn_set['InvoiceDate']<=end]
churn_set.head()
```

```
      InvoiceNo StockCode                       Description  Quantity
\
49034    540498     21485  RETROSPOT HEART HOT WATER BOTTLE         1

49035    540498     22112        CHOCOLATE HOT WATER BOTTLE         1

49036    540498    17091A           LAVENDER INCENSE IN TIN         6

49037    540498     84813     SET OF 4 DIAMOND NAPKIN RINGS         6

49038    540498     22795      SWEETHEART RECIPE BOOK STAND         3


              InvoiceDate  UnitPrice  CustomerID         Country
49034 2011-09-01 10:06:00       4.95     17243.0  United Kingdom
49035 2011-09-01 10:06:00       4.95     17243.0  United Kingdom
49036 2011-09-01 10:06:00       1.25     17243.0  United Kingdom
49037 2011-09-01 10:06:00      12.75     17243.0  United Kingdom
49038 2011-09-01 10:06:00       6.75     17243.0  United Kingdom
```

```
train_unique=train_set['CustomerID'].unique()
churn_unique=churn_set['CustomerID'].unique()

ischurnlis=[]
for id in train_unique:
    if id in churn_unique:
        ischurnlis.append(id)

train_set=train_set.assign(isChurn=[1 if x in ischurnlis else 0 for x
in train_set['CustomerID']])

train_set.head()
```

```
      InvoiceNo StockCode                       Description
Quantity  \
25281    538365     22469            HEART OF WICKER SMALL         8

25282    538365    84030E    ENGLISH ROSE HOT WATER BOTTLE         1

25283    538365     22112        CHOCOLATE HOT WATER BOTTLE         3

25284    538365     22835  HOT WATER BOTTLE I AM SO POORLY         5

25285    538365    84029E   RED WOOLLY HOTTIE WHITE HEART.         4
```

```
              InvoiceDate  UnitPrice  CustomerID         Country
isChurn
25281 2010-12-12 10:11:00       1.65     17243.0  United Kingdom
1
25282 2010-12-12 10:11:00       4.25     17243.0  United Kingdom
1
25283 2010-12-12 10:11:00       4.95     17243.0  United Kingdom
1
25284 2010-12-12 10:11:00       4.65     17243.0  United Kingdom
1
25285 2010-12-12 10:11:00       3.75     17243.0  United Kingdom
1
```

```
train_set.count()
```

```
InvoiceNo      242032
StockCode      242032
Description    242032
Quantity       242032
InvoiceDate    242032
UnitPrice      242032
CustomerID     242032
Country        242032
isChurn        242032
dtype: int64
```

```
#taking care of country
countries_dic={}

countries=train_set['Country'].unique()
for i,y in enumerate(countries):
    countries_dic[y]=i
countries_dic
```

```
{'United Kingdom': 0,
 'Japan': 1,
 'Spain': 2,
 'Germany': 3,
 'Australia': 4,
 'Cyprus': 5,
 'Sweden': 6,
 'Portugal': 7,
 'Austria': 8,
 'Israel': 9,
 'France': 10,
 'EIRE': 11,
 'Finland': 12,
 'Belgium': 13,
 'Switzerland': 14,
```

```
 'Netherlands': 15,
 'Italy': 16,
 'Poland': 17,
 'Greece': 18,
 'Singapore': 19,
 'Iceland': 20,
 'Channel Islands': 21,
 'Lebanon': 22,
 'Norway': 23,
 'United Arab Emirates': 24,
 'Denmark': 25,
 'Saudi Arabia': 26,
 'Czech Republic': 27,
 'Canada': 28,
 'Brazil': 29,
 'USA': 30,
 'European Community': 31,
 'Bahrain': 32,
 'Malta': 33,
 'Unspecified': 34}
```

```
train_set['Country']=[countries_dic[x] for x in train_set['Country']]
```

```
train_set['Country'].unique()
```

```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15,
16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32,
33,
       34])
```

```
train_set.head()
```

```
      InvoiceNo StockCode                      Description
Quantity  \
25281    538365     22469            HEART OF WICKER SMALL         8

25282    538365    84030E    ENGLISH ROSE HOT WATER BOTTLE         1

25283    538365     22112       CHOCOLATE HOT WATER BOTTLE         3

25284    538365     22835  HOT WATER BOTTLE I AM SO POORLY         5

25285    538365    84029E   RED WOOLLY HOTTIE WHITE HEART.         4


              InvoiceDate  UnitPrice  CustomerID  Country  isChurn
25281 2010-12-12 10:11:00       1.65     17243.0        0        1
25282 2010-12-12 10:11:00       4.25     17243.0        0        1
25283 2010-12-12 10:11:00       4.95     17243.0        0        1
```

```
25284 2010-12-12 10:11:00       4.65     17243.0        0        1
25285 2010-12-12 10:11:00       3.75     17243.0        0        1
```

```
train_set.count()
```

```
InvoiceNo      242032
StockCode      242032
Description    242032
Quantity       242032
InvoiceDate    242032
UnitPrice      242032
CustomerID     242032
Country        242032
isChurn        242032
dtype: int64
```

```
train_set.columns
```

```
Index(['InvoiceNo', 'StockCode', 'Description', 'Quantity',
'InvoiceDate',
       'UnitPrice', 'CustomerID', 'Country', 'isChurn'],
      dtype='object')
```

```
len(train_set['StockCode'].unique())
```

```
3574
```

```
train_set=train_set.drop(['Description'],axis=1)
```

```
train_set['StockCode']=train_set['StockCode'].str.replace('\D', '')
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:4:
FutureWarning: The default value of regex will change from True to
False in a future version.
  after removing the cwd from sys.path.
```

```
train_set=train_set[train_set['StockCode']!='']
```

```
train_set['StockCode']=train_set['StockCode'].astype(int)
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
```

```
train_set
```

```
       InvoiceNo  StockCode  Quantity         InvoiceDate
UnitPrice  \
25281     538365      22469         8 2010-12-12 10:11:00       1.65

25282     538365      84030         1 2010-12-12 10:11:00       4.25

25283     538365      22112         3 2010-12-12 10:11:00       4.95

25284     538365      22835         5 2010-12-12 10:11:00       4.65

25285     538365      84029         4 2010-12-12 10:11:00       3.75

...          ...        ...       ...                  ...        ...

540272    581474      21253         1 2011-08-12 20:01:00       0.79

540273    581474      22108         1 2011-08-12 20:01:00       1.25

540274    581474      22167         1 2011-08-12 20:01:00       9.95

540275    581474      21929         1 2011-08-12 20:01:00       2.08

540276    581474      20717         1 2011-08-12 20:01:00       1.25


        CustomerID  Country  isChurn
25281      17243.0        0        1
25282      17243.0        0        1
25283      17243.0        0        1
25284      17243.0        0        1
25285      17243.0        0        1
...            ...      ...      ...
540272     12748.0        0        1
540273     12748.0        0        1
540274     12748.0        0        1
540275     12748.0        0        1
540276     12748.0        0        1

[240977 rows x 8 columns]
```

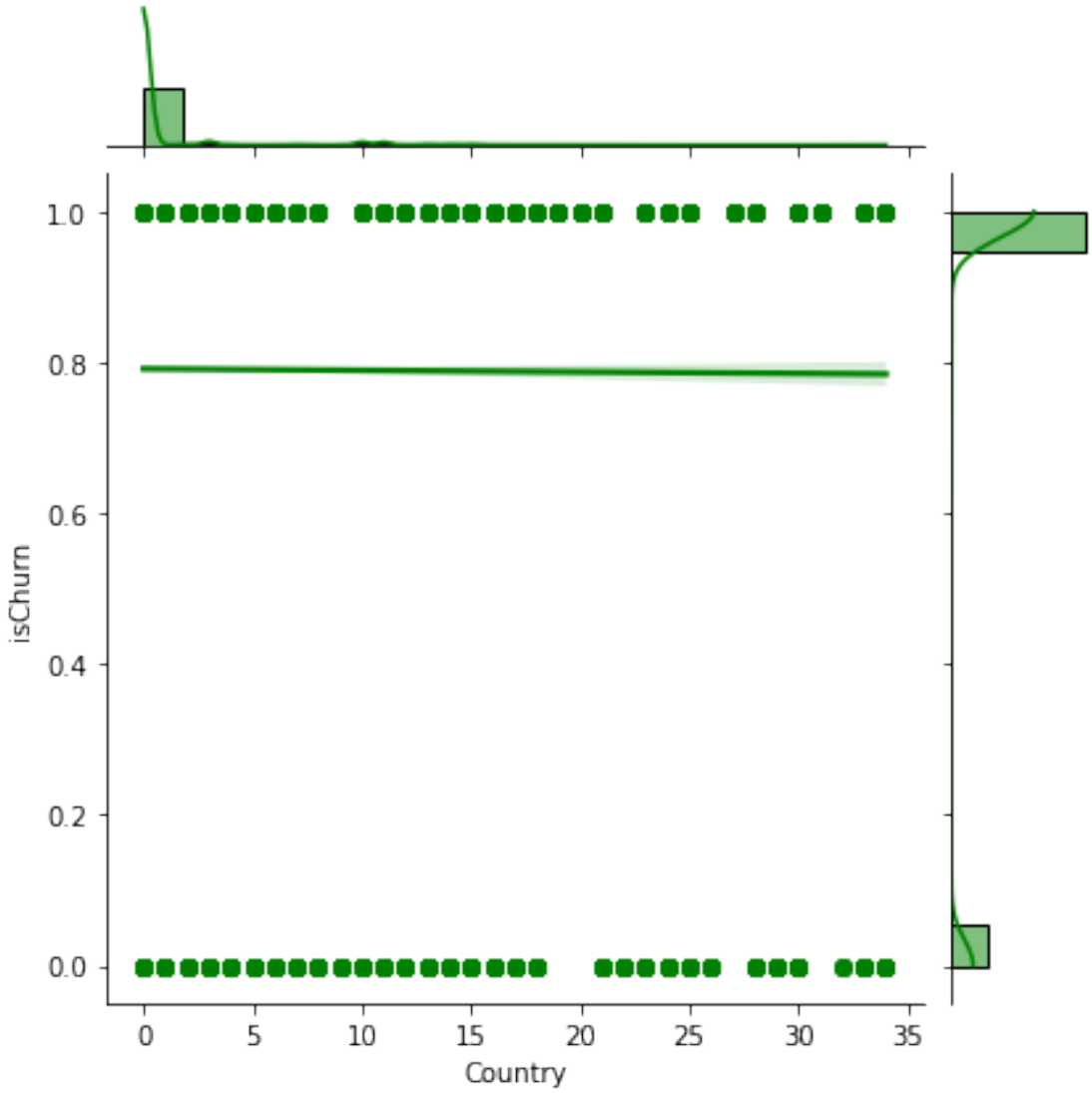
```
train_set['CustomerID']=train_set['CustomerID'].astype(int)
train_set=train_set.drop(['InvoiceNo'],axis=1)

train_set['month']=train_set['InvoiceDate'].dt.month.astype(int)
train_set['year']=train_set['InvoiceDate'].dt.year.astype(int)
train_set['day']=train_set['InvoiceDate'].dt.day.astype(int)
train_set['hour']=train_set['InvoiceDate'].dt.hour.astype(int)

train_set=train_set.drop(['InvoiceDate'],axis=1)
```

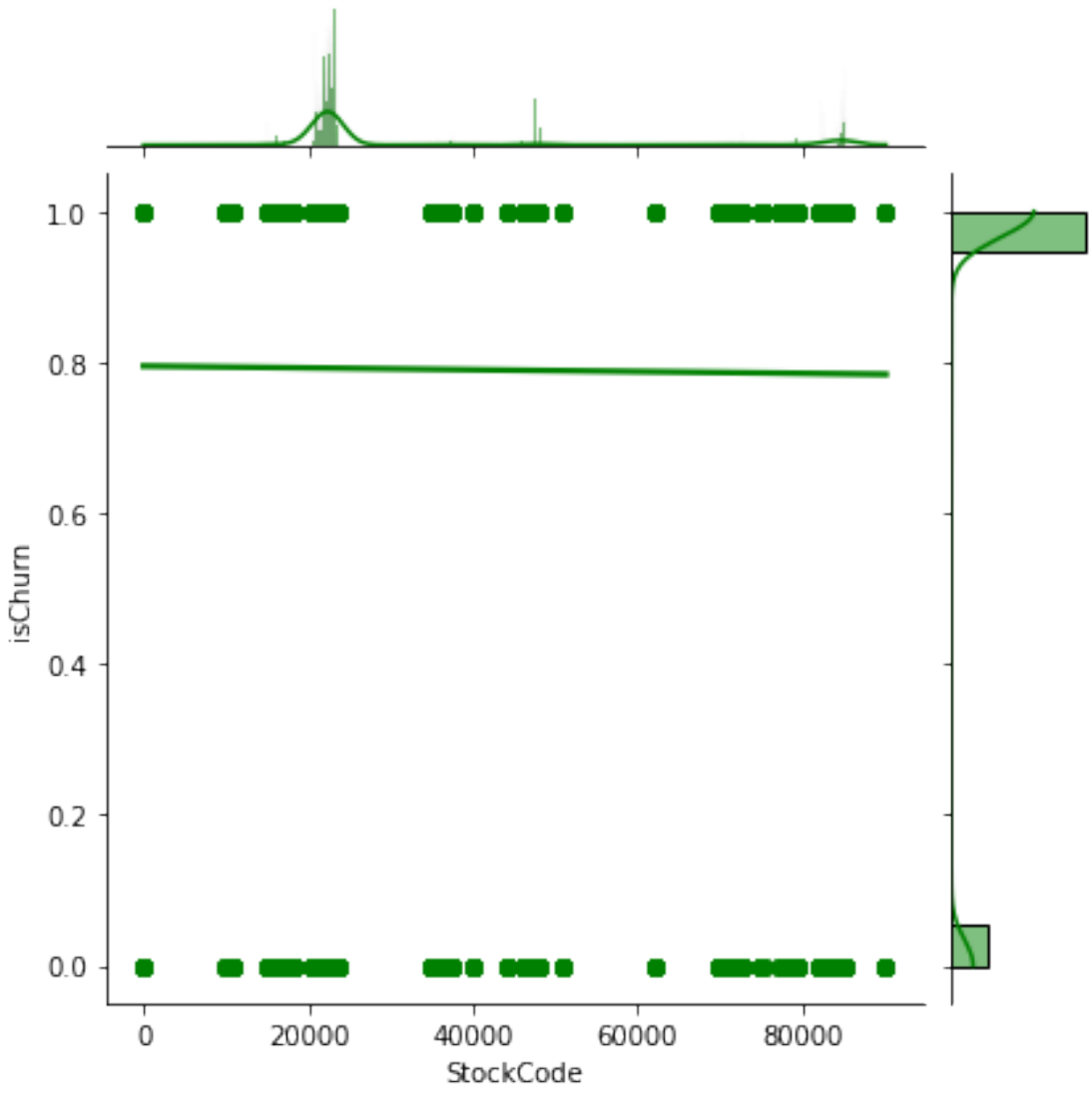
```
train_set.columns
```

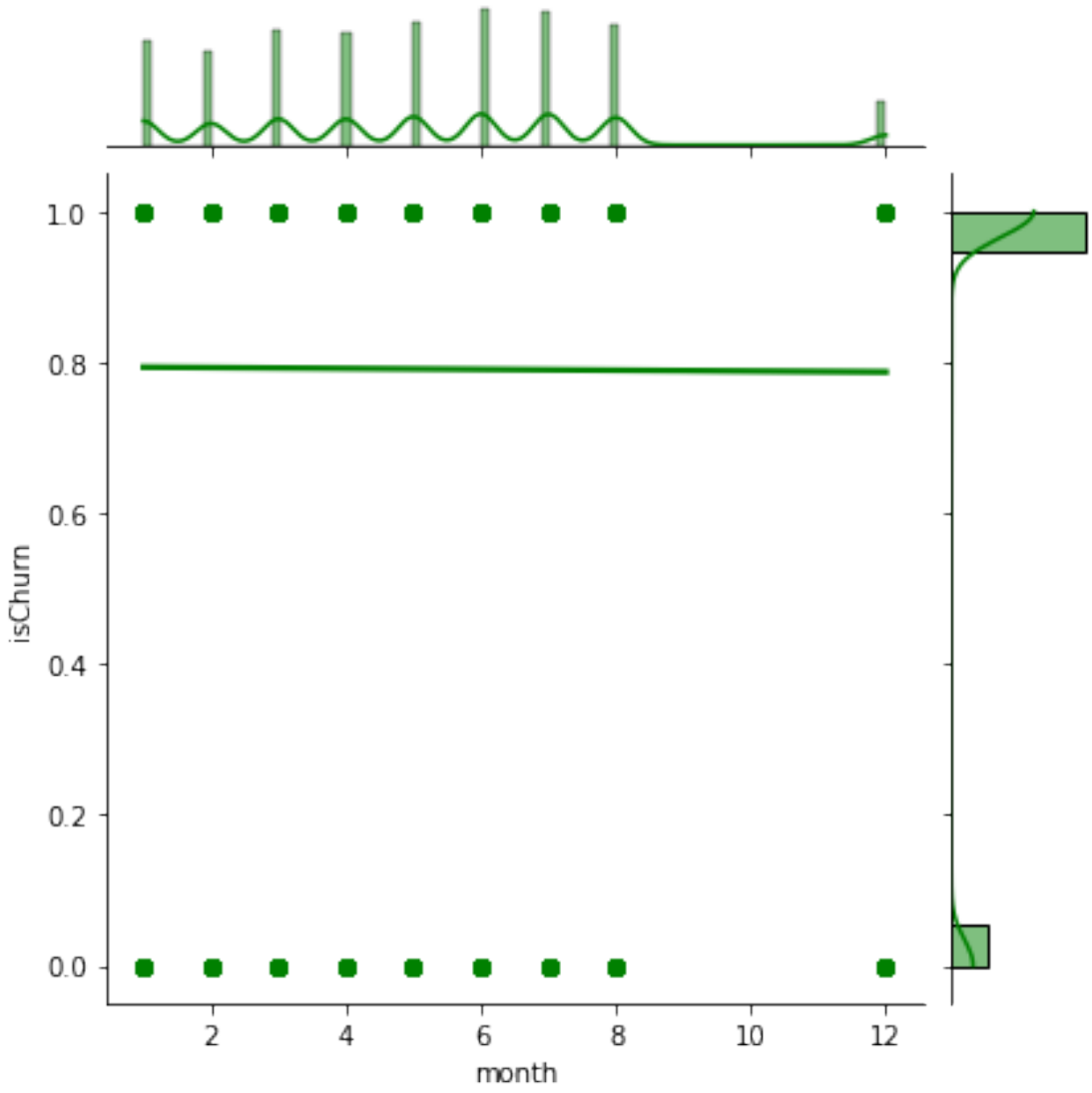
```
Index(['StockCode', 'Quantity', 'UnitPrice', 'CustomerID', 'Country',
       'isChurn', 'month', 'year', 'day', 'hour'],
      dtype='object')
```

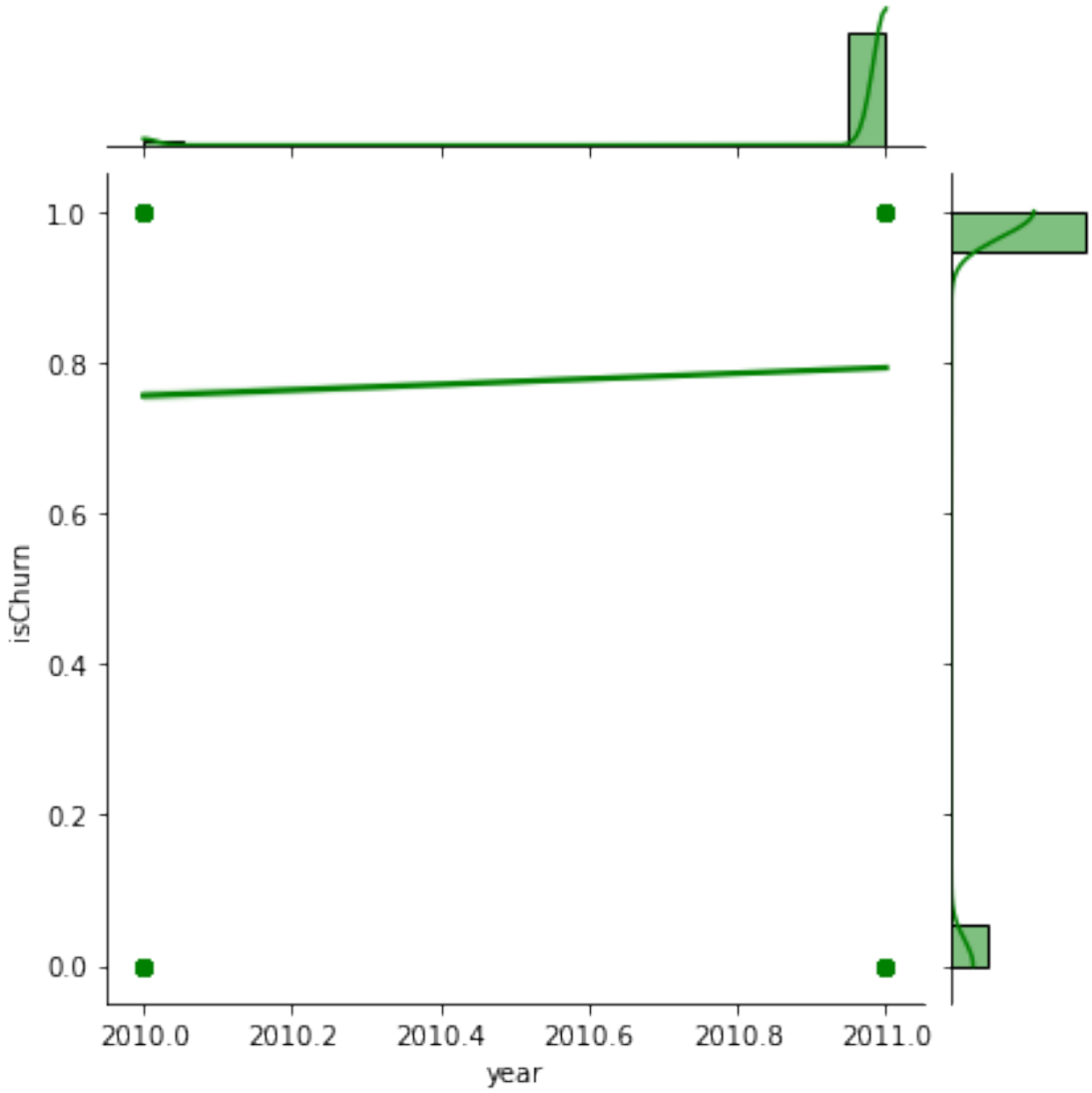
```
sns.jointplot(data=train_set, x='Country', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='StockCode', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='month', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='year', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='day', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='hour', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='UnitPrice', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='CustomerID', y='isChurn', kind='reg',
color='g')
sns.jointplot(data=train_set, x='Quantity', y='isChurn', kind='reg',
color='g')
```

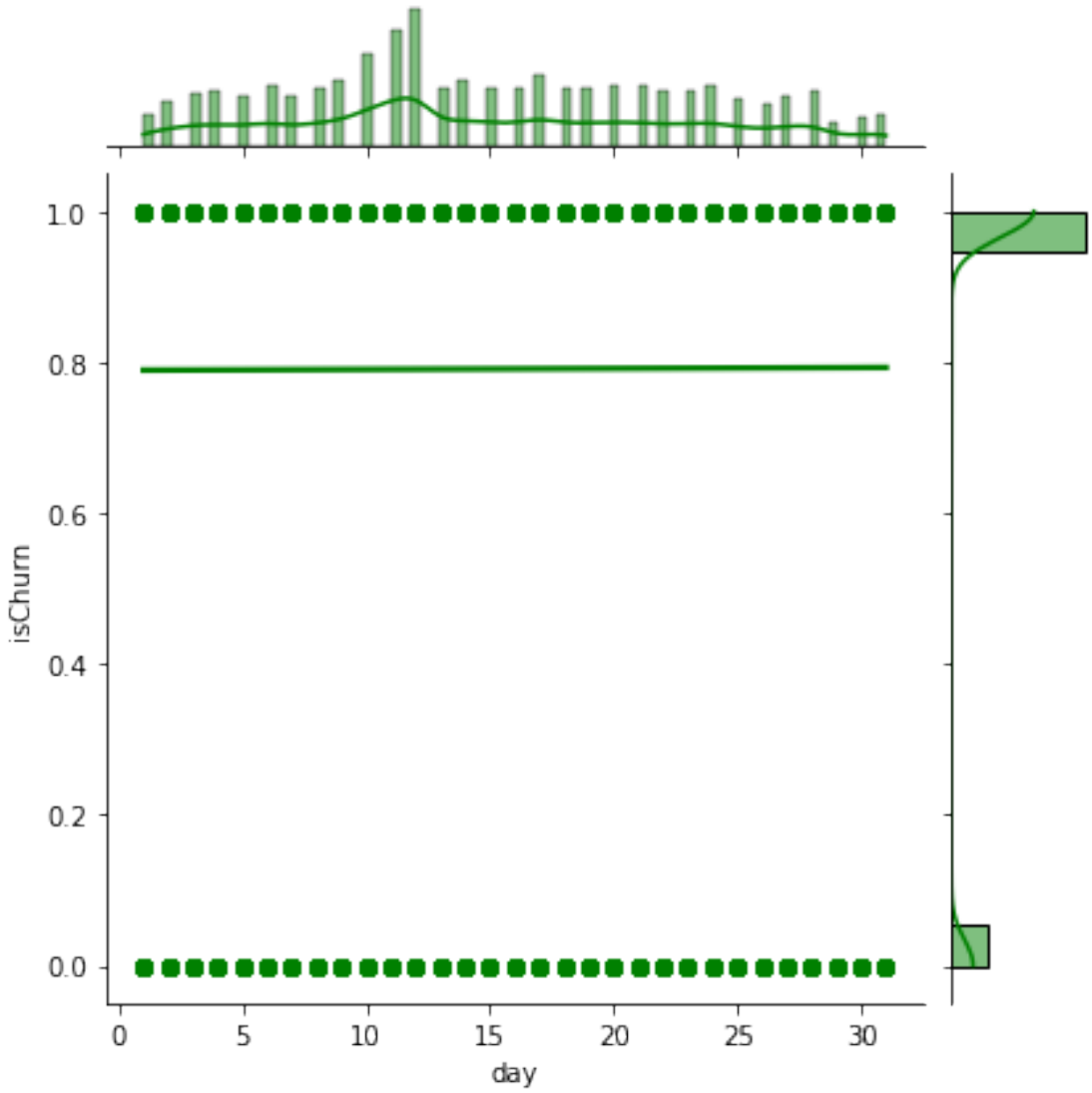
```
<seaborn.axisgrid.JointGrid at 0x7f960496acd0>
```

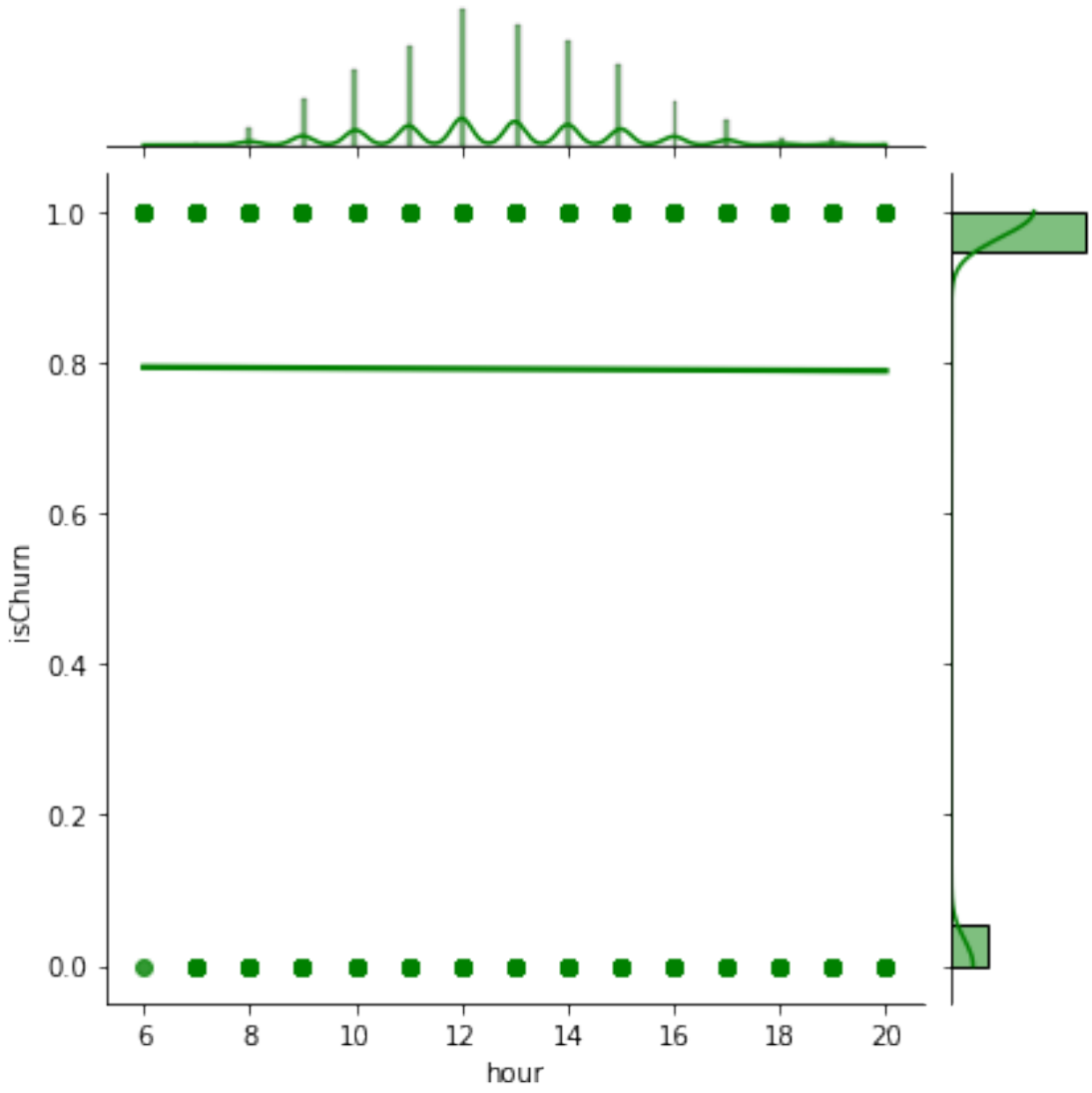

1.0
0.8
0.6
0.4
0.2
0.0
isChurn
0
5
10
15
20
25
30
35
Country

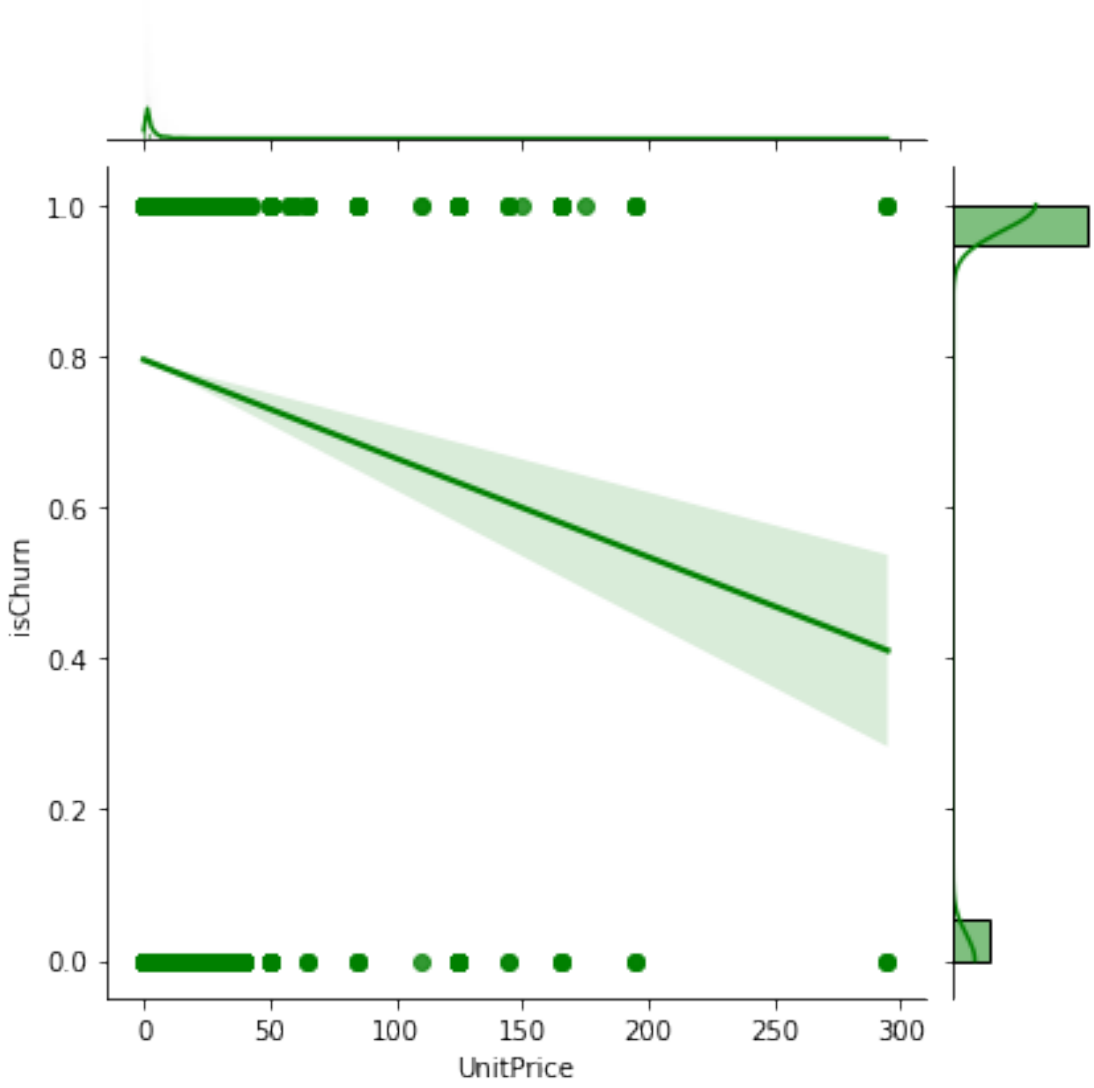

1.0
0.8
0.6
0.4
0.2
0.0
isChurn
0
20000
40000
60000
80000
StockCode

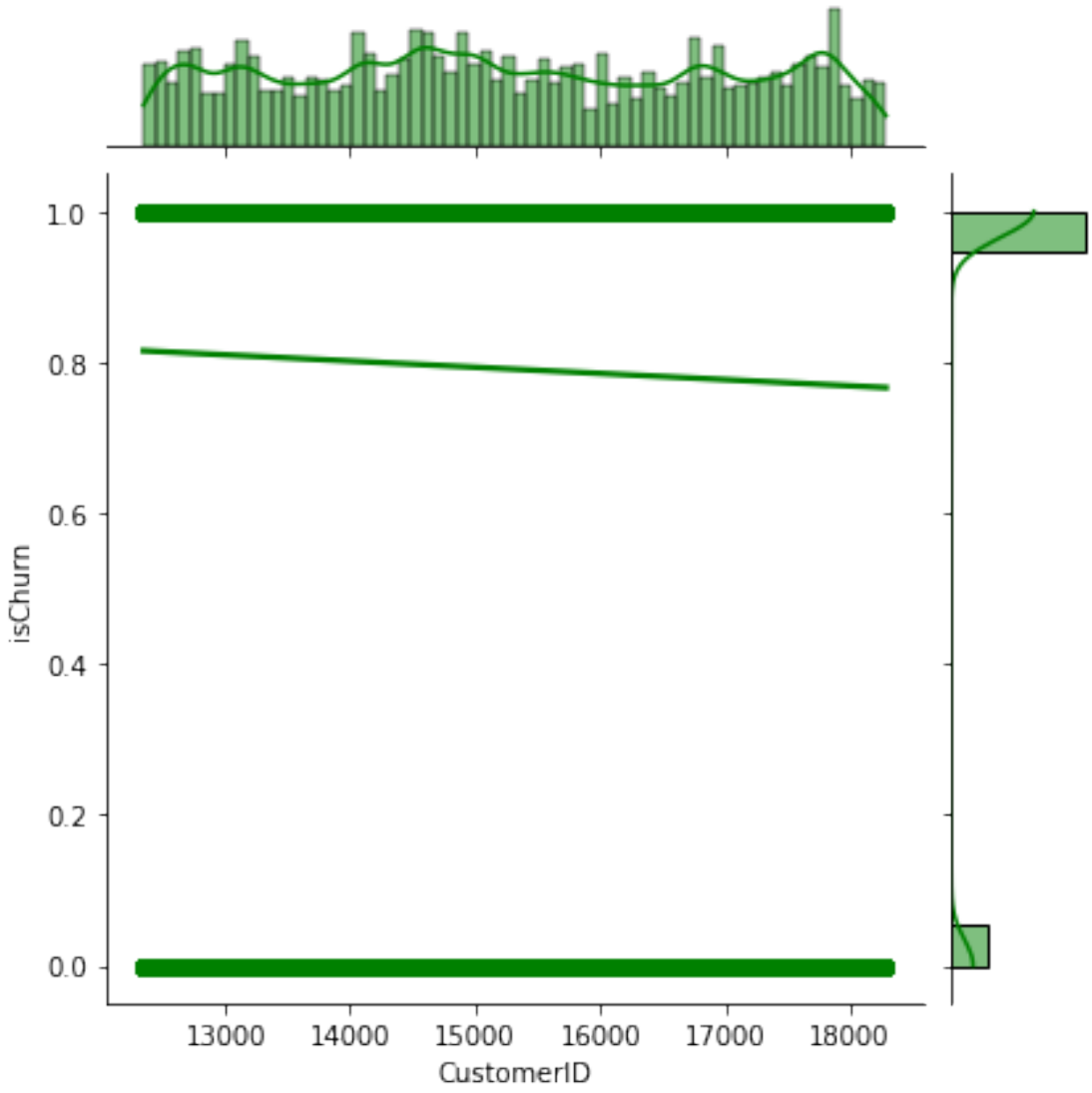

1.0
0.8
0.6
0.4
0.2
0.0
isChurn
2
4
6
8
10
12
month

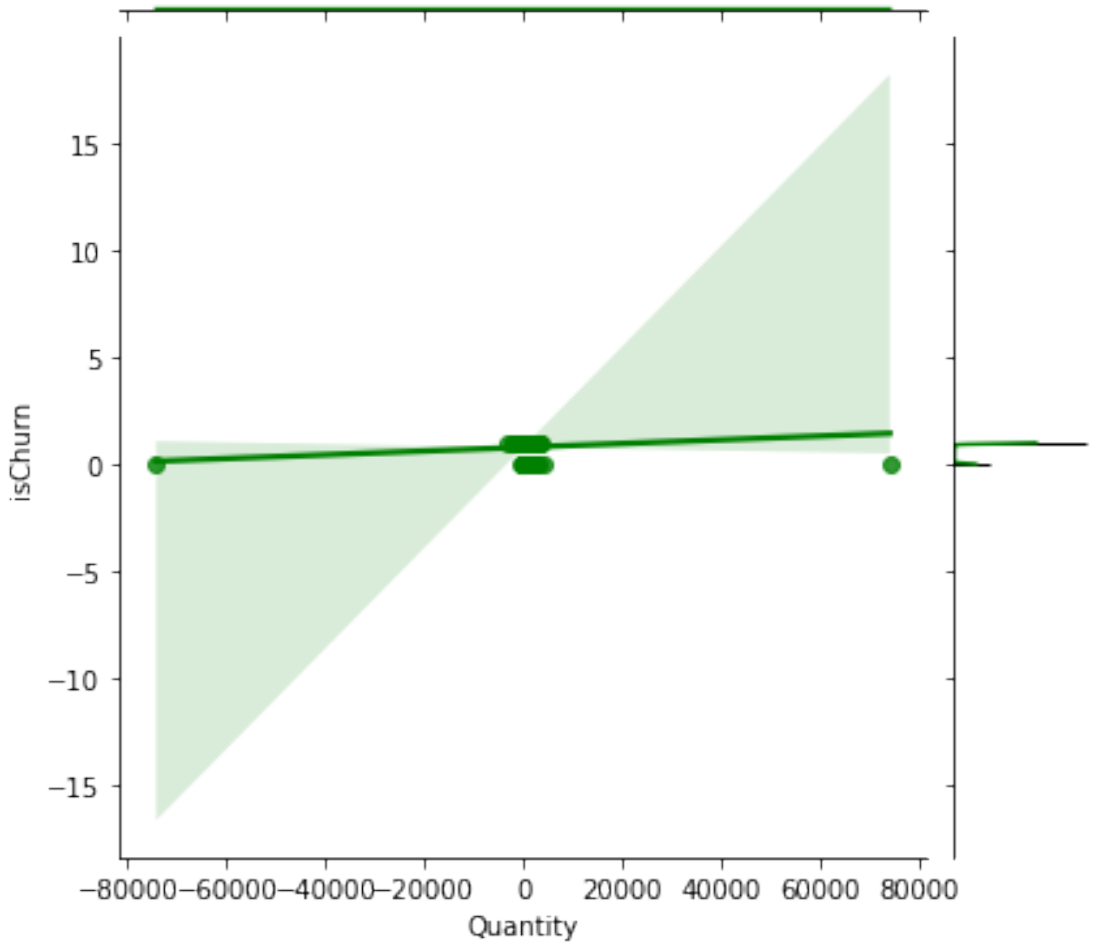

1.0
0.8
0.6
0.4
0.2
0.0
isChurn
2010.0
2010.2
2010.4
2010.6
2010.8
2011.0
year


1.0
0.8
0.6
0.4
0.2
0.0
isChurn
0
5
10
15
20
25
30
day


1.0
0.8
0.6
0.4
0.2
0.0
isChurn
6
8
10
12
14
16
18
20
hour

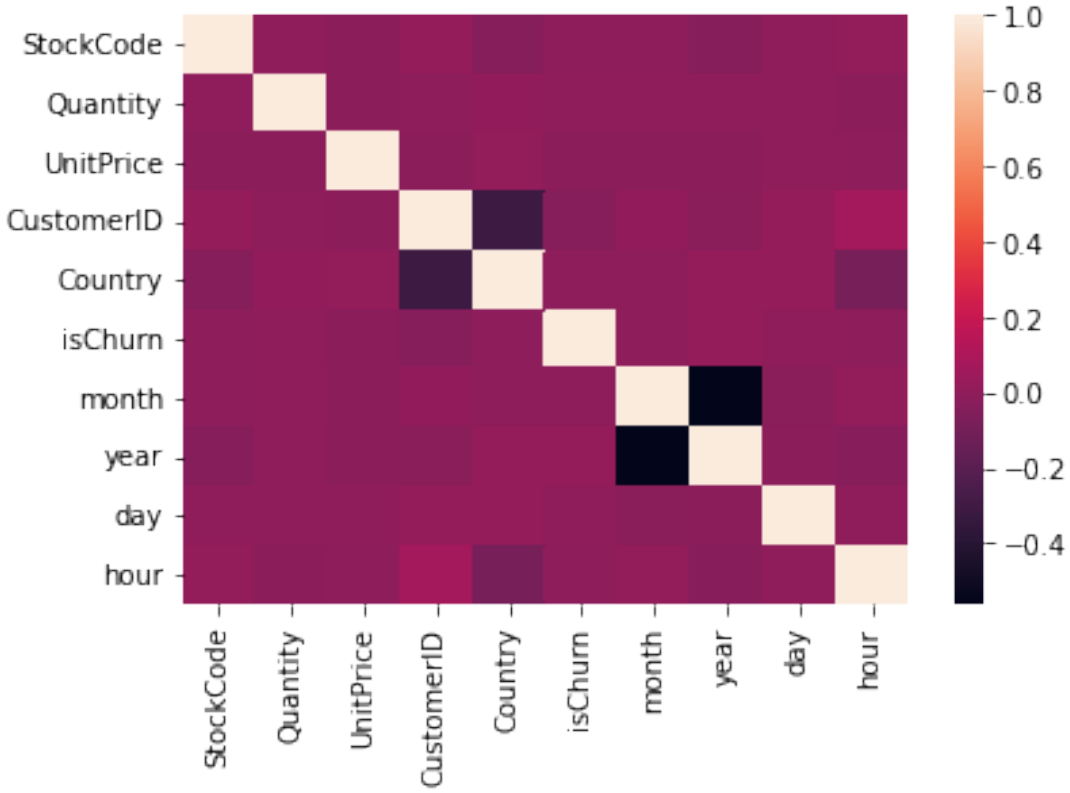

1.0
0.8
0.6
0.4
0.2
0.0
isChurn
0
50
100
150
200
250
300
UnitPrice


1.0
0.8
0.6
0.4
0.2
0.0
isChurn
13000
14000
15000
16000
17000
18000
CustomerID




```
sns.heatmap(train_set.corr())
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f94bd73a710>
```




```
from hmac import trans_36
from sklearn.preprocessing import StandardScaler,MinMaxScaler
scaler1=StandardScaler()
scaler2=MinMaxScaler()

train_set['StockCode']=scaler2.fit_transform(train_set[['StockCode']])
train_set['CustomerID']=scaler2.fit_transform(train_set[['CustomerID']
])
train_set['Country']=scaler2.fit_transform(train_set[['Country']])
train_set['Quantity']=scaler1.fit_transform(train_set[['Quantity']])
train_set['UnitPrice']=scaler1.fit_transform(train_set[['UnitPrice']])
train_set['month']=scaler1.fit_transform(train_set[['month']])
train_set['year']=scaler1.fit_transform(train_set[['year']])
train_set['day']=scaler1.fit_transform(train_set[['day']])
train_set['hour']=scaler1.fit_transform(train_set[['hour']])

train_set=train_set.drop(['year'],axis=1)
train_set
```

```
        StockCode  Quantity  UnitPrice  CustomerID  Country
isChurn  \
25281    0.249047 -0.020775  -0.291463    0.824272      0.0        1

25282    0.931450 -0.052812   0.295214    0.824272      0.0        1
```

```
25283    0.245089 -0.043658   0.453166    0.824272      0.0        1

25284    0.253104 -0.034505   0.385472    0.824272      0.0        1

25285    0.931439 -0.039082   0.182392    0.824272      0.0        1

...           ...       ...        ...         ...      ...      ...

540272   0.235567 -0.052812  -0.485518    0.067665      0.0        1

540273   0.245045 -0.052812  -0.381721    0.067665      0.0        1

540274   0.245699 -0.052812   1.581391    0.067665      0.0        1

540275   0.243061 -0.052812  -0.194436    0.067665      0.0        1

540276   0.229626 -0.052812  -0.381721    0.067665      0.0        1


          month       day      hour
25281   2.623536 -0.387228 -1.158925
25282   2.623536 -0.387228 -1.158925
25283   2.623536 -0.387228 -1.158925
25284   2.623536 -0.387228 -1.158925
25285   2.623536 -0.387228 -1.158925
...          ...       ...       ...
540272  1.119611 -0.387228  3.167983
540273  1.119611 -0.387228  3.167983
540274  1.119611 -0.387228  3.167983
540275  1.119611 -0.387228  3.167983
540276  1.119611 -0.387228  3.167983

[240977 rows x 9 columns]
```

```
y=train_set['isChurn']
x=train_set.drop(['isChurn'],axis=1)

from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test =
train_test_split(x,y,test_size=0.2,random_state=1)

X_train,X_val,y_train,y_val =
sk.model_selection.train_test_split(X_train,y_train,test_size=0.2,rand
om_state=1)

# Decision Tree

from sklearn.tree import DecisionTreeClassifier
```

```
model1=DecisionTreeClassifier()
model1.fit(X_train,y_train)
```

```
DecisionTreeClassifier()
```

```
y_pred = model1.predict(X_test)
```

```
# Evaluating decision tree
from sklearn.metrics import classification_report, confusion_matrix
print(confusion_matrix(y_test, y_pred))
print(classification_report(y_test, y_pred))
```

```
[[10069   161]
 [  191 37775]]
              precision    recall  f1-score   support

           0       0.98      0.98      0.98     10230
           1       1.00      0.99      1.00     37966

    accuracy                           0.99     48196
   macro avg       0.99      0.99      0.99     48196
weighted avg       0.99      0.99      0.99     48196
```

```
#SVM
from sklearn.svm import LinearSVC

model2=LinearSVC(max_iter=5000,verbose=True)
model2.fit(X_train,y_train)
```

```
[LibLinear]
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/svm/_base.py:1208:
ConvergenceWarning: Liblinear failed to converge, increase the number
of iterations.
  ConvergenceWarning,
```

```
LinearSVC(max_iter=5000, verbose=True)
```

```
y_pred = model2.predict(X_test)
```

```
# Evaluating SVM
from sklearn.metrics import classification_report, confusion_matrix
print(confusion_matrix(y_test, y_pred))
print(classification_report(y_test, y_pred))
```

```
[[    0 10230]
 [    2 37964]]
              precision    recall  f1-score   support

           0       0.00      0.00      0.00     10230
           1       0.79      1.00      0.88     37966
```

```
    accuracy                           0.79     48196
   macro avg       0.39      0.50      0.44     48196
weighted avg       0.62      0.79      0.69     48196
```

```
#ANN
from sklearn.neural_network import MLPClassifier

model3=MLPClassifier(max_iter=5000,verbose=True)
model3.fit(X_train,y_train)

y_pred = model3.predict(X_test)

# Evaluating neural network
from sklearn.metrics import classification_report, confusion_matrix
print(confusion_matrix(y_test, y_pred))
print(classification_report(y_test, y_pred))
```

```
[[ 1731  8499]
 [ 1096 36870]]
              precision    recall  f1-score   support

           0       0.61      0.17      0.27     10230
           1       0.81      0.97      0.88     37966

    accuracy                           0.80     48196
   macro avg       0.71      0.57      0.58     48196
weighted avg       0.77      0.80      0.75     48196
```