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

In [2]:
```
bank = pd.read_csv('bank-full.csv')
bank
```

Out[2]:

	age	job	marital	education	default	balance	housing	loan	contact	day	month
0	58	management	married	tertiary	no	2143	yes	no	unknown	5	may
1	44	technician	single	secondary	no	29	yes	no	unknown	5	may
2	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may
3	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may
4	33	unknown	single	unknown	no	1	no	no	unknown	5	may
...	...	...	...	...	...	...	...	...	...	...	...
45206	51	technician	married	tertiary	no	825	no	no	cellular	17	nov
45207	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov
45208	72	retired	married	secondary	no	5715	no	no	cellular	17	nov
45209	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov
45210	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov

45211 rows × 17 columns

In [3]:
```
df = bank.copy()
```

In [4]:
```
bank.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45211 entries, 0 to 45210
Data columns (total 17 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   age        45211 non-null  int64 
 1   job        45211 non-null  object
 2   marital    45211 non-null  object
 3   education  45211 non-null  object
 4   default    45211 non-null  object
 5   balance    45211 non-null  int64 
 6   housing    45211 non-null  object
 7   loan       45211 non-null  object
 8   contact    45211 non-null  object
 9   day        45211 non-null  int64 
 10  month      45211 non-null  object
```

```
 11  duration   45211 non-null  int64
 12  campaign   45211 non-null  int64
 13  pdays      45211 non-null  int64
 14  previous   45211 non-null  int64
 15  poutcome   45211 non-null  object
 16  y          45211 non-null  object
dtypes: int64(7), object(10)
memory usage: 5.9+ MB
```

In [5]:
```
#EDA
bank.isnull().sum()
```

Out[5]:
```
age          0
job          0
marital      0
education    0
default      0
balance      0
housing      0
loan         0
contact      0
day          0
month        0
duration     0
campaign     0
pdays        0
previous     0
poutcome     0
y            0
dtype: int64
```

In [6]:
```
bank[['y','housing','default','loan']] = bank[['y','housing','default','loan']].replace
bank
```

Out[6]:

	age	job	marital	education	default	balance	housing	loan	contact	day	month
0	58	management	married	tertiary	0	2143	1	0	unknown	5	may
1	44	technician	single	secondary	0	29	1	0	unknown	5	may
2	33	entrepreneur	married	secondary	0	2	1	1	unknown	5	may
3	47	blue-collar	married	unknown	0	1506	1	0	unknown	5	may
4	33	unknown	single	unknown	0	1	0	0	unknown	5	may
...	...	...	...	...	...	...	...	...	...	...	...
45206	51	technician	married	tertiary	0	825	0	0	cellular	17	nov
45207	71	retired	divorced	primary	0	1729	0	0	cellular	17	nov
45208	72	retired	married	secondary	0	5715	0	0	cellular	17	nov
45209	57	blue-collar	married	secondary	0	668	0	0	telephone	17	nov
45210	37	entrepreneur	married	secondary	0	2971	0	0	cellular	17	nov

45211 rows × 17 columns

In [7]:
```
bank[['y','housing','default','loan']] = bank[['y','housing','default','loan']].astype(
```

In [8]:
```
bank.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45211 entries, 0 to 45210
Data columns (total 17 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   age        45211 non-null  int64
 1   job        45211 non-null  object
 2   marital    45211 non-null  object
 3   education  45211 non-null  object
 4   default    45211 non-null  int32
 5   balance    45211 non-null  int64
 6   housing    45211 non-null  int32
 7   loan       45211 non-null  int32
 8   contact    45211 non-null  object
 9   day        45211 non-null  int64
 10  month      45211 non-null  object
 11  duration   45211 non-null  int64
 12  campaign   45211 non-null  int64
 13  pdays      45211 non-null  int64
 14  previous   45211 non-null  int64
 15  poutcome   45211 non-null  object
 16  y          45211 non-null  int32
dtypes: int32(4), int64(7), object(6)
memory usage: 5.2+ MB
```

In [9]:
```
bank['month'].unique()
```

Out[9]:
```
array(['may', 'jun', 'jul', 'aug', 'oct', 'nov', 'dec', 'jan', 'feb',
       'mar', 'apr', 'sep'], dtype=object)
```

In [10]:
```
bank.shape
```

Out[10]:
```
(45211, 17)
```

In [11]:
```
bank.head()
```

Out[11]:

	age	job	marital	education	default	balance	housing	loan	contact	day	month	dur
0	58	management	married	tertiary	0	2143	1	0	unknown	5	may	
1	44	technician	single	secondary	0	29	1	0	unknown	5	may	
2	33	entrepreneur	married	secondary	0	2	1	1	unknown	5	may	
3	47	blue-collar	married	unknown	0	1506	1	0	unknown	5	may	
4	33	unknown	single	unknown	0	1	0	0	unknown	5	may	

In [12]:

```
bank1 = pd.concat([bank.iloc[:,0:1],bank.iloc[:,4:8],bank.iloc[:,9:10],bank.iloc[:,11:1
bank1
```

Out[12]:

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous	y
0	58	0	2143	1	0	5	261	1	-1	0	0
1	44	0	29	1	0	5	151	1	-1	0	0
2	33	0	2	1	1	5	76	1	-1	0	0
3	47	0	1506	1	0	5	92	1	-1	0	0
4	33	0	1	0	0	5	198	1	-1	0	0
...	...	...	...	...	...	...	...	...	...	...	...
45206	51	0	825	0	0	17	977	3	-1	0	1
45207	71	0	1729	0	0	17	456	2	-1	0	1
45208	72	0	5715	0	0	17	1127	5	184	3	1
45209	57	0	668	0	0	17	508	4	-1	0	0
45210	37	0	2971	0	0	17	361	2	188	11	0

45211 rows × 11 columns

In [ ]:

```
```

In [13]:

```
#select features and target
x = bank1.drop('y',axis=1)
y = bank1['y']
x
```

Out[13]:

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous
0	58	0	2143	1	0	5	261	1	-1	0
1	44	0	29	1	0	5	151	1	-1	0
2	33	0	2	1	1	5	76	1	-1	0
3	47	0	1506	1	0	5	92	1	-1	0
4	33	0	1	0	0	5	198	1	-1	0
...	...	...	...	...	...	...	...	...	...	...
45206	51	0	825	0	0	17	977	3	-1	0
45207	71	0	1729	0	0	17	456	2	-1	0
45208	72	0	5715	0	0	17	1127	5	184	3
45209	57	0	668	0	0	17	508	4	-1	0
45210	37	0	2971	0	0	17	361	2	188	11

45211 rows × 10 columns

In [14]:
```
#train test spliting
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(x,y,test_size=0.25)
```

In [15]:
```
bank1.head()
```

Out[15]:

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous	y
0	58	0	2143	1	0	5	261	1	-1	0	0
1	44	0	29	1	0	5	151	1	-1	0	0
2	33	0	2	1	1	5	76	1	-1	0	0
3	47	0	1506	1	0	5	92	1	-1	0	0
4	33	0	1	0	0	5	198	1	-1	0	0

In [ ]:
```
```

In [16]:
```
X_test
```

Out[16]:

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous
18443	51	0	3029	1	1	31	118	2	-1	0
31473	27	0	0	1	0	1	124	1	-1	0
30988	26	0	1114	0	0	9	44	2	-1	0
12874	32	0	-398	0	1	7	387	2	-1	0
43295	42	0	16517	0	0	15	549	5	203	4
...	...	...	...	...	...	...	...	...	...	...
32800	34	0	520	1	0	17	401	1	248	4
32969	31	0	505	1	0	17	218	4	329	2
41541	67	0	708	0	0	11	96	2	-1	0
43528	31	0	410	0	0	23	342	1	-1	0
11764	43	0	584	0	0	20	27	1	-1	0

11303 rows × 10 columns

In [17]:
```
X_train
```

Out[17]:

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous
4199	34	0	705	1	1	19	1203	3	-1	0
7504	42	0	163	1	0	29	62	6	-1	0

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous
3023	60	0	751	1	0	14	115	3	-1	0
32377	48	0	113	1	0	16	255	2	318	5
334	45	0	24598	1	0	5	313	3	-1	0
...	...	...	...	...	...	...	...	...	...	...
6305	25	0	776	1	0	27	290	1	-1	0
36258	37	0	20	1	0	11	207	1	370	1
7361	34	0	500	1	0	29	399	1	-1	0
23167	40	0	6	0	0	27	26	16	-1	0
40796	24	0	2376	0	0	11	123	1	106	1

33908 rows × 10 columns

In [18]:
```
y_train
```

Out[18]:
```
4199     0
7504     0
3023     0
32377    0
334      0
        ..
6305     0
36258    0
7361     0
23167    0
40796    0
Name: y, Length: 33908, dtype: int32
```

In [19]:
```
y_test
```

Out[19]:
```
18443    0
31473    0
30988    0
12874    0
43295    0
        ..
32800    0
32969    0
41541    0
43528    1
11764    0
Name: y, Length: 11303, dtype: int32
```

In [20]:
```
#model creation
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(X_train,y_train)
```

Out[20]:
```
LogisticRegression()
```

In [21]:
```
#prediction
y_pred = model.predict(X_test)
```

In [22]:
```
pd.DataFrame({"Actual":y_test,"Prediction":y_pred})
```

Out[22]:

	Actual	Prediction
18443	0	0
31473	0	0
30988	0	0
12874	0	0
43295	0	0
...	...	...
32800	0	0
32969	0	0
41541	0	0
43528	1	0
11764	0	0

11303 rows × 2 columns

In [ ]:
```

```

In [23]:
```
#Accuracy testing (confusion matrix)
from sklearn.metrics import confusion_matrix, accuracy_score, classification_report
```

In [24]:
```
cm = confusion_matrix(y_test,y_pred)
cm
```

Out[24]:
```
array([[9765,  199],
       [1087,  252]], dtype=int64)
```

In [25]:
```
accuracy_score(y_test,y_pred)
```

Out[25]:
```
0.8862248960452977
```

In [26]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.90      0.98      0.94      9964
           1       0.56      0.19      0.28      1339
```

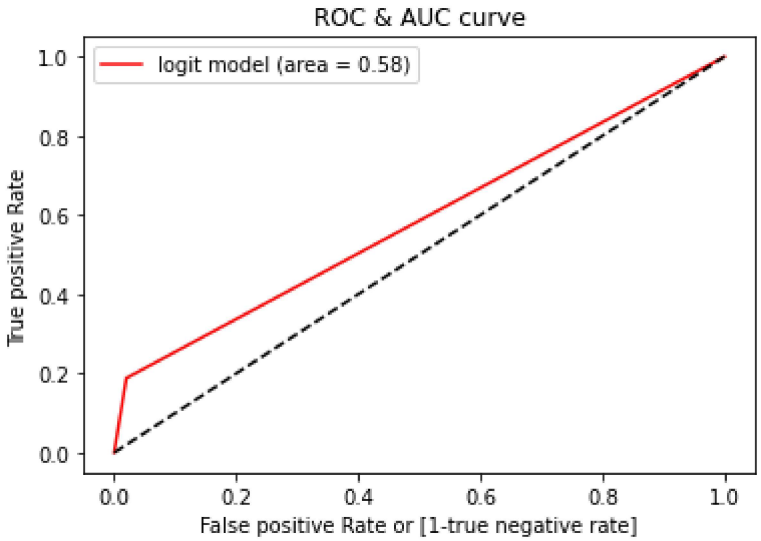
```
              accuracy                           0.89     11303
             macro avg       0.73      0.58      0.61     11303
          weighted avg       0.86      0.89      0.86     11303
```

In [27]:
```
#roc-auc curve
from sklearn.metrics import roc_curve,roc_auc_score
```

In [28]:
```
fpr, tpr, thresholds = roc_curve(y_test,y_pred)

auc = roc_auc_score(y_test,y_pred)
```

In [29]:
```
plt.plot(fpr, tpr, color='red', label='logit model (area = %0.2f)'%auc)
plt.plot([0,1],[0,1],'k--')
plt.title("ROC & AUC curve")
plt.xlabel('False positive Rate or [1-true negative rate]')
plt.ylabel('True positive Rate')
plt.legend()
plt.show()
```



In [45]:
```
#user testing
bank1.head()
```

Out[45]:

	age	default	balance	housing	loan	day	duration	campaign	pdays	previous	y
0	58	0	2143	1	0	5	261	1	-1	0	0
1	44	0	29	1	0	5	151	1	-1	0	0
2	33	0	2	1	1	5	76	1	-1	0	0
3	47	0	1506	1	0	5	92	1	-1	0	0
4	33	0	1	0	0	5	198	1	-1	0	0

In [40]:
```
def user_testing(data):
    new = pd.DataFrame(data,index=[0])
```

```
    result = model.predict(new)[0]
    if result==0:
        print("yes, subscribed a term deposit")
    else:
        print("Accepted!!")
```

In [46]:
```
data = {"age":33,"default":0,"balance":2,"housing":1,"loan":1,"day":5,"duration":76,"ca
```

In [47]:
```
user_testing(data)
```

```
yes, subscribed a term deposit
```

In [ ]:
```

```