a. Last name: Roy b. The date: 09/05/2019 c. I applied Random Forest Classifier d. AUC: 0.94 e. Dropped 'gender' and 'device type', and applied SMOTE to balance the data set

In [1]:

```
#Importing libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [2]:

```
#Importing datafile
raw_train_data = pd.read_csv('data/train.csv')
raw_test_data = pd.read_csv('data/test.csv')
```

In [3]:

```
#First 5 rows of train data
raw_train_data.head()
```

Out[3]:

	age	cost_of_ad	device_type	gender	in_initial_launch_location	income	n_drivers	n_vehicles	prior_ins_tenure	outco
0	56	0.005737	iPhone	M	0	62717	2	1	4	0
1	50	0.004733	desktop	F	0	64328	2	3	2	0
2	54	0.004129	laptop	M	0	83439	1	3	7	0
3	16	0.005117	Android	F	0	30110	2	3	0	0
4	37	0.003635	desktop	M	0	76565	2	1	5	0

In [4]:

```
#First 5 rows of test data
raw_test_data.head()
```

Out[4]:

	age	cost_of_ad	device_type	gender	in_initial_launch_location	income	n_drivers	n_vehicles	prior_ins_tenure
0	34	0.005134	Android	F	1	40376	1	3	7
1	53	0.005223	desktop	F	1	84511	1	1	11
2	46	0.004939	laptop	F	0	79322	1	1	4
3	36	0.004924	Android	F	0	63295	1	2	0
4	28	0.005146	other	F	1	36170	1	3	3

In [5]:

```
#Exploratory Data Analysis
```

In [6]:

```
raw_train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 10 columns):
```

```
age                            10000 non-null int64
cost_of_ad                     10000 non-null float64
device_type                    10000 non-null object
gender                         9731 non-null object
in_initial_launch_location     10000 non-null int64
income                         10000 non-null int64
n_drivers                      10000 non-null int64
n_vehicles                     10000 non-null int64
prior_ins_tenure               10000 non-null int64
outcome                        10000 non-null int64
dtypes: float64(1), int64(7), object(2)
memory usage: 781.3+ KB
```

In [13]:

```
#Making a list of the variables that contain missing values
raw_train_data.isnull().sum()
```

Out[13]:

```
age                            0
cost_of_ad                     0
device_type                    0
gender                       269
in_initial_launch_location     0
income                         0
n_drivers                      0
n_vehicles                     0
prior_ins_tenure               0
outcome                        0
dtype: int64
```

In [8]:

```
#Making a list of Unique values
raw_train_data.nunique()
```

Out[8]:

```
age                           45
cost_of_ad                  9984
device_type                    5
gender                         2
in_initial_launch_location     2
income                      9268
n_drivers                      2
n_vehicles                     3
prior_ins_tenure              23
outcome                        2
dtype: int64
```

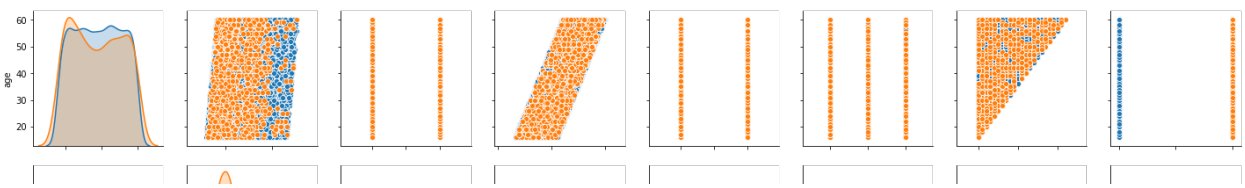
In [14]:

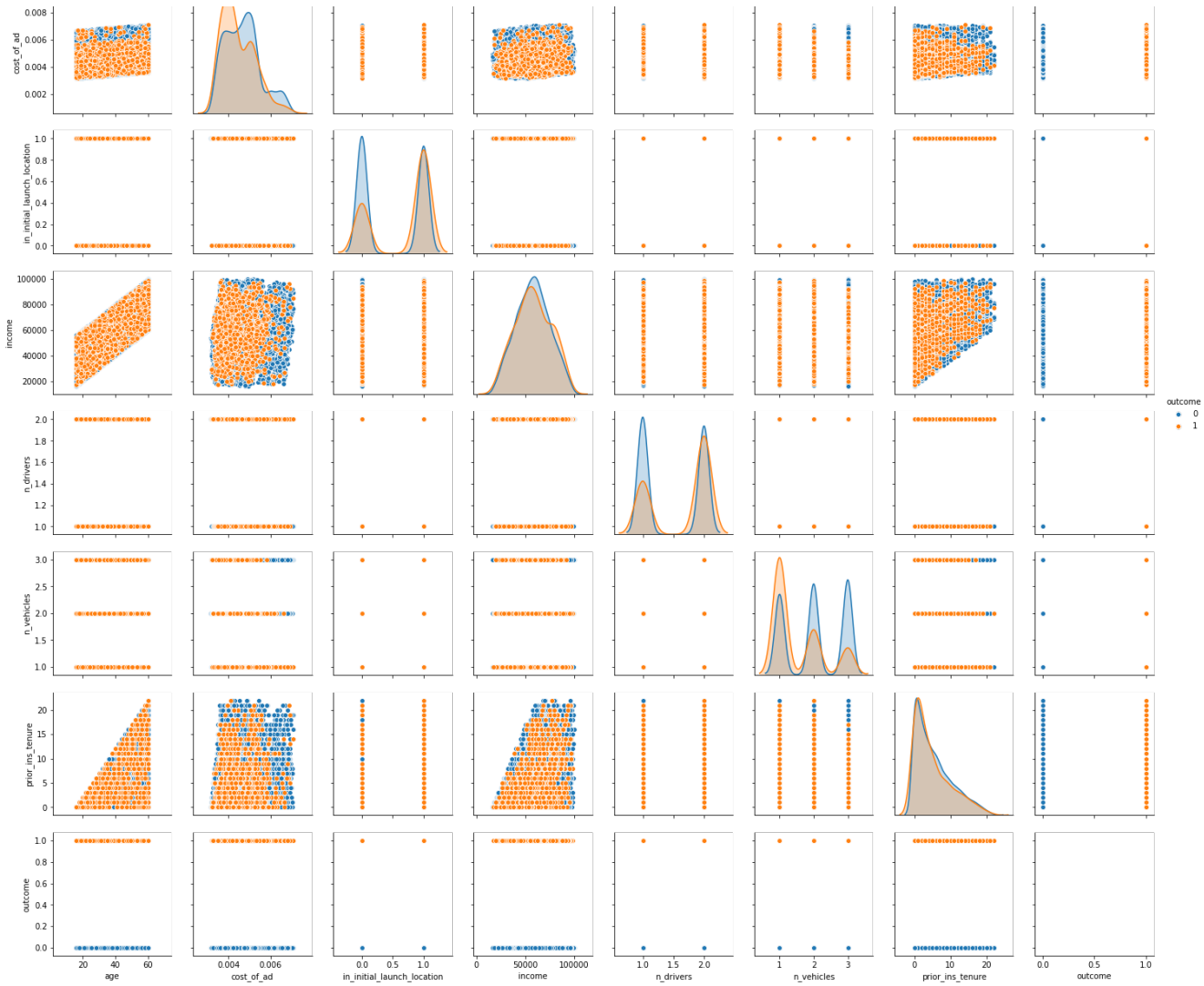
```
sns.pairplot(raw_train_data,hue='outcome')
```

```
C:\Users\imroy\Anaconda3\lib\site-packages\statsmodels\nonparametric\kde.py:487: RuntimeWarning: i
nvalid value encountered in true_divide
  binned = fast_linbin(X, a, b, gridsize) / (delta * nobs)
C:\Users\imroy\Anaconda3\lib\site-packages\statsmodels\nonparametric\kdetools.py:34:
RuntimeWarning: invalid value encountered in double_scalars
  FAC1 = 2*(np.pi*bw/RANGE)**2
```

Out[14]:

```
<seaborn.axisgrid.PairGrid at 0x1e638c868d0>
```



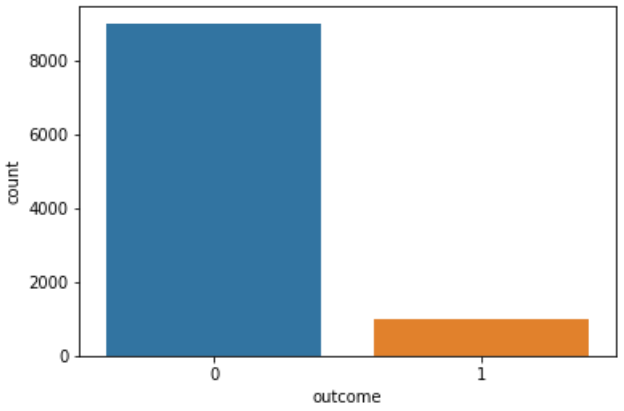


In [15]:

```
# Checking the balance of the train data
sns.countplot(x="outcome",data=raw_train_data)
```

Out[15]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1e63b787748>
```



In [16]:

```
raw_train_data.query('outcome==1').count()
```

Out[16]:

```
age                    982
cost_of_ad             982
device_type            982
gender                 973
```

```
in_initial_launch_location    982
income                        982
n_drivers                     982
n_vehicles                    982
prior_ins_tenure              982
outcome                       982
dtype: int64
```

In [17]:

```
#Oversampling to balance the data set
from imblearn.over_sampling import SMOTE

# Resample the minority class.
sm = SMOTE(sampling_strategy='minority', random_state=7)

# Fit the model to generate the data.
data_trainX, data_trainY = sm.fit_sample(raw_train_data.drop(['device_type','gender','outcome'],
axis=1),raw_train_data['outcome'])
```

```
C:\Users\imroy\Anaconda3\lib\site-packages\sklearn\externals\six.py:31: DeprecationWarning: The mo
dule is deprecated in version 0.21 and will be removed in version 0.23 since we've dropped support
for Python 2.7. Please rely on the official version of six (https://pypi.org/project/six/).
  "(https://pypi.org/project/six/).", DeprecationWarning)
```

In [18]:

```
raw_train_data.columns
```

Out[18]:

```
Index(['age', 'cost_of_ad', 'device_type', 'gender',
       'in_initial_launch_location', 'income', 'n_drivers', 'n_vehicles',
       'prior_ins_tenure', 'outcome'],
      dtype='object')
```

In [19]:

```
#Converting in to dataframe
data_trainY = pd.DataFrame(data_trainY)
data_trainX = pd.DataFrame(data_trainX)
#adding header
data_trainY.rename(columns={0:'outcome'}, inplace=True)
data_trainX.rename(columns={0:'age',1:'cost_of_ad',2:'in_initial_launch_location',3:'income',4:'n_d
rivers',5:'n_vehicles',6:'prior_ins_tenure'},inplace=True)
#mearging both the dataframe
oversampled_train = pd.concat([data_trainY, data_trainX], axis=1)
```

In [20]:

```
oversampled_train.head()
```

Out[20]:

	outcome	age	cost_of_ad	in_initial_launch_location	income	n_drivers	n_vehicles	prior_ins_tenure
0	0	56.0	0.005737	0.0	62717.0	2.0	1.0	4.0
1	0	50.0	0.004733	0.0	64328.0	2.0	3.0	2.0
2	0	54.0	0.004129	0.0	83439.0	1.0	3.0	7.0
3	0	16.0	0.005117	0.0	30110.0	2.0	3.0	0.0
4	0	37.0	0.003635	0.0	76565.0	2.0	1.0	5.0

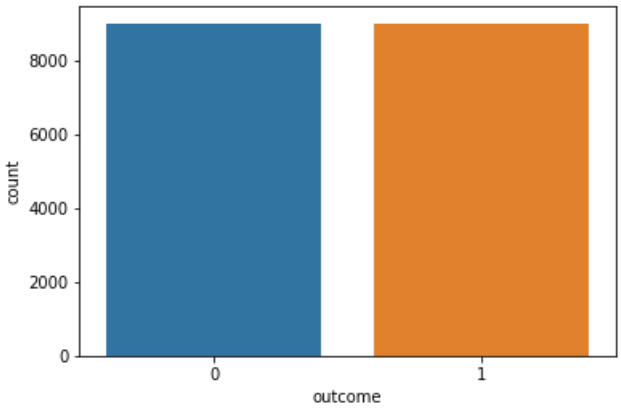
In [21]:

```
sns.countplot(x="outcome",data=oversampled_train)
```

Out[21]:

Out[21]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1e6402356d8>
```



In [22]:

```
oversampled_train.columns
```

Out[22]:

```
Index(['outcome', 'age', 'cost_of_ad', 'in_initial_launch_location', 'income',
       'n_drivers', 'n_vehicles', 'prior_ins_tenure'],
      dtype='object')
```

In [23]:

```
feature_cols = ['age', 'cost_of_ad', 'in_initial_launch_location', 'income',
       'n_drivers', 'n_vehicles', 'prior_ins_tenure']
```

In [24]:

```
target_col = ['outcome']
```

In [25]:

```
X = oversampled_train[feature_cols]
```

In [26]:

```
X.head()
```

Out[26]:

	age	cost_of_ad	in_initial_launch_location	income	n_drivers	n_vehicles	prior_ins_tenure
0	56.0	0.005737	0.0	62717.0	2.0	1.0	4.0
1	50.0	0.004733	0.0	64328.0	2.0	3.0	2.0
2	54.0	0.004129	0.0	83439.0	1.0	3.0	7.0
3	16.0	0.005117	0.0	30110.0	2.0	3.0	0.0
4	37.0	0.003635	0.0	76565.0	2.0	1.0	5.0

In [27]:

```
y = oversampled_train[target_col]
```

In [28]:

```
y.head()
```

Out[28]:

	outcome
0	0
1	0
2	0
3	0
4	0

In [29]:

```
from sklearn.model_selection import train_test_split
```

In [30]:

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

In [31]:

```
from sklearn.ensemble import RandomForestClassifier
```

In [32]:

```
RF = RandomForestClassifier(n_estimators=125)
```

In [33]:

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

```
C:\Users\imroy\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape of y to
(n_samples,), for example using ravel().
  """Entry point for launching an IPython kernel.
```

Out[33]:

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                       max_depth=None, max_features='auto', max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=125,
                       n_jobs=None, oob_score=False, random_state=None,
                       verbose=0, warm_start=False)
```

In [34]:

```
prediction_RF = RF.predict(X_test)
```

In [35]:

```
from sklearn.metrics import confusion_matrix,classification_report
```

In [36]:

```
#Random Forests Evaluation
print(confusion_matrix(y_test,prediction_RF))
```

```
[[2572   96]
 [ 256 2487]]
```

In [37]:

```
print(classification_report(y_test,prediction_RF))
```

```
              precision    recall  f1-score   support

           0       0.91      0.96      0.94      2668
           1       0.96      0.91      0.93      2743

    accuracy                           0.93      5411
   macro avg       0.94      0.94      0.93      5411
weighted avg       0.94      0.93      0.93      5411
```

In [38]:

```
from sklearn.metrics import roc_auc_score
```

In [39]:

```
roc_auc_score(y_test,prediction_RF)
```

Out[39]:

```
0.935344759264553
```

In [41]:

```
from sklearn.model_selection import cross_val_score
```

In [42]:

```
# Application of 10-fold stratified cross-validation
CV_Score = cross_val_score(RF, X, y, cv=10)
print("Cross-validation scores: {}".format(CV_Score))
print("Average cross-validation score: {:.2f}".format(CV_Score.mean()))
```

```
C:\Users\imroy\Anaconda3\lib\site-packages\sklearn\model_selection\_validation.py:514:
DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
e shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
C:\Users\imroy\Anaconda3\lib\site-packages\sklearn\model_selection\_validation.py:514:
DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
e shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
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DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
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DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
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DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
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C:\Users\imroy\Anaconda3\lib\site-packages\sklearn\model_selection\_validation.py:514:
DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
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  estimator.fit(X_train, y_train, **fit_params)
C:\Users\imroy\Anaconda3\lib\site-packages\sklearn\model_selection\_validation.py:514:
DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
e shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
C:\Users\imroy\Anaconda3\lib\site-packages\sklearn\model_selection\_validation.py:514:
```

```
DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change th
e shape of y to (n_samples,), for example using ravel().
  estimator.fit(X_train, y_train, **fit_params)
```

```
Cross-validation scores: [0.6097561  0.94013304 0.9695122  0.97616408 0.98059867 0.97616408
 0.97727273 0.98115299 0.9672586  0.9772475 ]
Average cross-validation score: 0.94
```

In [43]:

```
final_predict = RF.predict(raw_test_data[feature_cols])
```

In [47]:

```
final_predict = pd.DataFrame(final_predict)
```

In [51]:

```
final_predict.rename(columns={0:'outcome'}, inplace=True)
```

In [71]:

```
#Final result on Test data
final_predict.head()
```

Out[71]:

	outcome
0	0
1	0
2	0
3	0
4	0