Employee Turnover Prediction project

In [2]:
```
import pandas as pd
hr = pd.read_csv('D:\HR.csv')
col_names = hr.columns.tolist()
print("Column names:")
print(col_names)
print("\nSample data:")
hr.head()
```

```
Column names:
['satisfaction_level', 'last_evaluation', 'number_project', 'average_montly_hours', 'time_spend_company', 'Work_accident', 'left', 'promotion_last_5years', 'sales', 'salary']

Sample data:
```

Out[2]:

	satisfaction_level	last_evaluation	number_project	average_montly_hours	time_spend_company	Work_accident	left	promotion_last_5years	sales	salary
0	0.38	0.53	2	157	3	0	1	0	sales	low
1	0.80	0.86	5	262	6	0	1	0	sales	medium
2	0.11	0.88	7	272	4	0	1	0	sales	medium
3	0.72	0.87	5	223	5	0	1	0	sales	low
4	0.37	0.52	2	159	3	0	1	0	sales	low

In [3]:
```
hr=hr.rename(columns = {'sales':'department'})
```

In [4]:
```
hr['department'].unique()
```

Out[4]:
```
array(['sales', 'accounting', 'hr', 'technical', 'support', 'management',
       'IT', 'product_mng', 'marketing', 'RandD'], dtype=object)
```

In [5]:
```
import numpy as np
hr['department']=np.where(hr['department'] =='support', 'technical', hr['department'])
hr['department']=np.where(hr['department'] =='IT', 'technical', hr['department'])
```

In [6]:
```
cat_vars=['department','salary']
for var in cat_vars:
    cat_list='var'+'_'+var
    cat_list = pd.get_dummies(hr[var], prefix=var)
    hr1=hr.join(cat_list)
    hr=hr1
```

In [20]:
```
hr.drop(hr.columns[[8, 9]], axis=1, inplace=True)
hr.columns.values
```

Out[20]:
```
array(['satisfaction_level', 'last_evaluation', 'number_project',
       'average_montly_hours', 'time_spend_company', 'Work_accident',
       'left', 'promotion_last_5years', 'department_RandD',
       'department_accounting', 'department_hr', 'department_management',
       'department_marketing', 'department_product_mng',
       'department_sales', 'department_technical', 'salary_high',
       'salary_low', 'salary_medium'], dtype=object)
```

In [21]:
```
hr_vars=hr.columns.values.tolist()
y=['left']
X=[i for i in hr_vars if i not in y]
```

Feature Selection for Employee Turnover Prediction

Let's use the feature selection method to decide which variables are the best option that can predict employee turnover with great accuracy. There are a total of 18 columns in X, and now let's see how we can select about 10 from them:

In [31]:
```
from sklearn.feature_selection import RFE
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
rfe = RFE(model,n_features_to_select= 10)
rfe = rfe.fit(hr[X], hr[y])
print(rfe.support_)
print(rfe.ranking_)
```

```
C:\Users\HP\anaconda3\lib\site-packages\sklearn\utils\validation.py:993: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape o
f y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
C:\Users\HP\anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:814: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
C:\Users\HP\anaconda3\lib\site-packages\sklearn\utils\validation.py:993: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape o
f y to (n_samples, ), for example using ravel().
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  y = column_or_1d(y, warn=True)
C:\Users\HP\anaconda3\lib\site-packages\sklearn\utils\validation.py:993: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape o
f y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
[ True  True False False  True  True  True  True False  True  True False
 False False False  True  True False]
[1 1 3 9 1 1 1 1 5 1 1 6 8 7 4 1 1 2]
```

In [32]:
```
cols=['satisfaction_level', 'last_evaluation', 'time_spend_company', 'Work_accident', 'promotion_last_5years',
      'department_RandD', 'department_hr', 'department_management', 'salary_high', 'salary_low']
X=hr[cols]
y=hr['left']
```

Logistic Regression Model to Predict Employee Turnover

In [34]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)
from sklearn.linear_model import LogisticRegression
from sklearn import metrics
logreg = LogisticRegression()
logreg.fit(X_train, y_train)
```

Out[34]:
```
LogisticRegression()
```

In [35]:
```
from sklearn.metrics import accuracy_score


print('Logistic regression accuracy: {:.3f}'.format(accuracy_score(y_test, logreg.predict(X_test))))
```

```
Logistic regression accuracy: 0.771
```

Random Forest Classification Model

In [36]:
```
from sklearn.ensemble import RandomForestClassifier
rf = RandomForestClassifier()
rf.fit(X_train, y_train)
```

Out[36]:
```
RandomForestClassifier()
```

Now let's check the accuracy of our Random Forest Classification Model:

In [37]:
```
print('Random Forest Accuracy: {:.3f}'.format(accuracy_score(y_test, rf.predict(X_test))))
```

```
Random Forest Accuracy: 0.978
```

Confusion Matrix for our Machine Learning Models

Now I will construct a confusion matrix to visualize predictions made by our classifier and evaluate the accuracy of our machine learning classification.

In [42]:
```
from sklearn.metrics import classification_report
print(classification_report(y_test, rf.predict(X_test)))
```

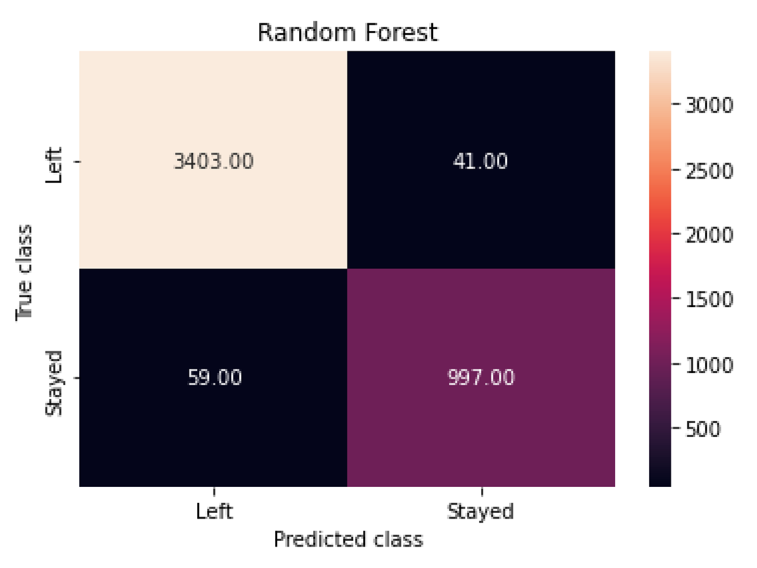
```
              precision    recall  f1-score   support

           0       0.99      0.98      0.99      3462
           1       0.94      0.96      0.95      1038

    accuracy                           0.98      4500
   macro avg       0.97      0.97      0.97      4500
weighted avg       0.98      0.98      0.98      4500
```

In [45]:
```
y_pred = rf.predict(X_test)
from sklearn.metrics import confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt
forest_cm = metrics.confusion_matrix(y_pred,y_test)
sns.heatmap(forest_cm, annot=True, fmt='.2f',xticklabels = ["Left", "Stayed"] , yticklabels = ["Left", "Stayed"] )
plt.ylabel('True class')
plt.xlabel('Predicted class')
plt.title('Random Forest')
```

Out[45]:
```
Text(0.5, 1.0, 'Random Forest')
```



Logistic Regression

In [46]:
```
print(classification_report(y_test, logreg.predict(X_test)))
```

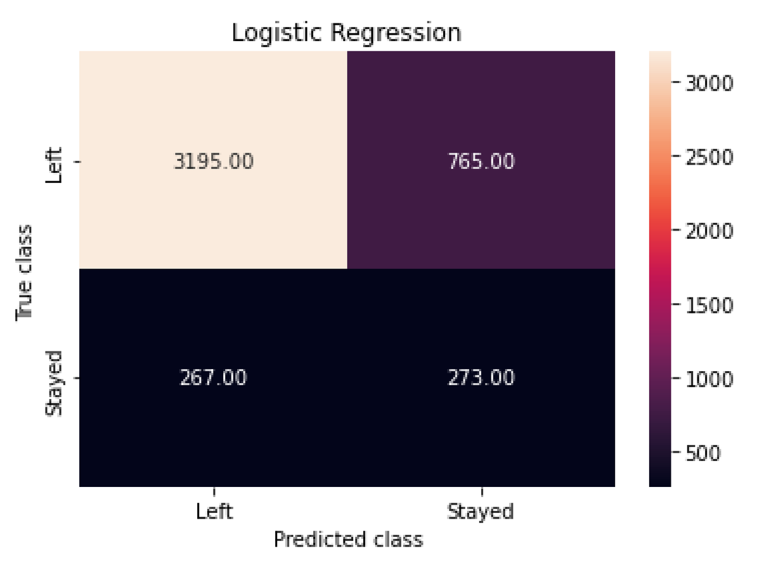
```
              precision    recall  f1-score   support

           0       0.81      0.92      0.86      3462
           1       0.51      0.26      0.35      1038

    accuracy                           0.77      4500
   macro avg       0.66      0.59      0.60      4500
weighted avg       0.74      0.77      0.74      4500
```

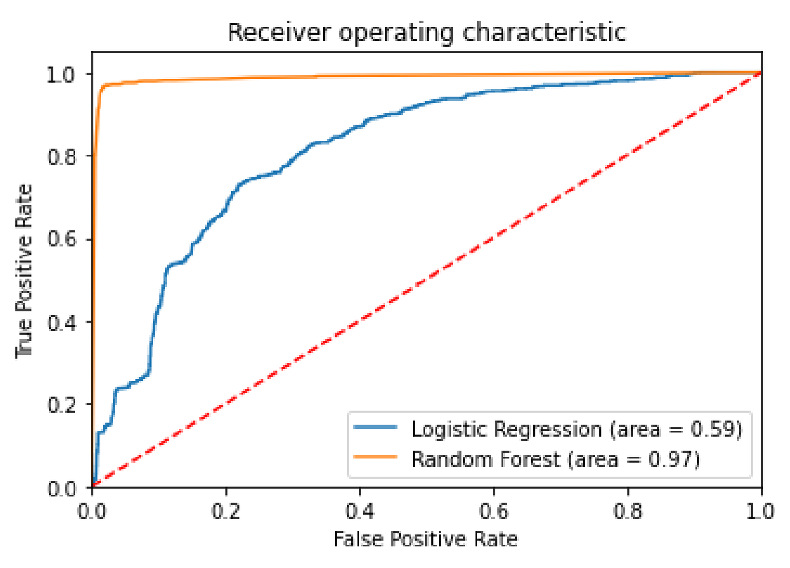
In [48]:
```
logreg_y_pred = logreg.predict(X_test)
logreg_cm = metrics.confusion_matrix(logreg_y_pred, y_test)
sns.heatmap(logreg_cm, annot=True, fmt='.2f',xticklabels = ["Left", "Stayed"] , yticklabels = ["Left", "Stayed"] )
plt.ylabel('True class')
plt.xlabel('Predicted class')
plt.title('Logistic Regression')
```

Out[48]:
```
Text(0.5, 1.0, 'Logistic Regression')
```



Employee Turnover Prediction Curve

In [49]:
```
from sklearn.metrics import roc_auc_score
from sklearn.metrics import roc_curve
logit_roc_auc = roc_auc_score(y_test, logreg.predict(X_test))
fpr, tpr, thresholds = roc_curve(y_test, logreg.predict_proba(X_test)[:,1])
rf_roc_auc = roc_auc_score(y_test, rf.predict(X_test))
rf_fpr, rf_tpr, rf_thresholds = roc_curve(y_test, rf.predict_proba(X_test)[:,1])
plt.figure()
plt.plot(fpr, tpr, label='Logistic Regression (area = %0.2f)' % logit_roc_auc)
plt.plot(rf_fpr, rf_tpr, label='Random Forest (area = %0.2f)' % rf_roc_auc)
plt.plot([0, 1], [0, 1],'r--')
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver operating characteristic')
plt.legend(loc="lower right")
plt.show()
```



The receiver operating characteristic (ROC) curve is a standard tool used with binary classifiers. The red dotted line represents the ROC curve of a purely random classifier; a good classifier stays as far away from that line as possible (toward the top-left corner).

So, as we can see that the Random Forest Model has proven to be more useful in the prediction of employee turnover, now let's have a look at the feature importance of our random forest classification model.

In [50]:
```
feature_labels = np.array(['satisfaction_level', 'last_evaluation', 'time_spend_company', 'Work_accident', 'promotion_last_5years',
      'department_RandD', 'department_hr', 'department_management', 'salary_high', 'salary_low'])
importance = rf.feature_importances_
feature_indexes_by_importance = importance.argsort()
for index in feature_indexes_by_importance:
    print('{}-{:.2f}%'.format(feature_labels[index], (importance[index] *100.0)))
```

```
promotion_last_5years-0.25%
department_management-0.25%
department_hr-0.32%
department_RandD-0.34%
salary_high-0.63%
salary_low-1.25%
Work_accident-1.45%
last_evaluation-18.79%
time_spend_company-26.76%
satisfaction_level-49.96%
```

According to our Random Forest classification model, the above aspects show the most important features which will influence whether an employee will leave the company, in ascending order.

In [ ]: