Test C

December 19, 2024

[1]:
```
import pandas as pd
import shap
import sklearn
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from xgboost import XGBClassifier
from sklearn.metrics import confusion_matrix, accuracy_score, precision_score,␣
 ↪recall_score

# Load the dataset
df = pd.read_csv("P2P-Loan.csv")
df
```

[1]:

	loan_amnt	term_mths	int_rate	installment	grade	empl_yrs	\
0	5000	36	9.67	160.57	1	2.0	
1	9250	36	15.31	322.07	1	10.0	
2	10350	36	16.29	365.36	1	10.0	
3	5000	36	15.22	173.87	1	2.0	
4	7750	36	11.14	254.24	1	7.0	
…	…	…	…	…	…	…	
19995	20000	36	11.67	661.14	1	9.0	
19996	28000	36	8.90	889.09	1	9.0	
19997	21000	36	12.99	707.48	1	4.0	
19998	19200	60	12.99	436.77	1	3.0	
19999	10950	36	21.99	418.13	0	2.0	

	annual_inc	verification_status	dti	open_acc	pub_rec	revol_bal	\
0	63000.0	0	6.74	12	0	7603	
1	38000.0	0	5.42	7	0	8939	
2	78000.0	0	12.69	6	0	2039	
3	41000.0	0	20.74	6	0	5436	
4	56000.0	0	0.54	6	0	991	
…	…	…	…	…	…	…	
19995	55000.0	1	8.18	8	1	3996	
19996	150000.0	1	15.54	11	0	45340	
19997	111500.0	1	28.52	25	0	28507	
19998	56000.0	1	18.11	7	0	10376	
19999	22000.0	1	32.41	8	1	19557	

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       revol_util  total_acc  mort_acc  pub_rec_bankruptcies  loan_status
0            57.2         33         3                     0            1
1            62.5         10         1                     0            1
2            25.2          7         0                     0            1
3            83.6         12         0                     0            1
4             6.5         27         0                     0            1
…             …          …         …                     …            …
19995        25.8         21         0                     1            0
19996        88.4         22         2                     0            0
19997        68.4         49         3                     0            0
19998        66.1         11         1                     0            0
19999        79.8         13         0                     1            0

[20000 rows x 17 columns]
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[2]:
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# Define features and target
X = df.drop(columns=['loan_status'])
y = df['loan_status']

# Split the dataset into training (80%) and test (20%)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=0)

# Q1: Random Forest Classifier
RF_model = RandomForestClassifier(n_estimators=500, random_state=1,␣
 ↪max_features="sqrt", max_depth=34)
RF_model.fit(X_train, y_train)
rf_predictions = RF_model.predict(X_test)
rf_accuracy = accuracy_score(y_test, rf_predictions)
print("Q1: Random Forest Accuracy:", rf_accuracy)

# Feature Importance for Random Forest
rf_importances = pd.DataFrame({'Feature': X_train.columns, 'Importance':␣
 ↪RF_model.feature_importances_})
rf_top3_features = rf_importances.sort_values(by='Importance', ascending=False).
 ↪head(3)
print("Q1: Top 3 features by importance (Random Forest):")
print(rf_top3_features)

# Q2: XGBoost Classifier
XG_model = XGBClassifier(n_estimators=500, random_state=1, learning_rate=0.01,␣
 ↪max_depth=4, objective='binary:logistic')
XG_model.fit(X_train, y_train)
xg_predictions = XG_model.predict(X_test)
cm = confusion_matrix(y_test, xg_predictions)
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# Confusion Matrix and Metrics
recall_loan_0 = recall_score(y_test, xg_predictions, pos_label=0)
precision_loan_1 = precision_score(y_test, xg_predictions, pos_label=1)
print("Q2: Confusion Matrix:")
print(cm)
print("Q2: Recall for loan_status=0:", recall_loan_0)
print("Q2: Precision for loan_status=1:", precision_loan_1)

# Feature Importance for XGBoost
xg_importances = pd.DataFrame({'Feature': X_train.columns, 'Importance':␣
 ↪XG_model.feature_importances_})
xg_top3_features = xg_importances.sort_values(by='Importance', ascending=False).
 ↪head(3)
print("Q2: Top 3 features by importance (XGBoost):")
print(xg_top3_features)

# Q3: Common feature in RF and XGBoost Top 3
common_features = set(rf_top3_features['Feature']).
 ↪intersection(set(xg_top3_features['Feature']))
print("Q3: Common feature in both models:", common_features)

# Q4: Predict loan_status for two given cases
case_A = pd.DataFrame({
    'loan_amnt': [1000], 'term_mths': [60], 'int_rate': [10], 'installment':␣
 ↪[360], 'grade': [1],
    'empl_yrs': [5], 'annual_inc': [10000], 'verification_status': [0], 'dti':␣
 ↪[10], 'open_acc': [3],
    'pub_rec': [0], 'revol_bal': [10000], 'revol_util': [50], 'total_acc': [5],␣
 ↪'mort_acc': [1],
    'pub_rec_bankruptcies': [0]
})

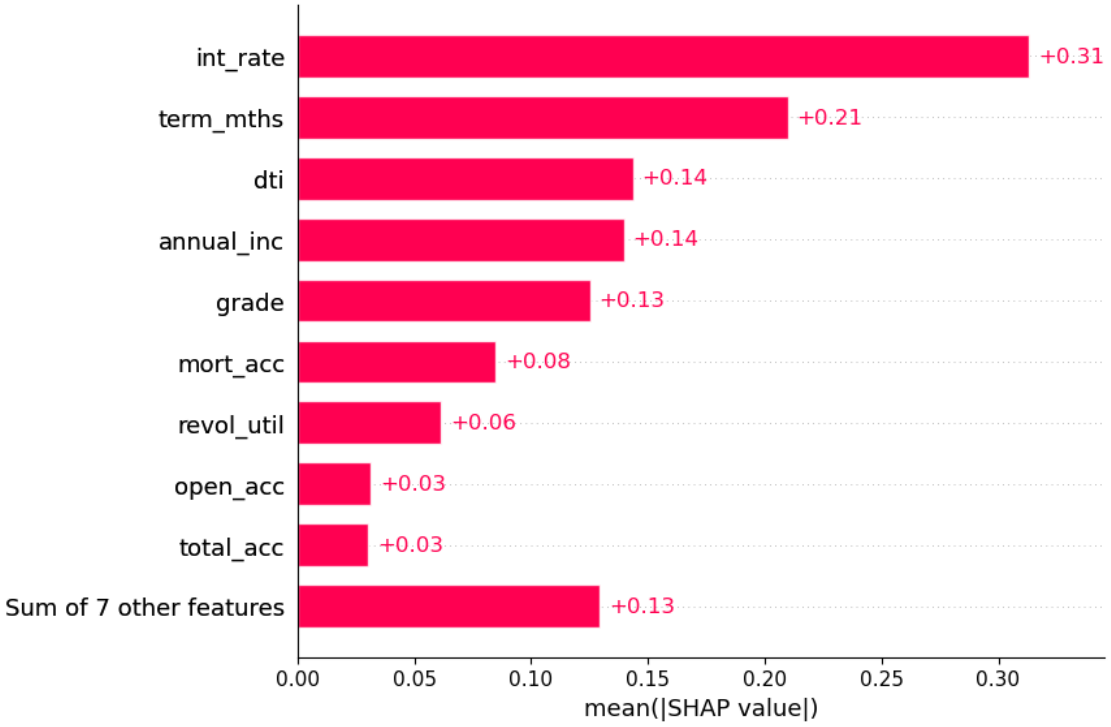
case_B = pd.DataFrame({
    'loan_amnt': [1000], 'term_mths': [60], 'int_rate': [8], 'installment':␣
 ↪[120], 'grade': [1],
    'empl_yrs': [10], 'annual_inc': [120000], 'verification_status': [1], 'dti':
 ↪ [5], 'open_acc': [1],
    'pub_rec': [0], 'revol_bal': [100000], 'revol_util': [5], 'total_acc': [2],␣
 ↪'mort_acc': [1],
    'pub_rec_bankruptcies': [1]
})

case_A_pred = XG_model.predict(case_A)
case_B_pred = XG_model.predict(case_B)
print(f"Q4: Prediction for Case A: {case_A_pred[0]} (0=No Default, 1=Default)")
print(f"Q4: Prediction for Case B: {case_B_pred[0]} (0=No Default, 1=Default)")
```

```
# Q5: SHAP Values Explanation
explainer = shap.Explainer(XG_model, X_test)
shap_values = explainer(X_test)
shap.plots.bar(shap_values)

# SHAP Top 3 Features
shap_values_df = pd.DataFrame({'Feature': X_train.columns, 'Mean_Abs_SHAP':␣
 ↪shap_values.abs.mean(0).values})
shap_top3_features = shap_values_df.sort_values(by='Mean_Abs_SHAP',␣
 ↪ascending=False).head(3)
print("Q5: Top 3 features by SHAP values:")
print(shap_top3_features)
```

```
Q1: Random Forest Accuracy: 0.6505
Q1: Top 3 features by importance (Random Forest):
      Feature  Importance
2    int_rate    0.126344
8         dti    0.109672
11  revol_bal    0.099535
Q2: Confusion Matrix:
[[1244  724]
 [ 659 1373]]
Q2: Recall for loan_status=0: 0.6321138211382114
Q2: Precision for loan_status=1: 0.6547448736289938
Q2: Top 3 features by importance (XGBoost):
     Feature  Importance
4      grade    0.365261
2   int_rate    0.248385
1  term_mths    0.080063
Q3: Common feature in both models: {'int_rate'}
Q4: Prediction for Case A: 1 (0=No Default, 1=Default)
Q4: Prediction for Case B: 0 (0=No Default, 1=Default)
 98%|==================| 3926/4000 [00:32<00:00]
```




```
Q5: Top 3 features by SHAP values:
     Feature  Mean_Abs_SHAP
2   int_rate       0.313195
1  term_mths       0.209905
8        dti       0.143638
```