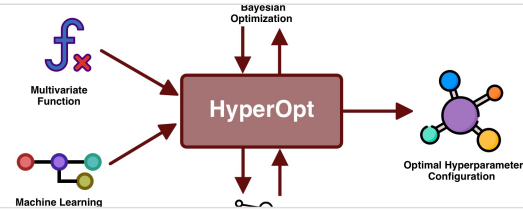# Optuna 튜닝 적용(주제1)

- HyperOpt vs Optuna 및 코드 참고

하이퍼파라미터 튜닝
캐글 노트북으로 하이퍼파라미터 튜닝 공부

ⓥ https://velog.io/@emseoyk/%ED%95%98%EC%9D%B4%ED%8D%BC%ED%8C%8C%EB%9D%BC%EB%AF%B8%ED%84%B
0-%ED%8A%9C%EB%8B%9D#-optuna

Optuna로 하이퍼파라미터 튜닝하기
하이퍼파라미터 튜닝 방법으로 optuna라는 새로운 방법을 알게 되어 정리해보려고 한다.Optuna란 하이퍼파라미터 최적화를 자동화해주는 프레임워크
이다.Optuna는 최적화할 함수인 Objective Function을 정의하여 하이퍼파라미터 조합을 입력으로 받고, 해당

ⓥ https://velog.io/@halinee/Optuna%EB%A1%9C-%ED%95%98%EC%9D%B4%ED%8D%BC%ED%8C%8C%EB%9D%BC%EB%
AF%B8%ED%84%B0-%ED%8A%9C%EB%8B%9D%ED%95%98%EA%B8%B0

💡 Optuna 사용 방법
- Study: 목적 함수에 기반한 최적화
    - Study의 목적 : 여러 번의 trial을 거쳐 최적의 하이퍼파라미터 조합을 찾는 것
- Trial: 목적함수 시행(다양한 조합으로 시행)

사용 이유
- 기존 그리드 서치의 경우, 소요 시간이 길어 튜닝 결과를 확인하여 성능을 개선하는 데에도 시간이 많이 소요

추가한 조건
- Optuna와 더불어 클래스 불균형 문제 해결을 위한 class_weight를 설정
    - balanced로 설정
    - 기본값은 None
    - 혹은 수동으로 설정 ex) `class_weight={0: 1, 1: 6}` : 0은 1배, 1은 6배

결론
- Optuna로 하이퍼파라미터 튜닝
    - RF
        - 기존 Grid Search: 0.7702528060655616
        - Optuna : 0.7772099317972689
    - XGB
        - 기존 Grid Search: 0.7895984167100275
        - Optuna : 0.8033568808416501

Appendix
- 코드

- 랜덤 포레스트

```python
def objective_rf(trial):
    n_estimators = trial.suggest_int('n_estimators', 50, 300)
    max_depth = trial.suggest_int('max_depth', 5, 20)
    min_samples_split = trial.suggest_int('min_samples_split', 2, 10)
    min_samples_leaf = trial.suggest_int('min_samples_leaf', 1, 5)
    bootstrap = trial.suggest_categorical('bootstrap', [True, False])

    class_weight = 'balanced'

    rf_model = RandomForestClassifier(
        n_estimators=n_estimators,
        max_depth=max_depth,
        min_samples_split=min_samples_split,
        min_samples_leaf=min_samples_leaf,
        bootstrap=bootstrap,
        class_weight=class_weight,
        random_state=42
    )
    rf_model.fit(X_train, y_train)
    y_pred_rf = rf_model.predict(X_valid)
    y_pred_rf_proba = rf_model.predict_proba(X_valid)[:, 1]

    return roc_auc_score(y_valid, y_pred_rf_proba)

X_train_full, X_test, y_train_full, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
X_train, X_valid, y_train, y_valid = train_test_split(X_train_full, y_train_full, test_size=0.25, random_state=42)

rf_study = optuna.create_study(direction='maximize')
rf_study.optimize(objective_rf, n_trials=20)
print("Best Random Forest Parameters:", rf_study.best_params)

best_rf_model = RandomForestClassifier(**rf_study.best_params, random_state=42)
best_rf_model.fit(X_train_full, y_train_full)

y_pred_rf = best_rf_model.predict(X_test)
y_pred_rf_proba = best_rf_model.predict_proba(X_test)[:, 1]

print("Classification Report:\n", classification_report(y_test, y_pred_rf))
print("ROC-AUC Score:", roc_auc_score(y_test, y_pred_rf_proba))
```

```
[I 2024-12-05 03:47:49,993] A new study created in memory with name: no-name-54af0c43-ba9e-424f-93b2-7bf80472e6f4
[I 2024-12-05 03:48:21,927] Trial 0 finished with value: 0.770223488128498 and parameters: {'n_estimators': 221, 'max
[I 2024-12-05 03:48:29,025] Trial 1 finished with value: 0.7623907838150372 and parameters: {'n_estimators': 72, 'max
[I 2024-12-05 03:48:34,168] Trial 2 finished with value: 0.7587243150218659 and parameters: {'n_estimators': 65, 'max
[I 2024-12-05 03:48:51,386] Trial 3 finished with value: 0.7730583436354626 and parameters: {'n_estimators': 200, 'ma
[I 2024-12-05 03:49:03,406] Trial 4 finished with value: 0.7595243411629515 and parameters: {'n_estimators': 107, 'ma
[I 2024-12-05 03:49:21,438] Trial 5 finished with value: 0.7728998633039065 and parameters: {'n_estimators': 202, 'ma
[I 2024-12-05 03:49:29,473] Trial 6 finished with value: 0.7462738060876054 and parameters: {'n_estimators': 65, 'max
[I 2024-12-05 03:50:06,562] Trial 7 finished with value: 0.7702942869020454 and parameters: {'n_estimators': 262, 'ma
[I 2024-12-05 03:50:15,541] Trial 8 finished with value: 0.7695810346423846 and parameters: {'n_estimators': 103, 'ma
[I 2024-12-05 03:50:48,892] Trial 9 finished with value: 0.767345971822088 and parameters: {'n_estimators': 293, 'max
[I 2024-12-05 03:50:53,825] Trial 10 finished with value: 0.7521952158182613 and parameters: {'n_estimators': 147, 'm
[I 2024-12-05 03:51:09,722] Trial 11 finished with value: 0.7714316056617234 and parameters: {'n_estimators': 196, 'm
[I 2024-12-05 03:51:27,051] Trial 12 finished with value: 0.7713535454755046 and parameters: {'n_estimators': 170, 'm
[I 2024-12-05 03:51:48,603] Trial 13 finished with value: 0.7709641522209938 and parameters: {'n_estimators': 230, 'm
[I 2024-12-05 03:51:56,458] Trial 14 finished with value: 0.7636513650548146 and parameters: {'n_estimators': 152, 'm
[I 2024-12-05 03:52:12,819] Trial 15 finished with value: 0.7693065532434007 and parameters: {'n_estimators': 204, 'm
[I 2024-12-05 03:52:35,634] Trial 16 finished with value: 0.7734194173805543 and parameters: {'n_estimators': 250, 'm
[I 2024-12-05 03:52:57,481] Trial 17 finished with value: 0.7734306725701952 and parameters: {'n_estimators': 255, 'm
[I 2024-12-05 03:53:21,773] Trial 18 finished with value: 0.7733863779528988 and parameters: {'n_estimators': 264, 'm
[I 2024-12-05 03:53:39,196] Trial 19 finished with value: 0.7667069675069936 and parameters: {'n_estimators': 292, 'm
Best Random Forest Parameters: {'n_estimators': 255, 'max_depth': 20, 'min_samples_split': 2, 'min_samples_leaf': 3,
Classification Report:
              precision    recall  f1-score   support

           0       0.88      1.00      0.93      6502
           1       0.70      0.07      0.13       938

    accuracy                           0.88      7440
   macro avg       0.79      0.53      0.53      7440
weighted avg       0.86      0.88      0.83      7440

ROC-AUC Score: 0.7772099317972689
```

```python
1  def objective_xgb(trial):
2      n_estimators = trial.suggest_int('n_estimators', 50, 300)
3      max_depth = trial.suggest_int('max_depth', 5, 20)
4      learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
5      min_child_weight = trial.suggest_int('min_child_weight', 1, 10)
6      subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
7      colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
8      gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
9      class_weight = {0: 1, 1: trial.suggest_int('class_weight', 1, 7)}
10
11     xgb_model = XGBClassifier(
12         n_estimators=n_estimators,
13         max_depth=max_depth,
14         learning_rate=learning_rate,
15         min_child_weight=min_child_weight,
16         subsample=subsample,
17         colsample_bytree=colsample_bytree,
18         gamma=gamma,
19         use_label_encoder=False,
20         eval_metric='logloss',
21         random_state=42
22     )
23     xgb_model.fit(X_train, y_train)
24     y_pred_xgb = xgb_model.predict(X_valid)
25     y_pred_xgb_proba = xgb_model.predict_proba(X_valid)[:, 1]
26
27     return roc_auc_score(y_valid, y_pred_xgb_proba)
28
29 X_train_full, X_test, y_train_full, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
30 X_train, X_valid, y_train, y_valid = train_test_split(X_train_full, y_train_full, test_size=0.25, random_state=42)
31
32 xgb_study = optuna.create_study(direction='maximize')
33 xgb_study.optimize(objective_xgb, n_trials=20)
34 print("Best XGBoost Parameters:", xgb_study.best_params)
35
36 best_xgb_model = XGBClassifier(**xgb_study.best_params, use_label_encoder=False, eval_metric='logloss', random_state=42)
37 best_xgb_model.fit(X_train_full, y_train_full)
38
39 y_pred_xgb = best_xgb_model.predict(X_test)
40 y_pred_xgb_proba = best_xgb_model.predict_proba(X_test)[:, 1]
41
42 print("Classification Report:\n", classification_report(y_test, y_pred_xgb))
43 print("ROC-AUC Score:", roc_auc_score(y_test, y_pred_xgb_proba))
```

▼ 결과 텍스트

```
[I 2024-12-05 03:55:05,165] A new study created in memory with name: no-name-b38b5a02-f32d-42c3-9d46-b6765599adce
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:05] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:10,280] Trial 0 finished with value: 0.7814365615758717 and parameters: {'n_estimators': 243,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:10] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:14,268] Trial 1 finished with value: 0.7583781271727508 and parameters: {'n_estimators': 161,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:14] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:16,655] Trial 2 finished with value: 0.7628193886979743 and parameters: {'n_estimators': 176,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
```

```
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:16] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:26,309] Trial 3 finished with value: 0.7816781850825169 and parameters: {'n_estimators': 208,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:26] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:29,939] Trial 4 finished with value: 0.7678873101367505 and parameters: {'n_estimators': 264,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:30] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:37,850] Trial 5 finished with value: 0.7807501765430956 and parameters: {'n_estimators': 114,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:38] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:41,917] Trial 6 finished with value: 0.7700804382988689 and parameters: {'n_estimators': 235,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:42] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:44,001] Trial 7 finished with value: 0.775225693782597 and parameters: {'n_estimators': 254, '
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:44] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:44,859] Trial 8 finished with value: 0.7601906665432228 and parameters: {'n_estimators': 132,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
```

```
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:44] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:45,792] Trial 9 finished with value: 0.7673732021196064 and parameters: {'n_estimators': 119,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:45] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:46,408] Trial 10 finished with value: 0.7539315103556821 and parameters: {'n_estimators': 63,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:46] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:50,676] Trial 11 finished with value: 0.7815325029907945 and parameters: {'n_estimators': 222,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:50] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:55:56,138] Trial 12 finished with value: 0.7748232299852775 and parameters: {'n_estimators': 205,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:55:56] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:01,376] Trial 13 finished with value: 0.7825637143578097 and parameters: {'n_estimators': 195,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:01] WARNING: /workspace/src/learn
```

```
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:11,217] Trial 14 finished with value: 0.7854466767237233 and parameters: {'n_estimators': 299,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:11] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:14,831] Trial 15 finished with value: 0.7855302737371043 and parameters: {'n_estimators': 296,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:14] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:16,308] Trial 16 finished with value: 0.7854942389767218 and parameters: {'n_estimators': 286,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:16] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:19,609] Trial 17 finished with value: 0.7686166282719472 and parameters: {'n_estimators': 299,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:19] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:24,269] Trial 18 finished with value: 0.7865161012749227 and parameters: {'n_estimators': 277,
<ipython-input-35-1e7d69e65a80>:4: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  learning_rate = trial.suggest_loguniform('learning_rate', 1e-4, 0.1)
<ipython-input-35-1e7d69e65a80>:6: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  subsample = trial.suggest_uniform('subsample', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:7: FutureWarning: suggest_uniform has been deprecated in v3.0.0. This feature will
  colsample_bytree = trial.suggest_uniform('colsample_bytree', 0.5, 1.0)
<ipython-input-35-1e7d69e65a80>:8: FutureWarning: suggest_loguniform has been deprecated in v3.0.0. This feature w
  gamma = trial.suggest_loguniform('gamma', 1e-4, 1e1)
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:24] WARNING: /workspace/src/learn
Parameters: { "use_label_encoder" } are not used.

  warnings.warn(smsg, UserWarning)
[I 2024-12-05 03:56:25,799] Trial 19 finished with value: 0.7869143897599559 and parameters: {'n_estimators': 271,
/usr/local/lib/python3.10/dist-packages/xgboost/core.py:158: UserWarning: [03:56:25] WARNING: /workspace/src/learn
Parameters: { "class_weight", "use_label_encoder" } are not used.
```

```
  warnings.warn(smsg, UserWarning)
Best XGBoost Parameters: {'n_estimators': 271, 'max_depth': 12, 'learning_rate': 0.05530542777551273, 'min_child_w
Classification Report:
              precision    recall  f1-score   support

           0       0.89      0.99      0.94      6502
           1       0.67      0.13      0.21       938

    accuracy                           0.88      7440
   macro avg       0.78      0.56      0.57      7440
weighted avg       0.86      0.88      0.85      7440

ROC-AUC Score: 0.8033568808416501
```