06a_eval_regression

May 26, 2024

1 Evaluate Classification with Logistic Regression

1.1 Content

1. Import Data
2. Create / Train Model
3. Metrics / Confusion Matrix
4. Grid Search

[23]:
```
# imports
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn import metrics
from sklearn.metrics import confusion_matrix
from sklearn.metrics import ConfusionMatrixDisplay
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import accuracy_score, precision_score, recall_score,␣
↪f1_score, roc_auc_score
```

Import Data

[24]:
```
# import files
df = pd.read_csv('files/fo_smote.csv')
not_automatable = [item[0] for item in pd.read_csv("files/not_automatable.csv").
↪values.tolist()]

# calculate fo_computerisation based on 'df_probability'
df['fo_computerisation'] = df['fo_probability'].apply(lambda x: 1 if x >= 0.5␣
↪else 0)

df.head(2)
```

[24]:
```
   isco08  Berufshauptgruppe    s1    s2    s3    s4    s5    s6    s7    s8  \
0    2655                  2  0.72  0.72  0.69  0.69  0.50  0.50  0.50  0.47
1    2612                  2  0.81  0.75  0.81  0.72  0.81  0.66  0.56  0.72

   …  a45  a46  a47  a48  a49  a50  a51  a52  fo_probability  \
0  …  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0            0.37
1  …  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0            0.40

   fo_computerisation
0                   0
1                   0

[2 rows x 91 columns]
```

Split in Train / Test Set and train Model

[25]:
```
# Declare x, y & split Data in training and test (80/20)
X = df[not_automatable]
y = df['fo_computerisation']

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
↪random_state=42)
```

[26]:
```
# Scale the features
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Create and train the model
model = LogisticRegression(C=0.3, penalty='l2', solver='newton-cg',␣
↪random_state=42, max_iter=1000)
model.fit(X_train_scaled, y_train)

# You can now use model.predict to make predictions on unseen data
predictions = model.predict(X_test_scaled)
```

[27]:
```
# Make prediction with train data
y_pred_train = model.predict(X_train_scaled)

# Make prediction with test data
y_proba = model.predict_proba(X_test_scaled)
y_pred = model.predict(X_test_scaled)

# Create a DataFrame with the probabilities and predictions
prediction_df = pd.DataFrame(np.c_[y_proba, y_pred], columns = ['Wkt Nicht␣
↪Substituierbar', 'Wkt Substituierbar', 'Vorhersage der Klasse'])
```

```
prediction_df.head(5)
```

[27]:

	Wkt Nicht Substituierbar	Wkt Substituierbar	Vorhersage der Klasse
0	0.235471	0.764529	1.0
1	0.159420	0.840580	1.0
2	0.377118	0.622882	1.0
3	0.806603	0.193397	0.0
4	0.089917	0.910083	1.0

Metrics

[28]:
```
# Calculate metrics for the training set
train_accuracy = accuracy_score(y_train, y_pred_train)
train_precision = precision_score(y_train, y_pred_train)
train_recall = recall_score(y_train, y_pred_train)
train_f1 = f1_score(y_train, y_pred_train)
train_auc = roc_auc_score(y_train, model.predict_proba(X_train_scaled)[:, 1])

# Calculate metrics for the test set
test_accuracy = accuracy_score(y_test, y_pred)
test_precision = precision_score(y_test, y_pred)
test_recall = recall_score(y_test, y_pred)
test_f1 = f1_score(y_test, y_pred)
test_auc = roc_auc_score(y_test, y_proba[:, 1])
```

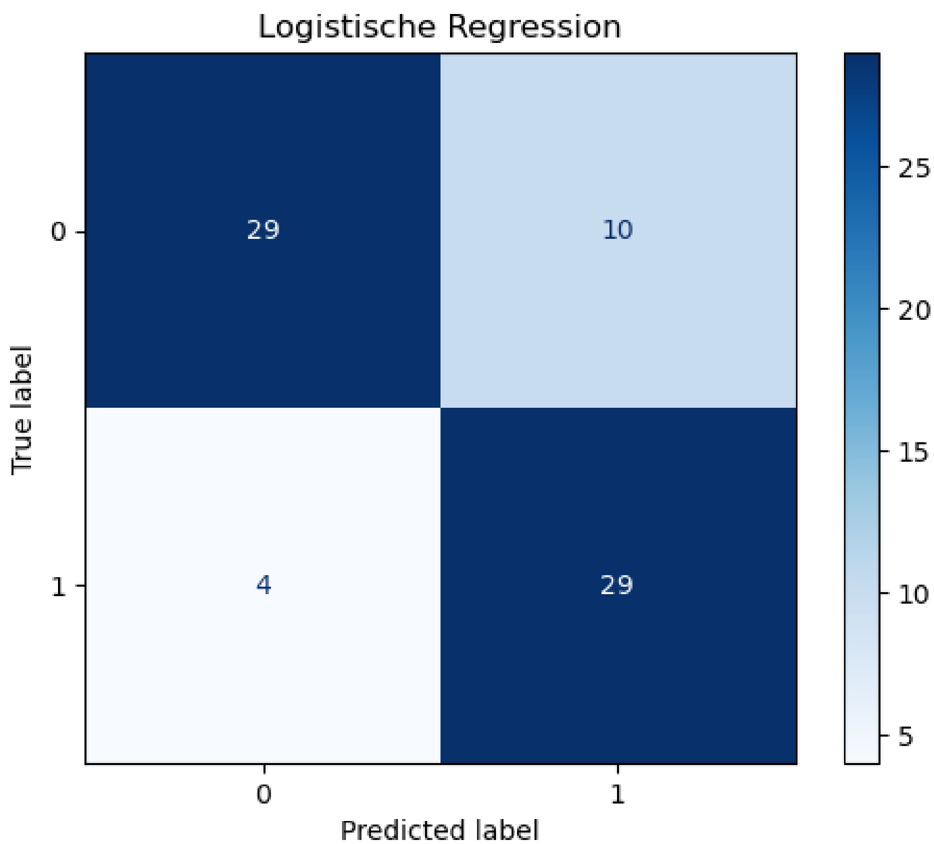
[29]:
```
# Read the CSV file into a DataFrame
try:
    metrics_df = pd.read_csv('files/metrics.csv')
except pd.errors.EmptyDataError:
    metrics_df = pd.DataFrame(columns=['Model', 'Test Accuracy', 'Train␣
 ↪Accuracy', 'Precision', 'Recall', 'F1 Score', 'AUC'])

# Check if the model exists in the DataFrame
if 'LinearRegression' in metrics_df['Model'].values:
    # Update the row for the XGBoost model
    metrics_df.loc[metrics_df['Model'] == 'LinearRegression', ['Test Accuracy',␣
 ↪'Train Accuracy', 'Precision', 'Recall', 'F1 Score', 'AUC']] =␣
 ↪[test_accuracy, train_accuracy, test_precision, test_recall, test_f1,␣
 ↪test_auc]
else:
    # Create a new DataFrame for the XGBoost model
    new_row = pd.DataFrame({'Model': ['LinearRegression'], 'Test Accuracy':␣
 ↪[test_accuracy], 'Train Accuracy': [train_accuracy], 'Precision':␣
 ↪[test_precision], 'Recall': [test_recall], 'F1 Score': [test_f1], 'AUC':␣
 ↪[test_auc]})

    # Concatenate the new row with the existing DataFrame
```

```python
    metrics_df = pd.concat([metrics_df, new_row], ignore_index=True)

# Save the DataFrame to the CSV file
metrics_df.to_csv('files/metrics.csv', index=False)
```

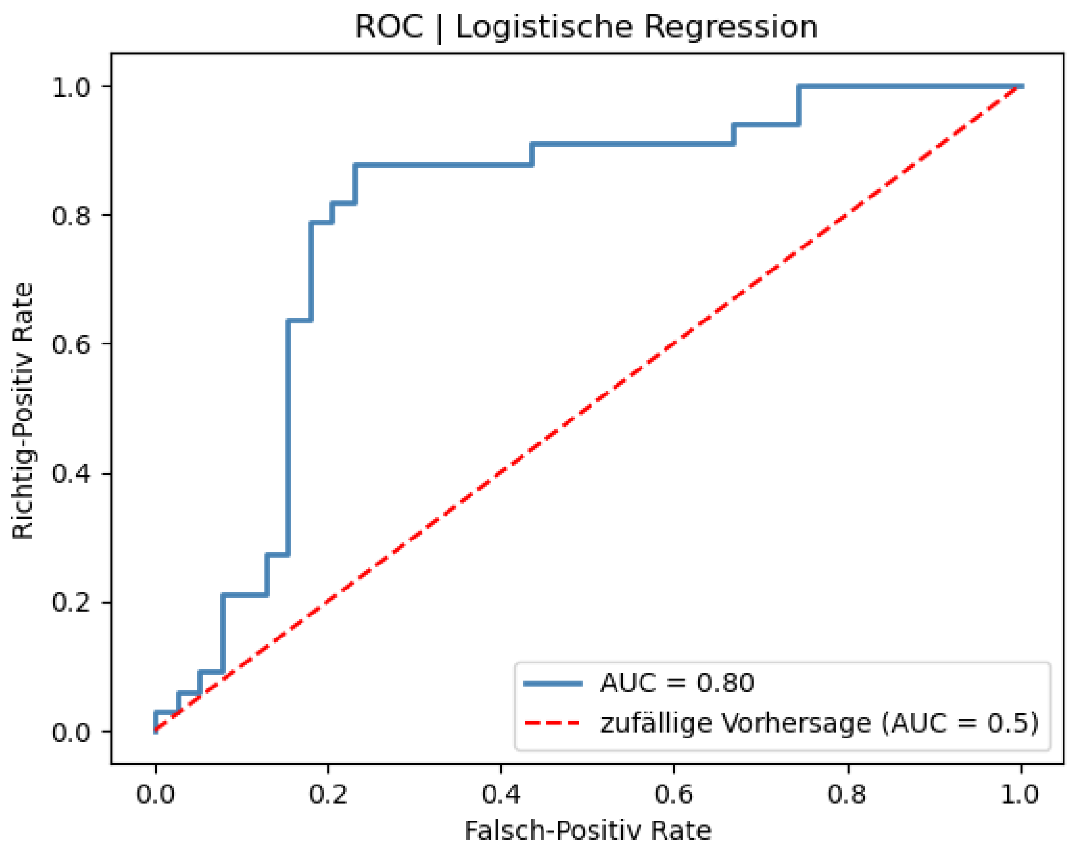
[30]:
```python
# Assuming y_test is your true labels
conf_matrix = confusion_matrix(y_test, y_pred)

# The output is a 2x2 numpy array
# conf_matrix[0, 0] is the count of true negatives
# conf_matrix[0, 1] is the count of false positives
# conf_matrix[1, 0] is the count of false negatives
# conf_matrix[1, 1] is the count of true positives

print(f"True Negatives: {conf_matrix[0, 0]}")
print(f"False Positives: {conf_matrix[0, 1]}")
print(f"False Negatives: {conf_matrix[1, 0]}")
print(f"True Positives: {conf_matrix[1, 1]}")
```

```
True Negatives: 29
False Positives: 10
False Negatives: 4
True Positives: 29
```

[31]:
```python
# Define the labels for your classes
class_names = ['0', '1']

# Create the ConfusionMatrixDisplay instance
disp = ConfusionMatrixDisplay(confusion_matrix=conf_matrix,
 ↪display_labels=class_names)

# Plot the confusion matrix
disp.plot(cmap='Blues')

plt.title('Logistische Regression')
plt.show()
```



[32]:
```
# plot ROC curve
fpr, tpr, _ = roc_curve(y_test, y_proba[:, 1])
roc_auc = auc(fpr, tpr)

plt.figure()
lw = 2
plt.plot(fpr, tpr, color='#4682B4', lw=lw, label='AUC = %0.2f' % roc_auc)
plt.ylabel('Richtig-Positiv Rate')
plt.plot([0 ,1] ,[0 ,1], 'r', label='zufällige Vorhersage (AUC = 0.5)',␣
 ↪linestyle='--')
plt.xlabel('Falsch-Positiv Rate')
plt.title('ROC | Logistische Regression')
plt.legend(loc="lower right")

plt.show()
```



Grid Search

[33]:
```python
# Define the parameter grid
param_grid = {
    'C': [0.001, 0.01, 0.1, 0.2, 0.3, 0.4, 0.5, 1],
    'penalty': ['l2'],
    'solver': ['newton-cg', 'lbfgs', 'liblinear', 'sag', 'saga']
}

# Create a GridSearchCV object
grid_search = GridSearchCV(LogisticRegression(random_state=42, max_iter=1000),␣
 ↪param_grid, cv=5, scoring='roc_auc')

# Fit the GridSearchCV object to the data
grid_search.fit(X_train_scaled, y_train)

# Print the best parameters and the best score
print("best params: ",grid_search.best_params_)
print(grid_search.best_score_)
```

```
best params:  {'C': 1, 'penalty': 'l2', 'solver': 'newton-cg'}
```

```
0.8662698412698413
```