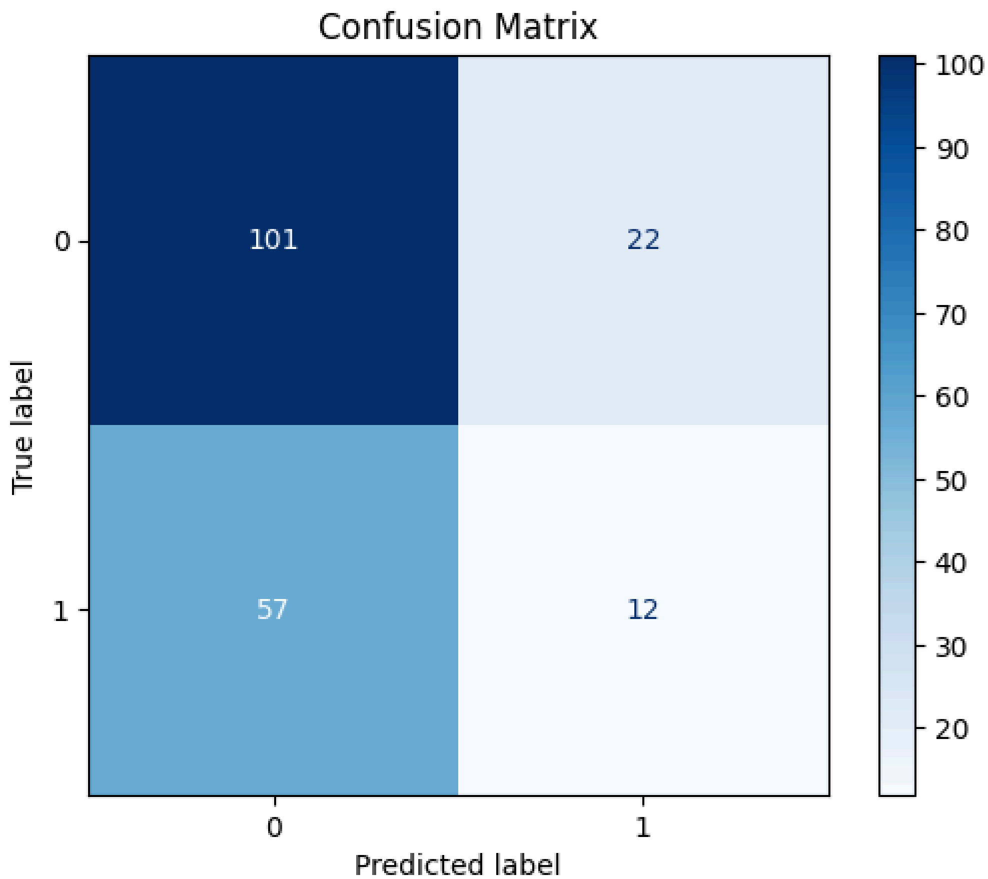
Regression

Logistic Regression

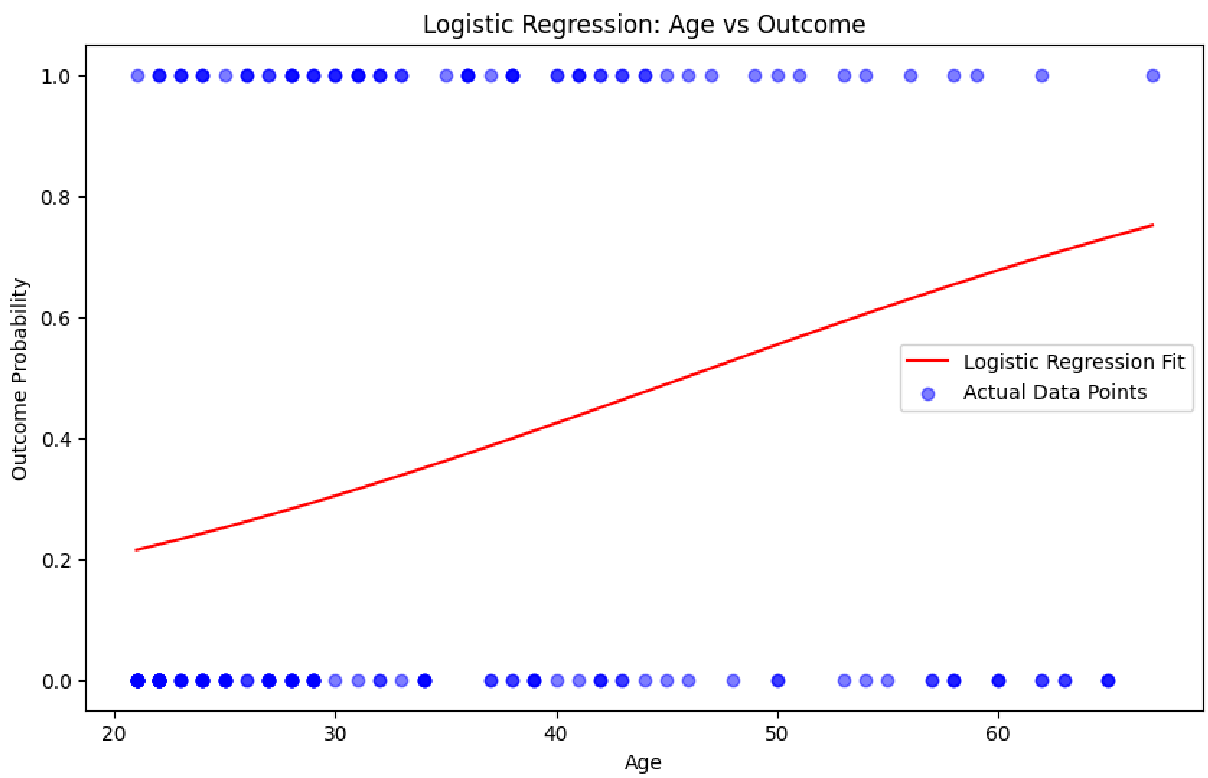
In [16]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score
from sklearn.metrics import mean_squared_error

# Load the dataset
data = pd.read_csv('diabetes_csv.csv')

# Display the first few rows of the data to understand it
print(data.head())

# Select 'Age' as the feature (X) and 'Outcome' as the target (y)
X = data[['Age']]  # Using double brackets to keep X as a DataFrame
y = data['Outcome']

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_st

# Train a logistic regression model using only 'Age' as the predictor
model = LogisticRegression(max_iter=1000)
model.fit(X_train, y_train)

# Predict the outcomes for the test set
y_pred = model.predict(X_test)

# Predict the probabilities for the test set
y_pred_proba = model.predict_proba(X_test)[:, 1]  # Predicted probabilities for the

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.4f}")

# Calculate precision
precision = precision_score(y_test, y_pred)
print(f"Precision: {precision:.4f}")

# Calculate recall
recall = recall_score(y_test, y_pred)
print(f"Recall: {recall:.4f}")

# Calculate F1-score
f1 = f1_score(y_test, y_pred)
print(f"F1 Score: {f1:.4f}")
```

```python
# Compute confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)

# Plot confusion matrix
plt.figure(figsize=(8, 6))
disp.plot(cmap=plt.cm.Blues, values_format='d')
plt.title('Confusion Matrix')
plt.show()

# Calculate Mean Squared Error (MSE)
mse = mean_squared_error(y_test, y_pred_proba)
print(f"Mean Squared Error (MSE): {mse:.4f}")

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(f"Root Mean Squared Error (RMSE): {rmse:.4f}")

# Sort values for a smooth line plot
X_test_sorted, y_pred_proba_sorted = zip(*sorted(zip(X_test['Age'], y_pred_proba)))

# Plotting Age vs Outcome using logistic regression probabilities
plt.figure(figsize=(10, 6))
plt.plot(X_test_sorted, y_pred_proba_sorted, color='red', label='Logistic Regressio
plt.scatter(X_test['Age'], y_test, color='blue', alpha=0.5, label='Actual Data Poin
plt.xlabel('Age')
plt.ylabel('Outcome Probability')
plt.title('Logistic Regression: Age vs Outcome')
plt.legend()
plt.show()
```

```
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            6      148             72             35        0  33.6
1            1       85             66             29        0  26.6
2            8      183             64              0        0  23.3
3            1       89             66             23       94  28.1
4            0      137             40             35      168  43.1

   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
Accuracy: 0.5885
Precision: 0.3529
Recall: 0.1739
F1 Score: 0.2330
<Figure size 800x600 with 0 Axes>
```



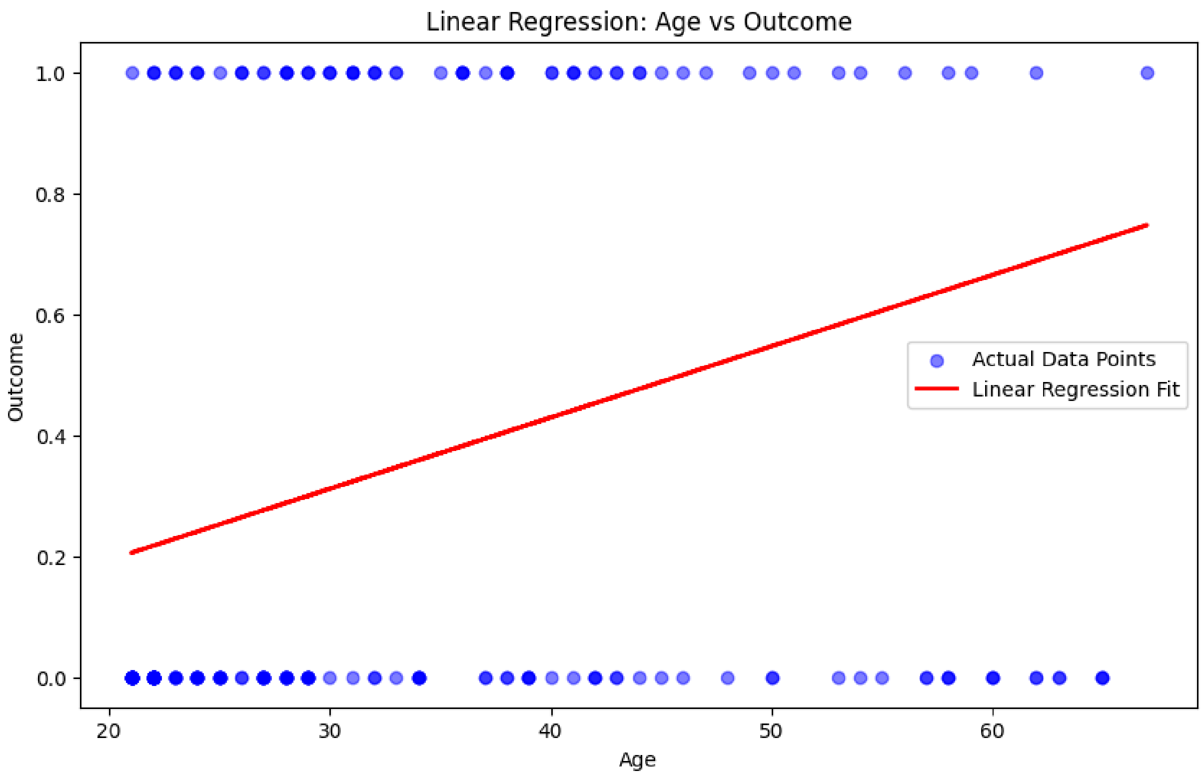

```
Mean Squared Error (MSE): 0.2383
Root Mean Squared Error (RMSE): 0.4881
```



Linear Regression

In [17]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score

# Load the dataset
data = pd.read_csv('diabetes_csv.csv')

# Display the first few rows of the data to understand it
print(data.head())

# Select 'Age' as the feature (X) and 'Outcome' as the target (y)
X = data[['Age']]  # Using double brackets to keep X as a DataFrame
y = data['Outcome']

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_st

# Train a linear regression model using only 'Age' as the predictor
model = LinearRegression()
model.fit(X_train, y_train)

# Predict the outcomes for the test set
y_pred = model.predict(X_test)

# Calculate Mean Squared Error (MSE)
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error (MSE): {mse:.4f}")

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(f"Root Mean Squared Error (RMSE): {rmse:.4f}")

# Calculate R-squared (R2) score
r2 = r2_score(y_test, y_pred)
print(f"R-squared (R2): {r2:.4f}")

# Plotting Age vs Outcome using linear regression line
plt.figure(figsize=(10, 6))
plt.scatter(X_test['Age'], y_test, color='blue', alpha=0.5, label='Actual Data Poin
plt.plot(X_test['Age'], y_pred, color='red', linewidth=2, label='Linear Regression 
plt.xlabel('Age')
plt.ylabel('Outcome')
plt.title('Linear Regression: Age vs Outcome')
plt.legend()
plt.show()
```

```
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            6      148             72             35        0  33.6
1            1       85             66             29        0  26.6
2            8      183             64              0        0  23.3
3            1       89             66             23       94  28.1
4            0      137             40             35      168  43.1

   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
Mean Squared Error (MSE): 0.2362
Root Mean Squared Error (RMSE): 0.4860
R-squared (R2): -0.0258
```



SGD

SGD w/ Linear Regression

In [19]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import SGDRegressor
from sklearn.metrics import mean_squared_error, r2_score

# Load the dataset
data = pd.read_csv('diabetes_csv.csv')
```

```python
# Display the first few rows of the data to understand it
print(data.head())

# Select 'Age' as the feature (X) and 'Outcome' as the target (y)
X = data[['Age']]  # Using double brackets to keep X as a DataFrame
y = data['Outcome']

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_st

# Train a linear regression model using SGD
model = SGDRegressor(max_iter=1000, tol=1e-3, random_state=42)
model.fit(X_train, y_train)

# Predict the outcomes for the test set
y_pred = model.predict(X_test)

# Calculate Mean Squared Error (MSE)
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error (MSE): {mse:.4f}")

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(f"Root Mean Squared Error (RMSE): {rmse:.4f}")

# Calculate R-squared (R2) score
r2 = r2_score(y_test, y_pred)
print(f"R-squared (R2): {r2:.4f}")

# Plotting Age vs Outcome using linear regression line
plt.figure(figsize=(10, 6))
plt.scatter(X_test['Age'], y_test, color='blue', alpha=0.5, label='Actual Data Poin
plt.plot(X_test['Age'], y_pred, color='red', linewidth=2, label='Linear Regression
plt.xlabel('Age')
plt.ylabel('Outcome')
plt.title('Linear Regression with SGD: Age vs Outcome')
plt.legend()
plt.show()
```

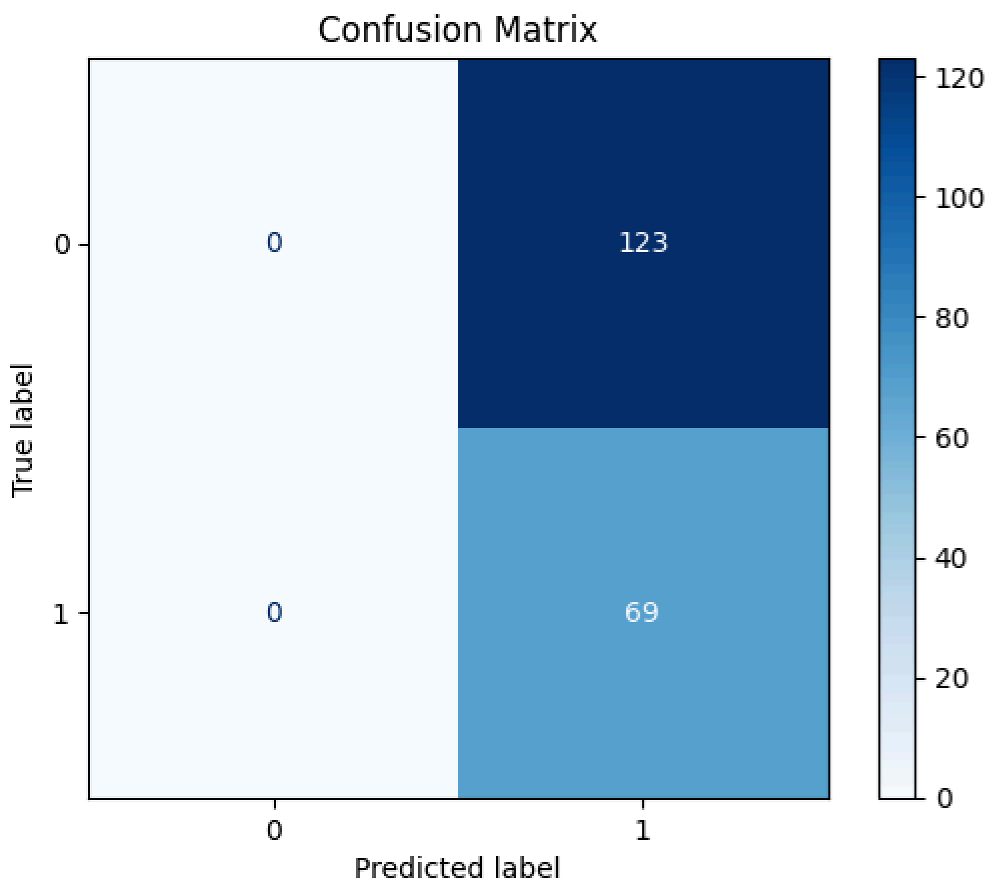
```
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            6      148             72             35        0  33.6
1            1       85             66             29        0  26.6
2            8      183             64              0        0  23.3
3            1       89             66             23       94  28.1
4            0      137             40             35      168  43.1

   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
Mean Squared Error (MSE): 0.3848
Root Mean Squared Error (RMSE): 0.6204
R-squared (R2): -0.6716
```

SGD w/ Logistic Regression

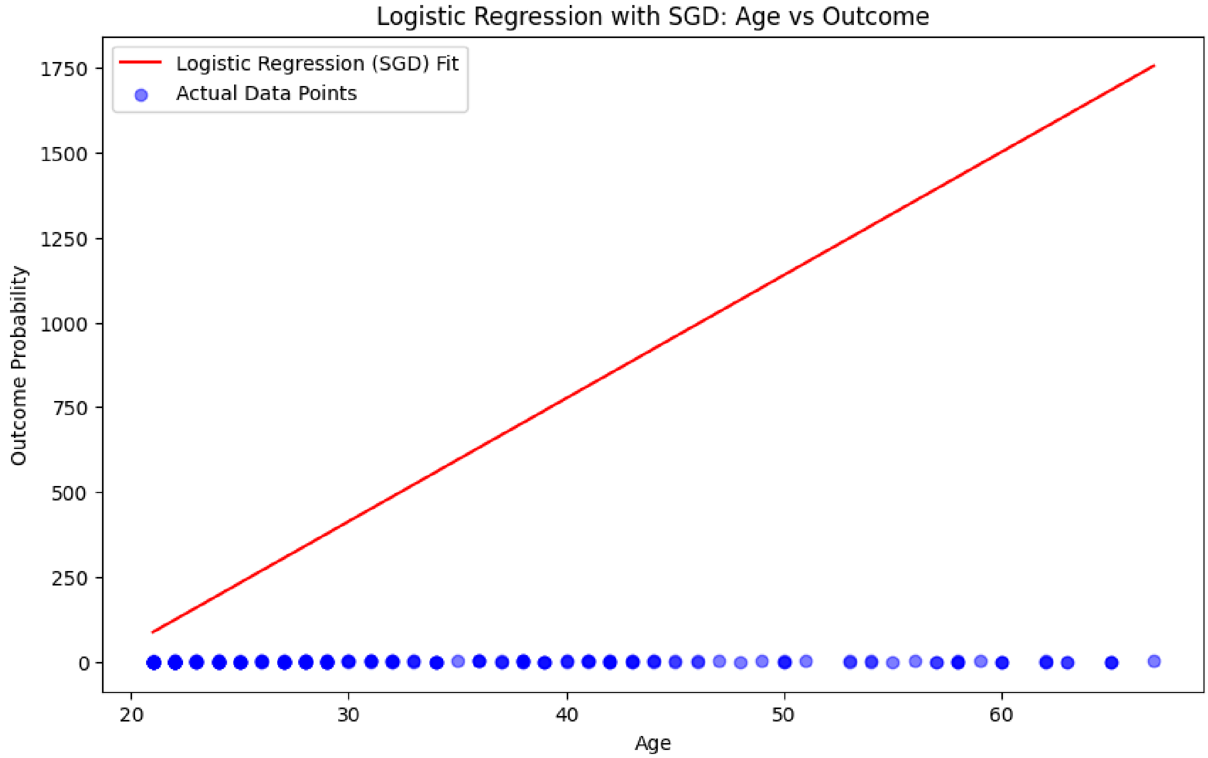
In [21]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import SGDClassifier
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score
from sklearn.metrics import mean_squared_error

# Load the dataset
data = pd.read_csv('diabetes_csv.csv')

# Display the first few rows of the data to understand it
print(data.head())

# Select 'Age' as the feature (X) and 'Outcome' as the target (y)
X = data[['Age']]  # Using double brackets to keep X as a DataFrame
y = data['Outcome']

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_st

# Train a logistic regression model using SGD
model = SGDClassifier(max_iter=1000, tol=1e-3, random_state=42, loss='log_loss')
model.fit(X_train, y_train)

# Predict the outcomes for the test set
y_pred = model.predict(X_test)

# Predict the probabilities for the test set using the decision function
```

```python
y_pred_proba = model.decision_function(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.4f}")

# Calculate precision
precision = precision_score(y_test, y_pred)
print(f"Precision: {precision:.4f}")

# Calculate recall
recall = recall_score(y_test, y_pred)
print(f"Recall: {recall:.4f}")

# Calculate F1-score
f1 = f1_score(y_test, y_pred)
print(f"F1 Score: {f1:.4f}")

# Compute confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)

# Plot confusion matrix
plt.figure(figsize=(8, 6))
disp.plot(cmap=plt.cm.Blues, values_format='d')
plt.title('Confusion Matrix')
plt.show()

# Calculate Mean Squared Error (MSE)
mse = mean_squared_error(y_test, y_pred_proba)
print(f"Mean Squared Error (MSE): {mse:.4f}")

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(f"Root Mean Squared Error (RMSE): {rmse:.4f}")

# Sort values for a smooth line plot
X_test_sorted, y_pred_proba_sorted = zip(*sorted(zip(X_test['Age'], y_pred_proba)))

# Plotting Age vs Outcome using logistic regression probabilities
plt.figure(figsize=(10, 6))
plt.plot(X_test_sorted, y_pred_proba_sorted, color='red', label='Logistic Regressio
plt.scatter(X_test['Age'], y_test, color='blue', alpha=0.5, label='Actual Data Poin
plt.xlabel('Age')
plt.ylabel('Outcome Probability')
plt.title('Logistic Regression with SGD: Age vs Outcome')
plt.legend()
plt.show()
```

```
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            6      148             72             35        0  33.6
1            1       85             66             29        0  26.6
2            8      183             64              0        0  23.3
3            1       89             66             23       94  28.1
4            0      137             40             35      168  43.1

   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
Accuracy: 0.3594
Precision: 0.3594
Recall: 1.0000
F1 Score: 0.5287
<Figure size 800x600 with 0 Axes>
```




```
Mean Squared Error (MSE): 523140.6782
Root Mean Squared Error (RMSE): 723.2846
```



Naive Bayes Classifier

In [ ]:

```

```