```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import classification_report, confusion_matrix,
accuracy_score

# Load dataset
df = pd.read_csv('diabetes_python.csv')

# Basic info
print("\nDataset Info:")
df.info()
print("\nSummary Statistics:")
print(df.describe())

# Check for missing or zero values
print("\nMissing or Zero Values:")
zero_columns = ['Glucose', 'BloodPressure', 'SkinThickness',
'Insulin', 'BMI']
print(df[zero_columns].eq(0).sum())

# Replace 0s with NaN and impute later
df[zero_columns] = df[zero_columns].replace(0, np.nan)

# Impute missing values with median
df.fillna(df.median(), inplace=True)

# EDA Plots
sns.set(style="whitegrid")

# Histograms
df.hist(bins=20, figsize=(14,10))
plt.suptitle('Feature Distributions')
plt.show()



# Correlation heatmap
plt.figure(figsize=(10,8))
sns.heatmap(df.corr(), annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Heatmap')
plt.show()

# Outcome distribution
```

```
sns.countplot(x='Outcome', data=df)
plt.title('Outcome Distribution')
plt.show()

# Box plots
plt.figure(figsize=(15, 8))
for idx, column in enumerate(df.columns[:-1], 1):
    plt.subplot(2, 4, idx)
    sns.boxplot(x='Outcome', y=column, data=df)
    plt.title(f'{column} vs Outcome')
plt.tight_layout()
plt.show()

# Preprocessing
X = df.drop('Outcome', axis=1)
y = df['Outcome']
X_train_raw, X_test_raw, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train_raw)
X_test = scaler.transform(X_test_raw)

# Logistic Regression Model
clf = LogisticRegression(class_weight='balanced', max_iter=1000)
clf.fit(X_train, y_train)

# Evaluation
y_pred = clf.predict(X_test)
print("\nClassification Report:")
print(classification_report(y_test, y_pred))
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))
print("Accuracy:", accuracy_score(y_test, y_pred))

# Confusion Matrix Heatmap
plt.figure(figsize=(6, 4))
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d',
cmap='Blues')
plt.title('Confusion Matrix Heatmap')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.show()


Dataset Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype
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```
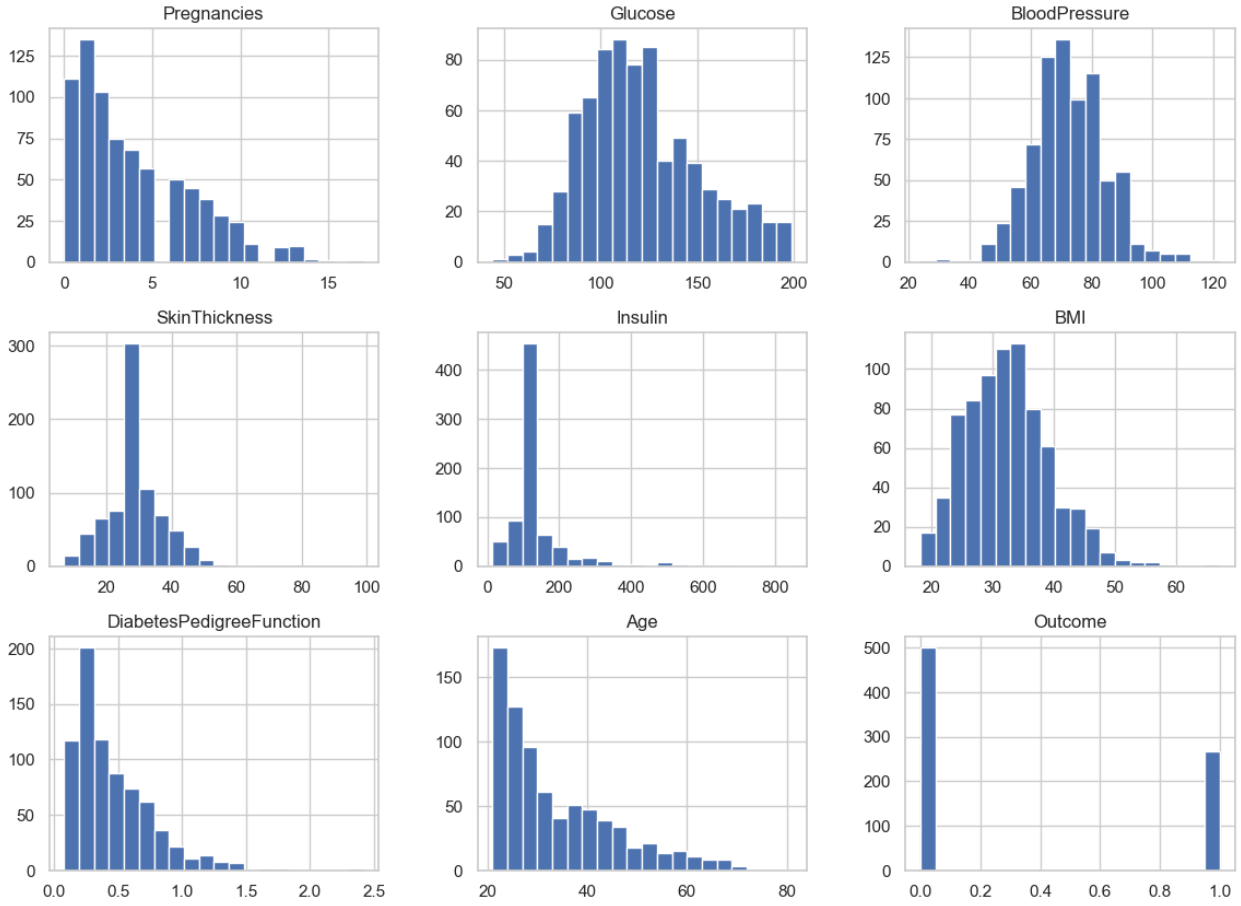
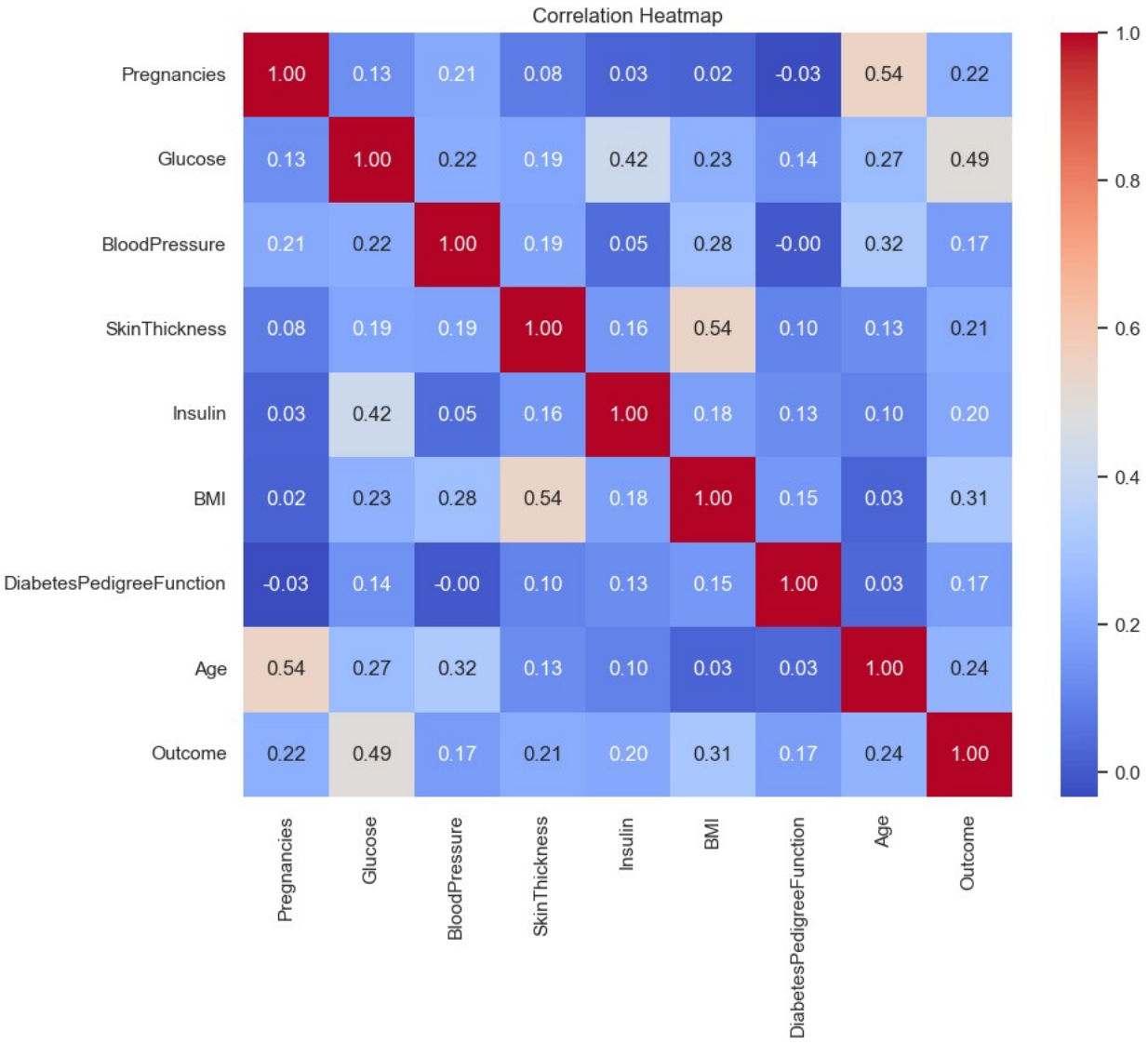
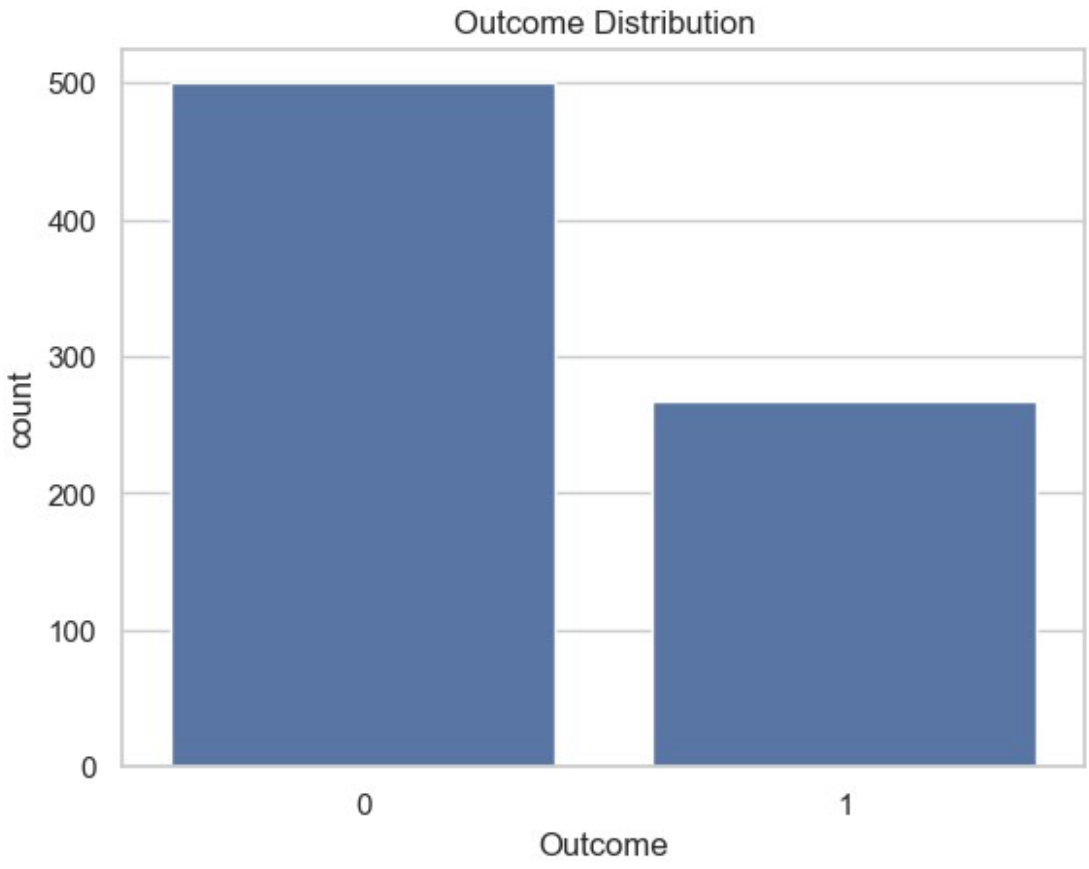
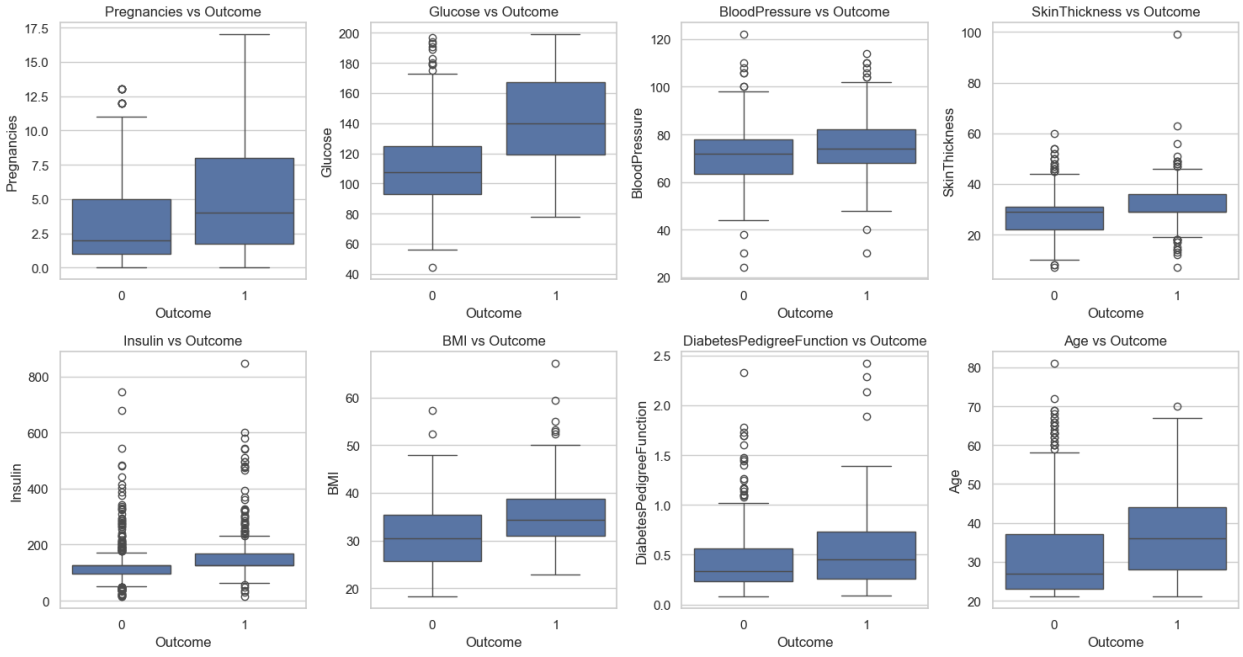

```
 0   Pregnancies               768 non-null    int64
 1   Glucose                   768 non-null    int64
 2   BloodPressure             768 non-null    int64
 3   SkinThickness             768 non-null    int64
 4   Insulin                   768 non-null    int64
 5   BMI                       768 non-null    float64
 6   DiabetesPedigreeFunction  768 non-null    float64
 7   Age                       768 non-null    int64
 8   Outcome                   768 non-null    int64
dtypes: float64(2), int64(7)
memory usage: 54.1 KB

Summary Statistics:
       Pregnancies     Glucose  BloodPressure  SkinThickness
Insulin  \
count   768.000000  768.000000     768.000000     768.000000
768.000000
mean      3.845052  120.894531      69.105469      20.536458
79.799479
std       3.369578   31.972618      19.355807      15.952218
115.244002
min       0.000000    0.000000       0.000000       0.000000
0.000000
25%       1.000000   99.000000      62.000000       0.000000
0.000000
50%       3.000000  117.000000      72.000000      23.000000
30.500000
75%       6.000000  140.250000      80.000000      32.000000
127.250000
max      17.000000  199.000000     122.000000      99.000000
846.000000

              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    31.992578                  0.471876   33.240885    0.348958
std      7.884160                  0.331329   11.760232    0.476951
min      0.000000                  0.078000   21.000000    0.000000
25%     27.300000                  0.243750   24.000000    0.000000
50%     32.000000                  0.372500   29.000000    0.000000
75%     36.600000                  0.626250   41.000000    1.000000
max     67.100000                  2.420000   81.000000    1.000000

Missing or Zero Values:
Glucose            5
BloodPressure     35
SkinThickness    227
Insulin          374
BMI               11
dtype: int64
```


Feature Distributions
Pregnancies
Glucose
BloodPressure
SkinThickness
Insulin
BMI
DiabetesPedigreeFunction
Age
Outcome


Correlation Heatmap
Pregnancies 1.00 0.13 0.21 0.08 0.03 0.02 -0.03 0.54 0.22
Glucose 0.13 1.00 0.22 0.19 0.42 0.23 0.14 0.27 0.49
BloodPressure 0.21 0.22 1.00 0.19 0.05 0.28 -0.00 0.32 0.17
SkinThickness 0.08 0.19 0.19 1.00 0.16 0.54 0.10 0.13 0.21
Insulin 0.03 0.42 0.05 0.16 1.00 0.18 0.13 0.10 0.20
BMI 0.02 0.23 0.28 0.54 0.18 1.00 0.15 0.03 0.31
DiabetesPedigreeFunction -0.03 0.14 -0.00 0.10 0.13 0.15 1.00 0.03 0.17
Age 0.54 0.27 0.32 0.13 0.10 0.03 0.03 1.00 0.24
Outcome 0.22 0.49 0.17 0.21 0.20 0.31 0.17 0.24 1.00
Pregnancies
Glucose
BloodPressure
SkinThickness
Insulin
BMI
DiabetesPedigreeFunction
Age
Outcome
1.0
0.8
0.6
0.4
0.2
0.0






```
Classification Report:
              precision    recall  f1-score   support
```

```
              precision    recall  f1-score   support

           0       0.81      0.70      0.75        99
           1       0.57      0.71      0.63        55

    accuracy                           0.70       154
   macro avg       0.69      0.70      0.69       154
weighted avg       0.72      0.70      0.71       154

Confusion Matrix:
[[69 30]
 [16 39]]
Accuracy: 0.7012987012987013
```