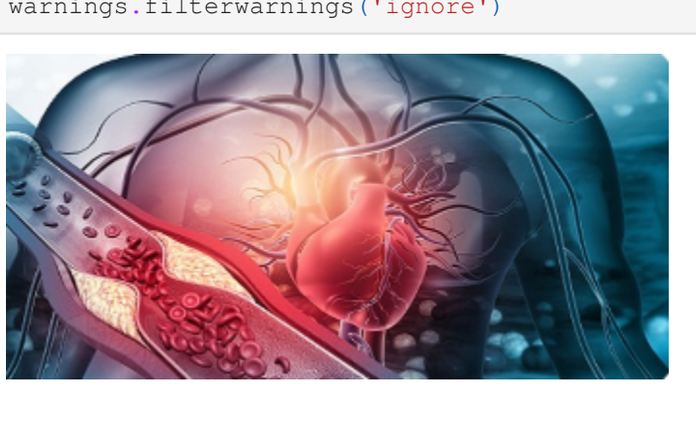
Heart Disease Classification

Import Necessary Libraries

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler

import warnings
warnings.filterwarnings('ignore')
```



About Dataset

In [2]:
```
# Age:  Refers to the number of years a person has lived; it is a critical factor in assessing health risks,
# including heart-related conditions, as risks often increase with age.
# gender : (0 for Female, 1 for Male)
# # Heart Rate (Impulse): The number of times the heart beats per minute, indicating cardiovascular activity.
# # Systolic BP (Pressurehigh): The pressure in the arteries when the heart contracts and pumps blood.
# # Diastolic BP (Pressurelow): The pressure in the arteries when the heart is at rest between beats.
# # Blood Sugar (Glucose): The amount of glucose present in the blood, crucial for energy and metabolism.
# # CK-MB (KCM): An enzyme found in the heart muscle; elevated levels indicate heart muscle damage.
# # Test-Troponin (Troponin): A protein released into the blood when the heart muscle is damaged, a key marker for diagnosing heart attacks.
```

1. Load & Data Acquisition

In [40]:
```
df = pd.read_csv("Heart Attack.csv")
df
```

Out[40]:

	age	gender	impluse	pressurehight	pressurelow	glucose	kcm	troponin	class
0	64	1	66	160	83	160.0	1.80	0.012	negative
1	21	1	94	98	46	296.0	6.75	1.060	positive
2	55	1	64	160	77	270.0	1.99	0.003	negative
3	64	1	70	120	55	270.0	13.87	0.122	positive
4	55	1	64	112	65	300.0	1.08	0.003	negative
...	...	...	...	...	...	...	...	...	...
1314	44	1	94	122	67	204.0	1.63	0.006	negative
1315	66	1	84	125	55	149.0	1.33	0.172	positive
1316	45	1	85	168	104	96.0	1.24	4.250	positive
1317	54	1	58	117	68	443.0	5.80	0.359	positive
1318	51	1	94	157	79	134.0	50.89	1.770	positive

1319 rows × 9 columns

2. Data Preprocessing

In [41]:
```
# View the first 5 rows of the dataset
df.head()
```

Out[41]:

	age	gender	impluse	pressurehight	pressurelow	glucose	kcm	troponin	class
0	64	1	66	160	83	160.0	1.80	0.012	negative
1	21	1	94	98	46	296.0	6.75	1.060	positive
2	55	1	64	160	77	270.0	1.99	0.003	negative
3	64	1	70	120	55	270.0	13.87	0.122	positive
4	55	1	64	112	65	300.0	1.08	0.003	negative

In [42]:
```
# Check for missing values
df.isnull().sum()
```

Out[42]:
```
age              0
gender           0
impluse          0
pressurehight    0
pressurelow      0
glucose          0
kcm              0
troponin         0
class            0
dtype: int64
```

In [43]:
```
# summary of the df
df.describe()
```

Out[43]:

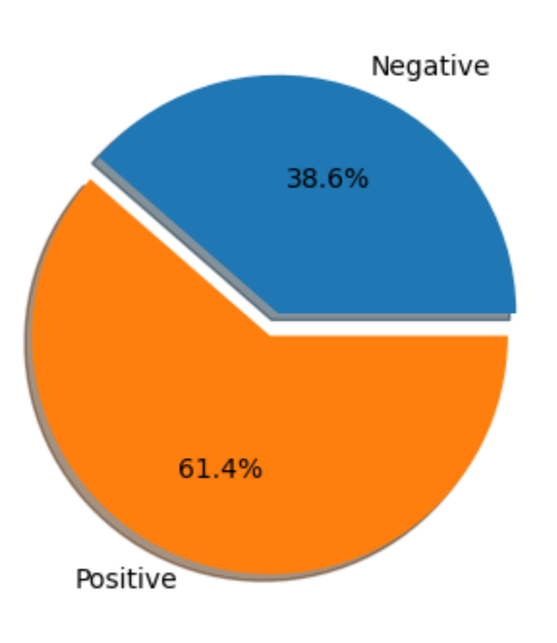
	age	gender	impluse	pressurehight	pressurelow	glucose	kcm	troponin
count	1319.000000	1319.000000	1319.000000	1319.000000	1319.000000	1319.000000	1319.000000	1319.000000
mean	56.191812	0.659591	78.336619	127.170584	72.269143	146.634344	15.274306	0.360942
std	13.647315	0.474027	51.630270	26.122720	14.033924	74.923045	46.327083	1.154568
min	14.000000	0.000000	20.000000	42.000000	38.000000	35.000000	0.321000	0.001000
25%	47.000000	0.000000	64.000000	110.000000	62.000000	98.000000	1.655000	0.006000
50%	58.000000	1.000000	74.000000	124.000000	72.000000	116.000000	2.850000	0.014000
75%	65.000000	1.000000	85.000000	143.000000	81.000000	169.500000	5.805000	0.085500
max	103.000000	1.000000	1111.000000	223.000000	154.000000	541.000000	300.000000	10.300000

In [44]:
```
# Check the data types
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1319 entries, 0 to 1318
Data columns (total 9 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   age            1319 non-null   int64  
 1   gender         1319 non-null   int64  
 2   impluse        1319 non-null   int64  
 3   pressurehight  1319 non-null   int64  
 4   pressurelow    1319 non-null   int64  
 5   glucose        1319 non-null   float64
 6   kcm            1319 non-null   float64
 7   troponin       1319 non-null   float64
 8   class          1319 non-null   object 
dtypes: float64(3), int64(5), object(1)
memory usage: 92.9+ KB
```

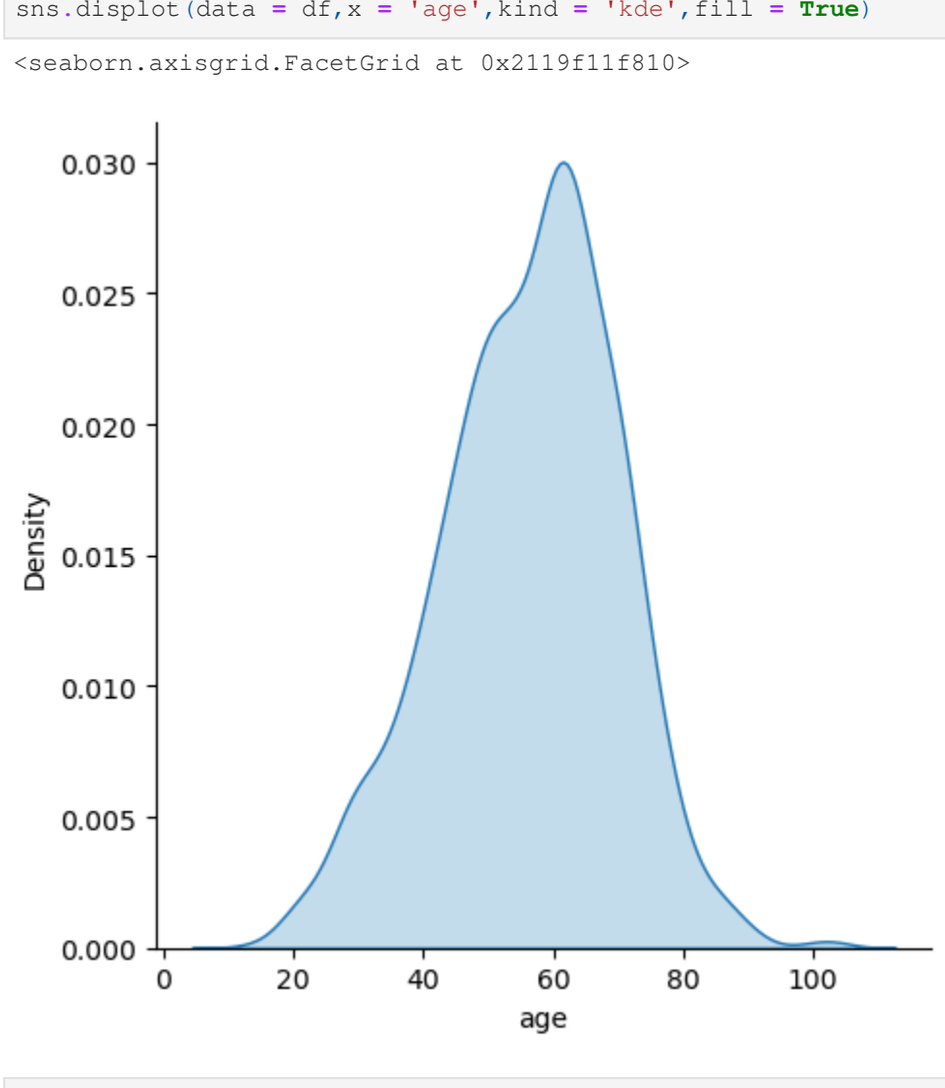
EDA (Exploratory Data Analysis)

In [45]:
```
fig = plt.figure(figsize =(15, 4))

plt.pie(df[['class']].groupby('class').size(), labels =['Negative', 'Positive'], explode=(0, 0.1), autopct='%1.1f%%', shadow=True)

plt.show()
```

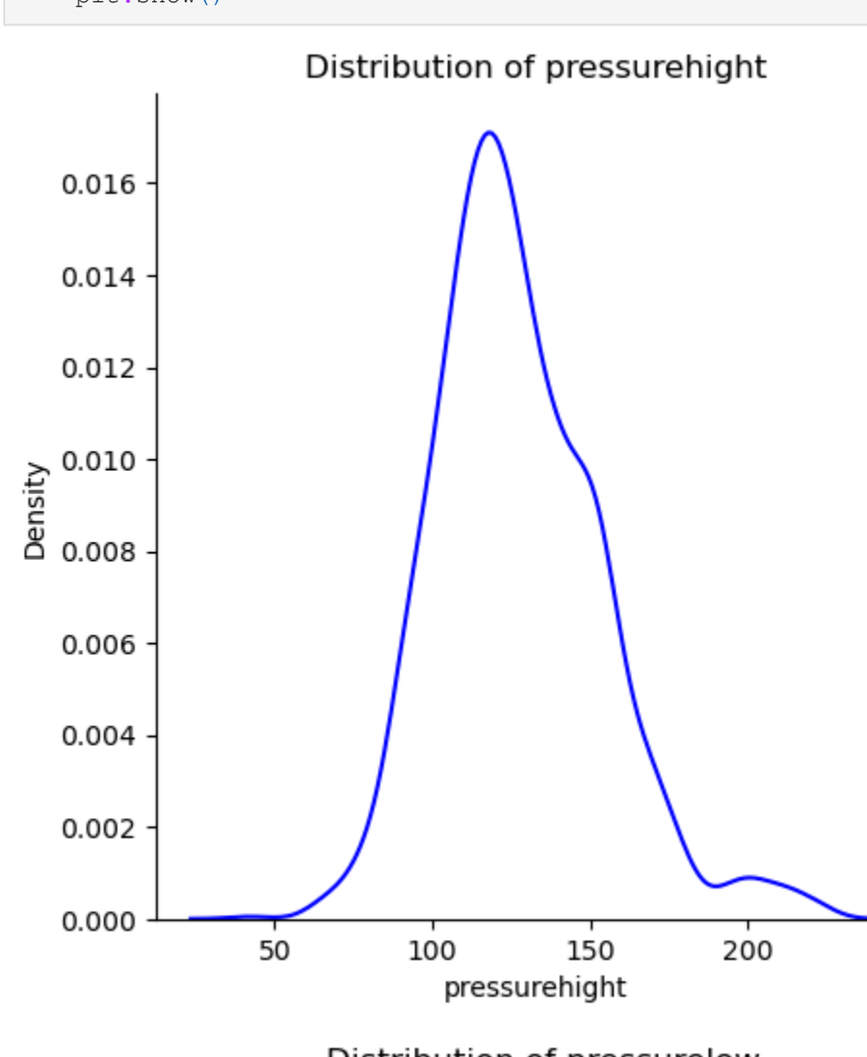


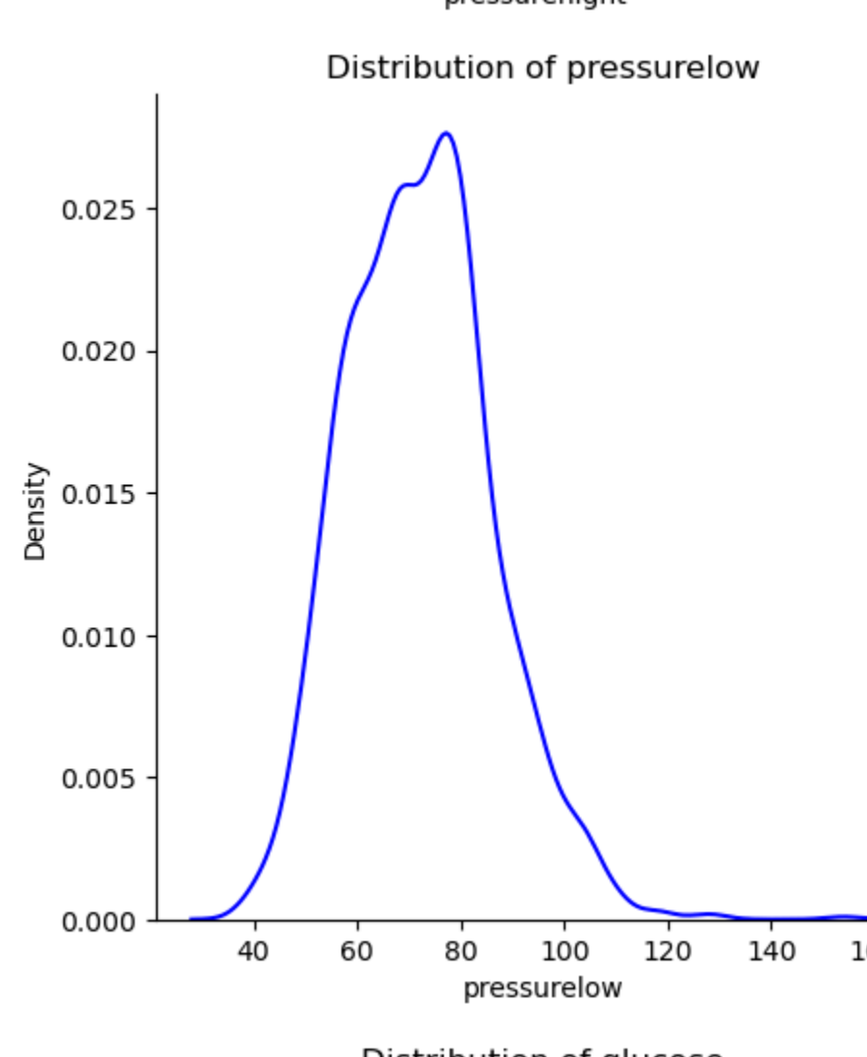
In [46]:
```
sns.displot(data = df,x = 'age',kind = 'kde',fill = True)
```

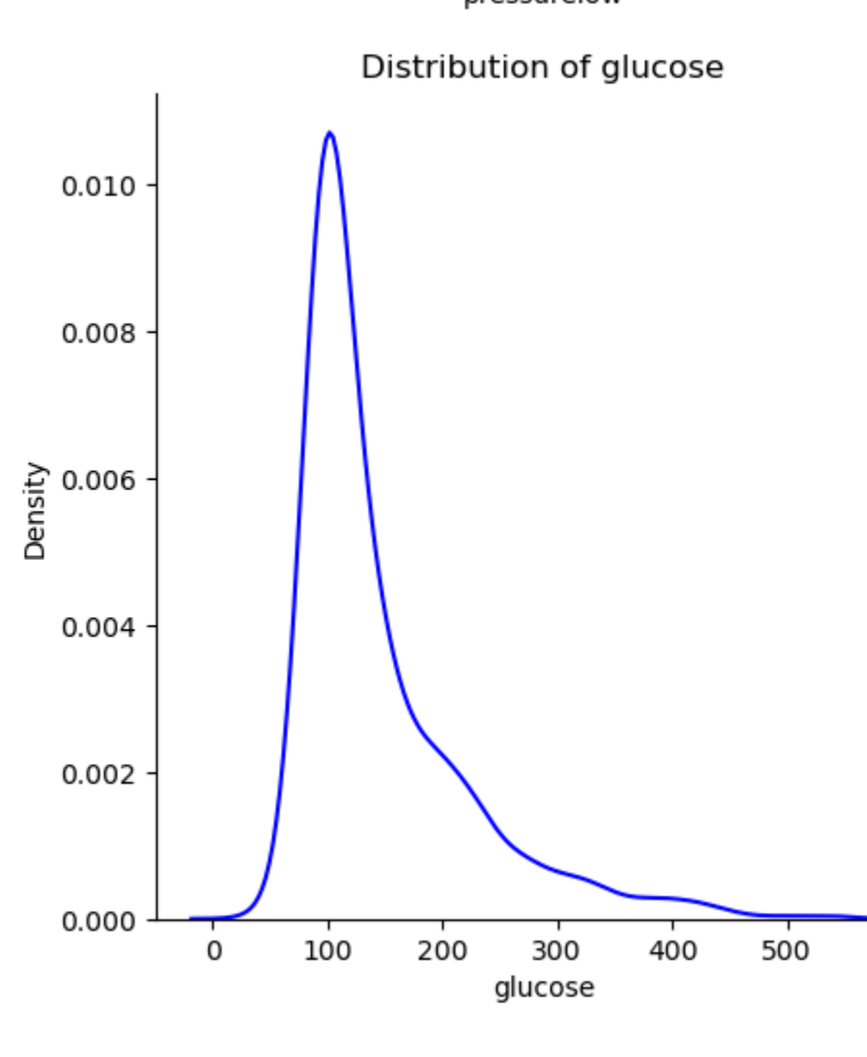
Out[46]:
```
<seaborn.axisgrid.FacetGrid at 0x2119f11f810>
```



In [47]:
```
columns = df.columns[3:6]

for col in columns:
    sns.displot(df[col], kind = 'kde', color='blue')
    plt.title(f'Distribution of {col}')
    plt.xlabel(col)
    plt.show()
```



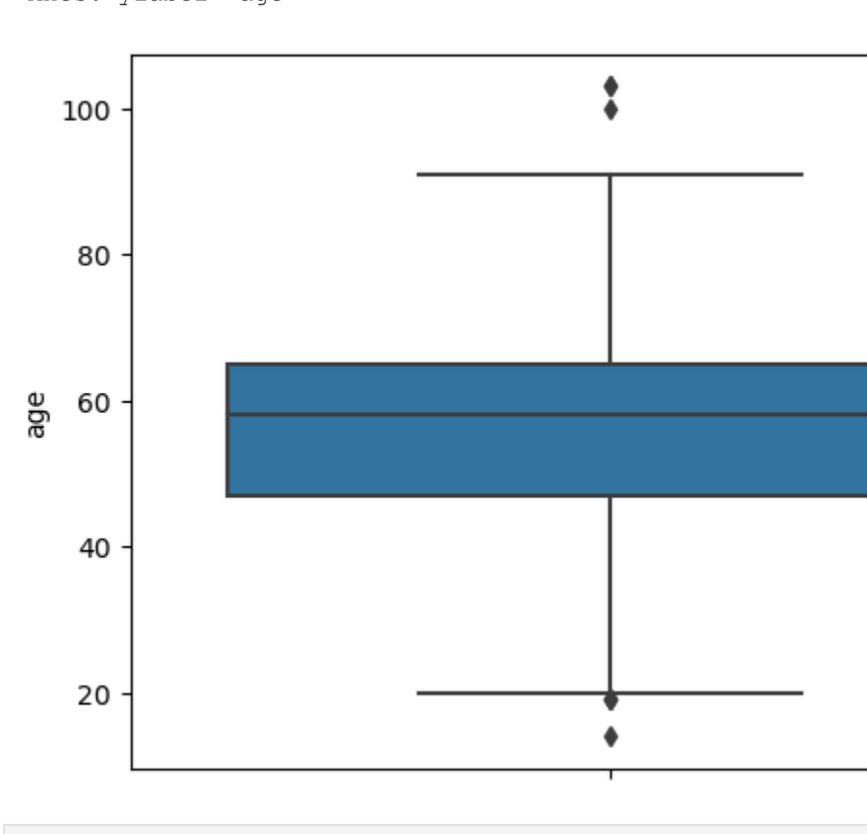




Outliers Handling

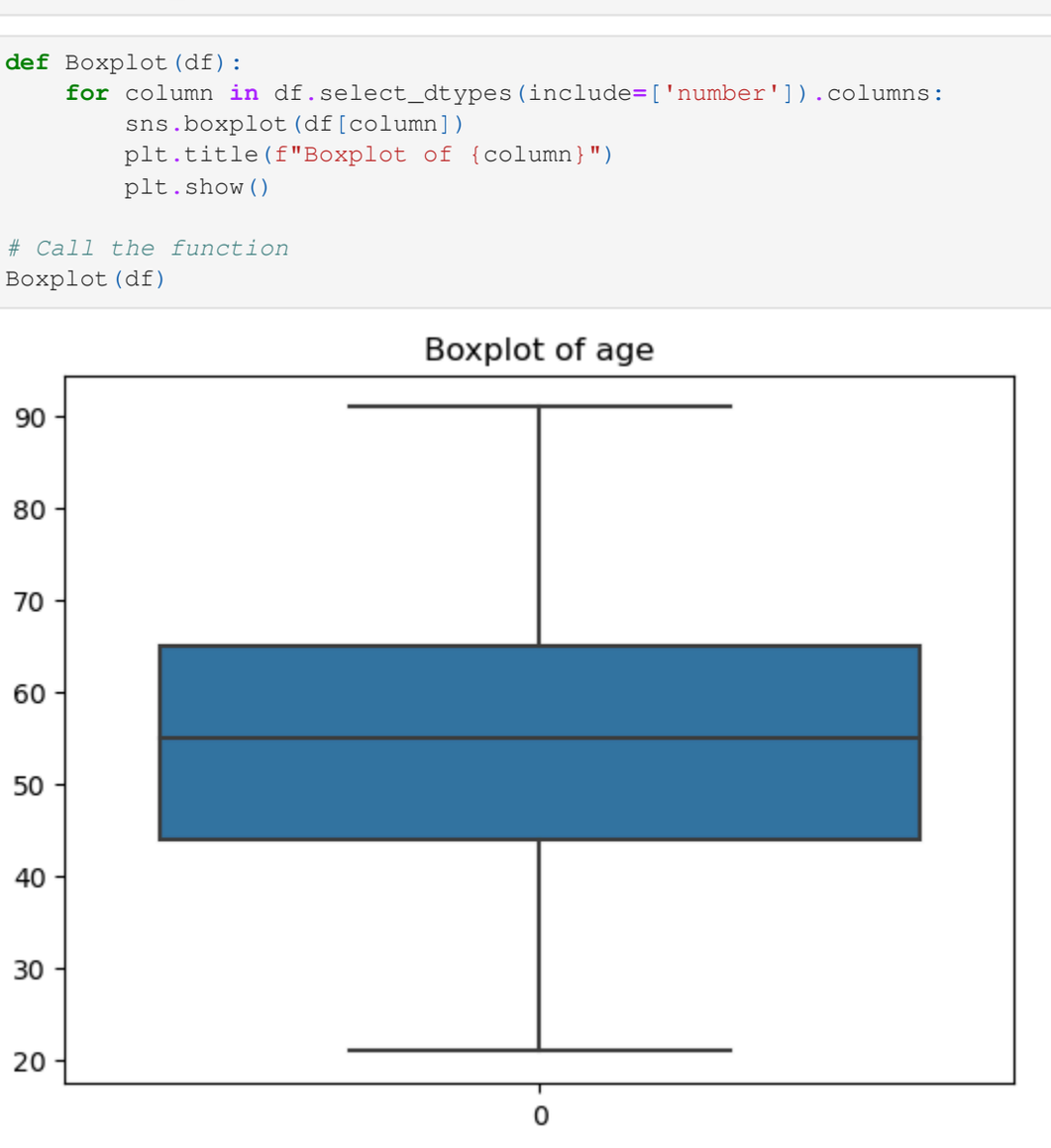
In [48]:
```
sns.boxplot(data = df,y = 'age')
```

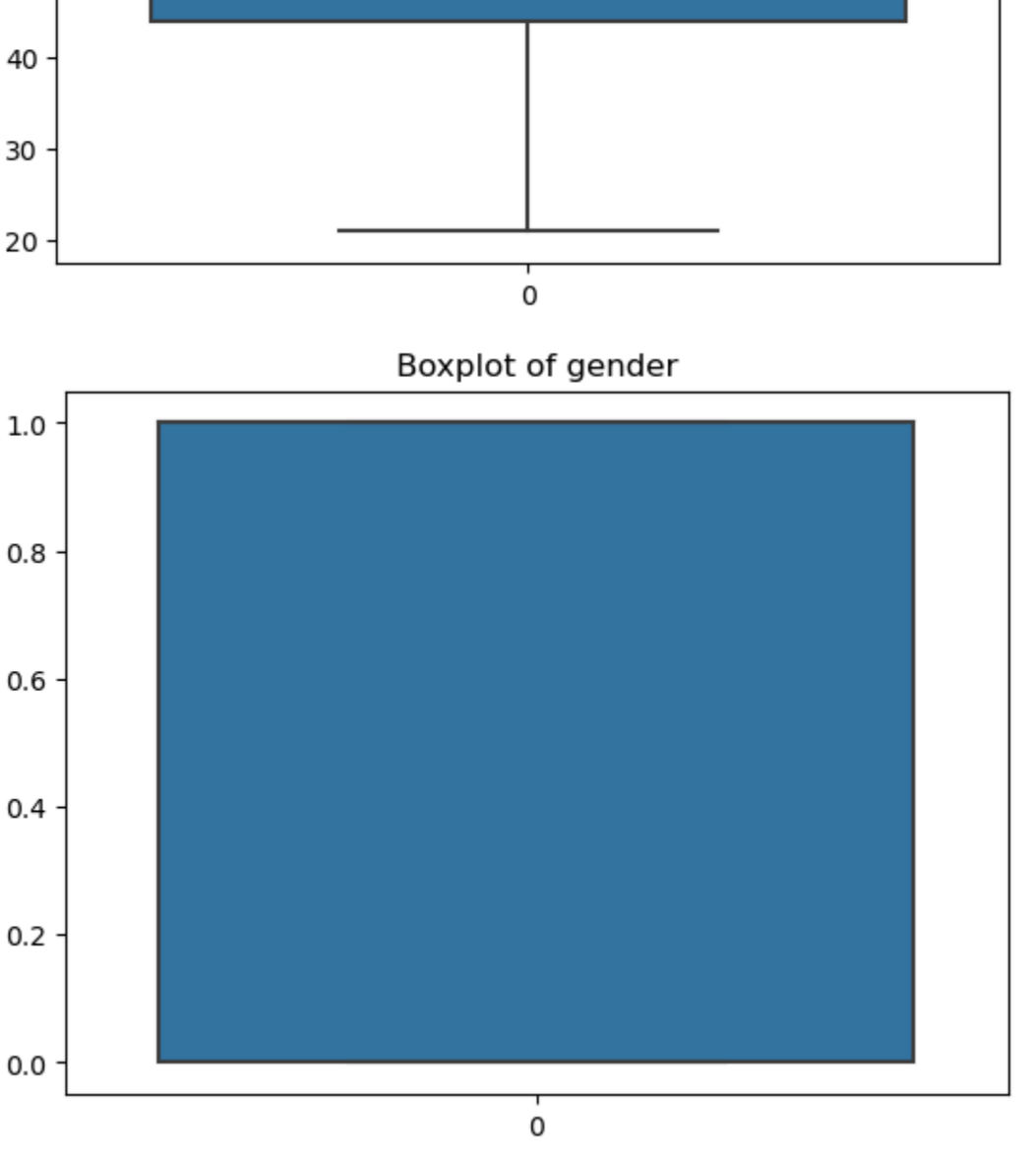
Out[48]:
```
<Axes: ylabel='age'>
```

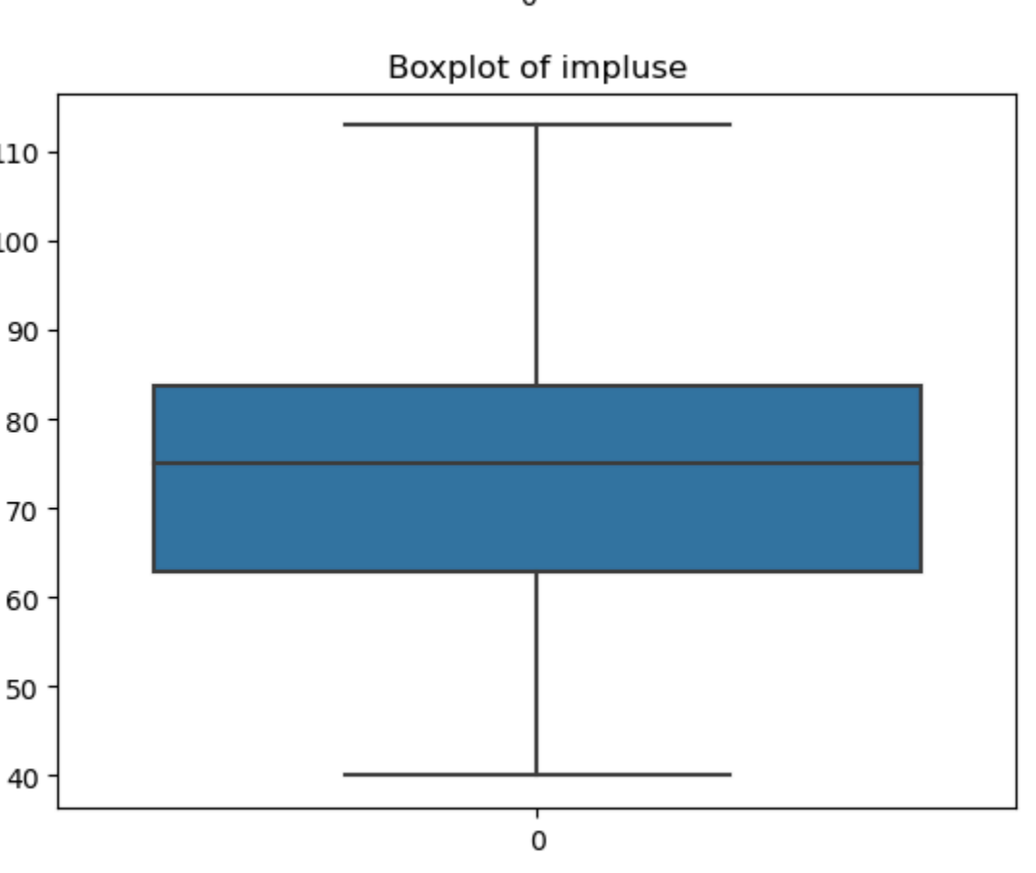


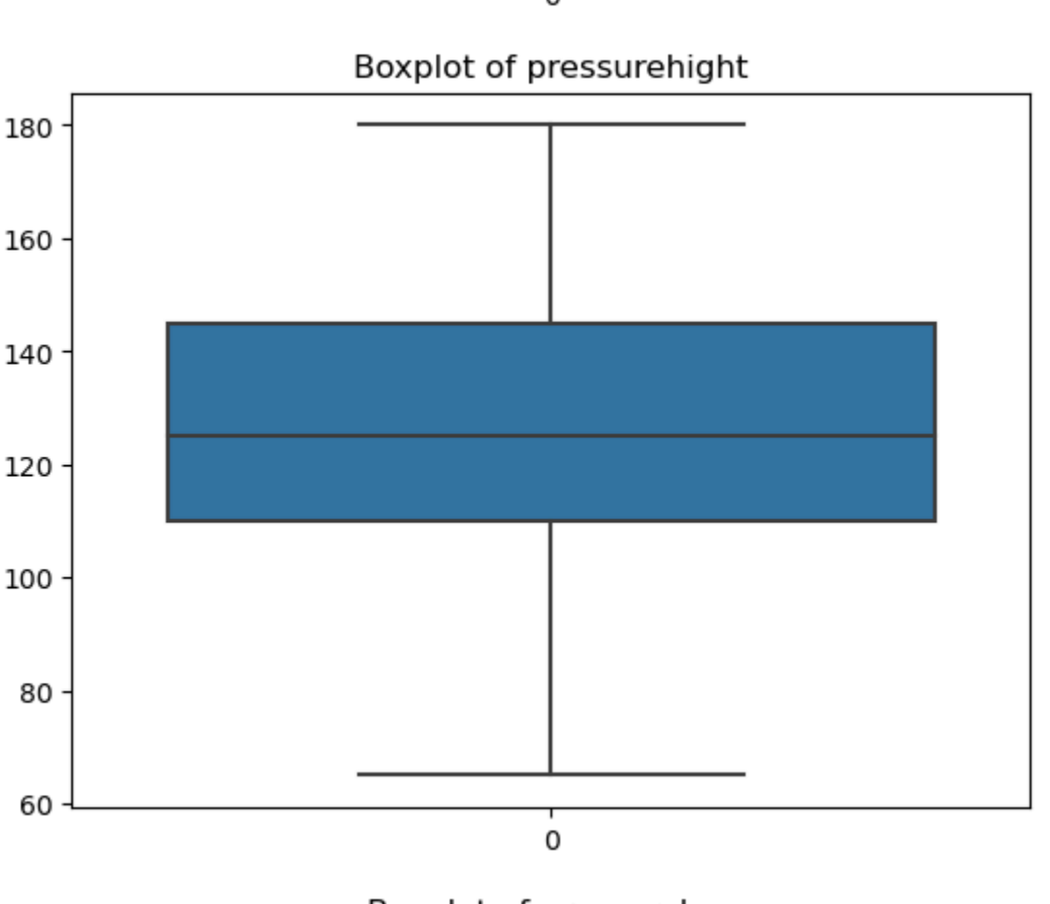
In [62]:
```
# Function to remove outliers using the IQR method
def remove_outliers(df):
    for column in df.select_dtypes(include=['number']).columns:  # Numerical columns only
        Q1 = df[column].quantile(0.25)
        Q3 = df[column].quantile(0.75)
        IQR = Q3 - Q1
        lower_bound = Q1 - 1.5 * IQR
        upper_bound = Q3 + 1.5 * IQR
        df = df[(df[column] >= lower_bound) & (df[column] <= upper_bound)]
    return df

# Remove outliers from the dataset
df = remove_outliers(df)
```

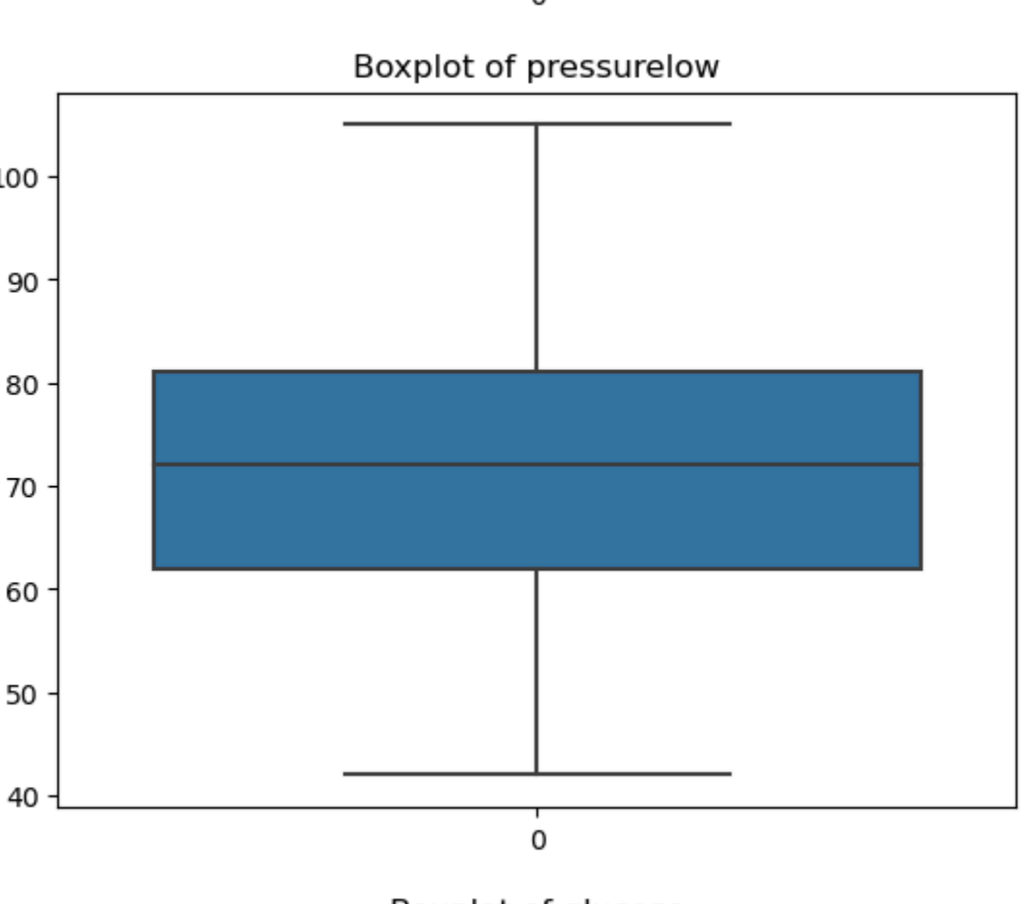
In [73]:
```
def Boxplot(df):
    for column in df.select_dtypes(include=['number']).columns:
        sns.boxplot(df[column])
        plt.title(f"Boxplot of {column}")
        plt.show()

# Call the function
Boxplot(df)
```

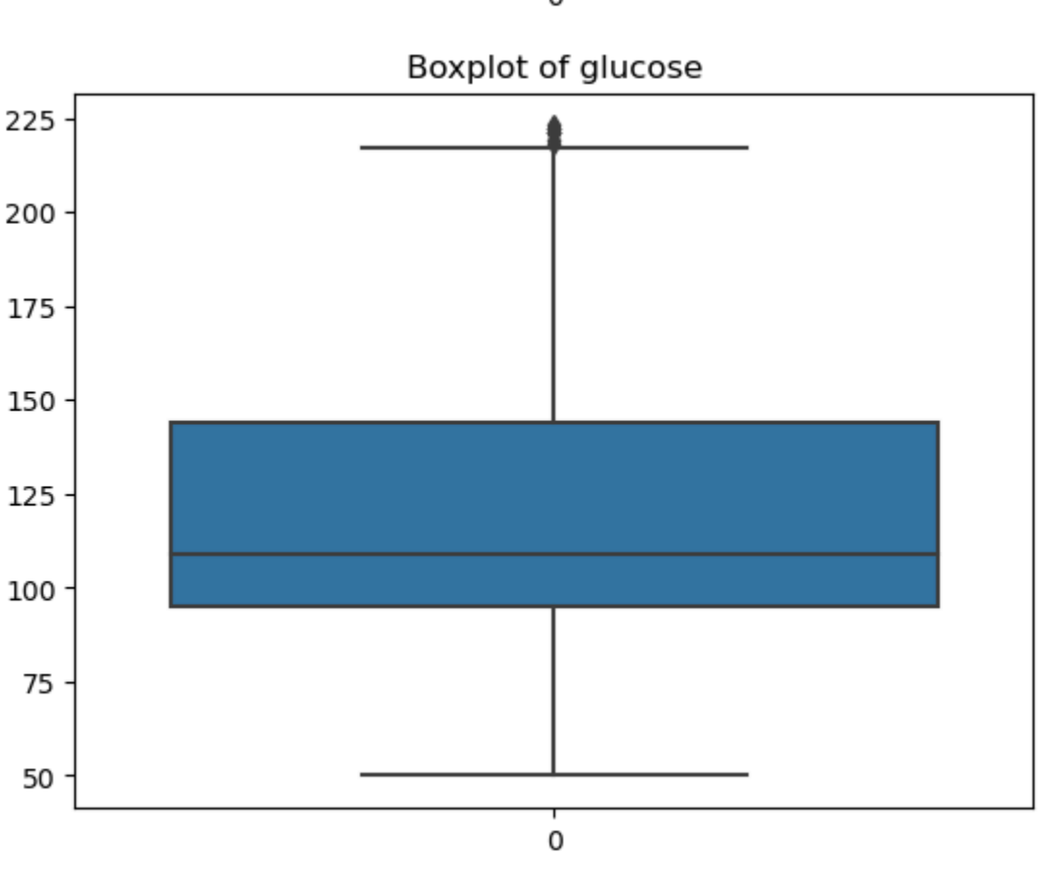


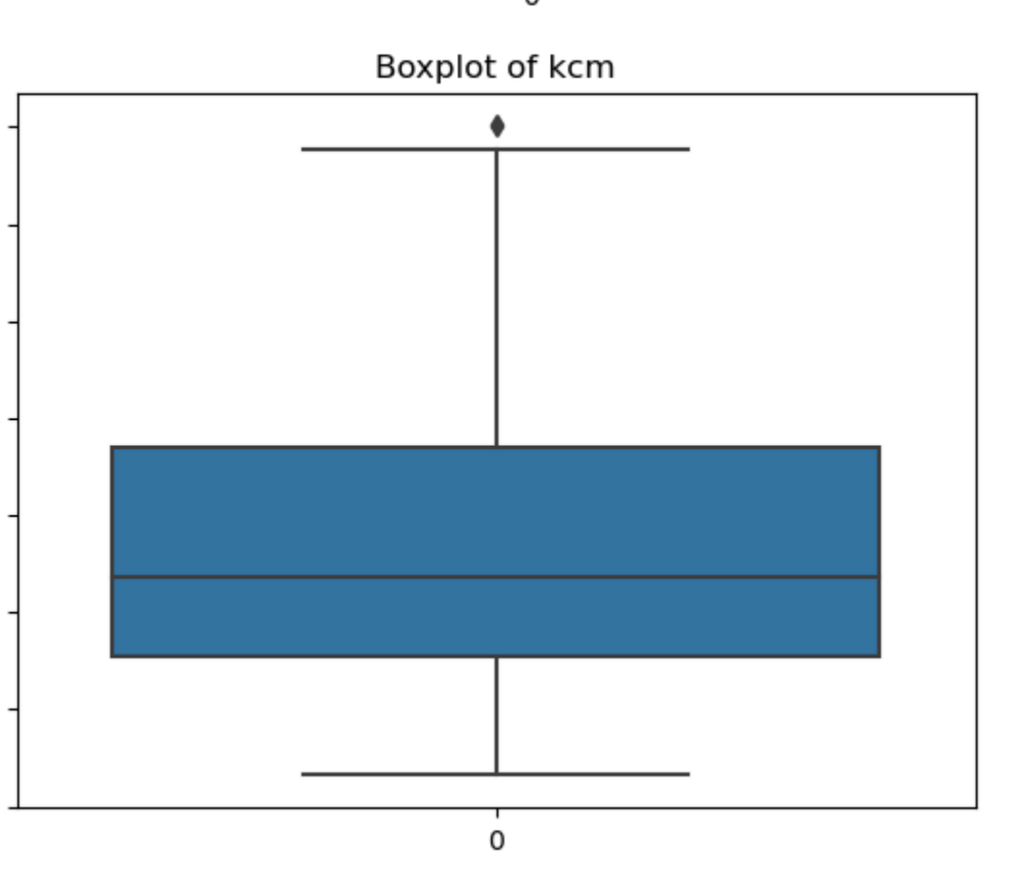


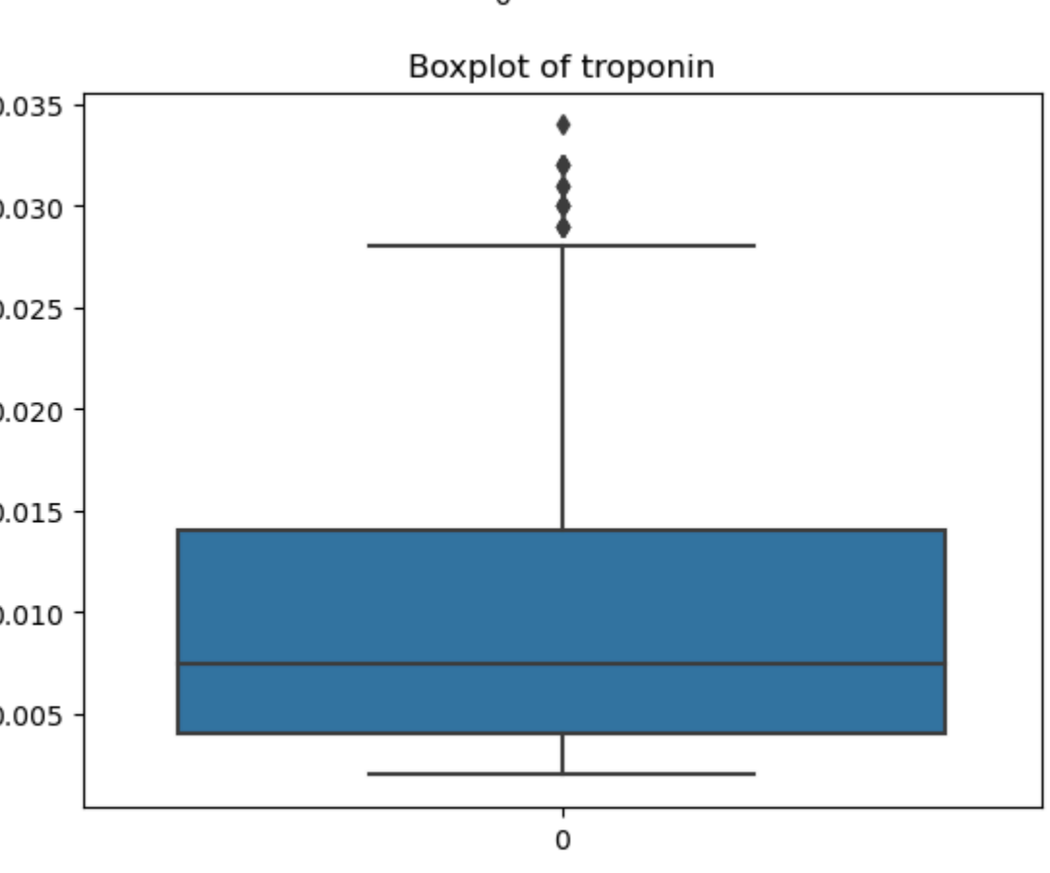












Feature Engineering

In [89]:
```
# Initialize StandardScaler
scaler = StandardScaler()

# Select feature columns to scale
feature_columns = ['age', 'gender', 'impluse', 'pressurehight', 'pressurelow', 'glucose',
       'kcm', 'troponin', ]

# Apply StandardScaler
df[feature_columns] = scaler.fit_transform(df[feature_columns])
```

In [79]:
```
# Separate features (X) and target (y)
X = df.drop(columns=["class"])
y = df["class"]

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

In [95]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(452, 8)
(114, 8)
(452,)
(114,)
```

Build the model

In [84]:
```
model = LogisticRegression(random_state=42)
model.fit(X_train, y_train)
```

Out[84]:
```
LogisticRegression
LogisticRegression(random_state=42)
```

In [85]:
```
#  Make predictions
y_pred = model.predict(X_test)
```

In [90]:
```
comparison_df = pd.DataFrame({"Actual":y_test,"Predicted":y_pred})
comparison_df
```

Out[90]:

	Actual	Predicted
1253	positive	positive
1201	positive	positive
541	negative	negative
1208	positive	positive
1133	negative	negative
...	...	...
197	negative	negative
1197	negative	negative
1002	negative	negative
68	negative	negative
766	negative	negative

114 rows × 2 columns

In [86]:
```
# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")
```

```
Accuracy: 0.91
```

In [87]:
```
# Classification report and confusion matrix
print("\nClassification Report:")
print(classification_report(y_test, y_pred))
```

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

    negative       0.91      0.96      0.94        77
    positive       0.91      0.81      0.86        37

    accuracy                           0.91       114
   macro avg       0.91      0.89      0.90       114
weighted avg       0.91      0.91      0.91       114
```

In [144…
```
print("\nConfusion Matrix:")
conf_matrix = confusion_matrix(y_test, y_pred)
sns.heatmap(conf_matrix, annot=True, fmt="d", cmap="Reds", xticklabels=["No Disease", "Disease"], yticklabels=["No Disease", "Disease"])
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix")
plt.show()
```

```
Confusion Matrix:
```

Naive Bayes

In [116…
```
from sklearn.naive_bayes import GaussianNB
```

In [117…
```
nb = GaussianNB()

nb.fit(X_train,y_train)
```

Out[117]:
```
GaussianNB
GaussianNB()
```

In [118…
```
y_pred = nb.predict(X_test)
```

In [121…
```
print("\nNaive Bayes Model")
print("Accuracy: ",accuracy_score(y_test,y_pred))
```

```
Naive Bayes Model
Accuracy:  0.9210526315789473
```

Random Forest

In [124…
```
from sklearn.ensemble import RandomForestClassifier
```

In [126…
```
# Initialize Random Forest classifier
rf_model = RandomForestClassifier(n_estimators=100, random_state=42)

# Train the model

rf_model.fit(X_train,y_train)
```

Out[126]:
```
RandomForestClassifier
RandomForestClassifier(random_state=42)
```

In [128…
```
y_pred = rf_model.predict(X_test)
```

In [133…
```
print("\nRandom Forest Classifier")
print("Accuracy: ",accuracy_score(y_test,y_pred))
```

```
Random Forest Classifier
Accuracy:  0.9736842105263158
```

Support Vector Classiffier

In [134…
```
from sklearn.svm import SVC
```

In [135…
```
# Initialize Support Vector Machine classifier
svm_model = SVC(kernel='linear', random_state=42)  # 'linear' kernel for linear SVM

svm_model.fit(X_train,y_train)
```

Out[135]:
```
SVC
SVC(kernel='linear', random_state=42)
```

In [138…
```
y_pred = svm_model.predict(X_test)
```

In [140…
```
print("\nSupport Vector Classifier")
print("Accuracy: ",accuracy_score(y_test,y_pred))
```

```
Support Vector Classifier
Accuracy:  0.9298245614035088
```

In [115…
```
def predict_heart_disease():
    print("Please enter the following details:")

    # Step 1: Taking input from the user
    age = int(input("Enter age: "))
    gender = int(input("Enter Gender: "))
    impluse = float(input("Enter impluse: "))
    pressurehight = float(input("Enter pressurehight: "))
    pressurelow = float(input("Enter pressurelow: "))
    glucose = float(input("Enter Glucose: "))
    kcm = float(input("Enter kcm: "))
    troponin = float(input("Enter troponin: "))

    # Step 2: Create a feature vector from the user input
    input_data = np.array([[age, gender, impluse, pressurehight, pressurelow, glucose,
       kcm, troponin]])

    # Step 3: Scale the input data
    input_data_scaled = scaler.transform(input_data)

    # Step 4: Use the trained model to predict
    prediction = model.predict(input_data_scaled)[0]

    # Step 5: Output the result
    print(f"\nPredicted Class: {prediction}")

# Call the function
predict_heart_disease()
```

```
Please enter the following details:
Enter age: 90
Enter Gender: 0
Enter impluse: 25
Enter pressurehight: 120
Enter pressurelow: 80
Enter Glucose: 200
Enter kcm: 0.2
Enter troponin: 0.01

Predicted Class: negative
```

In [141…
```
from sklearn.svm import SVC
kernels = ['linear', 'poly', 'rbf', 'sigmoid']

for kernel in kernels:
    svm_model = SVC(kernel=kernel)
    svm_model.fit(X_train, y_train)  # Assuming you have training data
    y_pred = svm_model.predict(X_test)
    print(f"Accuracy with {kernel} kernel: {accuracy_score(y_test, y_pred) * 100:.2f}%")
```

```
Accuracy with linear kernel: 92.98%
Accuracy with poly kernel: 88.60%
Accuracy with rbf kernel: 94.74%
Accuracy with sigmoid kernel: 88.60%
```

In [ ]: