In [1]:
```
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#Homework #2

#https://github.com/Gmaldonad17/4105-Machine-Learning/tree/main/HW2
```

In [2]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

In [3]:
```
import seaborn as sns

def matrix_print(cnf_matrix):
    class_names = [0,1]
    fig, ax = plt.subplots()
    tick_marks = np.arange(len(class_names))
    plt.xticks(tick_marks, class_names)
    plt.yticks(tick_marks, class_names)

    sns.heatmap(pd.DataFrame(cnf_matrix), annot = True, cmap = "YlGnBu", fmt = 'g')
    ax.xaxis.set_label_position("top")
    plt.tight_layout()
    plt.title('Confusion matrix', y=1.1)
    plt.ylabel('Actual label')
    plt.xlabel('Predicted label')
```

In [4]:
```
from sklearn import metrics

def metrics_print(y_pred):
    print("Accuracy:", metrics.accuracy_score(y_test, y_pred))
    print("Precision:", metrics.precision_score(y_test, y_pred))
    print("Recall:", metrics.recall_score(y_test, y_pred))
```

In [5]:
```
raw_data = pd.read_csv('Data/diabetes.csv')
raw_data
```

Out[5]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
0	6	148	72	35	0	33.6	0.627	50
1	1	85	66	29	0	26.6	0.351	31
2	8	183	64	0	0	23.3	0.672	32
3	1	89	66	23	94	28.1	0.167	21
4	0	137	40	35	168	43.1	2.288	33
...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63
764	2	122	70	27	0	36.8	0.340	27
765	5	121	72	23	112	26.2	0.245	30

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
766	1	126	60	0	0	30.1	0.349	47
767	1	93	70	31	0	30.4	0.315	23

768 rows × 9 columns

In [6]:
```
varlist = ['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin', 'BMI'
raw_x = raw_data[varlist]
raw_y = raw_data['Outcome']
```

In [7]:
```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler

x_train, x_test, y_train, y_test = train_test_split(raw_x, raw_y, test_size = 0.20, ran

sc_X = StandardScaler()
x_train = sc_X.fit_transform(x_train)
x_test = sc_X.transform(x_test)
```

In [8]:
```
#Problem 1:
```

In [9]:
```
from sklearn.linear_model import LogisticRegression

LR_classifier = LogisticRegression()
LR_classifier.fit(x_train, y_train)
```

Out[9]:
```
LogisticRegression()
```

In [10]:
```
#Prints out the predictions from the Logistic Regression Model
LR_y_pred = LR_classifier.predict(x_test)
print("Y Prediction: \n", LR_y_pred)
```

```
Y Prediction:
 [0 1 1 0 0 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 1 0 0 1 1 1 0 1 0 1 1 0 1 0 0 0
 1 0 0 0 0 0 1 1 0 0 1 0 0 0 0 0 1 1 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0
 0 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 1 0 0 0 0 1 0 1
 0 0 0 1 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 1
 0 1 0 1 0 0]
```

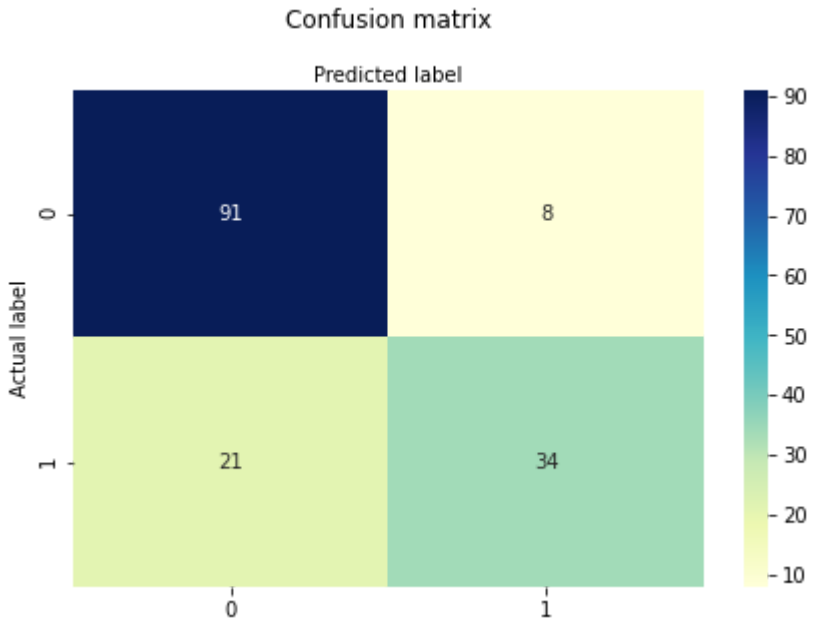
In [11]:
```
from sklearn.metrics import confusion_matrix

#Creates Logistic Regression Confusion Matrix
LR_matrix = confusion_matrix(y_test, LR_y_pred)
print("LR_Matrix: \n\n", LR_matrix)
```

```
LR_Matrix:

 [[91  8]
 [21 34]]
```

In [12]:
```
#Prints Metrics for problem 1
print("Logistic Regression Metrics: \n")
metrics_print(LR_y_pred)
```

```
Logistic Regression Metrics:

Accuracy: 0.8116883116883117
Precision: 0.8095238095238095
Recall: 0.6181818181818182
```

In [13]:
```
#Prints Confusion Matrix for problem 1
matrix_print(LR_matrix)
```



In [14]:
```
#Problem 2
```

In [15]:
```
from sklearn.naive_bayes import GaussianNB

NB_classifier = GaussianNB()
NB_classifier.fit(x_train, y_train)
```

Out[15]:
```
GaussianNB()
```

In [16]:
```
#Prints out the predictions from the Logistic Regression Model
NB_y_pred = NB_classifier.predict(x_test)
print("Y Prediction: \n", NB_y_pred)
```

```
Y Prediction:
 [0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 0 0 1 1 1 0 1 0 1 1 0 1 0 0 0
 1 0 0 0 0 0 1 1 0 1 1 0 0 0 0 0 1 1 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0
 0 1 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 1 0 0 0 0 1 0 1
 0 0 0 1 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 1 0 1 1 0 0 0 0 1 0 0 0 0 0 1 0 0 1
 0 1 0 1 0 0]
```

In [17]:
```
#Creates the Naive Bayes Confusion Matrix
NB_matrix = confusion_matrix (y_test, NB_y_pred)
```

```
print("NB_Matrix: \n\n", NB_matrix)
```

```
NB_Matrix:

 [[89 10]
 [22 33]]
```

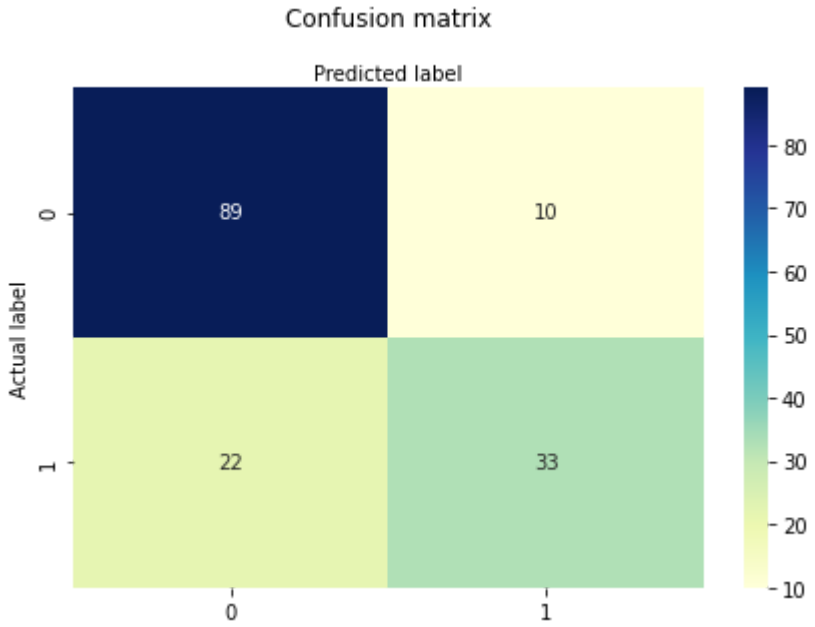
In [18]:

```
#Prints Metrics for problem 2
print("Naive Bayes Metrics: \n")
metrics_print(NB_y_pred)
```

```
Naive Bayes Metrics:

Accuracy: 0.7922077922077922
Precision: 0.7674418604651163
Recall: 0.6
```

In [19]:

```
#Prints Confusion Matrix for problem 1
matrix_print(NB_matrix)
```



In [20]:

```
#Problem 3:
```

In [21]:

```
from sklearn.model_selection import cross_val_score

K5_scores = cross_val_score(LR_classifier, x_train, y_train, cv = 5)
K10_scores = cross_val_score(LR_classifier, x_train, y_train, cv = 10)

print("Five K-folds Scores: \n", K5_scores)
print("\nTen K-folds Scores: \n", K10_scores)
```

```
Five K-folds Scores:
 [0.77235772 0.78861789 0.75609756 0.76422764 0.7295082 ]

Ten K-folds Scores:
 [0.75806452 0.83870968 0.83870968 0.72580645 0.72131148 0.75409836
 0.7704918  0.72131148 0.72131148 0.72131148]
```

In [22]:
```
#Problem 4:
#It does not make sense to use K-Folds on Naive Bayes because there is no training of t
#The model works on prediction values and probablity based on the data infront of it.
#If the data is split between training and testing it will only slightly change the pro
```

In [23]:
```
NB_scores = cross_val_score(NB_classifier, x_train, y_train, cv = 5)
print("Naive Bayes K-fold Scores: \n", NB_scores)
```

```
Naive Bayes K-fold Scores:
 [0.74796748 0.76422764 0.71544715 0.74796748 0.73770492]
```