In [1]:
```
'''
Patrick Ballou
ID: 801130521
ECGR 4105
Homework 3
Problem 2
'''
```

Out[1]:
```
'\nPatrick Ballou\nID: 801130521\nECGR 4105\nHomework 3\nProblem 2\n'
```

In [8]:
```
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings("ignore")
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import metrics
from sklearn.model_selection import train_test_split
from sklearn.datasets import load_breast_cancer
from sklearn import datasets
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import MinMaxScaler, StandardScaler
from sklearn.metrics import PrecisionRecallDisplay
from sklearn.decomposition import PCA
```

In [9]:
```
breast = load_breast_cancer()
x = pd.DataFrame(breast['data'])
Y = pd.DataFrame(breast['target'])
```

In [10]:
```
#standard scaler is best here
scaler = StandardScaler()
#scaler = MinMaxScaler()
X = scaler.fit_transform(x)
```

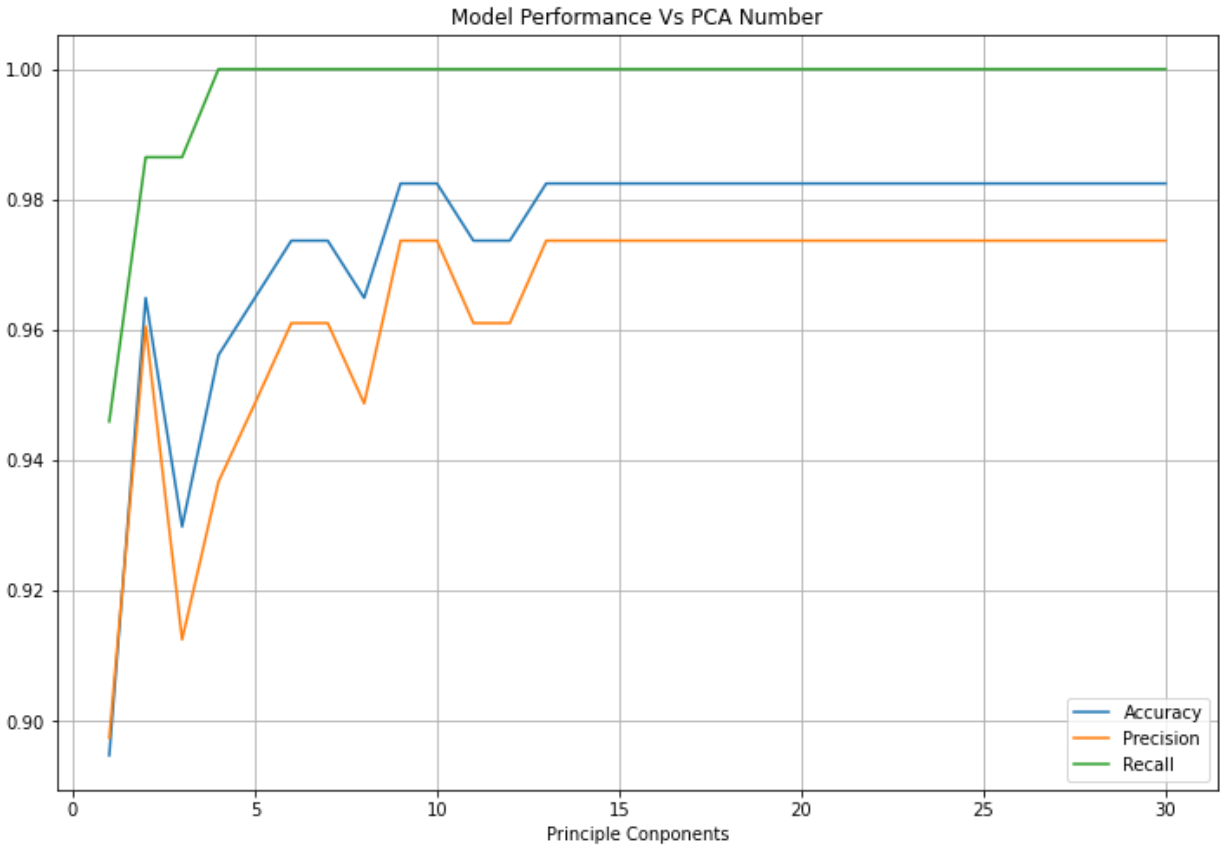
In [21]:
```
metrics_history = {}
accuracy_history = list()
precision_history = list()
recall_history = list()
for pca_num in range(1, 31):
    pca = PCA(n_components=pca_num)
    principalComponents = pca.fit_transform(X)
    principalDf = pd.DataFrame(data = principalComponents)

    X_train, X_test, Y_train, Y_test = train_test_split(principalDf, Y, train_size=.8,

    classifier = LogisticRegression(random_state=7)
    classifier.fit(X_train, Y_train)
    Y_pred = classifier.predict(X_test)
    accuracy_history.append(metrics.accuracy_score(Y_test, Y_pred))
    precision_history.append(metrics.precision_score(Y_test, Y_pred))
    recall_history.append(metrics.recall_score(Y_test, Y_pred))
```

In [23]:
```
plt.plot(range(1, 31), accuracy_history, label="Accuracy")
plt.plot(range(1, 31), precision_history, label="Precision")
plt.plot(range(1, 31), recall_history, label="Recall")
plt.rcParams["figure.figsize"] = (12,8)
```

```
plt.xlabel("Principle Conponents")
plt.title("Model Performance Vs PCA Number")
plt.legend()
plt.grid()
plt.show()
```



In [25]:
```
#pca_num=9 is the optimal number of components, so now we can evaluate the model
pca = PCA(n_components=9)
principalComponents = pca.fit_transform(X)
principalDf = pd.DataFrame(data = principalComponents)

X_train, X_test, Y_train, Y_test = train_test_split(principalDf, Y, train_size=.8, rar
classifier = LogisticRegression()
classifier.fit(X_train, Y_train)
Y_pred = classifier.predict(X_test)
```

In [26]:
```
print(metrics.classification_report(Y_test, Y_pred))
print(metrics.confusion_matrix(Y_test, Y_pred))
plt.rcParams["figure.figsize"] = (12,8)
```

```
              precision    recall  f1-score   support

           0       1.00      0.95      0.97        40
           1       0.97      1.00      0.99        74

    accuracy                           0.98       114
   macro avg       0.99      0.97      0.98       114
weighted avg       0.98      0.98      0.98       114

[[38  2]
 [ 0 74]]
```

In [27]:
```
cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix=metrics.confusion_matrix(
cm_display.plot()
```

Out[27]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x22b9a1efeb0>
```