week 5

August 30, 2023

[1]:

```
import numpy as np
```

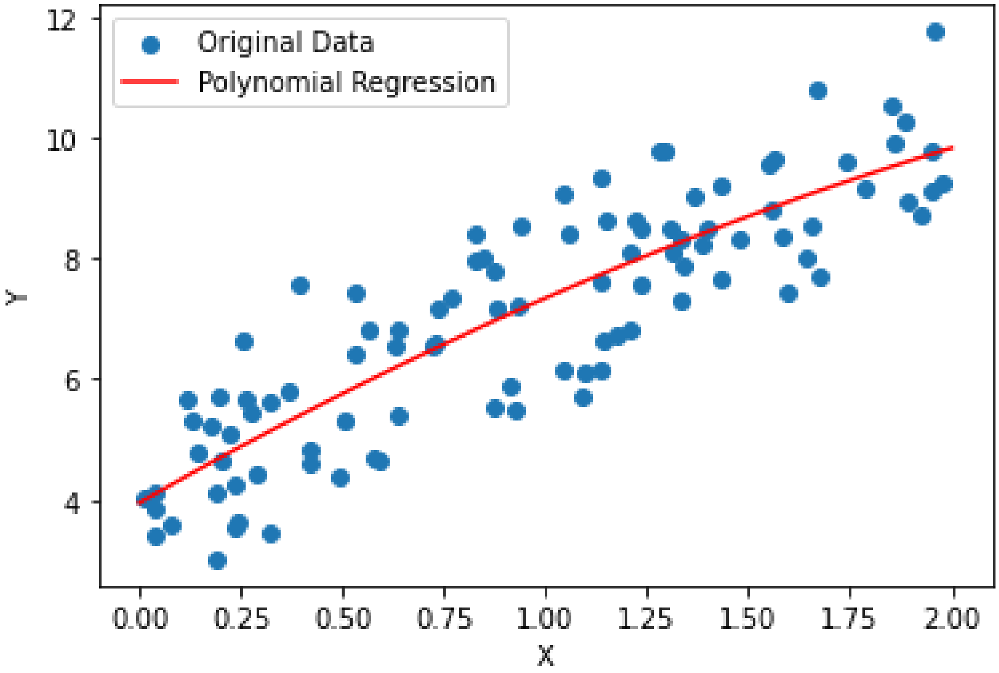
[5]:

```
# matrix inversion
A = np.array([[2,1],[1,3]])
B = np.array([4,7])
X = np.linalg.inv(A).dot(B)
print('Solution')
print(X)
```

```
Solution
[1. 2.]
```

[10]:

```
import numpy as np
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures
import matplotlib.pyplot as plt

# generate sample data
np.random.seed(0)
X = 2 * np.random.rand(100,1)
Y = 4 + 3*X + np.random.randn(100,1)

# fit a polynomial regression model
degree = 2 # can be changed as needed
poly_features = PolynomialFeatures(degree = degree)
X_poly = poly_features.fit_transform(X)

model = LinearRegression()
model.fit(X_poly , Y)

# make prediction
X_new = np.linspace(0,2,100).reshape(-1,1)
X_new_poly = poly_features.transform(X_new)
Y_new = model.predict(X_new_poly)

# Plot the original data and the polynomial regression curve
plt.scatter(X, Y, label='Original Data')
plt.plot(X_new, Y_new, 'r-', label='Polynomial Regression')
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.show()

# The coefficients of the multivariate polynomial regression model
coefficients = model.coef_
intercept = model.intercept_
print("Coefficients:")
print(coefficients)
print("Intercept:")
print(intercept)
```



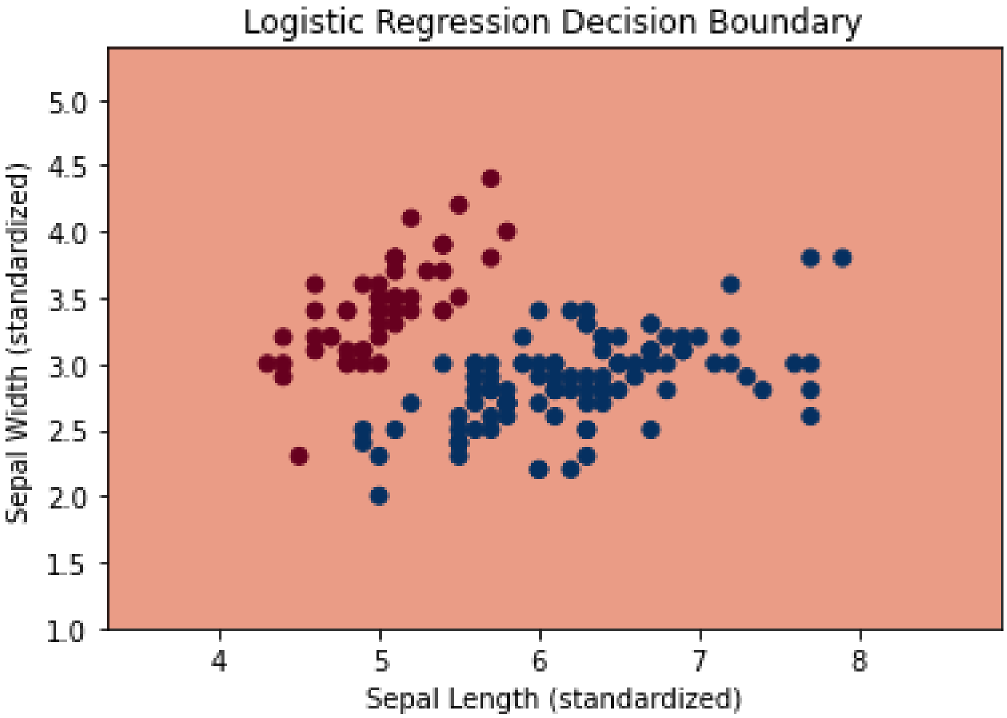
```
Coefficients:
[[ 0.          3.84100842 -0.45190593]]
Intercept:
[3.95139826]
```

[13]:

```
# example of logistic regression
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import classification_report, confusion_matrix

# Load the Iris dataset
iris = datasets.load_iris()
X = iris.data[:, :2] # We'll use only the first two features for simplicity
y = (iris.target != 0) * 1 # Convert target labels to binary 0 or 1

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
 ↪random_state=42)


# Standardize the feature data
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Create a logistic regression model
model = LogisticRegression(solver='liblinear')

# Train the model
model.fit(X_train, y_train)
# Make predictions on the test set
y_pred = model.predict(X_test)

# Evaluate the model
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("\nClassification Report:")
print(classification_report(y_test, y_pred))
# Plot the decision boundary
x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, 0.01), np.arange(y_min, y_max, 0.
 ↪01))
Z = model.predict(np.c_[xx.ravel(), yy.ravel()])
Z = Z.reshape(xx.shape)

plt.contourf(xx, yy, Z, cmap=plt.cm.RdBu, alpha=0.8)
plt.scatter(X[:, 0], X[:, 1], c=y, cmap=plt.cm.RdBu)
plt.xlabel('Sepal Length (standardized)')
plt.ylabel('Sepal Width (standardized)')
plt.title('Logistic Regression Decision Boundary')
plt.show()
```

```
Confusion Matrix:
```

```
[[19  0]
 [ 0 26]]

Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        26

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
weighted avg       1.00      1.00      1.00        45
```

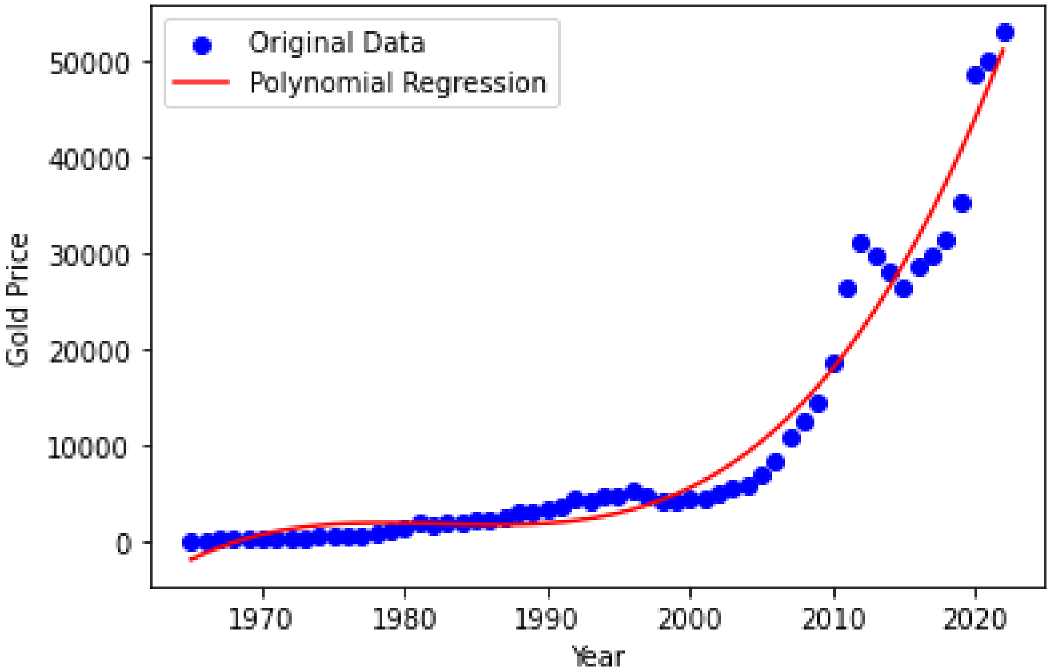


1 Lab Questions

1. Suppose you have a gold/silver price dataset with a single independent variable (X) and a dependent variable (Y). You want to fit a polynomial regression model to this data. Implement the process of selecting the appropriate degree for the polynomial (e.g., linear, quadratic, cubic) based on the dataset using Python.

```
[19]: import numpy as np
      import pandas as pd
```

```python
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures
import matplotlib.pyplot as plt


gold = pd.read_csv("gold.csv")
x= gold.iloc[:, 0:1].values
y= gold.iloc[:, 1].values
model = LinearRegression()
model.fit(x,y)
degree = 3 # You can change the degree as needed
poly_features = PolynomialFeatures(degree=degree)
x_poly = poly_features.fit_transform(x)
model.fit(x_poly, y)# Make predictions

plt.scatter(x, y, label='Original Data',color='blue')
plt.plot(x,model.predict(x_poly), label='Polynomial Regression',color='red')
plt.xlabel('Year')
plt.ylabel('Gold Price')
plt.legend()
plt.show()

# coefficients
coefficients = model.coef_
intercept = model.intercept_
print("Coefficients:")
print(coefficients)
print("Intercept:")
print(intercept)
```



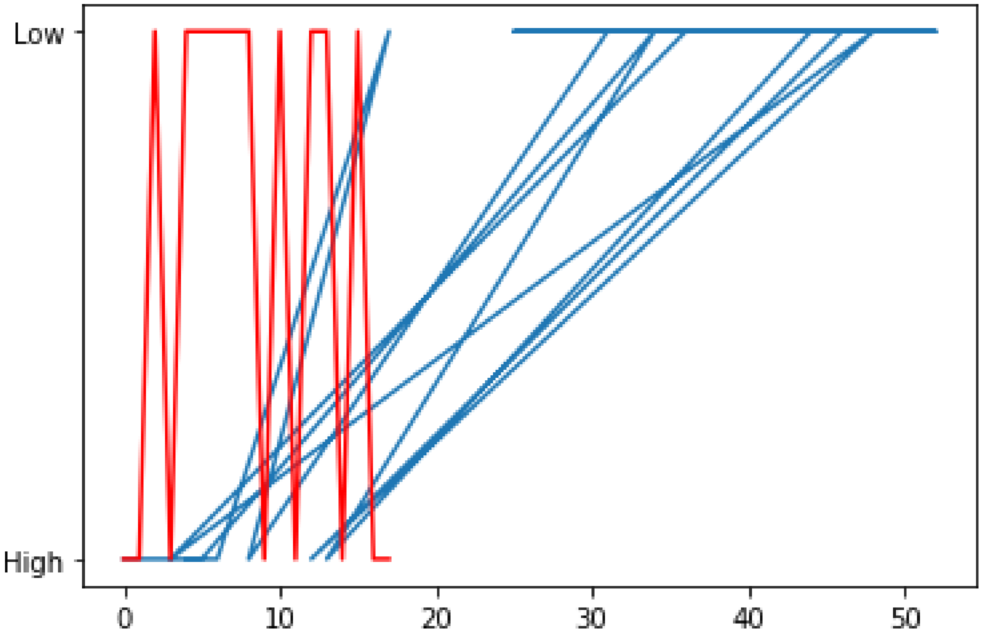
```
Coefficients:
[ 0.00000000e+00  9.74149598e+06 -4.91370043e+03  8.26168569e-01]
Intercept:
-6437533278.116175
```

2. Suppose you have a gold/silver price dataset with a single independent variable (X) and a dependent variable (Y). You want to fit a logistic regression model to this data. Develop an example code snippet in Python.

```
[24]: from sklearn import datasets
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import confusion_matrix,accuracy_score

gold = pd.read_csv("gold.csv")
gold["Range"] = gold["Price"] > 10000
# change the value of True and false to High and low
gold["Range"] = gold["Range"].map({True: "High",False: "Low"})
x = gold.iloc[:,:1]
y = gold.iloc[:,-1]
X_train,X_test,y_train,y_test = train_test_split(x,y,test_size = 0.
 ↪3,random_state = 42)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
```

```
X_test = scaler.transform(X_test)
model = LogisticRegression(solver='liblinear')
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
# Evaluate the model
plt.plot(y_test)
plt.plot(y_pred,color = 'red')
print(accuracy_score(y_test, y_pred))
print(model.score(X_test,y_test))
print()
```

```
1.0
1.0
```



3. Imagine you have a gold and silver price dataset with two independent variables (X1 and X2) and a dependent variable (Y). Implement in python, how you can perform multivariate polynomial regression to model the relationship between the independent variables and the dependent variable.

[30]:
```
import numpy as np
import pandas as pd
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures
from sklearn.metrics import mean_squared_error
```

```python
gs = pd.read_csv('gold_silver.csv')
x = gs.iloc[:,:-1]
y = gs.iloc[:,-1]
degree = 3
poly = PolynomialFeatures(degree=degree)
X_poly = poly.fit_transform(x)
model = LinearRegression()
model.fit(X_poly, y)
# The coefficients of the multivariate polynomial regression model
coefficients = model.coef_
intercept = model.intercept_
print('Coefficients: ',coefficients)
print('Intercept: ',intercept)
print('MSE: ',mean_squared_error(y,predict))
```

```
Coefficients:  [ 0.00000000e+00  1.04113939e+02 -1.28159900e+04 -3.15986752e+01
  1.29610354e+01 -4.10329546e-03  1.05822530e-02 -3.27624700e-03
  2.09969031e-06 -1.21532651e-09]
Intercept:  41529557.599422954
MSE:  4173782.1526020737
```

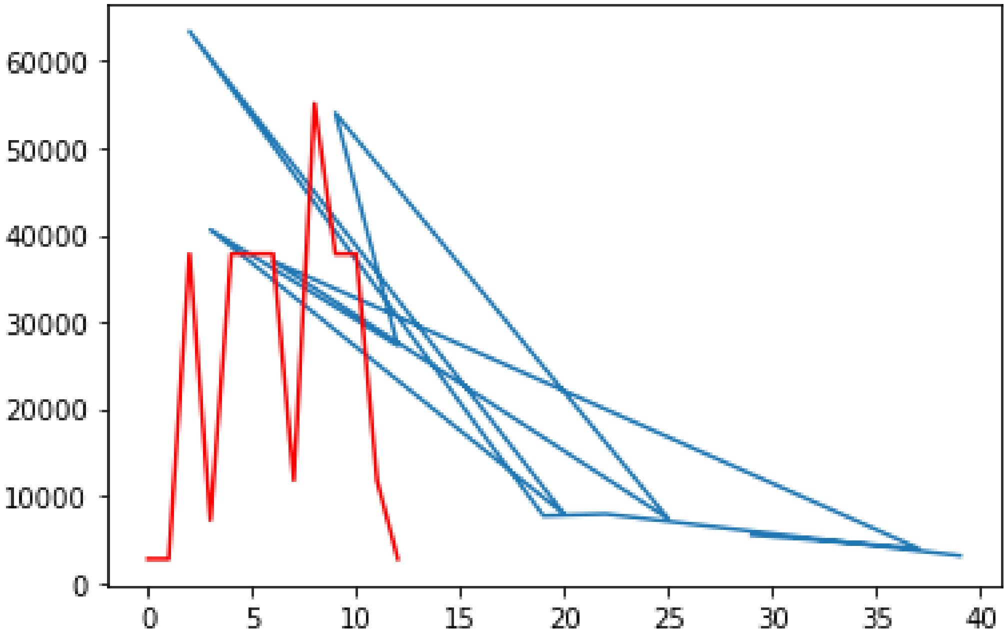
4. Imagine you have a gold and silver price dataset with two independent variables (X1 and X2) and a dependent variable (Y). Implement in python, how you can perform the logistic regression to model the relationship between the independent variables and the dependent variable

[21]:

```python
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import␣
 ↪classification_report,confusion_matrix,accuracy_score

gs = pd.read_csv("gold_silver.csv")
x = gs.iloc[:,:-1]
y = gs.iloc[:,-1:]

X_train,X_test,y_train,y_test = train_test_split(x,y,test_size = 0.3)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
model = LogisticRegression(solver='liblinear')
model.fit(X_train, y_train)
y_pred = model.predict(X_test)

# Evaluate the model
```

```python
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))
print("\nClassification Report:")
print(classification_report(y_test, y_pred))


# Evaluate the model
plt.plot(y_test)
plt.plot(y_pred,color = 'red')
print(accuracy_score(y_test, y_pred))
```

```
Confusion Matrix:
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0]]

Classification Report:
              precision    recall  f1-score   support

        2715       0.00      0.00      0.00       0.0
        3105       0.00      0.00      0.00       1.0
        3955       0.00      0.00      0.00       1.0
        5489       0.00      0.00      0.00       1.0
        7215       0.00      0.00      0.00       0.0
        7345       0.00      0.00      0.00       1.0
        7695       0.00      0.00      0.00       1.0
        7875       0.00      0.00      0.00       1.0
        7900       0.00      0.00      0.00       1.0
       11770       0.00      0.00      0.00       0.0
       17405       0.00      0.00      0.00       1.0
       27255       0.00      0.00      0.00       1.0
       36990       0.00      0.00      0.00       1.0
       37825       0.00      0.00      0.00       0.0
       40600       0.00      0.00      0.00       1.0
       54030       0.00      0.00      0.00       1.0
       55100       0.00      0.00      0.00       0.0
       63435       0.00      0.00      0.00       1.0

    accuracy                           0.00      13.0
   macro avg       0.00      0.00      0.00      13.0
weighted avg       0.00      0.00      0.00      13.0

0.0

/usr/lib/python3/dist-packages/sklearn/utils/validation.py:72:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  return f(**kwargs)
/usr/lib/python3/dist-packages/sklearn/metrics/_classification.py:1221:
UndefinedMetricWarning: Precision and F-score are ill-defined and being set to
0.0 in labels with no predicted samples. Use `zero_division` parameter to
control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/usr/lib/python3/dist-packages/sklearn/metrics/_classification.py:1221:
UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0
in labels with no true samples. Use `zero_division` parameter to control this
behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```



[ ]:

```

```