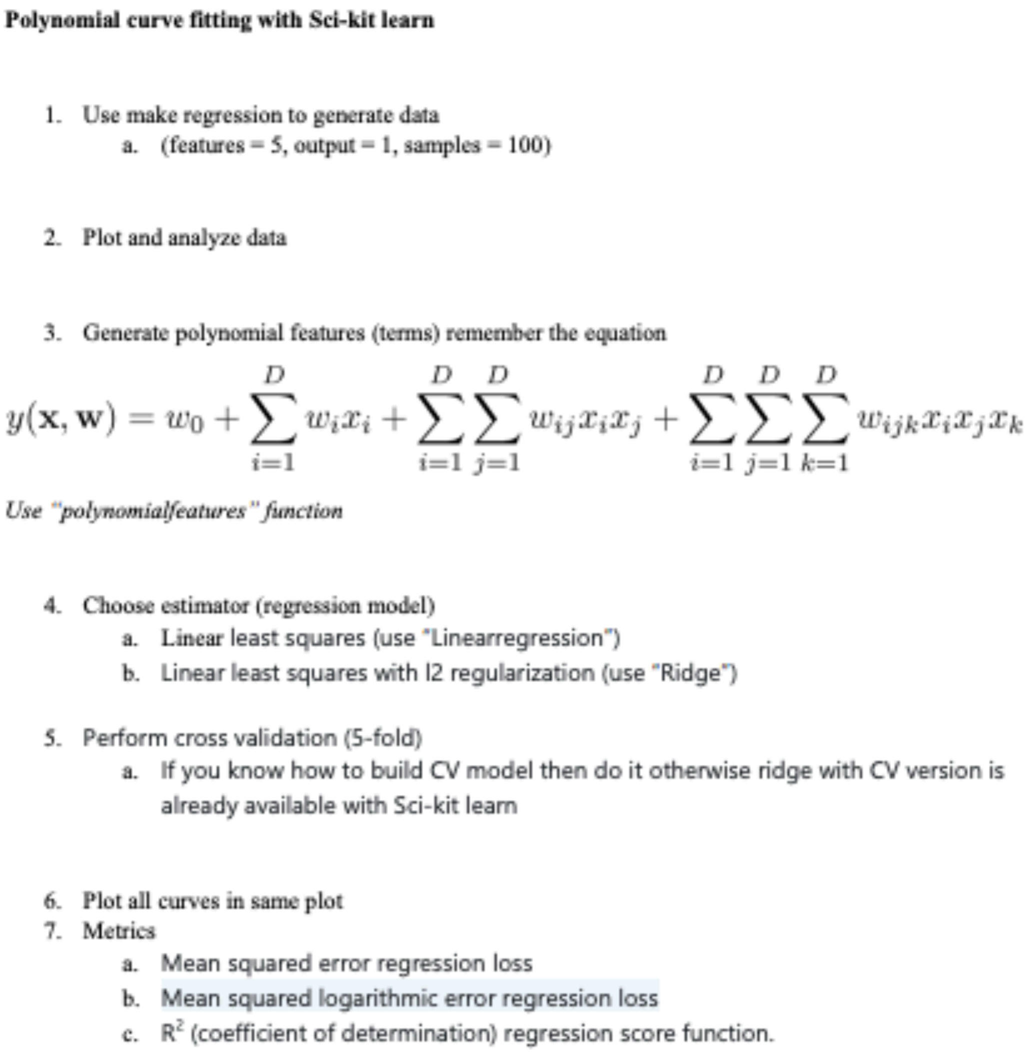
EXPERIMENT 5

Polynomial Regression

GITHUB LINK => https://github.com/ishikkkkaaaa/UPES/blob/master/Pattern-and-Anomoly-Detection/LAB5%20POLYNOMIAL%20REGRESSION/main.ipynb



Polynomial curve fitting with Sci-kit learn

1. Use make regression to generate data
   a. (features = 5, output = 1, samples = 100)

2. Plot and analyze data

3. Generate polynomial features (terms) remember the equation

$$y(\mathbf{x}, \mathbf{w}) = w_0 + \sum_{i=1}^{D} w_i x_i + \sum_{i=1}^{D}\sum_{j=1}^{D} w_{ij} x_i x_j + \sum_{i=1}^{D}\sum_{j=1}^{D}\sum_{k=1}^{D} w_{ijk} x_i x_j x_k$$

Use "polynomialfeatures" function

4. Choose estimator (regression model)
   a. Linear least squares (use "Linearregression")
   b. Linear least squares with l2 regularization (use "Ridge")

5. Perform cross validation (5-fold)
   a. If you know how to build CV model then do it otherwise ridge with CV version is already available with Sci-kit learn

6. Plot all curves in same plot
7. Metrics
   a. Mean squared error regression loss
   b. Mean squared logarithmic error regression loss
   c. R^2 (coefficient of determination) regression score function.

Importing libraries!

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

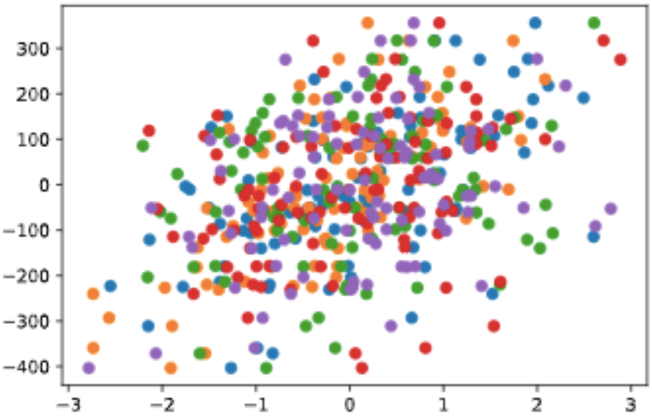
1) Make the Regression!

```
In [2]: from sklearn.datasets import make_regression
        x,y = make_regression(n_samples=100,n_features=5,noise=20,random_state=101)
```

2) Plot and Analyze data

```
In [12]: plt.scatter(x[:,0],y)
         plt.scatter(x[:,1],y)
         plt.scatter(x[:,2],y)
         plt.scatter(x[:,3],y)
         plt.scatter(x[:,4],y)

Out[12]: <matplotlib.collections.PathCollection at 0x7faaa30903d0>
```



```
In [13]: #print mean, standar deviation, and variance of x
         print(np.mean(x))
         print(np.std(x))
         print(np.var(x))

         0.024085009436645873
         1.0546520360023408
         1.1122909170438826
```

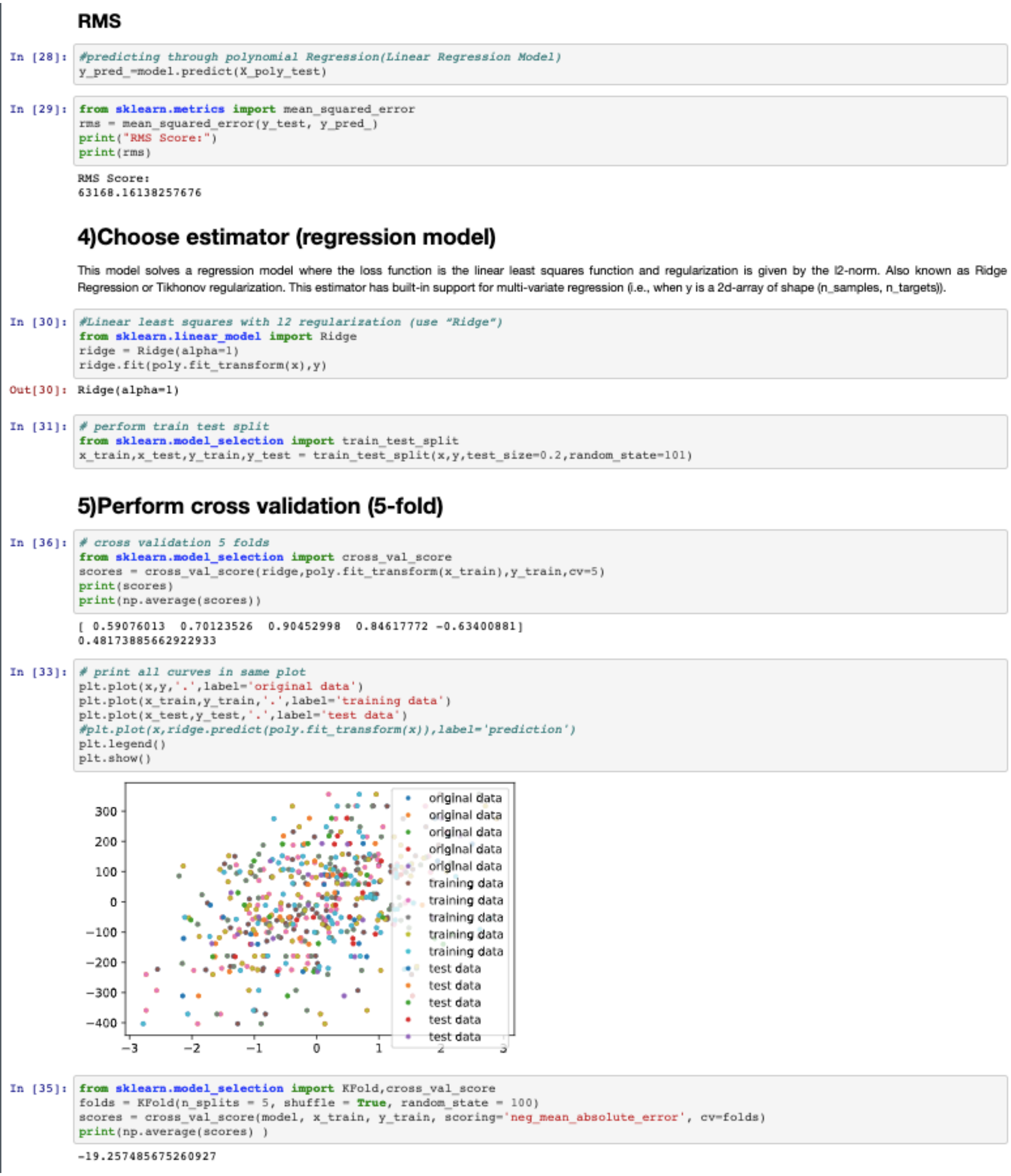
```
In [14]: #training test split
         from sklearn.model_selection import train_test_split
         x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3,random_state=101)
```

3)Generate polynomial features (terms) remember the equation

```
In [16]: from sklearn.linear_model import LinearRegression
```

```
In [24]: from sklearn.preprocessing import PolynomialFeatures
         poly = PolynomialFeatures(degree=3)
         X_poly=poly.fit_transform(x_train)
```

```
In [27]: poly.fit(X_poly, y_train)
         model = LinearRegression()
         model.fit(X_poly, y_train)
         X_poly_test=poly.fit_transform(x_test)
```



RMS

```
In [28]: #predicting through polynomial Regression(Linear Regression Model)
         y_pred_=model.predict(X_poly_test)
```

```
In [29]: from sklearn.metrics import mean_squared_error
         rms = mean_squared_error(y_test, y_pred_)
         print("RMS Score:")
         print(rms)

         RMS Score:
         63168.16138257676
```

4)Choose estimator (regression model)

This model solves a regression model where the loss function is the linear least squares function and regularization is given by the l2-norm. Also known as Ridge Regression or Tikhonov regularization. This estimator has built-in support for multi-variate regression (i.e., when y is a 2d-array of shape (n_samples, n_targets)).

```
In [30]: #Linear least squares with l2 regularization (use "Ridge")
         from sklearn.linear_model import Ridge
         ridge = Ridge(alpha=1)
         ridge.fit(poly.fit_transform(x),y)

Out[30]: Ridge(alpha=1)
```

```
In [31]: # perform train test split
         from sklearn.model_selection import train_test_split
         x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=101)
```

5)Perform cross validation (5-fold)

```
In [36]: # cross validation 5 folds
         from sklearn.model_selection import cross_val_score
         scores = cross_val_score(ridge,poly.fit_transform(x_train),y_train,cv=5)
         print(scores)
         print(np.average(scores))

         [ 0.59076013  0.70123526  0.90452998  0.84617772 -0.63400881]
         0.48173885662922933
```

```
In [33]: # print all curves in same plot
         plt.plot(x,y,'.',label='original data')
         plt.plot(x_train,y_train,'.',label='training data')
         plt.plot(x_test,y_test,'.',label='test data')
         #plt.plot(x,ridge.predict(poly.fit_transform(x)),label='prediction')
         plt.legend()
         plt.show()
```

```
In [35]: from sklearn.model_selection import KFold,cross_val_score
         folds = KFold(n_splits = 5, shuffle = True, random_state = 100)
         scores = cross_val_score(model, x_train, y_train, scoring='neg_mean_absolute_error', cv=folds)
         print(np.average(scores) )

         -19.257485675260927
```