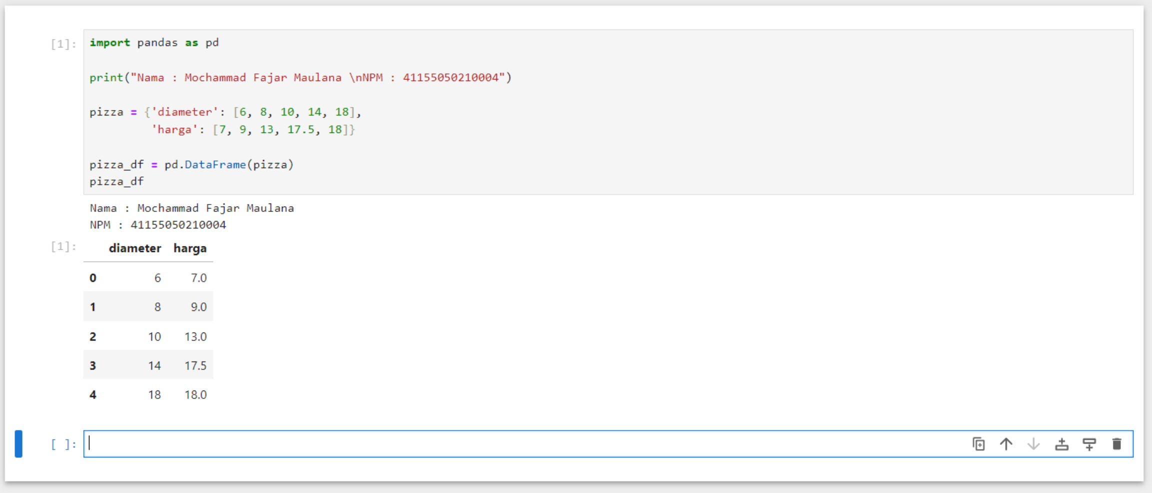
Nama : Mochammad Fajar Maulana

NPM : 41155050210004

Kelas : INF A1

Tugas 2

1. Lakukan praktek dari https://youtu.be/lcjq7-2zMSA?si=f4jWJR6lY8y0BZKl dan buat screen shot hasil run dengan nama anda pada hasil run tersebut. Praktek tersebut yaitu:
   1. Sample dataset



```
[1]: import pandas as pd

     print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

     pizza = {'diameter': [6, 8, 10, 14, 18],
              'harga': [7, 9, 13, 17.5, 18]}

     pizza_df = pd.DataFrame(pizza)
     pizza_df
```

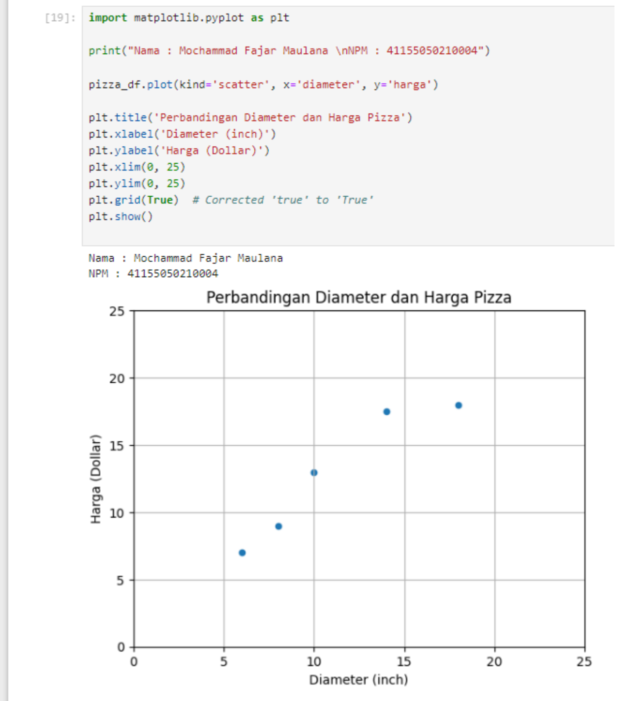
```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
```

[1]:

	diameter	harga
0	6	7.0
1	8	9.0
2	10	13.0
3	14	17.5
4	18	18.0

[ ]:

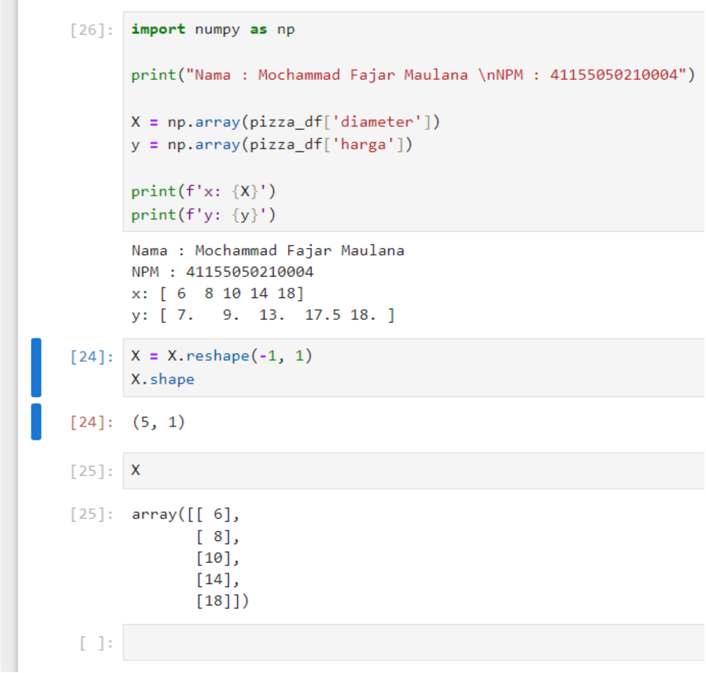
   2. Visualisasi dataset



```
[19]: import matplotlib.pyplot as plt

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      pizza_df.plot(kind='scatter', x='diameter', y='harga')

      plt.title('Perbandingan Diameter dan Harga Pizza')
      plt.xlabel('Diameter (inch)')
      plt.ylabel('Harga (Dollar)')
      plt.xlim(0, 25)
      plt.ylim(0, 25)
      plt.grid(True)  # Corrected 'true' to 'True'
      plt.show()
```

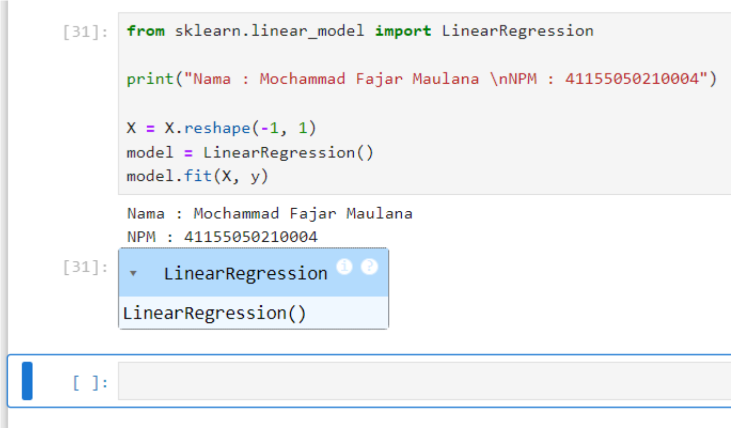
```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
```

3. Transformasi dataset



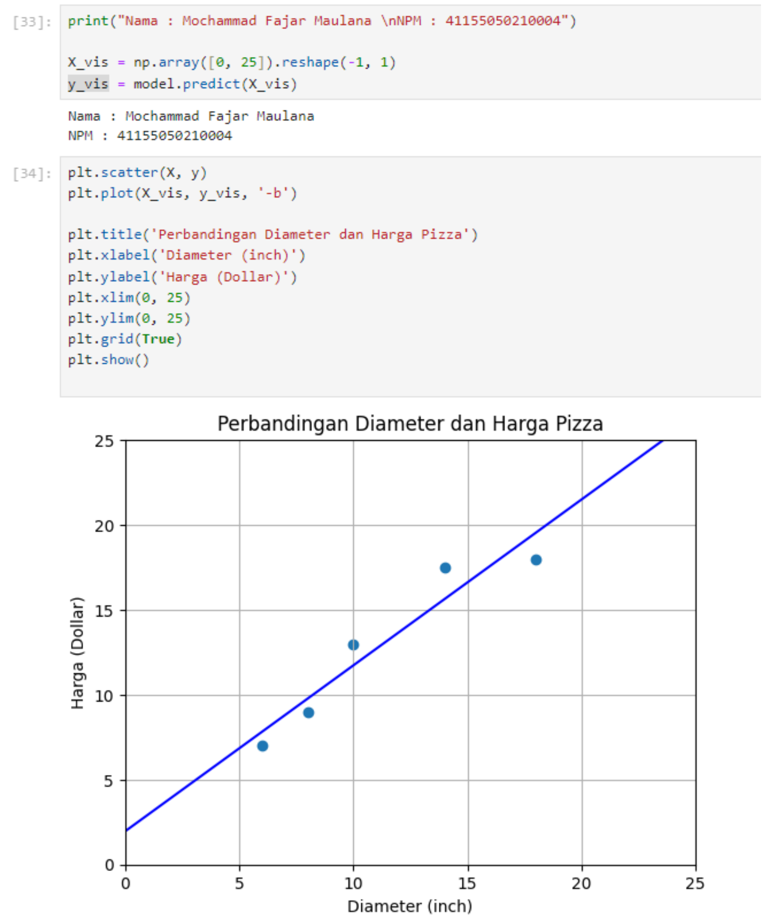
```
[26]: import numpy as np

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      X = np.array(pizza_df['diameter'])
      y = np.array(pizza_df['harga'])

      print(f'x: {X}')
      print(f'y: {y}')

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
      x: [ 6  8 10 14 18]
      y: [ 7.   9.   13.   17.5 18. ]

[24]: X = X.reshape(-1, 1)
      X.shape

[24]: (5, 1)

[25]: X

[25]: array([[ 6],
             [ 8],
             [10],
             [14],
             [18]])

[ ]:
```

4. Training Simple Linear Regression Model



```
[31]: from sklearn.linear_model import LinearRegression

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      X = X.reshape(-1, 1)
      model = LinearRegression()
      model.fit(X, y)

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

[31]: ▾ LinearRegression
      LinearRegression()

[ ]:
```

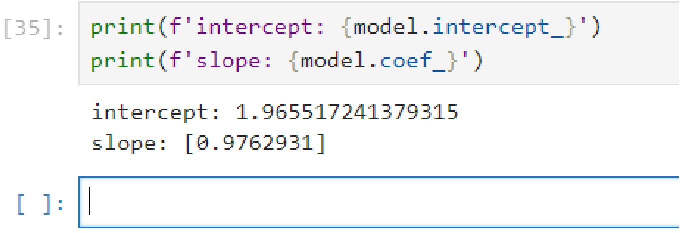
5. Visualisasi Simple Linear Regression Model | Penjelasan persamaan garis linear



```
[33]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      X_vis = np.array([0, 25]).reshape(-1, 1)
      y_vis = model.predict(X_vis)
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
```

```
[34]: plt.scatter(X, y)
      plt.plot(X_vis, y_vis, '-b')

      plt.title('Perbandingan Diameter dan Harga Pizza')
      plt.xlabel('Diameter (inch)')
      plt.ylabel('Harga (Dollar)')
      plt.xlim(0, 25)
      plt.ylim(0, 25)
      plt.grid(True)
      plt.show()
```

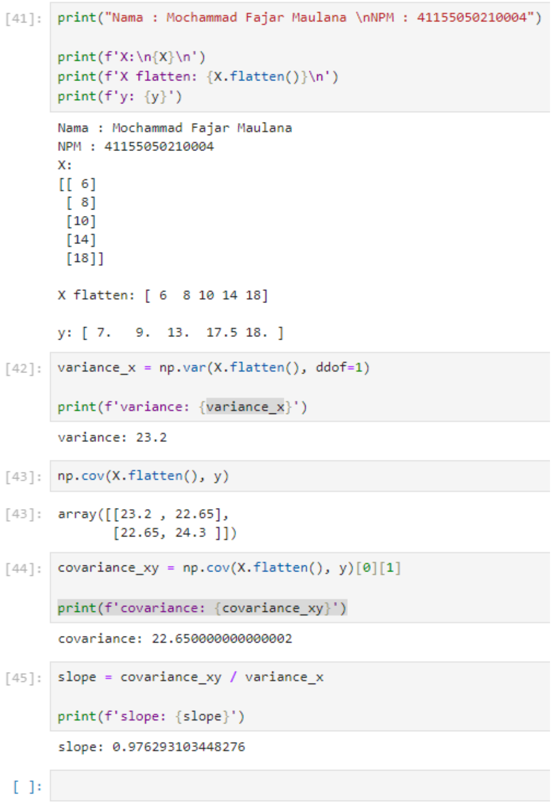


```
[35]: print(f'intercept: {model.intercept_}')
      print(f'slope: {model.coef_}')
```

```
intercept: 1.965517241379315
slope: [0.9762931]
```

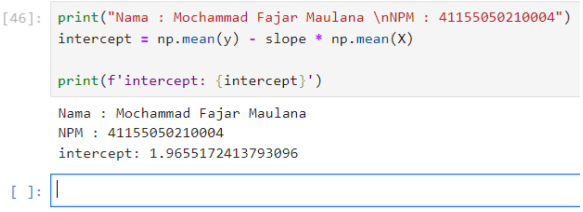
```
[ ]:
```

6. Kalkulasi nilai slope



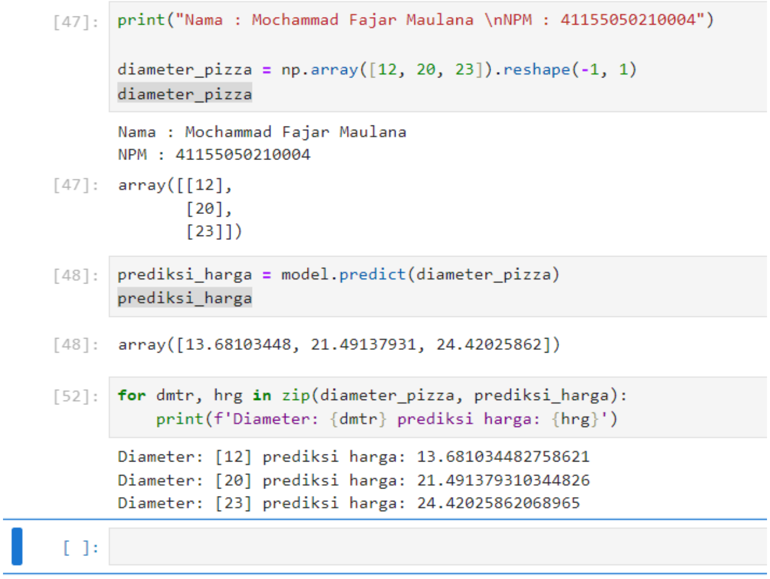
```
[41]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      print(f'X:\n{X}\n')
      print(f'X flatten: {X.flatten()}\n')
      print(f'y: {y}')

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
      X:
      [[ 6]
       [ 8]
       [10]
       [14]
       [18]]

      X flatten: [ 6  8 10 14 18]

      y: [ 7.   9.  13.  17.5 18. ]

[42]: variance_x = np.var(X.flatten(), ddof=1)

      print(f'variance: {variance_x}')

      variance: 23.2

[43]: np.cov(X.flatten(), y)

[43]: array([[23.2 , 22.65],
             [22.65, 24.3 ]])

[44]: covariance_xy = np.cov(X.flatten(), y)[0][1]

      print(f'covariance: {covariance_xy}')

      covariance: 22.650000000000002

[45]: slope = covariance_xy / variance_x

      print(f'slope: {slope}')

      slope: 0.976293103448276

[ ]:
```

7. Kalkukasi nilai intercept



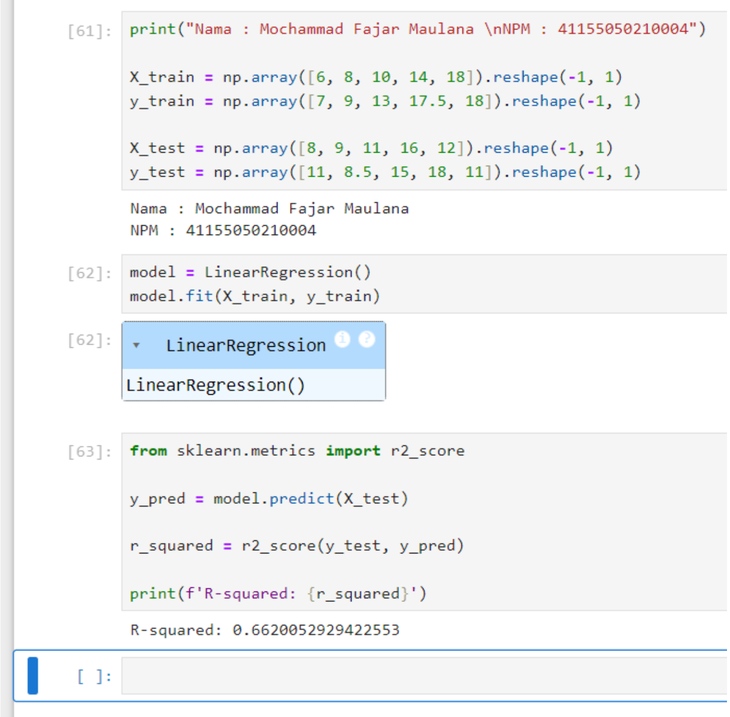
```
[46]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")
      intercept = np.mean(y) - slope * np.mean(X)

      print(f'intercept: {intercept}')

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
      intercept: 1.9655172413793096

[ ]:
```

8. Prediksi harga pizza dengan Simple Linear Regression Model



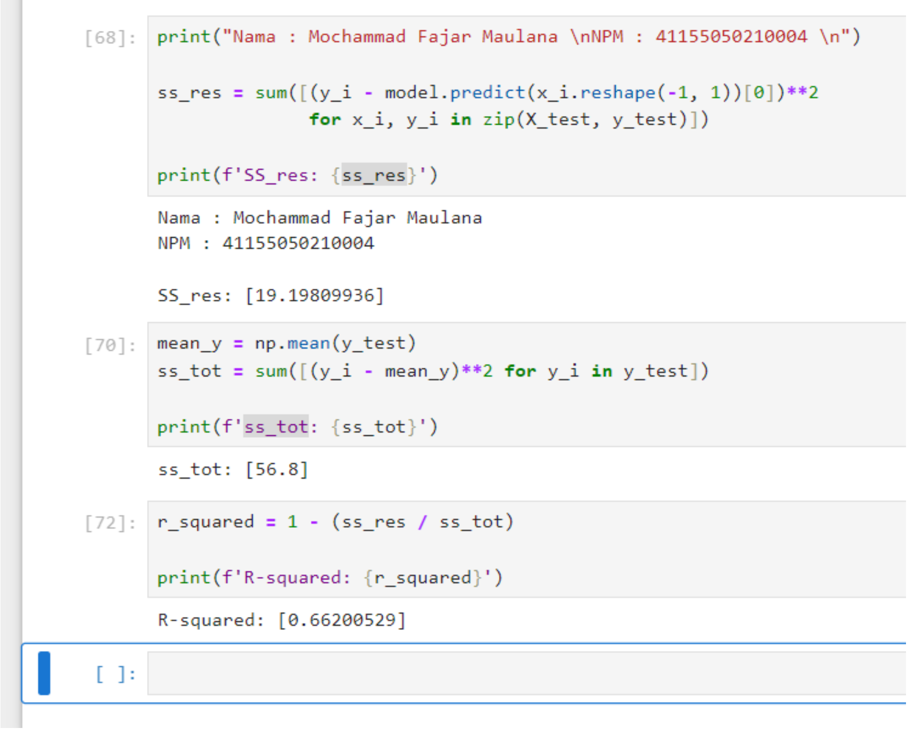
```
[47]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      diameter_pizza = np.array([12, 20, 23]).reshape(-1, 1)
      diameter_pizza

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

[47]: array([[12],
             [20],
             [23]])

[48]: prediksi_harga = model.predict(diameter_pizza)
      prediksi_harga

[48]: array([13.68103448, 21.49137931, 24.42025862])

[52]: for dmtr, hrg in zip(diameter_pizza, prediksi_harga):
          print(f'Diameter: {dmtr} prediksi harga: {hrg}')

      Diameter: [12] prediksi harga: 13.681034482758621
      Diameter: [20] prediksi harga: 21.491379310344826
      Diameter: [23] prediksi harga: 24.42025862068965

[ ]:
```

9. Evaluasi model dengan Coefficient of Determination | R Squared



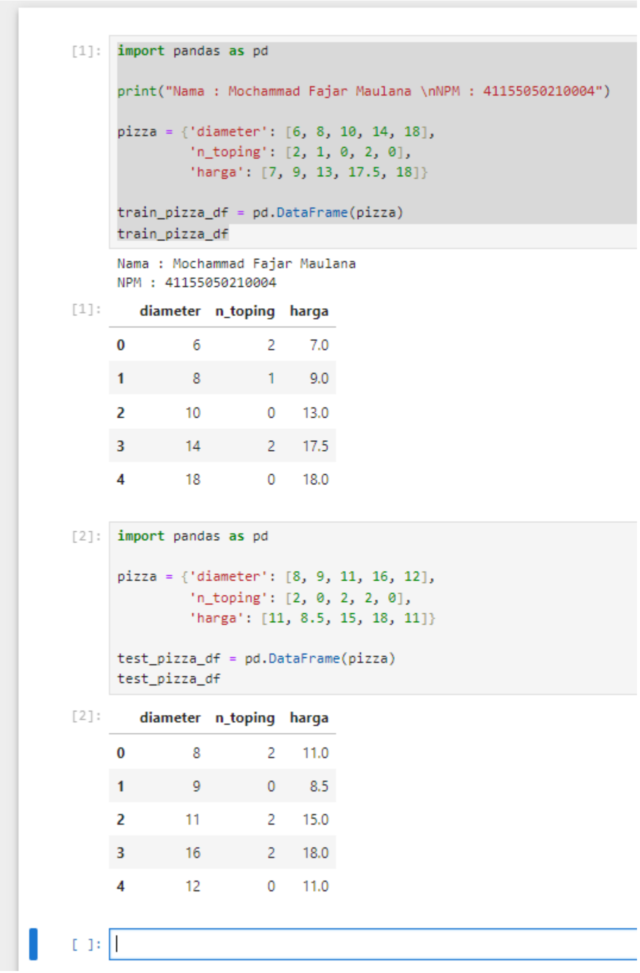
```
[61]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      X_train = np.array([6, 8, 10, 14, 18]).reshape(-1, 1)
      y_train = np.array([7, 9, 13, 17.5, 18]).reshape(-1, 1)

      X_test = np.array([8, 9, 11, 16, 12]).reshape(-1, 1)
      y_test = np.array([11, 8.5, 15, 18, 11]).reshape(-1, 1)

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

[62]: model = LinearRegression()
      model.fit(X_train, y_train)

[62]: ▾ LinearRegression
      LinearRegression()

[63]: from sklearn.metrics import r2_score

      y_pred = model.predict(X_test)

      r_squared = r2_score(y_test, y_pred)

      print(f'R-squared: {r_squared}')

      R-squared: 0.6620052929422553

[ ]:
```

10. Kalkulasi nilai R Squared | Coefficient of Determination



```
[68]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004 \n")

      ss_res = sum([(y_i - model.predict(x_i.reshape(-1, 1))[0])**2
                   for x_i, y_i in zip(X_test, y_test)])

      print(f'SS_res: {ss_res}')

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

      SS_res: [19.19809936]

[70]: mean_y = np.mean(y_test)
      ss_tot = sum([(y_i - mean_y)**2 for y_i in y_test])

      print(f'ss_tot: {ss_tot}')

      ss_tot: [56.8]

[72]: r_squared = 1 - (ss_res / ss_tot)

      print(f'R-squared: {r_squared}')

      R-squared: [0.66200529]

[ ]:
```

2. Lakukan praktek dari https://youtu.be/nWJUJenAyB8?si=BQDzWwrMnr8jtzpV dan buat screen shot hasil run dengan nama anda pada hasil run tersebut. Praktek tersebut yaitu:
   1. Persiapan sample dataset



[1]:

```
import pandas as pd

print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

pizza = {'diameter': [6, 8, 10, 14, 18],
         'n_toping': [2, 1, 0, 2, 0],
         'harga': [7, 9, 13, 17.5, 18]}

train_pizza_df = pd.DataFrame(pizza)
train_pizza_df
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
```

[1]:

	diameter	n_toping	harga
0	6	2	7.0
1	8	1	9.0
2	10	0	13.0
3	14	2	17.5
4	18	0	18.0

[2]:

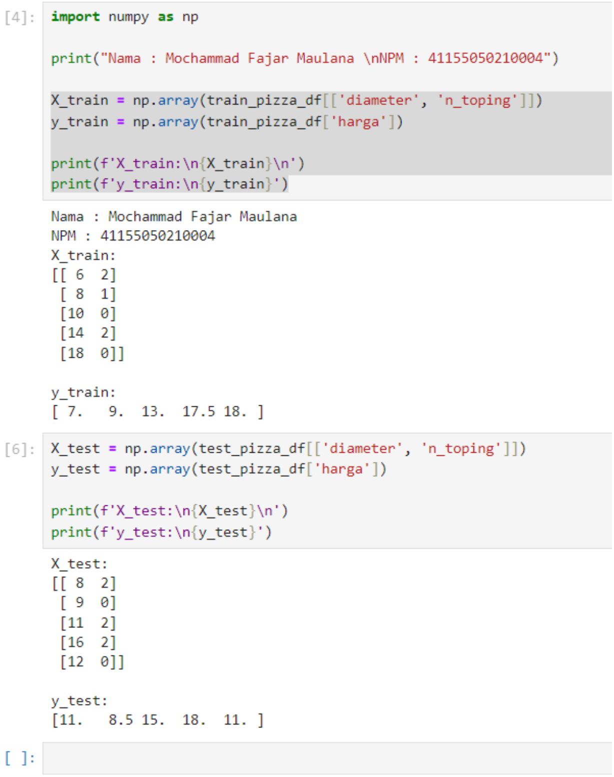
```
import pandas as pd

pizza = {'diameter': [8, 9, 11, 16, 12],
         'n_toping': [2, 0, 2, 2, 0],
         'harga': [11, 8.5, 15, 18, 11]}

test_pizza_df = pd.DataFrame(pizza)
test_pizza_df
```

[2]:

	diameter	n_toping	harga
0	8	2	11.0
1	9	0	8.5
2	11	2	15.0
3	16	2	18.0
4	12	0	11.0

[ ]:

2. Preprocessing dataset



[4]:

```
import numpy as np

print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

X_train = np.array(train_pizza_df[['diameter', 'n_toping']])
y_train = np.array(train_pizza_df['harga'])

print(f'X_train:\n{X_train}\n')
print(f'y_train:\n{y_train}')
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
X_train:
[[ 6  2]
 [ 8  1]
 [10  0]
 [14  2]
 [18  0]]

y_train:
[ 7.   9.  13.  17.5 18. ]
```

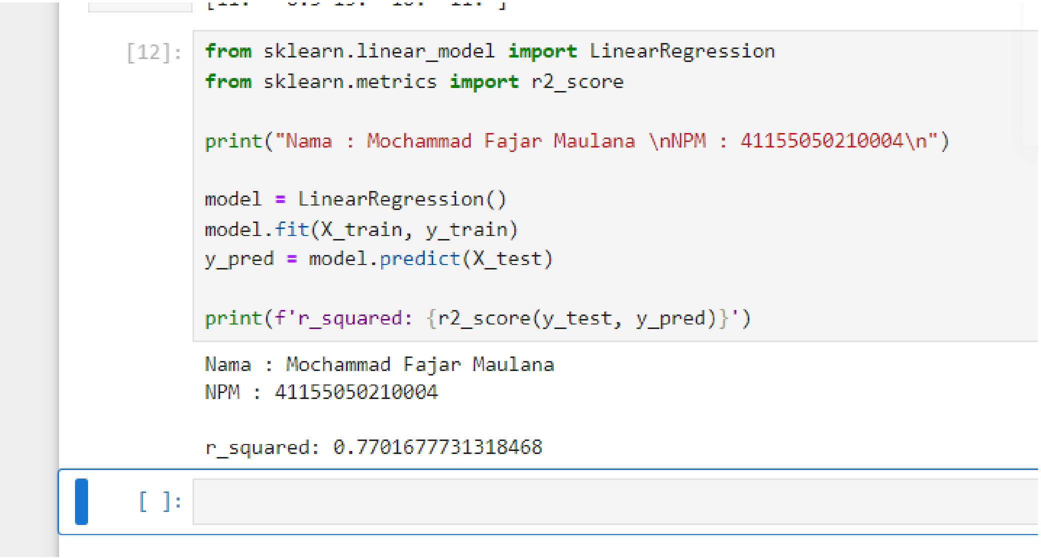
[6]:

```
X_test = np.array(test_pizza_df[['diameter', 'n_toping']])
y_test = np.array(test_pizza_df['harga'])

print(f'X_test:\n{X_test}\n')
print(f'y_test:\n{y_test}')
```

```
X_test:
[[ 8  2]
 [ 9  0]
 [11  2]
 [16  2]
 [12  0]]

y_test:
[11.   8.5 15.  18.  11. ]
```

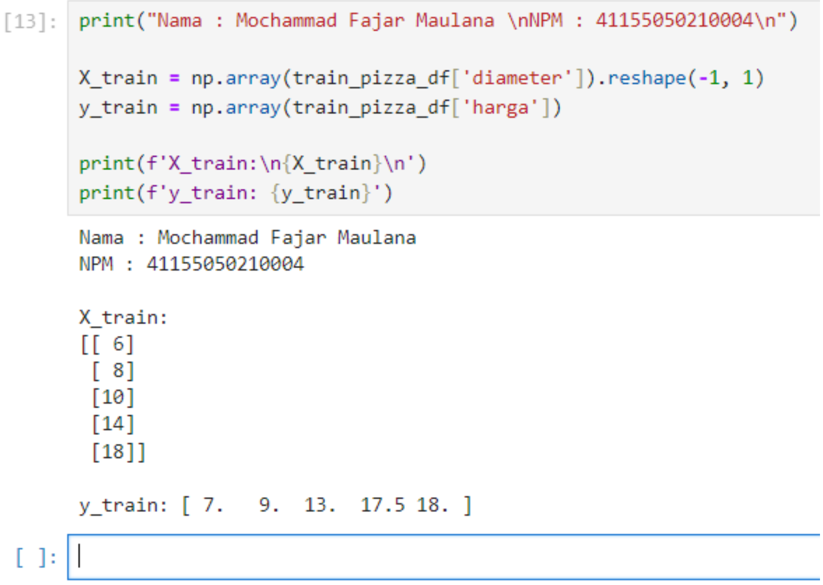
[ ]:

3. Pengenalan Multiple Linear Regression | Apa itu Multiple Linear Regression?



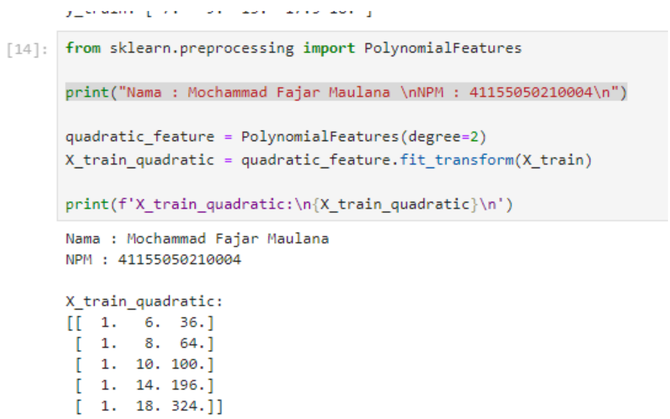
```
[12]: from sklearn.linear_model import LinearRegression
      from sklearn.metrics import r2_score

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      model = LinearRegression()
      model.fit(X_train, y_train)
      y_pred = model.predict(X_test)

      print(f'r_squared: {r2_score(y_test, y_pred)}')

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

      r_squared: 0.7701677731318468

[ ]:
```

4. Pengenalan Polynomial Regression | Apa itu Polynomial Regression?



```
[13]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      X_train = np.array(train_pizza_df['diameter']).reshape(-1, 1)
      y_train = np.array(train_pizza_df['harga'])

      print(f'X_train:\n{X_train}\n')
      print(f'y_train: {y_train}')

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

      X_train:
      [[ 6]
       [ 8]
       [10]
       [14]
       [18]]

      y_train: [ 7.   9.  13.  17.5 18. ]

[ ]:
```

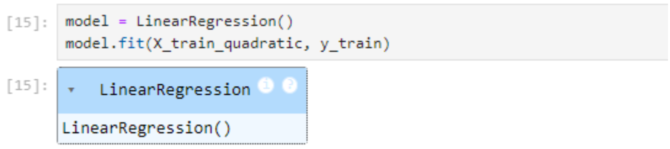
5. Quadratic Polynomial Regression



```
y_train: [ 7.    9.   13.   17.5  18. ]
```

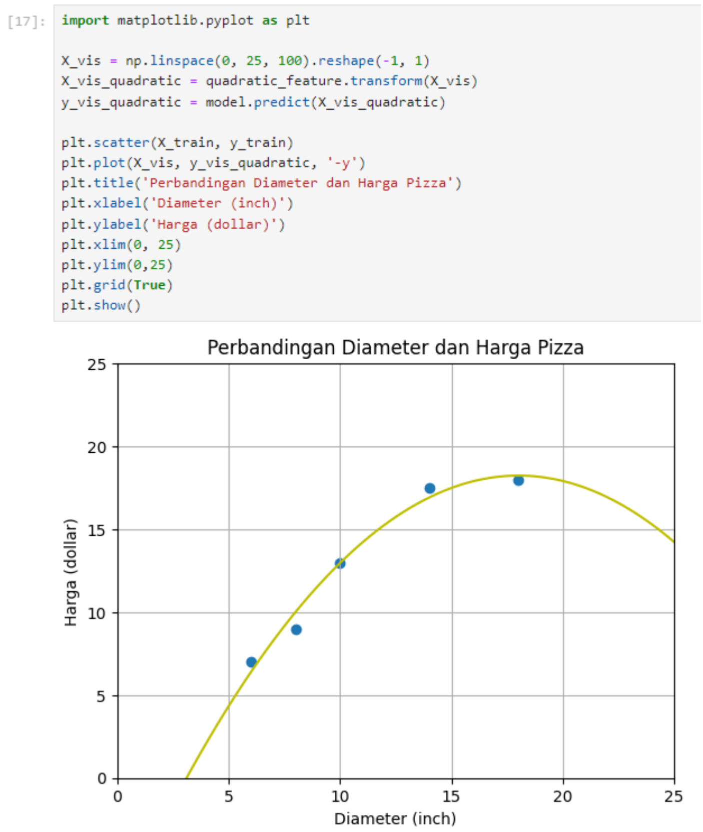
```
[14]: from sklearn.preprocessing import PolynomialFeatures

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      quadratic_feature = PolynomialFeatures(degree=2)
      X_train_quadratic = quadratic_feature.fit_transform(X_train)

      print(f'X_train_quadratic:\n{X_train_quadratic}\n')
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004

X_train_quadratic:
[[  1.   6.  36.]
 [  1.   8.  64.]
 [  1.  10. 100.]
 [  1.  14. 196.]
 [  1.  18. 324.]]
```



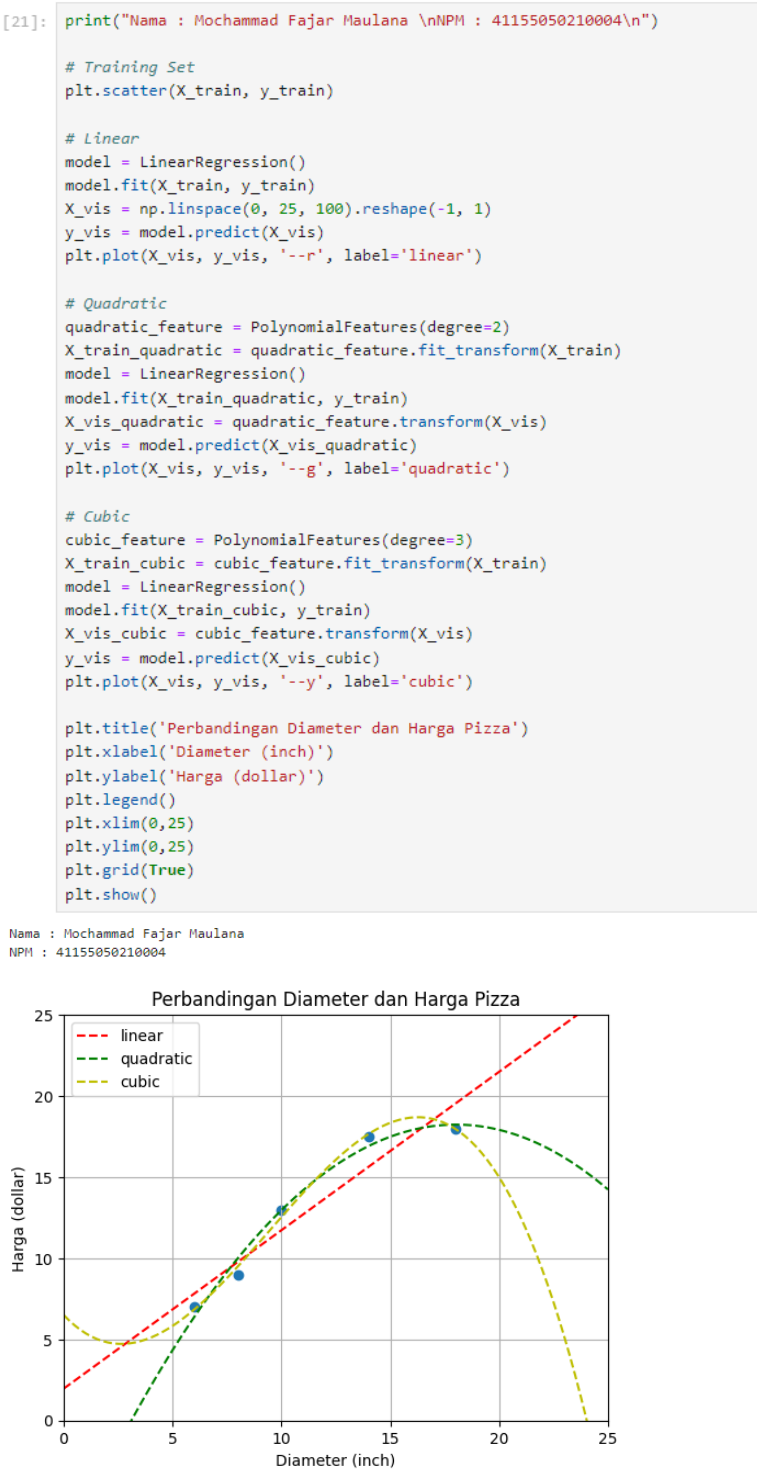
```
[15]: model = LinearRegression()
      model.fit(X_train_quadratic, y_train)
```

```
[15]: ▾ LinearRegression
      LinearRegression()
```



```
[17]: import matplotlib.pyplot as plt

      X_vis = np.linspace(0, 25, 100).reshape(-1, 1)
      X_vis_quadratic = quadratic_feature.transform(X_vis)
      y_vis_quadratic = model.predict(X_vis_quadratic)

      plt.scatter(X_train, y_train)
      plt.plot(X_vis, y_vis_quadratic, '-y')
      plt.title('Perbandingan Diameter dan Harga Pizza')
      plt.xlabel('Diameter (inch)')
      plt.ylabel('Harga (dollar)')
      plt.xlim(0, 25)
      plt.ylim(0,25)
      plt.grid(True)
      plt.show()
```

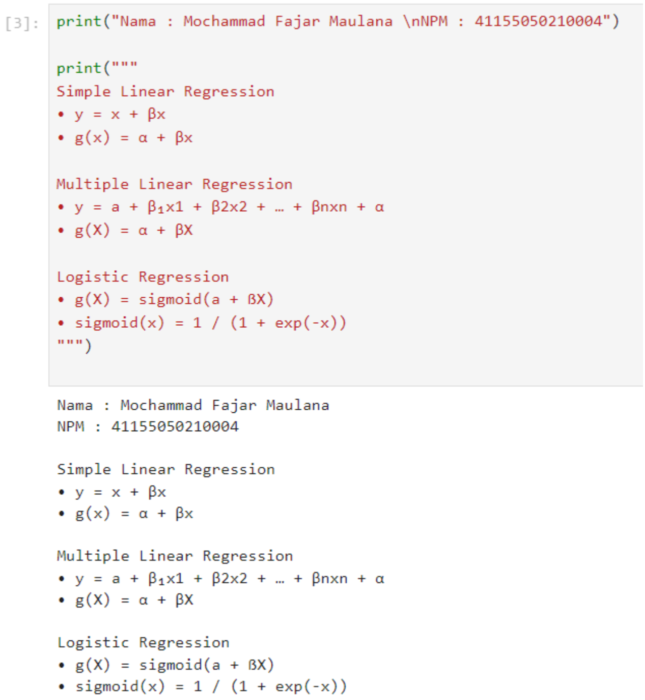
6. Linear Regression vs Quadratic Polynomial Regression vs Cubic Polynomial Regression



```
[21]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      # Training Set
      plt.scatter(X_train, y_train)

      # Linear
      model = LinearRegression()
      model.fit(X_train, y_train)
      X_vis = np.linspace(0, 25, 100).reshape(-1, 1)
      y_vis = model.predict(X_vis)
      plt.plot(X_vis, y_vis, '--r', label='linear')

      # Quadratic
      quadratic_feature = PolynomialFeatures(degree=2)
      X_train_quadratic = quadratic_feature.fit_transform(X_train)
      model = LinearRegression()
      model.fit(X_train_quadratic, y_train)
      X_vis_quadratic = quadratic_feature.transform(X_vis)
      y_vis = model.predict(X_vis_quadratic)
      plt.plot(X_vis, y_vis, '--g', label='quadratic')

      # Cubic
      cubic_feature = PolynomialFeatures(degree=3)
      X_train_cubic = cubic_feature.fit_transform(X_train)
      model = LinearRegression()
      model.fit(X_train_cubic, y_train)
      X_vis_cubic = cubic_feature.transform(X_vis)
      y_vis = model.predict(X_vis_cubic)
      plt.plot(X_vis, y_vis, '--y', label='cubic')

      plt.title('Perbandingan Diameter dan Harga Pizza')
      plt.xlabel('Diameter (inch)')
      plt.ylabel('Harga (dollar)')
      plt.legend()
      plt.xlim(0,25)
      plt.ylim(0,25)
      plt.grid(True)
      plt.show()
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
```

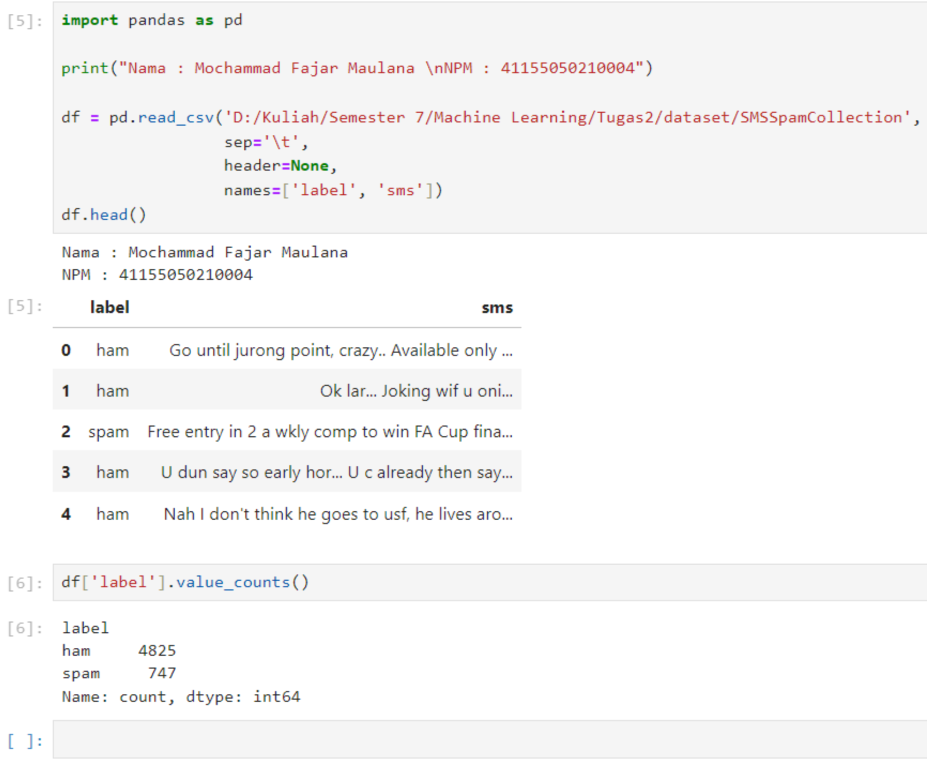
3. Lakukan praktek dari https://youtu.be/oe7DW4rSH1o?si=H-PZJ9rs9-Kab-Ln dan buat screen shot hasil run dengan nama anda pada hasil run tersebut. Praktek tersebut yaitu:
   1. Formula dasar pembentuk Logistic Regression | Fungsi Sigmoid



```
[3]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

     print("""
     Simple Linear Regression
     • y = x + βx
     • g(x) = α + βx

     Multiple Linear Regression
     • y = a + β₁x1 + β2x2 + … + βnxn + α
     • g(X) = α + βX

     Logistic Regression
     • g(X) = sigmoid(a + ΒX)
     • sigmoid(x) = 1 / (1 + exp(-x))
     """)
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004

Simple Linear Regression
• y = x + βx
• g(x) = α + βx

Multiple Linear Regression
• y = a + β₁x1 + β2x2 + … + βnxn + α
• g(X) = α + βX

Logistic Regression
• g(X) = sigmoid(a + ΒX)
• sigmoid(x) = 1 / (1 + exp(-x))
```

2. Persiapan dataset | SMS Spam Collection Dataset



```
[5]: import pandas as pd

     print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

     df = pd.read_csv('D:/Kuliah/Semester 7/Machine Learning/Tugas2/dataset/SMSSpamCollection',
                      sep='\t',
                      header=None,
                      names=['label', 'sms'])
     df.head()
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
```

[5]:

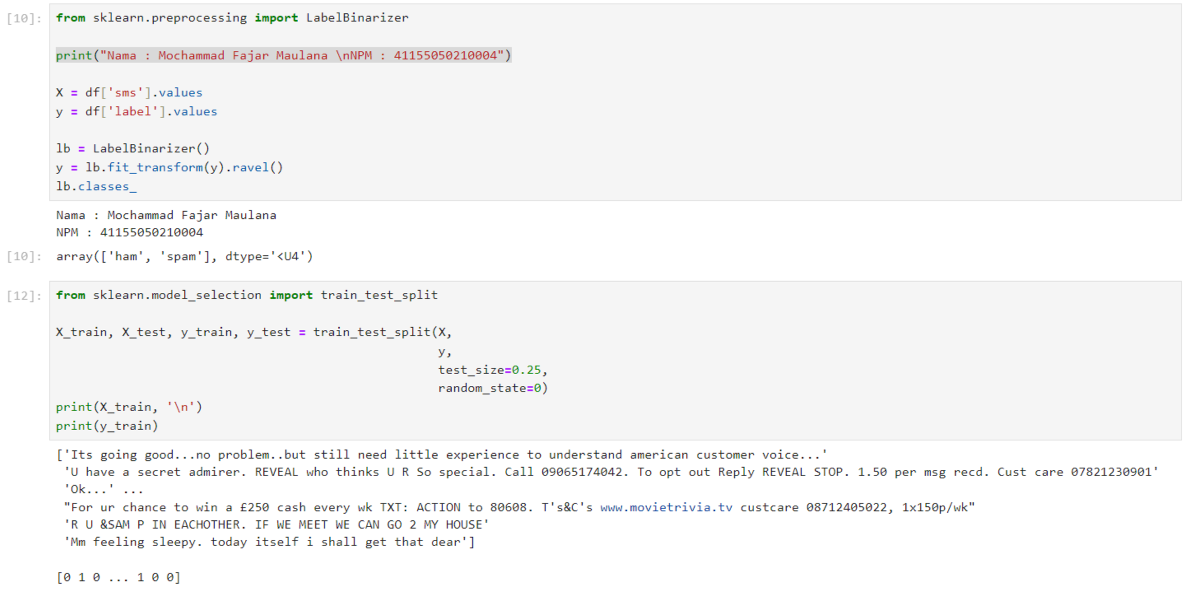
	label	sms
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

```
[6]: df['label'].value_counts()
```

```
[6]: label
     ham     4825
     spam     747
     Name: count, dtype: int64
```

```
[ ]:
```

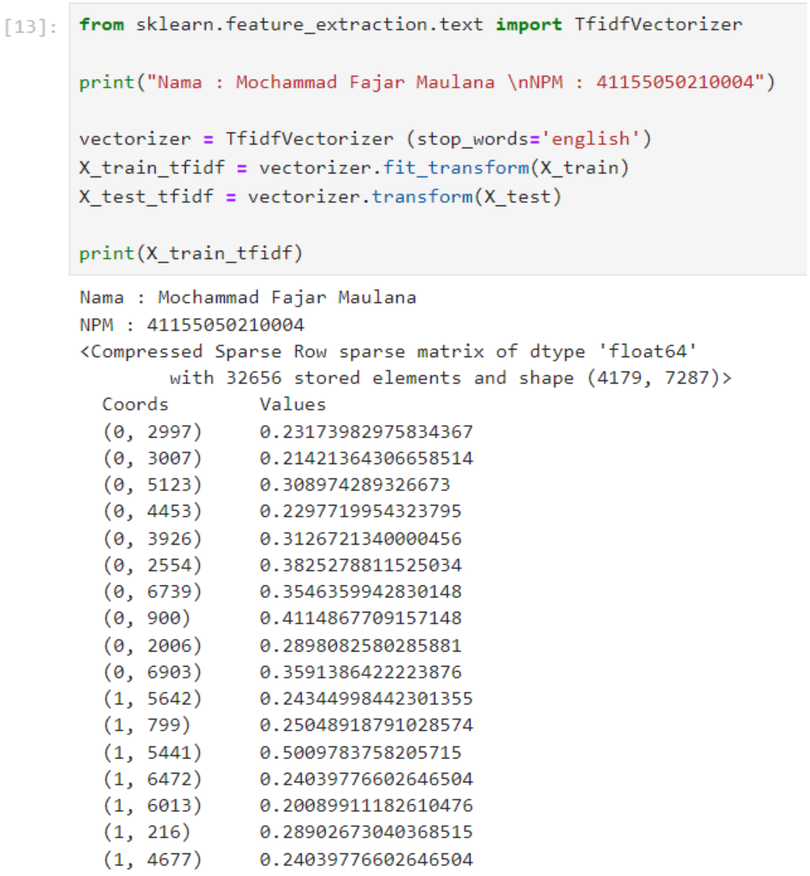
3. Pembagian training dan testing set



```
[10]: from sklearn.preprocessing import LabelBinarizer

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      X = df['sms'].values
      y = df['label'].values

      lb = LabelBinarizer()
      y = lb.fit_transform(y).ravel()
      lb.classes_

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
[10]: array(['ham', 'spam'], dtype='<U4')
```

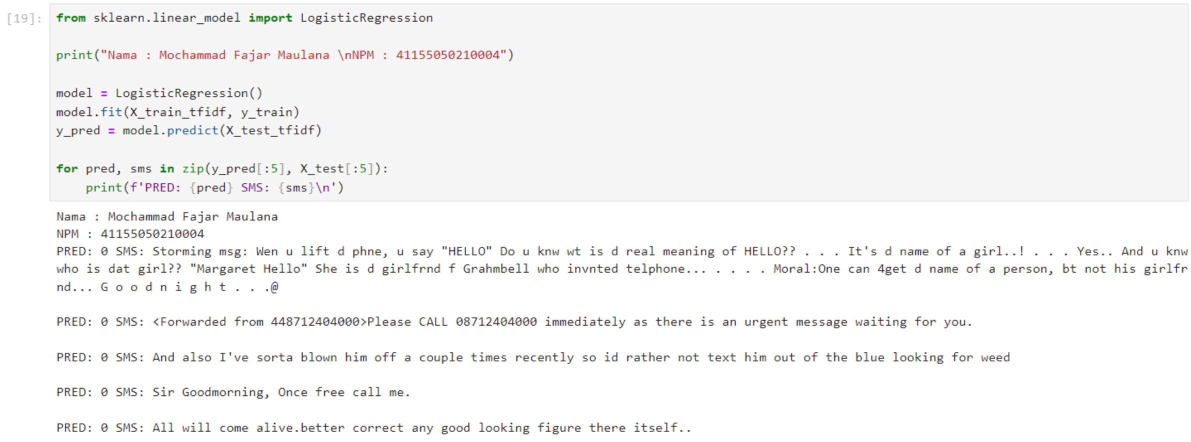
```
[12]: from sklearn.model_selection import train_test_split

      X_train, X_test, y_train, y_test = train_test_split(X,
                                                          y,
                                                          test_size=0.25,
                                                          random_state=0)
      print(X_train, '\n')
      print(y_train)

      ['Its going good...no problem..but still need little experience to understand american customer voice...'
       'U have a secret admirer. REVEAL who thinks U R So special. Call 09065174042. To opt out Reply REVEAL STOP. 1.50 per msg recd. Cust care 07821230901'
       'Ok...' ...
       "For ur chance to win a £250 cash every wk TXT: ACTION to 80608. T's&C's www.movietrivia.tv custcare 08712405022, 1x150p/wk"
       'R U &SAM P IN EACHOTHER. IF WE MEET WE CAN GO 2 MY HOUSE'
       'Mm feeling sleepy. today itself i shall get that dear']

      [0 1 0 ... 1 0 0]
```

4. Feature extraction dengan TF-IDF



```
[13]: from sklearn.feature_extraction.text import TfidfVectorizer

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      vectorizer = TfidfVectorizer (stop_words='english')
      X_train_tfidf = vectorizer.fit_transform(X_train)
      X_test_tfidf = vectorizer.transform(X_test)

      print(X_train_tfidf)

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
      <Compressed Sparse Row sparse matrix of dtype 'float64'
              with 32656 stored elements and shape (4179, 7287)>
        Coords        Values
        (0, 2997)     0.23173982975834367
        (0, 3007)     0.21421364306658514
        (0, 5123)     0.308974289326673
        (0, 4453)     0.2297719954323795
        (0, 3926)     0.3126721340000456
        (0, 2554)     0.3825278811525034
        (0, 6739)     0.3546359942830148
        (0, 900)      0.4114867709157148
        (0, 2006)     0.2898082580285881
        (0, 6903)     0.3591386422223876
        (1, 5642)     0.24344998442301355
        (1, 799)      0.25048918791028574
        (1, 5441)     0.5009783758205715
        (1, 6472)     0.24039776602646504
        (1, 6013)     0.20089911182610476
        (1, 216)      0.28902673040368515
        (1, 4677)     0.24039776602646504
```

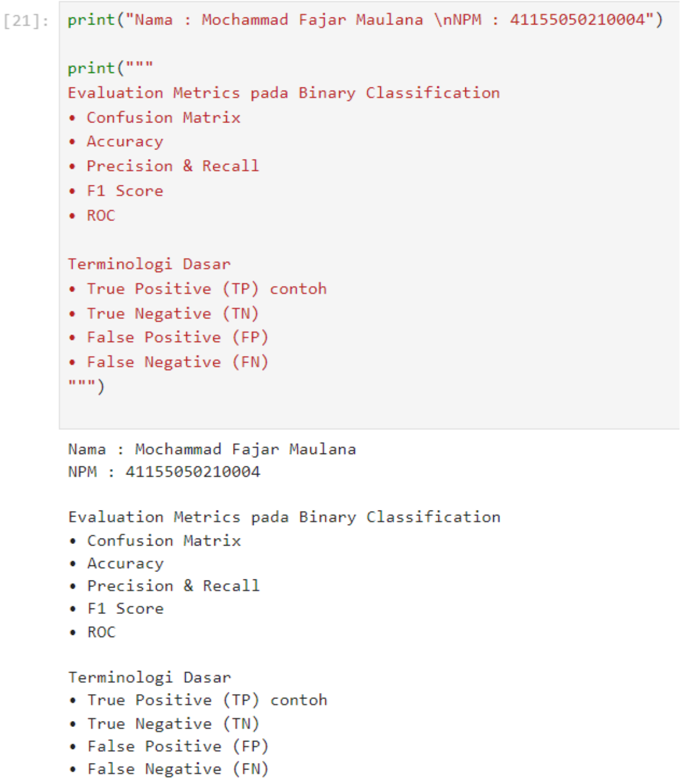
5. Binary Classification dengan Logistic Regression



```
[19]: from sklearn.linear_model import LogisticRegression

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      model = LogisticRegression()
      model.fit(X_train_tfidf, y_train)
      y_pred = model.predict(X_test_tfidf)

      for pred, sms in zip(y_pred[:5], X_test[:5]):
          print(f'PRED: {pred} SMS: {sms}\n')
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004
PRED: 0 SMS: Storming msg: Wen u lift d phne, u say "HELLO" Do u knw wt is d real meaning of HELLO?? . . . It's d name of a girl..! . . . Yes.. And u knw
who is dat girl?? "Margaret Hello" She is d girlfrnd f Grahmbell who invnted telphone... . . . . Moral:One can 4get d name of a person, bt not his girlfr
nd... G o o d n i g h t . . .@

PRED: 0 SMS: <Forwarded from 448712404000>Please CALL 08712404000 immediately as there is an urgent message waiting for you.

PRED: 0 SMS: And also I've sorta blown him off a couple times recently so id rather not text him out of the blue looking for weed

PRED: 0 SMS: Sir Goodmorning, Once free call me.

PRED: 0 SMS: All will come alive.better correct any good looking figure there itself..
```

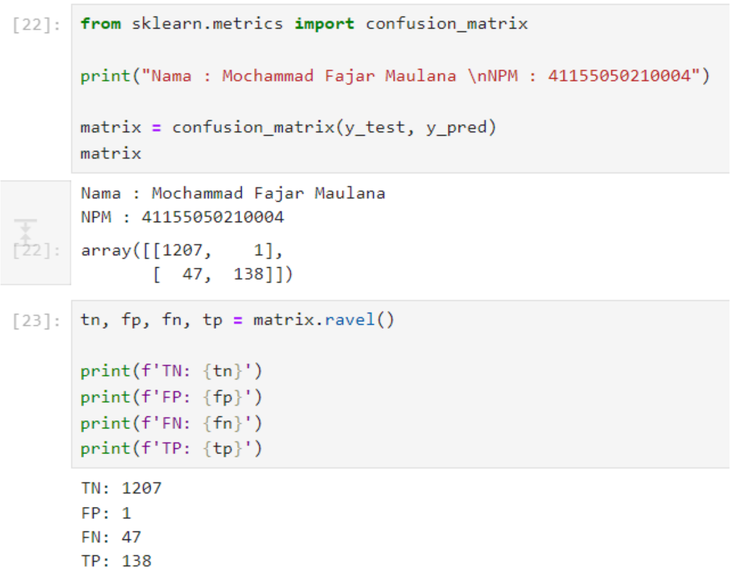
6. Evaluation Metrics pada Binary Classification Task



```
[21]: print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      print("""
      Evaluation Metrics pada Binary Classification
      • Confusion Matrix
      • Accuracy
      • Precision & Recall
      • F1 Score
      • ROC

      Terminologi Dasar
      • True Positive (TP) contoh
      • True Negative (TN)
      • False Positive (FP)
      • False Negative (FN)
      """)
```

```
Nama : Mochammad Fajar Maulana
NPM : 41155050210004

Evaluation Metrics pada Binary Classification
• Confusion Matrix
• Accuracy
• Precision & Recall
• F1 Score
• ROC

Terminologi Dasar
• True Positive (TP) contoh
• True Negative (TN)
• False Positive (FP)
• False Negative (FN)
```

7. Pengenalan Confusion Matrix

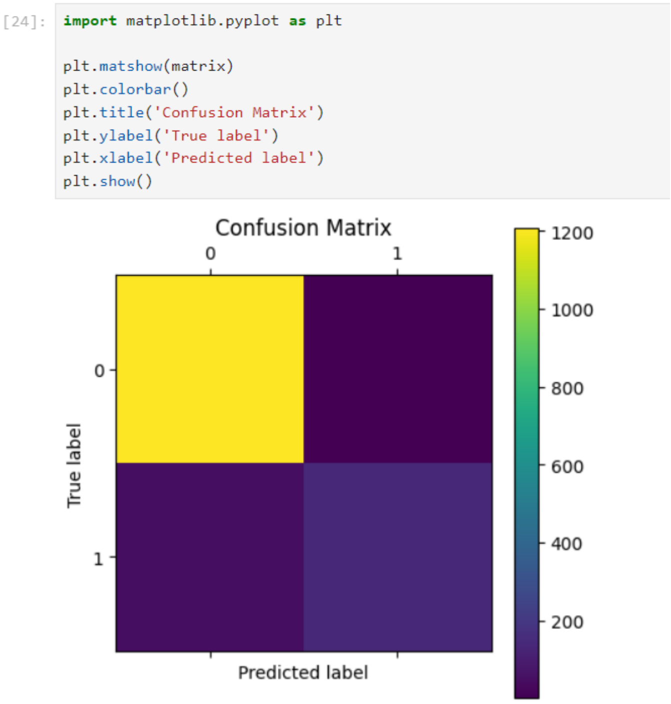


```
[22]: from sklearn.metrics import confusion_matrix

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004")

      matrix = confusion_matrix(y_test, y_pred)
      matrix
```

```
      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
[22]: array([[1207,    1],
             [  47,  138]])
```

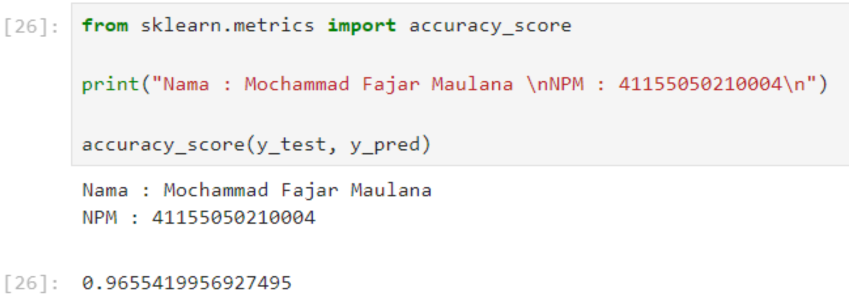
```
[23]: tn, fp, fn, tp = matrix.ravel()

      print(f'TN: {tn}')
      print(f'FP: {fp}')
      print(f'FN: {fn}')
      print(f'TP: {tp}')
```

```
      TN: 1207
      FP: 1
      FN: 47
      TP: 138
```



```
[24]: import matplotlib.pyplot as plt

      plt.matshow(matrix)
      plt.colorbar()
      plt.title('Confusion Matrix')
      plt.ylabel('True label')
      plt.xlabel('Predicted label')
      plt.show()
```

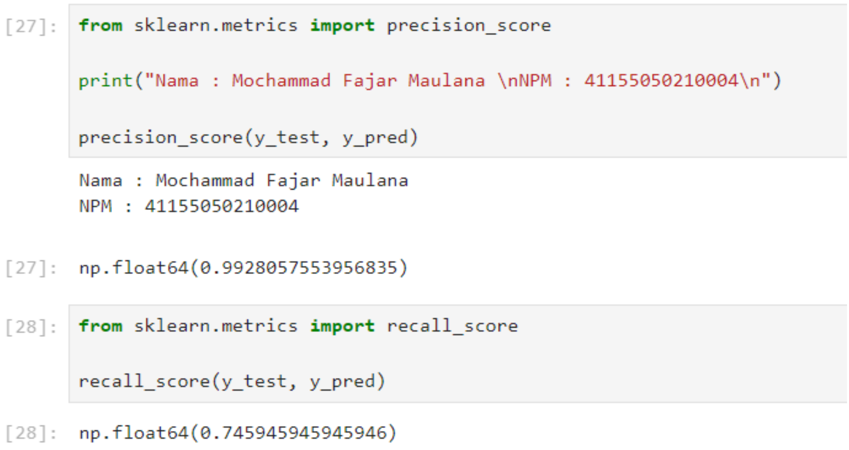
8. Pengenalan Accuracy Score



```
[26]: from sklearn.metrics import accuracy_score

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      accuracy_score(y_test, y_pred)
```

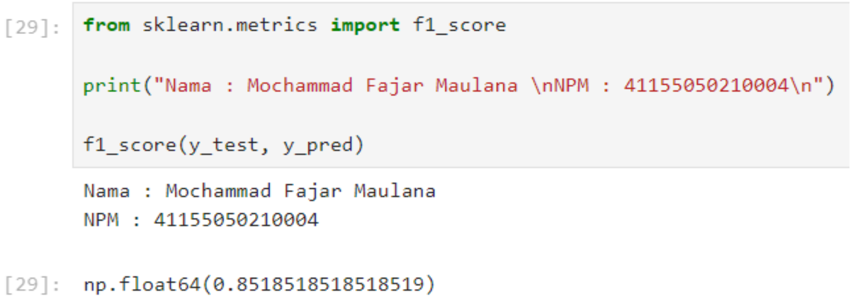
```
      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

[26]: 0.9655419956927495
```

9. Pengenalan Precision dan Recall



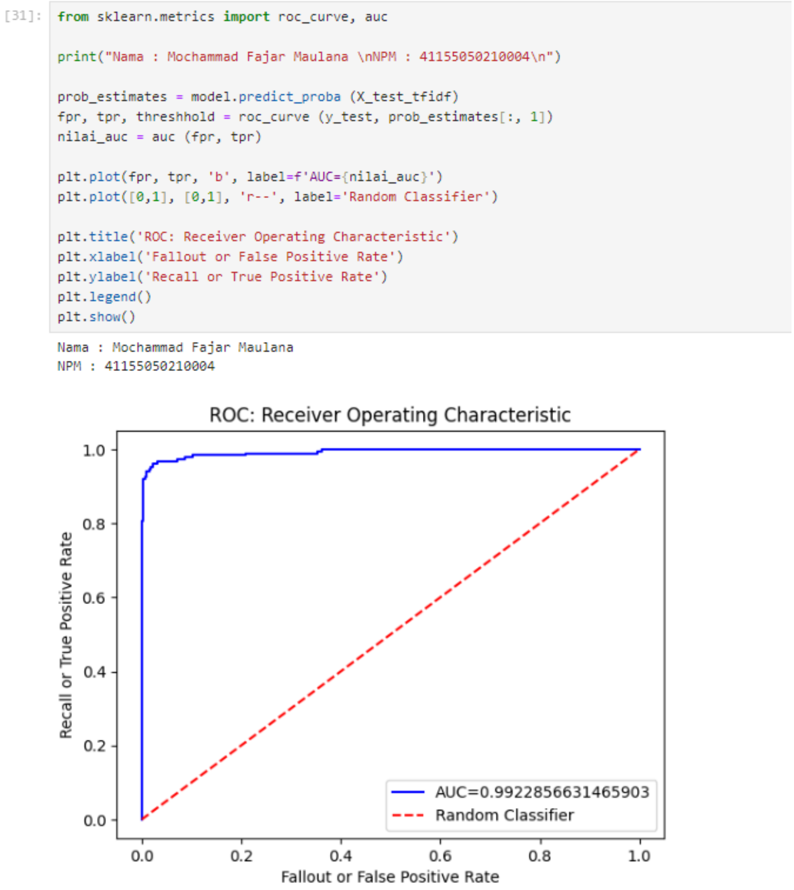
```
[27]: from sklearn.metrics import precision_score

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      precision_score(y_test, y_pred)

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

[27]: np.float64(0.9928057553956835)

[28]: from sklearn.metrics import recall_score

      recall_score(y_test, y_pred)

[28]: np.float64(0.745945945945946)
```

10. Pengenalan F1 Score | F1 Measure



```
[29]: from sklearn.metrics import f1_score

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      f1_score(y_test, y_pred)

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004

[29]: np.float64(0.8518518518518519)
```

11. Pengenalan ROC | Receiver Operating Characteristic



```
[31]: from sklearn.metrics import roc_curve, auc

      print("Nama : Mochammad Fajar Maulana \nNPM : 41155050210004\n")

      prob_estimates = model.predict_proba (X_test_tfidf)
      fpr, tpr, threshhold = roc_curve (y_test, prob_estimates[:, 1])
      nilai_auc = auc (fpr, tpr)

      plt.plot(fpr, tpr, 'b', label=f'AUC={nilai_auc}')
      plt.plot([0,1], [0,1], 'r--', label='Random Classifier')

      plt.title('ROC: Receiver Operating Characteristic')
      plt.xlabel('Fallout or False Positive Rate')
      plt.ylabel('Recall or True Positive Rate')
      plt.legend()
      plt.show()

      Nama : Mochammad Fajar Maulana
      NPM : 41155050210004
```

ROC: Receiver Operating Characteristic
Recall or True Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
Fallout or False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
AUC=0.9922856631465903
Random Classifier