6qj34tjcj

July 31, 2023

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

```
[ ]: df=pd.read_csv("/content/8_BreastCancerPrediction.csv")
     df
```

```
[ ]:            id diagnosis  radius_mean  texture_mean  perimeter_mean  area_mean  \
     0      842302         M        17.99         10.38          122.80     1001.0
     1      842517         M        20.57         17.77          132.90     1326.0
     2    84300903         M        19.69         21.25          130.00     1203.0
     3    84348301         M        11.42         20.38           77.58      386.1
     4    84358402         M        20.29         14.34          135.10     1297.0
     ..        …       …          …           …              …        …
     564    926424         M        21.56         22.39          142.00     1479.0
     565    926682         M        20.13         28.25          131.20     1261.0
     566    926954         M        16.60         28.08          108.30      858.1
     567    927241         M        20.60         29.33          140.10     1265.0
     568     92751         B         7.76         24.54           47.92      181.0

          smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
     0            0.11840           0.27760         0.30010              0.14710
     1            0.08474           0.07864         0.08690              0.07017
     2            0.10960           0.15990         0.19740              0.12790
     3            0.14250           0.28390         0.24140              0.10520
     4            0.10030           0.13280         0.19800              0.10430
     ..               …               …              …                   …
     564          0.11100           0.11590         0.24390              0.13890
     565          0.09780           0.10340         0.14400              0.09791
     566          0.08455           0.10230         0.09251              0.05302
     567          0.11780           0.27700         0.35140              0.15200
     568          0.05263           0.04362         0.00000              0.00000

          …  texture_worst  perimeter_worst  area_worst  smoothness_worst  \
     0    …          17.33           184.60      2019.0           0.16220
     1    …          23.41           158.80      1956.0           0.12380
```

```
2    …          25.53           152.50       1709.0            0.14440
3    …          26.50            98.87        567.7            0.20980
4    …          16.67           152.20       1575.0            0.13740
..   …            …               …           …              …
564  …          26.40           166.10       2027.0            0.14100
565  …          38.25           155.00       1731.0            0.11660
566  …          34.12           126.70       1124.0            0.11390
567  …          39.42           184.60       1821.0            0.16500
568  …          30.37            59.16        268.6            0.08996

     compactness_worst  concavity_worst  concave points_worst  symmetry_worst  \
0              0.66560           0.7119                0.2654          0.4601
1              0.18660           0.2416                0.1860          0.2750
2              0.42450           0.4504                0.2430          0.3613
3              0.86630           0.6869                0.2575          0.6638
4              0.20500           0.4000                0.1625          0.2364
..                 …               …                   …               …
564            0.21130           0.4107                0.2216          0.2060
565            0.19220           0.3215                0.1628          0.2572
566            0.30940           0.3403                0.1418          0.2218
567            0.86810           0.9387                0.2650          0.4087
568            0.06444           0.0000                0.0000          0.2871

     fractal_dimension_worst  Unnamed: 32
0                    0.11890          NaN
1                    0.08902          NaN
2                    0.08758          NaN
3                    0.17300          NaN
4                    0.07678          NaN
..                       …          …
564                  0.07115          NaN
565                  0.06637          NaN
566                  0.07820          NaN
567                  0.12400          NaN
568                  0.07039          NaN

[569 rows x 33 columns]
```

[ ]:
```
df.head()
```

[ ]:
```
         id diagnosis  radius_mean  texture_mean  perimeter_mean  area_mean  \
0    842302         M        17.99         10.38          122.80     1001.0
1    842517         M        20.57         17.77          132.90     1326.0
2  84300903         M        19.69         21.25          130.00     1203.0
3  84348301         M        11.42         20.38           77.58      386.1
4  84358402         M        20.29         14.34          135.10     1297.0
```

```
   smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
0          0.11840           0.27760          0.3001              0.14710
1          0.08474           0.07864          0.0869              0.07017
2          0.10960           0.15990          0.1974              0.12790
3          0.14250           0.28390          0.2414              0.10520
4          0.10030           0.13280          0.1980              0.10430

   …  texture_worst  perimeter_worst  area_worst  smoothness_worst  \
0  …          17.33           184.60      2019.0            0.1622
1  …          23.41           158.80      1956.0            0.1238
2  …          25.53           152.50      1709.0            0.1444
3  …          26.50            98.87       567.7            0.2098
4  …          16.67           152.20      1575.0            0.1374

   compactness_worst  concavity_worst  concave points_worst  symmetry_worst  \
0             0.6656           0.7119                0.2654          0.4601
1             0.1866           0.2416                0.1860          0.2750
2             0.4245           0.4504                0.2430          0.3613
3             0.8663           0.6869                0.2575          0.6638
4             0.2050           0.4000                0.1625          0.2364

   fractal_dimension_worst  Unnamed: 32
0                  0.11890          NaN
1                  0.08902          NaN
2                  0.08758          NaN
3                  0.17300          NaN
4                  0.07678          NaN

[5 rows x 33 columns]
```

1 DATA CLEANING AND DATA PREPROCESSING

[ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 33 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   id                       569 non-null    int64
 1   diagnosis                569 non-null    object
 2   radius_mean              569 non-null    float64
 3   texture_mean             569 non-null    float64
 4   perimeter_mean           569 non-null    float64
 5   area_mean                569 non-null    float64
 6   smoothness_mean          569 non-null    float64
 7   compactness_mean         569 non-null    float64
 8   concavity_mean           569 non-null    float64
 9   concave points_mean      569 non-null    float64
 10  symmetry_mean            569 non-null    float64
 11  fractal_dimension_mean   569 non-null    float64
 12  radius_se                569 non-null    float64
 13  texture_se               569 non-null    float64
 14  perimeter_se             569 non-null    float64
 15  area_se                  569 non-null    float64
 16  smoothness_se            569 non-null    float64
 17  compactness_se           569 non-null    float64
 18  concavity_se             569 non-null    float64
 19  concave points_se        569 non-null    float64
 20  symmetry_se              569 non-null    float64
 21  fractal_dimension_se     569 non-null    float64
 22  radius_worst             569 non-null    float64
 23  texture_worst            569 non-null    float64
 24  perimeter_worst          569 non-null    float64
 25  area_worst               569 non-null    float64
 26  smoothness_worst         569 non-null    float64
 27  compactness_worst        569 non-null    float64
 28  concavity_worst          569 non-null    float64
 29  concave points_worst     569 non-null    float64
 30  symmetry_worst           569 non-null    float64
 31  fractal_dimension_worst  569 non-null    float64
 32  Unnamed: 32              0 non-null      float64
dtypes: float64(31), int64(1), object(1)
memory usage: 146.8+ KB
```

[ ]:
```
df.describe()
```

[ ]:
```
                 id  radius_mean  texture_mean  perimeter_mean    area_mean  \
count  5.690000e+02   569.000000    569.000000      569.000000   569.000000
mean   3.037183e+07    14.127292     19.289649       91.969033   654.889104
std    1.250206e+08     3.524049      4.301036       24.298981   351.914129
min    8.670000e+03     6.981000      9.710000       43.790000   143.500000
25%    8.692180e+05    11.700000     16.170000       75.170000   420.300000
50%    9.060240e+05    13.370000     18.840000       86.240000   551.100000
75%    8.813129e+06    15.780000     21.800000      104.100000   782.700000
max    9.113205e+08    28.110000     39.280000      188.500000  2501.000000

       smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
count       569.000000        569.000000      569.000000           569.000000
mean          0.096360          0.104341        0.088799             0.048919
std           0.014064          0.052813        0.079720             0.038803
min           0.052630          0.019380        0.000000             0.000000
25%           0.086370          0.064920        0.029560             0.020310
```

```
50%           0.095870          0.092630        0.061540               0.033500
75%           0.105300          0.130400        0.130700               0.074000
max           0.163400          0.345400        0.426800               0.201200

       symmetry_mean  …  texture_worst  perimeter_worst   area_worst  \
count     569.000000  …     569.000000       569.000000   569.000000
mean        0.181162  …      25.677223       107.261213   880.583128
std         0.027414  …       6.146258        33.602542   569.356993
min         0.106000  …      12.020000        50.410000   185.200000
25%         0.161900  …      21.080000        84.110000   515.300000
50%         0.179200  …      25.410000        97.660000   686.500000
75%         0.195700  …      29.720000       125.400000  1084.000000
max         0.304000  …      49.540000       251.200000  4254.000000

       smoothness_worst  compactness_worst  concavity_worst  \
count        569.000000         569.000000       569.000000
mean           0.132369           0.254265         0.272188
std            0.022832           0.157336         0.208624
min            0.071170           0.027290         0.000000
25%            0.116600           0.147200         0.114500
50%            0.131300           0.211900         0.226700
75%            0.146000           0.339100         0.382900
max            0.222600           1.058000         1.252000

       concave points_worst  symmetry_worst  fractional_dimension_worst  \
count            569.000000      569.000000               569.000000
mean               0.114606        0.290076                 0.083946
std                0.065732        0.061867                 0.018061
min                0.000000        0.156500                 0.055040
25%                0.064930        0.250400                 0.071460
50%                0.099930        0.282200                 0.080040
75%                0.161400        0.317900                 0.092080
max                0.291000        0.663800                 0.207500

       Unnamed: 32
count          0.0
mean           NaN
std            NaN
min            NaN
25%            NaN
50%            NaN
75%            NaN
max            NaN

[8 rows x 32 columns]
```

[ ]:
```
df.columns
```

```
[ ]: Index(['id', 'diagnosis', 'radius_mean', 'texture_mean', 'perimeter_mean',
            'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean',
            'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
            'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
            'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se',
            'fractal_dimension_se', 'radius_worst', 'texture_worst',
            'perimeter_worst', 'area_worst', 'smoothness_worst',
            'compactness_worst', 'concavity_worst', 'concave points_worst',
            'symmetry_worst', 'fractal_dimension_worst', 'Unnamed: 32'],
           dtype='object')
```

```
[ ]: df1=df.dropna(axis=1)
     df1
```

```
[ ]:            id diagnosis  radius_mean  texture_mean  perimeter_mean  area_mean  \
     0      842302         M        17.99         10.38          122.80     1001.0
     1      842517         M        20.57         17.77          132.90     1326.0
     2    84300903         M        19.69         21.25          130.00     1203.0
     3    84348301         M        11.42         20.38           77.58      386.1
     4    84358402         M        20.29         14.34          135.10     1297.0
     ..        …       …           …            …              …          …
     564    926424         M        21.56         22.39          142.00     1479.0
     565    926682         M        20.13         28.25          131.20     1261.0
     566    926954         M        16.60         28.08          108.30      858.1
     567    927241         M        20.60         29.33          140.10     1265.0
     568     92751         B         7.76         24.54           47.92      181.0

          smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
     0            0.11840           0.27760         0.30010              0.14710
     1            0.08474           0.07864         0.08690              0.07017
     2            0.10960           0.15990         0.19740              0.12790
     3            0.14250           0.28390         0.24140              0.10520
     4            0.10030           0.13280         0.19800              0.10430
     ..               …               …              …                  …
     564          0.11100           0.11590         0.24390              0.13890
     565          0.09780           0.10340         0.14400              0.09791
     566          0.08455           0.10230         0.09251              0.05302
     567          0.11780           0.27700         0.35140              0.15200
     568          0.05263           0.04362         0.00000              0.00000

          …  radius_worst  texture_worst  perimeter_worst  area_worst  \
     0    …        25.380          17.33           184.60      2019.0
     1    …        24.990          23.41           158.80      1956.0
     2    …        23.570          25.53           152.50      1709.0
     3    …        14.910          26.50            98.87       567.7
     4    …        22.540          16.67           152.20      1575.0
     ..   …           …              …               …          …
```

```
564  …        25.450          26.40          166.10      2027.0
565  …        23.690          38.25          155.00      1731.0
566  …        18.980          34.12          126.70      1124.0
567  …        25.740          39.42          184.60      1821.0
568  …         9.456          30.37           59.16       268.6

     smoothness_worst  compactness_worst  concavity_worst  \
0             0.16220            0.66560           0.7119
1             0.12380            0.18660           0.2416
2             0.14440            0.42450           0.4504
3             0.20980            0.86630           0.6869
4             0.13740            0.20500           0.4000
..                …                  …                …
564           0.14100            0.21130           0.4107
565           0.11660            0.19220           0.3215
566           0.11390            0.30940           0.3403
567           0.16500            0.86810           0.9387
568           0.08996            0.06444           0.0000

     concave points_worst  symmetry_worst  fractal_dimension_worst
0                  0.2654          0.4601                  0.11890
1                  0.1860          0.2750                  0.08902
2                  0.2430          0.3613                  0.08758
3                  0.2575          0.6638                  0.17300
4                  0.1625          0.2364                  0.07678
..                    …              …                       …
564                0.2216          0.2060                  0.07115
565                0.1628          0.2572                  0.06637
566                0.1418          0.2218                  0.07820
567                0.2650          0.4087                  0.12400
568                0.0000          0.2871                  0.07039

[569 rows x 32 columns]
```

```
[ ]: df1.columns
```

```
[ ]: Index(['id', 'diagnosis', 'radius_mean', 'texture_mean', 'perimeter_mean',
            'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean',
            'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
            'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
            'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se',
            'fractal_dimension_se', 'radius_worst', 'texture_worst',
            'perimeter_worst', 'area_worst', 'smoothness_worst',
            'compactness_worst', 'concavity_worst', 'concave points_worst',
            'symmetry_worst', 'fractal_dimension_worst'],
           dtype='object')
```

[ ]:
```
df1=df1[['id', 'radius_mean', 'texture_mean', 'perimeter_mean',
       'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean',
       'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
       'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
       'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se',
       'fractal_dimension_se', 'radius_worst', 'texture_worst',
       'perimeter_worst', 'area_worst', 'smoothness_worst',
       'compactness_worst', 'concavity_worst', 'concave points_worst',
       'symmetry_worst', 'fractal_dimension_worst']]
```

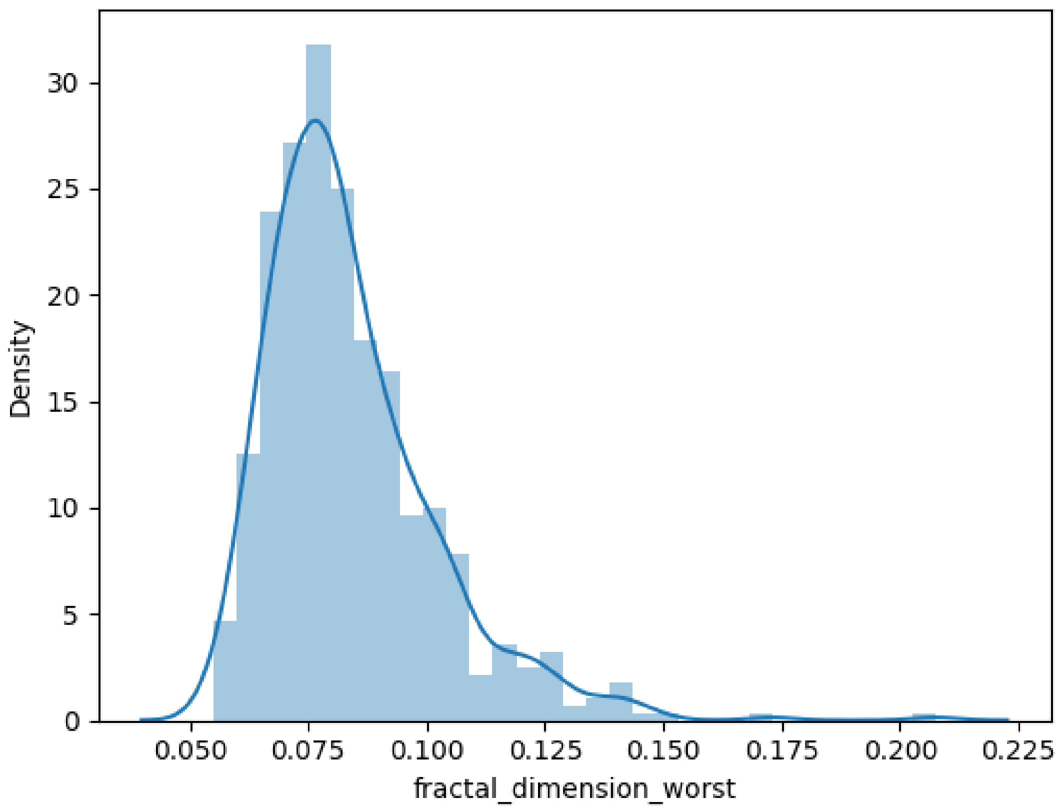
2 EDA AND VISUALIZATION

[ ]:
```
sns.pairplot(df1)
```

[ ]:
```
sns.distplot(df1['fractal_dimension_worst'])
```

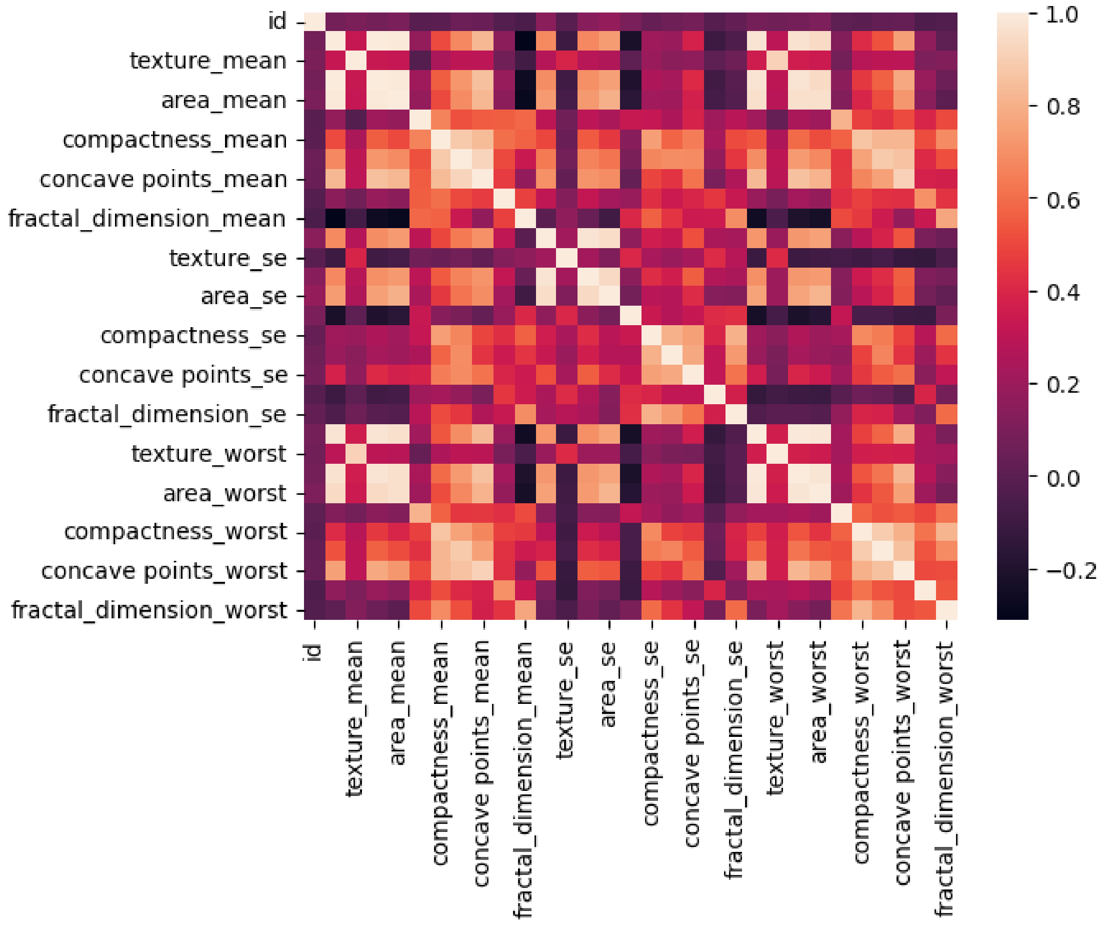
```
<ipython-input-11-a88705766b47>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df1['fractal_dimension_worst'])
```

[ ]:
```
<Axes: xlabel='fractal_dimension_worst', ylabel='Density'>
```



[ ]:
```
sns.heatmap(df1.corr())
```

[ ]:
```
<Axes: >
```



3 TO TRAIN THE MODEL AND MODEL BULDING

```
[ ]: x=df[['id', 'radius_mean', 'texture_mean', 'perimeter_mean',
            'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean',
            'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
            'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
            'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se',
            'fractal_dimension_se', 'radius_worst', 'texture_worst',
            'perimeter_worst', 'area_worst', 'smoothness_worst',
            'compactness_worst', 'concavity_worst', 'concave points_worst',
            'symmetry_worst']]
     y=df['fractal_dimension_worst']
```

```
[ ]: 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)
```

[ ]:
```
from sklearn.linear_model import LinearRegression
lr=LinearRegression()
lr.fit(x_train,y_train)
```

[ ]:
```
LinearRegression()
```

[ ]:
```
lr.intercept_
```

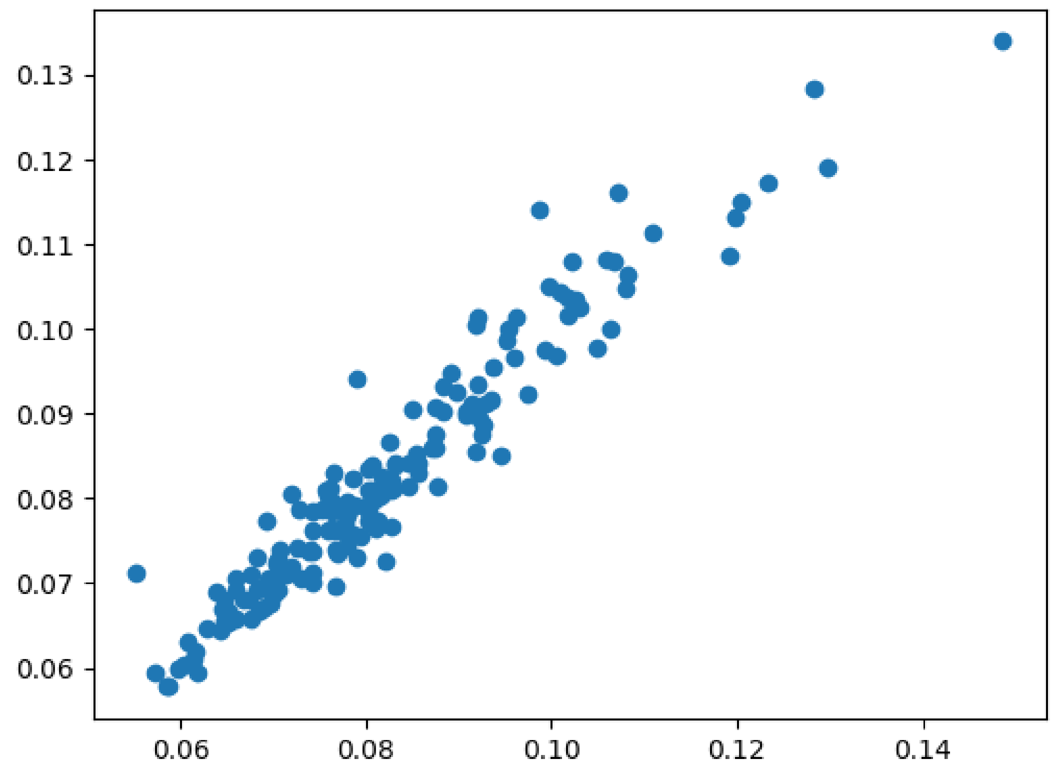
[ ]:
```
-0.02522352461946234
```

[ ]:
```
coeff=pd.DataFrame(lr.coef_,x.columns,columns=['Co-efficient'])
coeff
```

[ ]:
```
                        Co-efficient
id                     -2.368699e-12
radius_mean            -4.511013e-03
texture_mean            9.049861e-05
perimeter_mean          4.266956e-04
area_mean               1.334342e-05
smoothness_mean        -4.189968e-02
compactness_mean       -1.255826e-01
concavity_mean         -7.826449e-02
concave points_mean     1.226514e-01
symmetry_mean          -9.055320e-03
fractal_dimension_mean  1.353105e+00
radius_se              -2.380030e-02
texture_se             -3.482709e-04
perimeter_se            1.753643e-03
area_se                 1.059917e-04
smoothness_se           2.663329e-02
compactness_se         -2.229326e-01
concavity_se           -5.444331e-02
concave points_se       3.975217e-03
symmetry_se            -1.310632e-01
fractal_dimension_se    2.501342e+00
radius_worst            4.608262e-03
texture_worst           2.582736e-05
perimeter_worst        -3.221786e-04
area_worst             -2.072206e-05
smoothness_worst        3.703889e-02
compactness_worst       8.202149e-02
concavity_worst         3.061067e-02
concave points_worst   -2.675547e-02
symmetry_worst          1.846634e-02
```

[ ]:
```
prediction =lr.predict(x_test)
plt.scatter(y_test,prediction)
```

```
[ ]: <matplotlib.collections.PathCollection at 0x79c611056590>
```



4 ACCURACY

```
[ ]: lr.score(x_test,y_test)
```

```
[ ]: 0.9233132157702097
```

```
[ ]: lr.score(x_train,y_train)
```

```
[ ]: 0.948976497088863
```

```
[ ]: from sklearn.linear_model import Ridge,Lasso
```

```
[ ]: rr=Ridge(alpha=10)
     rr.fit(x_train,y_train)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_ridge.py:216:
LinAlgWarning: Ill-conditioned matrix (rcond=1.17448e-18): result may not be
accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
```

```
[ ]: Ridge(alpha=10)
```

```
[ ]: rr.score(x_test,y_test)
```

```
[ ]: 0.5746650890022684
```

```
[ ]: rr.score(x_train,y_train)
```

```
[ ]: 0.7336880934371385
```

```
[ ]: la=Lasso(alpha=10)
     la.fit(x_train,y_train)
```

```
[ ]: Lasso(alpha=10)
```

```
[ ]: la.score(x_train,y_train)
```

```
[ ]: 0.005397561150582653
```

```
[ ]: la.score(x_test,y_test)
```

```
[ ]: -0.052287624054701665
```

```
[ ]: from sklearn.linear_model import ElasticNet
     en=ElasticNet()
     en.fit(x_train,y_train)
```

```
[ ]: ElasticNet()
```

```
[ ]: print(en.coef_)
     print(en.intercept_)
```

```
[-1.24296074e-11 -0.00000000e+00  0.00000000e+00  0.00000000e+00
 -0.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00
  0.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00
 -0.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00
  0.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00
  0.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00
  1.07358175e-06  0.00000000e+00  0.00000000e+00  0.00000000e+00
  0.00000000e+00  0.00000000e+00]
0.0840957924659967
```

```
[ ]: prediction = en.predict(x_test)
     prediction
```

```
[ ]: array([0.08455865, 0.08457146, 0.08573119, 0.08540216, 0.084625  ,
            0.08471444, 0.08616002, 0.08447038, 0.0850591 , 0.08439037,
       0.08439053, 0.08559143, 0.08490055, 0.08441967, 0.08465697,
       0.08382654, 0.08406431, 0.0852778 , 0.08455799, 0.08508447,
       0.08351115, 0.08479157, 0.08500984, 0.08576744, 0.08462018,
       0.08656732, 0.08477026, 0.08472277, 0.08454943, 0.08580545,
       0.08497228, 0.08364913, 0.08449755, 0.08474442, 0.08348542,
       0.08454477, 0.08440187, 0.08665969, 0.08507828, 0.08531197,
       0.08465772, 0.0847311 , 0.08441888, 0.08585151, 0.08543896,
       0.08378377, 0.08497712, 0.08577774, 0.08509188, 0.08475442,
       0.08488871, 0.08491039, 0.07353777, 0.08473641, 0.08497154,
       0.08472022, 0.08444254, 0.08514717, 0.08453426, 0.08596358,
       0.08506703, 0.08465687, 0.08482248, 0.08462712, 0.08478043,
       0.08487899, 0.08459543, 0.08455283, 0.08458955, 0.08353322,
       0.08490374, 0.08439069, 0.0847297 , 0.08459523, 0.08443922,
       0.08464332, 0.08530698, 0.08467034, 0.08456705, 0.08485626,
       0.0844411 , 0.07494125, 0.08388402, 0.08436322, 0.08393765,
       0.08478575, 0.08529757, 0.08467915, 0.08485589, 0.08495327,
       0.08468523, 0.08561536, 0.08628876, 0.08362875, 0.08465727,
       0.08499618, 0.08632765, 0.08496507, 0.08452695, 0.08463882,
       0.08551529, 0.08497659, 0.08506073, 0.08499094, 0.0842839 ,
       0.08468727, 0.08497392, 0.08508191, 0.08490866, 0.08476759,
       0.08506164, 0.08530176, 0.08373132, 0.08360219, 0.08477117,
       0.08606445, 0.08467656, 0.08483594, 0.0844762 , 0.08544757,
       0.08488272, 0.08667415, 0.0846448 , 0.08538389, 0.08490503,
       0.08753757, 0.0857577 , 0.08469314, 0.0852482 , 0.08472337,
       0.08463553, 0.08567233, 0.08425905, 0.08470207, 0.0846185 ,
       0.08459594, 0.0848348 , 0.07393166, 0.07329997, 0.08463528,
       0.08437161, 0.08602647, 0.08505777, 0.08443503, 0.08342465,
       0.08473964, 0.08464128, 0.08486429, 0.08473853, 0.08469521,
       0.08463698, 0.0845812 , 0.08458254, 0.08567895, 0.08458651,
       0.08473814, 0.0846879 , 0.08559868, 0.08637464, 0.08538226,
       0.08455304, 0.08478669, 0.08456458, 0.08444544, 0.08533675,
       0.08350501, 0.08666916, 0.08389358, 0.08540098, 0.08448084,
       0.08472828])
```

[ ]:
```
en.score(x_test,y_test)
```

[ ]:
```
-0.046833447192170086
```

[ ]:
```
from sklearn import metrics
print("Mean Absolute Error: ", metrics.mean_absolute_error(y_test,prediction))
print("Mean Squared Error: ", metrics.mean_squared_error(y_test,prediction))
print("Root Mean Squared Error: ", np.sqrt(metrics.
 ↪mean_squared_error(y_test,prediction)))
```

```
Mean Absolute Error:  0.01222927830188647
Mean Squared Error:  0.00024742092701344494
Root Mean Squared Error:  0.015729619417310926
```