In [1]:

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

In [2]:

```
df1=pd.read_csv(r'C:\Users\user\Downloads\8_BreastCancerPrediction.csv')
df1
```

Out[2]:

| | id | diagnosis | radius_mean | texture_mean | perimeter_mean | area_mean | smoothne |
|---|---|---|---|---|---|---|---|
| **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 | |

569 rows × 33 columns

In [3]:

```
df=df1.head(50)
df
```

Out[3]:

| | id | diagnosis | radius_mean | texture_mean | perimeter_mean | area_mean | smoothnes |
|---|---|---|---|---|---|---|---|
| **0** | 842302 | M | 17.990 | 10.38 | 122.80 | 1001.0 | |
| **1** | 842517 | M | 20.570 | 17.77 | 132.90 | 1326.0 | |
| **2** | 84300903 | M | 19.690 | 21.25 | 130.00 | 1203.0 | |
| **3** | 84348301 | M | 11.420 | 20.38 | 77.58 | 386.1 | |
| **4** | 84358402 | M | 20.290 | 14.34 | 135.10 | 1297.0 | |
| **5** | 843786 | M | 12.450 | 15.70 | 82.57 | 477.1 | |
| **6** | 844359 | M | 18.250 | 19.98 | 119.60 | 1040.0 | |
| **7** | 84458202 | M | 13.710 | 20.83 | 90.20 | 577.9 | |
| **8** | 844981 | M | 13.000 | 21.82 | 87.50 | 519.8 | |
| **9** | 84501001 | M | 12.460 | 24.04 | 83.97 | 475.9 | |
| **10** | 845636 | M | 16.020 | 23.24 | 102.70 | 797.8 | |
| **11** | 84610002 | M | 15.780 | 17.89 | 103.60 | 781.0 | |
| **12** | 846226 | M | 19.170 | 24.80 | 132.40 | 1123.0 | |
| **13** | 846381 | M | 15.850 | 23.95 | 103.70 | 782.7 | |
| **14** | 84667401 | M | 13.730 | 22.61 | 93.60 | 578.3 | |
| **15** | 84799002 | M | 14.540 | 27.54 | 96.73 | 658.8 | |
| **16** | 848406 | M | 14.680 | 20.13 | 94.74 | 684.5 | |
| **17** | 84862001 | M | 16.130 | 20.68 | 108.10 | 798.8 | |
| **18** | 849014 | M | 19.810 | 22.15 | 130.00 | 1260.0 | |
| **19** | 8510426 | B | 13.540 | 14.36 | 87.46 | 566.3 | |
| **20** | 8510653 | B | 13.080 | 15.71 | 85.63 | 520.0 | |
| **21** | 8510824 | B | 9.504 | 12.44 | 60.34 | 273.9 | |
| **22** | 8511133 | M | 15.340 | 14.26 | 102.50 | 704.4 | |
| **23** | 851509 | M | 21.160 | 23.04 | 137.20 | 1404.0 | |
| **24** | 852552 | M | 16.650 | 21.38 | 110.00 | 904.6 | |
| **25** | 852631 | M | 17.140 | 16.40 | 116.00 | 912.7 | |
| **26** | 852763 | M | 14.580 | 21.53 | 97.41 | 644.8 | |
| **27** | 852781 | M | 18.610 | 20.25 | 122.10 | 1094.0 | |
| **28** | 852973 | M | 15.300 | 25.27 | 102.40 | 732.4 | |
| **29** | 853201 | M | 17.570 | 15.05 | 115.00 | 955.1 | |
| **30** | 853401 | M | 18.630 | 25.11 | 124.80 | 1088.0 | |
| **31** | 853612 | M | 11.840 | 18.70 | 77.93 | 440.6 | |
| **32** | 85382601 | M | 17.020 | 23.98 | 112.80 | 899.3 | |
| **33** | 854002 | M | 19.270 | 26.47 | 127.90 | 1162.0 | |
| **34** | 854039 | M | 16.130 | 17.88 | 107.00 | 807.2 | |
| **35** | 854253 | M | 16.740 | 21.59 | 110.10 | 869.5 | |

| | id | diagnosis | radius_mean | texture_mean | perimeter_mean | area_mean | smoothnes |
|---|---|---|---|---|---|---|---|
| **36** | 854268 | M | 14.250 | 21.72 | 93.63 | 633.0 | |
| **37** | 854941 | B | 13.030 | 18.42 | 82.61 | 523.8 | |
| **38** | 855133 | M | 14.990 | 25.20 | 95.54 | 698.8 | |
| **39** | 855138 | M | 13.480 | 20.82 | 88.40 | 559.2 | |
| **40** | 855167 | M | 13.440 | 21.58 | 86.18 | 563.0 | |
| **41** | 855563 | M | 10.950 | 21.35 | 71.90 | 371.1 | |
| **42** | 855625 | M | 19.070 | 24.81 | 128.30 | 1104.0 | |
| **43** | 856106 | M | 13.280 | 20.28 | 87.32 | 545.2 | |
| **44** | 85638502 | M | 13.170 | 21.81 | 85.42 | 531.5 | |
| **45** | 857010 | M | 18.650 | 17.60 | 123.70 | 1076.0 | |
| **46** | 85713702 | B | 8.196 | 16.84 | 51.71 | 201.9 | |
| **47** | 85715 | M | 13.170 | 18.66 | 85.98 | 534.6 | |
| **48** | 857155 | B | 12.050 | 14.63 | 78.04 | 449.3 | |
| **49** | 857156 | B | 13.490 | 22.30 | 86.91 | 561.0 | |

50 rows × 33 columns

In [4]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50 entries, 0 to 49
Data columns (total 33 columns):
 #   Column                   Non-Null Count  Dtype  
---  ------                   --------------  -----  
 0   id                       50 non-null     int64  
 1   diagnosis                50 non-null     object 
 2   radius_mean              50 non-null     float64
 3   texture_mean             50 non-null     float64
 4   perimeter_mean           50 non-null     float64
 5   area_mean                50 non-null     float64
 6   smoothness_mean          50 non-null     float64
 7   compactness_mean         50 non-null     float64
 8   concavity_mean           50 non-null     float64
 9   concave points_mean      50 non-null     float64
 10  symmetry_mean            50 non-null     float64
 11  fractal_dimension_mean   50 non-null     float64
 12  radius_se                50 non-null     float64
 13  texture_se               50 non-null     float64
 14  perimeter_se             50 non-null     float64
 15  area_se                  50 non-null     float64
 16  smoothness_se            50 non-null     float64
 17  compactness_se           50 non-null     float64
 18  concavity_se             50 non-null     float64
 19  concave points_se        50 non-null     float64
 20  symmetry_se              50 non-null     float64
 21  fractal_dimension_se     50 non-null     float64
 22  radius_worst             50 non-null     float64
 23  texture_worst            50 non-null     float64
 24  perimeter_worst          50 non-null     float64
 25  area_worst               50 non-null     float64
 26  smoothness_worst         50 non-null     float64
 27  compactness_worst        50 non-null     float64
 28  concavity_worst          50 non-null     float64
 29  concave points_worst     50 non-null     float64
 30  symmetry_worst           50 non-null     float64
 31  fractal_dimension_worst  50 non-null     float64
 32  Unnamed: 32              0 non-null      float64
dtypes: float64(31), int64(1), object(1)
memory usage: 13.0+ KB
```

In [5]:

```
df.describe()
```

Out[5]:

| | id | radius_mean | texture_mean | perimeter_mean | area_mean | smoothness_ |
|---|---|---|---|---|---|---|
| **count** | 5.000000e+01 | 50.000000 | 50.000000 | 50.00000 | 50.000000 | 50.0( |
| **mean** | 2.159747e+07 | 15.377200 | 20.178400 | 101.40000 | 761.998000 | 0.1( |
| **std** | 3.594020e+07 | 3.011576 | 3.828225 | 20.43648 | 294.515104 | 0.0' |
| **min** | 8.571500e+04 | 8.196000 | 10.380000 | 51.71000 | 201.900000 | 0.0{ |
| **25%** | 8.525718e+05 | 13.197500 | 17.797500 | 86.36250 | 537.250000 | 0.0{ |
| **50%** | 8.550370e+05 | 15.145000 | 20.825000 | 99.90500 | 701.600000 | 0.1( |
| **75%** | 8.511056e+06 | 17.885000 | 22.532500 | 118.70000 | 989.525000 | 0.1' |
| **max** | 8.571370e+07 | 21.160000 | 27.540000 | 137.20000 | 1404.000000 | 0.1{ |

8 rows × 32 columns

In [6]:

```
df.columns
```

Out[6]:

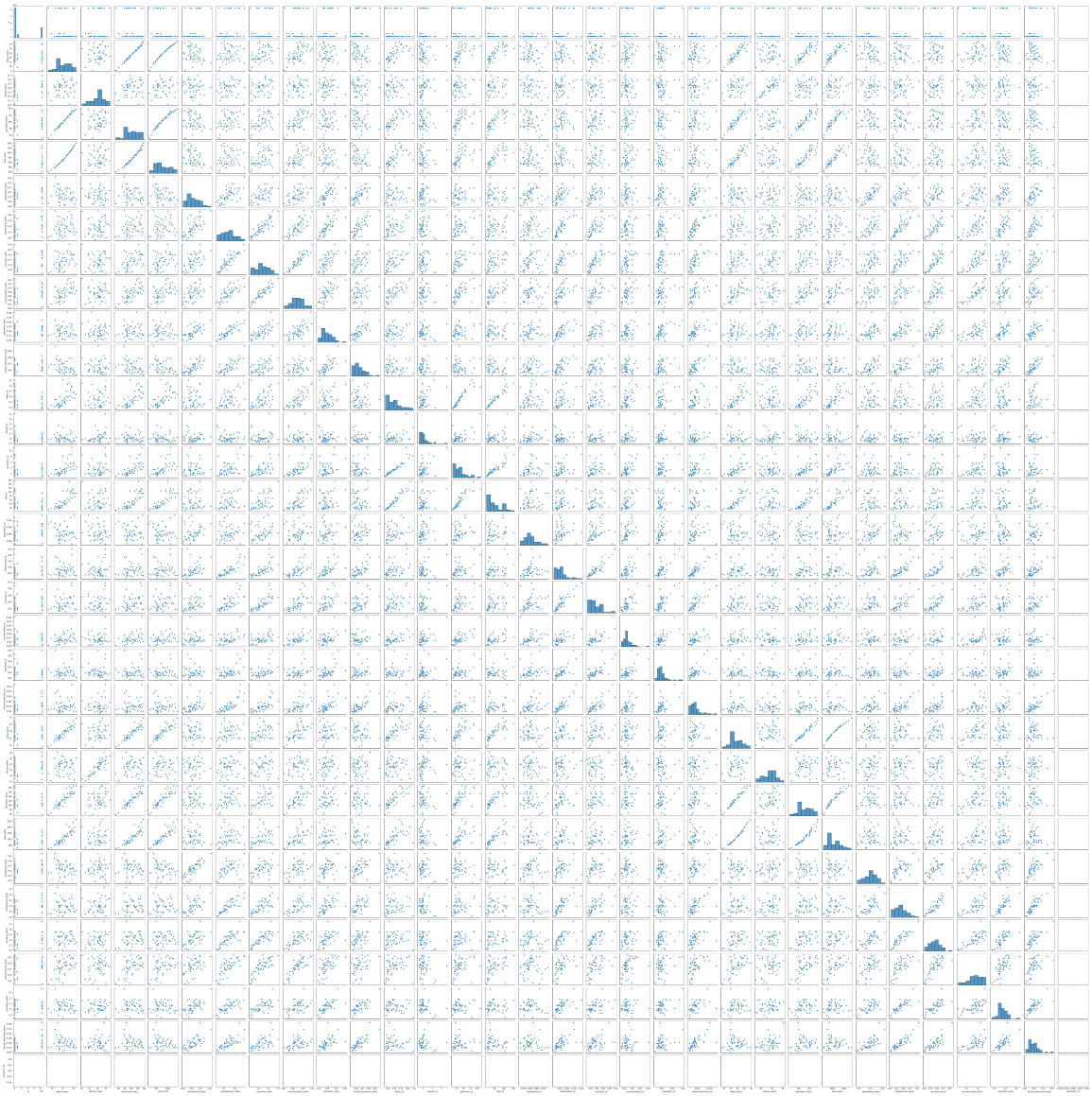
```
Index(['id', 'diagnosis', 'radius_mean', 'texture_mean', 'perimeter_mean',
       'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mea
n',
       'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
       'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_s
e',
       'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_s
e',
       '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')
```

In [7]:

```
sns.pairplot(df)
```

Out[7]:

```
<seaborn.axisgrid.PairGrid at 0x22e9da364c0>
```



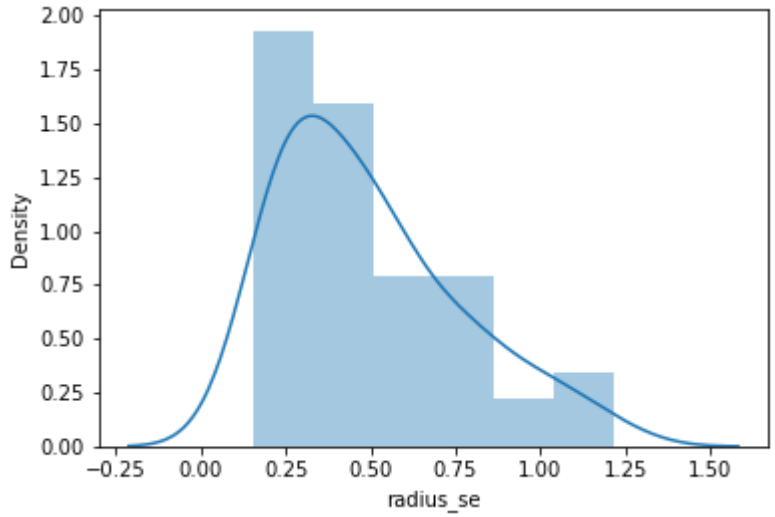
In [8]:

```
sns.distplot(df['radius_se'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2557:
FutureWarning: `distplot` is a deprecated function and will be removed in
a future version. Please adapt your code to use either `displot` (a figure
-level function with similar flexibility) or `histplot` (an axes-level fun
ction for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[8]:

```
<AxesSubplot:xlabel='radius_se', ylabel='Density'>
```

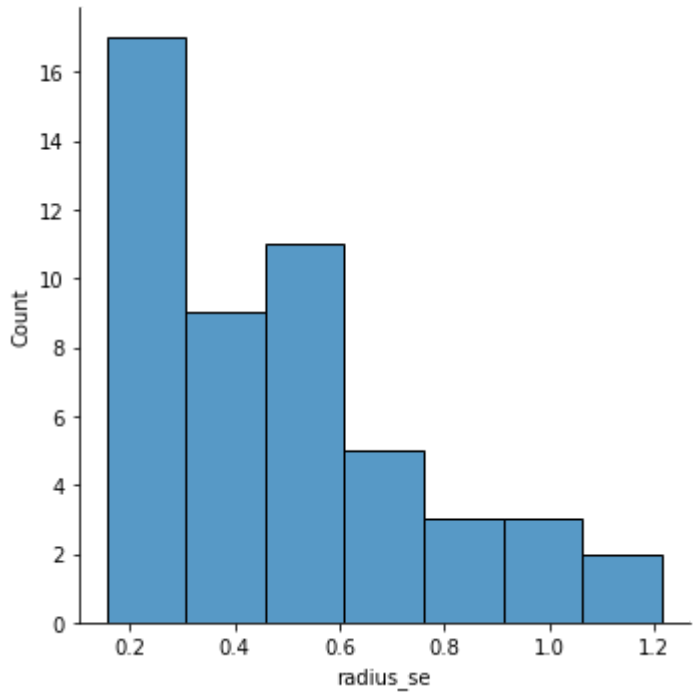



In [9]:

```
sns.displot(df["radius_se"])
```

Out[9]:

```
<seaborn.axisgrid.FacetGrid at 0x22ec288bee0>
```



In [10]:

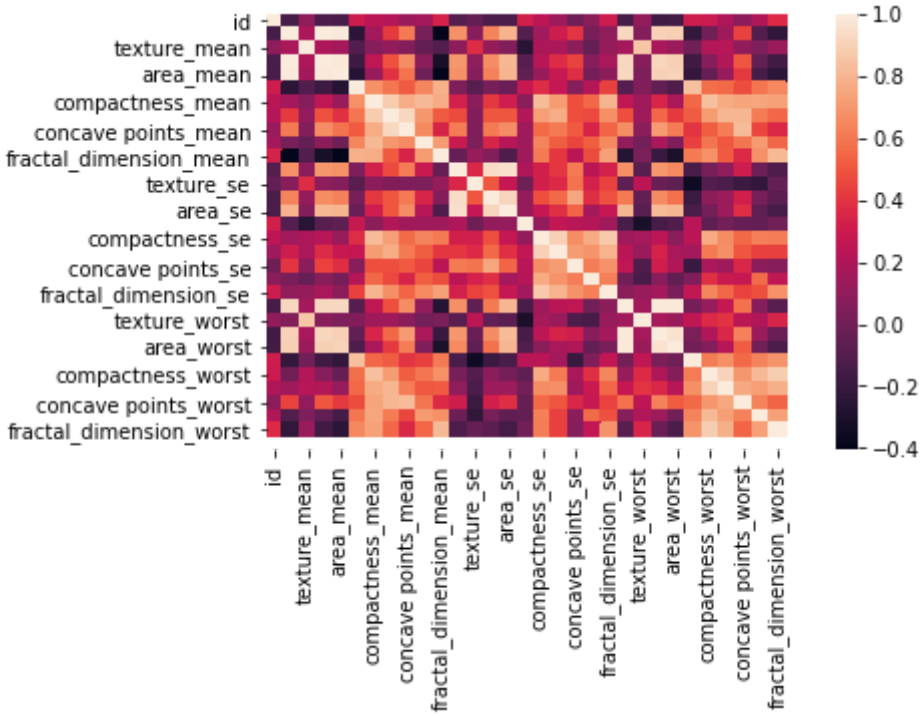
```
df1=df[['id', 'diagnosis', 'radius_mean', 'texture_mean', 'perimeter_mean',
       'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean',
       'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
       'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
       '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']]
```

In [11]:

```
sns.heatmap(df1.corr())
```

Out[11]:

```
<AxesSubplot:>
```



In [12]:

```
df2=df.dropna(axis=1)
df2
```

Out[12]:

| | id | diagnosis | radius_mean | texture_mean | perimeter_mean | area_mean | smoothnes |
|---|---|---|---|---|---|---|---|
| **0** | 842302 | M | 17.990 | 10.38 | 122.80 | 1001.0 | |
| **1** | 842517 | M | 20.570 | 17.77 | 132.90 | 1326.0 | |
| **2** | 84300903 | M | 19.690 | 21.25 | 130.00 | 1203.0 | |
| **3** | 84348301 | M | 11.420 | 20.38 | 77.58 | 386.1 | |
| **4** | 84358402 | M | 20.290 | 14.34 | 135.10 | 1297.0 | |
| **5** | 843786 | M | 12.450 | 15.70 | 82.57 | 477.1 | |
| **6** | 844359 | M | 18.250 | 19.98 | 119.60 | 1040.0 | |
| **7** | 84458202 | M | 13.710 | 20.83 | 90.20 | 577.9 | |
| **8** | 844981 | M | 13.000 | 21.82 | 87.50 | 519.8 | |
| **9** | 84501001 | M | 12.460 | 24.04 | 83.97 | 475.9 | |
| **10** | 845636 | M | 16.020 | 23.24 | 102.70 | 797.8 | |
| **11** | 84610002 | M | 15.780 | 17.89 | 103.60 | 781.0 | |
| **12** | 846226 | M | 19.170 | 24.80 | 132.40 | 1123.0 | |
| **13** | 846381 | M | 15.850 | 23.95 | 103.70 | 782.7 | |
| **14** | 84667401 | M | 13.730 | 22.61 | 93.60 | 578.3 | |
| **15** | 84799002 | M | 14.540 | 27.54 | 96.73 | 658.8 | |
| **16** | 848406 | M | 14.680 | 20.13 | 94.74 | 684.5 | |
| **17** | 84862001 | M | 16.130 | 20.68 | 108.10 | 798.8 | |
| **18** | 849014 | M | 19.810 | 22.15 | 130.00 | 1260.0 | |
| **19** | 8510426 | B | 13.540 | 14.36 | 87.46 | 566.3 | |
| **20** | 8510653 | B | 13.080 | 15.71 | 85.63 | 520.0 | |
| **21** | 8510824 | B | 9.504 | 12.44 | 60.34 | 273.9 | |
| **22** | 8511133 | M | 15.340 | 14.26 | 102.50 | 704.4 | |
| **23** | 851509 | M | 21.160 | 23.04 | 137.20 | 1404.0 | |
| **24** | 852552 | M | 16.650 | 21.38 | 110.00 | 904.6 | |
| **25** | 852631 | M | 17.140 | 16.40 | 116.00 | 912.7 | |
| **26** | 852763 | M | 14.580 | 21.53 | 97.41 | 644.8 | |
| **27** | 852781 | M | 18.610 | 20.25 | 122.10 | 1094.0 | |
| **28** | 852973 | M | 15.300 | 25.27 | 102.40 | 732.4 | |
| **29** | 853201 | M | 17.570 | 15.05 | 115.00 | 955.1 | |
| **30** | 853401 | M | 18.630 | 25.11 | 124.80 | 1088.0 | |
| **31** | 853612 | M | 11.840 | 18.70 | 77.93 | 440.6 | |
| **32** | 85382601 | M | 17.020 | 23.98 | 112.80 | 899.3 | |
| **33** | 854002 | M | 19.270 | 26.47 | 127.90 | 1162.0 | |
| **34** | 854039 | M | 16.130 | 17.88 | 107.00 | 807.2 | |
| **35** | 854253 | M | 16.740 | 21.59 | 110.10 | 869.5 | |

| | id | diagnosis | radius_mean | texture_mean | perimeter_mean | area_mean | smoothnes |
|---|---|---|---|---|---|---|---|
| **36** | 854268 | M | 14.250 | 21.72 | 93.63 | 633.0 | |
| **37** | 854941 | B | 13.030 | 18.42 | 82.61 | 523.8 | |
| **38** | 855133 | M | 14.990 | 25.20 | 95.54 | 698.8 | |
| **39** | 855138 | M | 13.480 | 20.82 | 88.40 | 559.2 | |
| **40** | 855167 | M | 13.440 | 21.58 | 86.18 | 563.0 | |
| **41** | 855563 | M | 10.950 | 21.35 | 71.90 | 371.1 | |
| **42** | 855625 | M | 19.070 | 24.81 | 128.30 | 1104.0 | |
| **43** | 856106 | M | 13.280 | 20.28 | 87.32 | 545.2 | |
| **44** | 85638502 | M | 13.170 | 21.81 | 85.42 | 531.5 | |
| **45** | 857010 | M | 18.650 | 17.60 | 123.70 | 1076.0 | |
| **46** | 85713702 | B | 8.196 | 16.84 | 51.71 | 201.9 | |
| **47** | 85715 | M | 13.170 | 18.66 | 85.98 | 534.6 | |
| **48** | 857155 | B | 12.050 | 14.63 | 78.04 | 449.3 | |
| **49** | 857156 | B | 13.490 | 22.30 | 86.91 | 561.0 | |

50 rows × 32 columns

In [13]:

```
x=df2[['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', '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']]
y=df2[['area_se']]
```

In [14]:

```
from sklearn.model_selection import train_test_split
```

In [15]:

```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3)
```

In [16]:

```
from sklearn.linear_model import LinearRegression

lr=LinearRegression()
lr.fit(x_train,y_train)#ValueError: Input contains NaN, infinity or a value too large for
```

Out[16]:

```
LinearRegression()
```

In [17]:

```
print(lr.intercept_)
```

```
[-38.7765838]
```

In [18]:

```
coef= pd.DataFrame(lr.coef_)
coef
```

Out[18]:

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **0** | 4.826039e-08 | 9.625415 | 0.123232 | -0.493058 | -0.048435 | 32.219881 | 46.955362 | 177.229164 | -11 |

1 rows × 30 columns

In [19]:

```
print(lr.score(x_test,y_test))
```

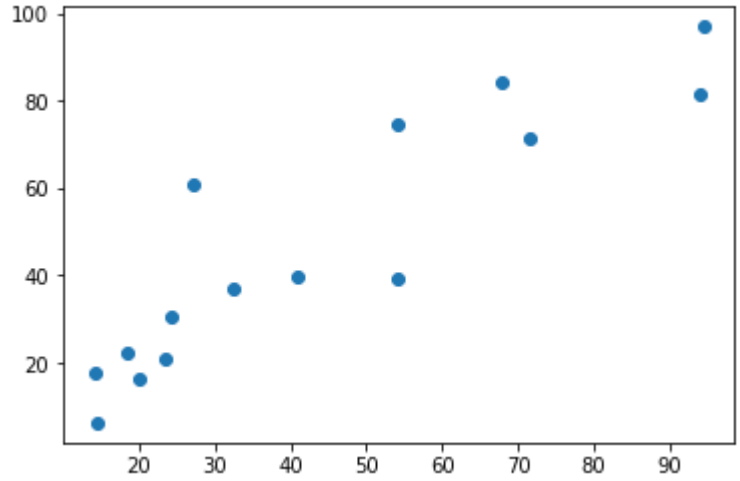
```
0.7765218813971904
```

In [20]:

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

Out[20]:

```
<matplotlib.collections.PathCollection at 0x22ece512b50>
```




In [21]:

```
lr.score(x_test,y_test)
```

Out[21]:

```
0.7765218813971904
```

In [22]:

```
lr.score(x_train,y_train)
```

Out[22]:

```
0.9991339207457316
```

In [23]:

```
from sklearn.linear_model import Ridge,Lasso
```

In [24]:

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

Out[24]:

```
Ridge(alpha=10)
```

In [25]:

```
rr.score(x_test,y_test)
```

Out[25]:

```
0.9562763906017642
```

In [26]:

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

Out[26]:

```
Lasso(alpha=10)
```

In [27]:

```
la.score(x_test,y_test)
```

Out[27]:

```
0.9594626274133204
```

# Elastic Net

In [28]:

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

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\linear_model\_coordinat
e_descent.py:530: ConvergenceWarning: Objective did not converge. You migh
t want to increase the number of iterations. Duality gap: 2108.64976245704
1, tolerance: 5.050654914714285
  model = cd_fast.enet_coordinate_descent(
```

Out[28]:

```
ElasticNet()
```

In [29]:

```
print(en.coef_)
```

```
[ 1.67281462e-08  0.00000000e+00  3.52823557e-01  4.96957957e-01
 -4.27654096e-02  0.00000000e+00  0.00000000e+00  0.00000000e+00
  0.00000000e+00  0.00000000e+00  0.00000000e+00  1.02926027e+00
  6.19271358e-01  9.58665424e+00  0.00000000e+00 -0.00000000e+00
  0.00000000e+00 -0.00000000e+00 -0.00000000e+00 -0.00000000e+00
 -0.00000000e+00 -9.00939144e-01 -3.12157565e-01  5.26746133e-02
  0.00000000e+00 -0.00000000e+00  0.00000000e+00 -0.00000000e+00
 -0.00000000e+00 -0.00000000e+00]
```

In [30]:

```
print(en.intercept_)
```

```
[-3.8574205]
```

In [31]:

```
prediction=en.predict(x_test)
print(prediction)
```

```
[33.28734388 20.81217309 16.00488779 27.21629652 62.84965842 41.29415137
 30.08085788 20.97952792 60.81839647 82.83346448 88.11441009 36.20386307
 18.17300227 58.48957198 76.36046717]
```

In [32]:

```
print(en.score(x_test,y_test))
```

```
0.9573828879436148
```

# Evaluation Metrics

In [33]:

```
from sklearn import metrics
```

In [34]:

```
print("Mean Absolute Error:",metrics.mean_absolute_error(y_test,prediction))
```

```
Mean Absolute Error: 4.674466791157979
```

In [35]:

```
print("Mean Squared Error:",metrics.mean_squared_error(y_test,prediction))
```

```
Mean Squared Error: 30.593345912549655
```

In [36]:

```
print("Root Mean Squared Error:",np.sqrt(metrics.mean_squared_error(y_test,prediction)))
```

```
Root Mean Squared Error: 5.531125194076668
```