#### Project: Predicing Breast-Cancer using Linear Regression

#### **Problem Statement:**

The goal is to predict whether a breast cancer diagnosis is benign or malignant based on the given attributes in the dataset etc:using Linear Regression.

# Data Collection: Use the Kaggle Breast-Cancer dataset, Download it from Kaggle.

https://www.kaggle.com/datasets/yasserh/breast-cancer-dataset

#### (Data Wrangling and Cleaning)

<pre>import pandas as data = pd.read_c cancer.csv")</pre>			e\Downloads\arch	nive\breast-
data				
id di area mean \	agnosis rad	dius_mean tex	ture_mean peri	meter_mean
0 842302 1001.0	М	17.99	10.38	122.80
1 842517 1326.0	М	20.57	17.77	132.90
2 84300903 1203.0	М	19.69	21.25	130.00
3 84348301 386.1	М	11.42	20.38	77.58
4 84358402 1297.0	M	20.29	14.34	135.10
564 926424 1479.0	М	21.56	22.39	142.00
565 926682 1261.0	M	20.13	28.25	131.20
566 926954 858.1	М	16.60	28.08	108.30
567 927241 1265.0	М	20.60	29.33	140.10
568 92751 181.0	В	7.76	24.54	47.92
<pre>smoothness_ points mean \</pre>	mean compa	ctness_mean c	concavity_mean	concave
	1840	0.27760	0.30010	

0.14	710				
1	017	0.08474	0.07864	0.08690	
0.070	017	0 10060	0 15000	0 10740	
2 0.12	700	0.10960	0.15990	0.19740	
3	790	0.14250	0.28390	0.24140	
0.10	520	0114250	0.20330	0124140	
4		0.10030	0.13280	0.19800	
0.104	430				
		0 11100	0 11500	0.04000	
564	000	0.11100	0.11590	0.24390	
0.138 565	890	0.09780	0.10340	0.14400	
0.09	791	0.09760	0.10340	0.14400	
566	7 3 1	0.08455	0.10230	0.09251	
0.053	302	0.00.55	0.10250	0.00251	
567		0.11780	0.27700	0.35140	
0.152	200				
568		0.05263	0.04362	0.00000	
0.000	000				
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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
	cmoothn	acc varet con	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	concovity vonet	. \
O	SIIIOO LIIII	ess_worst com 0.16220	npactness_worst 0.66560	concavity_worst 0.7119	
0 1 2 3		0.12380	0.18660	0.2416	
7		0.14440	0.42450	0.4504	
2		0.20980	0.86630	0.6869	
4		0.13740	0.20500	0.4000	
			0.20300		
564		0.14100	0.21130	0.4107	
565		0.11660	0.19220	0.3215	
566		0.11390	0.30940	0.3403	3
567		0.16500	0.86810	0.9387	,
568		0.08996	0.06444	0.0000	
	concave	points_worst	symmetry_worst	fractal_dimens	_
0		0.2654	0.4601		0.11890

1		. 1860	0.2750		0.08902	
2 3		. 2430	0.3613		0.08758	
4		. 2575 . 1625	0.6638 0.2364		0.17300 0.07678	
4	9		0.2304		0.07076	
564	0	 .2216	0.2060		0.07115	
565		. 1628	0.2572		0.06637	
566		. 1418	0.2218		0.07820	
567	0	. 2650	0.4087		0.12400	
568	0	. 0000	0.2871		0.07039	
[569 rows	x 32 column	ns]				
data.head(	)					
		s radius_mea	an textur	re_mean per	imeter_mean	
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0 84230	2 ľ	17.9	99	10.38	122.80	
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2 8430090	3 1	19.6	69	21.25	130.00	
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3 8434830	1	11.4	12	20.38	77.58	
386.1						
4 8435840	2 N	1 20.2	29	14.34	135.10	
1297.0						
smoothn	ess mean o	compactness m	nean conc	ravity mean	concave	
points mea		compactificas_ii	ican conc	cavicy_mean	Concave	
0	0.11840	0.27	7760	0.3001		
0.14710						
1	0.08474	0.07	7864	0.0869		
0.07017						
2	0.10960	0.15	5990	0.1974		
0.12790 3	0.14250	0.28	200	0.2414		
0.10520	0.14230	0.20	5390	0.2414		
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0.10430	0.10000	0.20	,	0.1500		
	dius_worst	texture_wor		meter_worst	area_worst \	\
0 1 2 3	25.38	17.		184.60	2019.0	
1	24.99	23.		158.80	1956.0	
2	23.57	25.		152.50	1709.0	
4	14.91 22.54	26 . 16 .		98.87 152.20	567.7 1575.0	
7	22.34	10.	07	132.20	13/3.0	
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points_wor	st \			_		

0	0.1622	0.6656	0.7119	
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0.1860 2	0.1444	0.4245	0.4504	
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0.1625				
symmetry 0 1 2 3	y_worst frac 0.4601 0.2750 0.3613 0.6638 0.2364	tal_dimension_wo 0.11 0.08 0.08 0.17 0.07	890 902 758 300	
[5 rows x 3	32 columns]			
data.tail(	)			
		radius_mean tex	ture_mean perim	eter_mean
area_mean 564 92642		21.56	22.39	142.00
1479.0 565 926683	2 M	20.13	28.25	131.20
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858.1 567 92724	1 M	20.60	29.33	140.10
1265.0 568 9275 181.0	1 B	7.76	24.54	47.92
	hness_mean c	ompactnoss moan	concavity mean	concavo
points_mean	n \ _	· <u>-</u>	· <del>-</del>	concave
564 0.13890	0.11100	0.11590	0.24390	
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 0.00000	0.05263	0.04362	0.00000	
564	radius_worst 25.450	texture_worst 26.40	perimeter_worst 166.10	area_worst \ 2027.0

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                                  38.25
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                23.690
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566
                18.980
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567
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                                                               1821.0
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                                                    59.16
                                                                268.6
568
                        compactness worst
     smoothness worst
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              0.14100
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                                             fractal dimension worst
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                                     0.2060
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                                     0.4087
                                                              0.12400
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                    0.0000
                                     0.2871
                                                              0.07039
[5 rows x 32 columns]
data.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 32 columns):
     Column
#
                                Non-Null Count
                                                 Dtype
     -----
                                -----
0
     id
                                569 non-null
                                                 int64
1
                                                 object
     diagnosis
                               569 non-null
 2
     radius mean
                               569 non-null
                                                 float64
 3
                               569 non-null
                                                 float64
     texture mean
 4
     perimeter mean
                               569 non-null
                                                float64
5
     area mean
                               569 non-null
                                                float64
 6
     smoothness mean
                               569 non-null
                                                 float64
 7
                                                 float64
                               569 non-null
     compactness mean
 8
                                                 float64
     concavity mean
                               569 non-null
 9
     concave points mean
                                                float64
                               569 non-null
 10
     symmetry mean
                               569 non-null
                                                float64
 11
     fractal dimension mean
                               569 non-null
                                                 float64
                                                float64
 12
     radius se
                               569 non-null
 13
                                                float64
     texture se
                               569 non-null
 14
                                                float64
                                569 non-null
     perimeter se
 15
                               569 non-null
                                                float64
     area se
 16
     smoothness se
                                569 non-null
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 17
                                                float64
     compactness se
                               569 non-null
 18
     concavity_se
                               569 non-null
                                                float64
19
                                                float64
     concave points_se
                               569 non-null
                                                float64
 20
                               569 non-null
     symmetry se
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     fractal dimension se
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<pre>22 radius_worst 23 texture_worst 24 perimeter_worst 25 area_worst 26 smoothness_worst 27 compactness wors</pre>	569 569 569 t 569	non-null f non-null f non-null f non-null f	loat64 loat64 loat64 loat64 loat64 loat64
28 concavity_worst 29 concave points_v 30 symmetry_worst 31 fractal_dimension dtypes: float64(30), memory usage: 142.4+	569 worst 569 569 on_worst 569 int64(1), ob	non-null f non-null f non-null f non-null f	loat64 loat64 loat64 loat64
data.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+07 654.889104	14.127292	19.289649	91.969033
std 1.250206e+08 351.914129	3.524049	4.301036	24.298981
min 9 6700000102	6 001000	0 710000	42 700000

area_mean	\				
count 5.0	590000e+02	569.000000	569.000000	569.000000	
569.000000					
mean 3.0	937183e+07	14.127292	19.289649	91.969033	
654.889104	4				
std 1.2	250206e+08	3.524049	4.301036	24.298981	
351.914129	9				
min 8.0	570000e+03	6.981000	9.710000	43.790000	
143.500000	9				
25% 8.6	592180e+05	11.700000	16.170000	75.170000	
420.30000	9				
50% 9.0	960240e+05	13.370000	18.840000	86.240000	
551.100000	9				
75% 8.8	313129e+06	15.780000	21.800000	104.100000	
782.700000	9				
max 9.3	113205e+08	28.110000	39.280000	188.500000	
2501.00000	90				

	_	compactness_mean	concavity_mean	concave
<pre>points_mean</pre>				
count	569.000000	569.000000	569.000000	
569.000000	0.006360	0 104241	0 000700	
mean 0.048919	0.096360	0.104341	0.088799	
std	0.014064	0.052813	0.079720	
0.038803	0.014004	0.032013	0.075720	
min	0.052630	0.019380	0.00000	
0.000000				
25%	0.086370	0.064920	0.029560	
0.020310				
50%	0.095870	0.092630	0.061540	
0.033500	0 105200	0 120400	0 120700	
75%	0.105300	0.130400	0.130700	
0.074000				

max 0.201200	0.163400	0.34	5400 0.4	26800
perimeter_w	orst \	radius_wo	_	
count 5	69.000000 .	569.000	569.000	000
mean 107.261213	0.181162 .	16.269	25.677	223
std 33.602542	0.027414 .	4.833	6.146	258
min	0.106000 .	7.930	12.020	000
50.410000 25%	0.161900 .	13.016	0000 21.080	000
84.110000 50%	0.179200 .	14.976	0000 25.410	000
97.660000 75%	0.195700 .	18.790	0000 29.720	000
125.400000				
max 251.200000	0.304000 .	36.046	1000 49.540	900
are	a_worst smo	othness_worst	compactness_w	orst
concavity_w count 569 569.000000	orst \ .000000	569.00000	569.00	0000
mean 880	.583128	0.132369	0.25	4265
	.356993	0.022832	0.15	7336
0.208624 min 185	.200000	0.071176	0.02	7290
0.000000 25% 515	.300000	0.116600	0.14	7200
0.114500	.500000	0.131306		
0.226700		0.25250	V. ==	
75% 1084 0.382900	.000000	0.146000	0.33	9100
max 4254 1.252000	.000000	0.222600	1.05	8000
	ave points_w	_		l_dimension_worst
count mean	569.00 0.11		0.000000 0.290076	569.000000 0.083946
std min	0.06 0.00		0.061867 0.156500	0.018061 0.055040
25%	0.06	4930 6	.250400	0.071460
50% 75%	0.16	1400 6	).282200 ).317900	0.080040 0.092080
max	0.29	1000	0.663800	0.207500

```
[8 rows x 31 columns]
data.ndim
2
data.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')
```

### Handling Missing Data

data	a.isnull	()			
	id	diagnosis	radius_mean	texture_mean	perimeter_mean
area	a_mean	\	_	_	<del>_</del>
	False	False	False	False	False
Fals					
	False	False	False	False	False
Fals					
	False	False	False	False	False
Fals		- 1	F 1		- 1
	False	False	False	False	False
Fals		Гајаа	F-1	Галаа	Falaa
4 Fals	False	False	False	False	False
	False	False	False	False	False
Fals					
-	False	False	False	False	False
Fals	se				
566	False	False	False	False	False
Fals	se				
567	False	False	False	False	False

False				
568 False	False	False	False	False
False				
cmoothnoo	s moon s	ampastnoss moan	concavity moan	concavo
points mean \	_	Jilipac triess_illean	concavity_mean	concave
0	False	False	False	
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1	False	False	False	
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2	False	False	False	
False				
3	False	False	False	
False				
4	False	False	False	
False				
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564	False	False	False	
False		1 4 1 3 0	14150	
565	False	False	False	
False				
566	False	False	False	
False	E-1	E-1	F.1	
567 False	False	False	False	
568	False	False	False	
False	1 4 6 5 6	ratsc	racsc	
radi	.us_worst	texture_worst	perimeter_worst	
0	False	False	False	False
1	False	False	False	
2	False	False	False	
	False	False	False	False
4	False	False	False	False
564	False	 False	 False	 False
565	False	False	False	False
566	False	False	False	False
567	False	False	False	False
568	False	False	False	False
smoothnes		compactness_wors		
0	False	Fals		
1	False	Fals		
2	False	Fals		
1 2 3 4	False	Fals		
	False	Fals		
564	False	 Fals		
JU-	1 4 6 3 6	1013	1 0 1	30

565	False	False	False
566	False	False	False
567	False	False	False
568	False	False	False
0	concave points_worst	symmetry_worst	fractal_dimension_worst False False False False False False False
1	False	False	
2	False	False	
3	False	False	
4	False	False	
564	False	False	False
565	False	False	False
566	False	False	False
567	False	False	False
568	False	False	False
_	<pre>rows x 32 columns] isnull().sum()</pre>		
id diagn radiu textu perim area_ smoot conca symme fract radiu perim area_ smoot compa conca symme fract radiu perim area_ smoot conca symme fract radiu perim area_ smoot	nosis is_mean ire_mean meter_mean ichness_mean ictness_mean ivity_mean ive points_mean itry_mean itry_mean is_se ire_se meter_se	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	

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concavity_worst
                            0
concave points worst
                            0
symmetry_worst
                            0
fractal dimension_worst
dtype: int64
data.duplicated()
0
       False
1
       False
2
       False
3
       False
4
       False
564
       False
565
       False
566
       False
567
       False
       False
568
Length: 569, dtype: bool
data.duplicated().sum()
0
data.fillna(data.mean(), inplace=True)
data
           id diagnosis radius mean texture mean perimeter mean
area_mean \
       842302
                                17.99
                                               10.38
                                                              122.80
1001.0
       842517
                                20.57
                                               17.77
                                                              132.90
1326.0
                                               21.25
     84300903
                                19.69
                                                              130.00
1203.0
                                11.42
                                               20.38
                                                               77.58
     84348301
386.1
     84358402
                                20.29
                                               14.34
                                                              135.10
1297.0
. . .
                                21.56
                                               22.39
564
       926424
                                                              142.00
1479.0
       926682
                                20.13
                                               28.25
                                                              131.20
565
1261.0
       926954
                                16.60
                                               28.08
                                                              108.30
566
858.1
       927241
                                20.60
                                               29.33
                                                              140.10
567
1265.0
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568 927 181.0	51	B 7.76	24.54	47.92
smooth points_mean 0 0.14710	_	compactness_mean 0.27760	concavity_mean 0.30010	concave
1 0.07017	0.08474	0.07864	0.08690	
0.07017 2 0.12790	0.10960	0.15990	0.19740	
3 0.10520	0.14250	0.28390	0.24140	
4 0.10430	0.10030	0.13280	0.19800	
564 0.13890	0.11100	0.11590	0.24390	
565 0.09791	0.09780	0.10340	0.14400	
566 0.05302	0.08455	0.10230	0.09251	
567 0.15200	0.11780	0.27700	0.35140	
568 0.00000	0.05263	0.04362	0.00000	
0 1 2 3 4 564 565	adius_worst 25.380 24.990 23.570 14.910 22.540  25.450 23.690	-17.33 23.41 25.53 26.50 16.67  26.40 38.25	184.60 158.80 152.50 98.87 152.20  166.10 155.00	area_worst \ 2019.0 1956.0 1709.0 567.7 1575.0 2027.0 1731.0
566 567 568	18.980 25.740 9.456	34.12 39.42 30.37	126.70 184.60 59.16	1124.0 1821.0 268.6
0 1 2 3 4	ness_worst 0.16220 0.12380 0.14440 0.20980 0.13740	compactness_wors 0.6650 0.1860 0.4241 0.8663 0.2050	$     \begin{array}{ccccccccccccccccccccccccccccccccc$	.19 .16 .04 .69 
564 565	0.14100 0.11660	0.2113 0.1923		

566 567 568	0.11390 0.16500 0.08996	0.30940 0.86810 0.06444	0.3403 0.9387 0.0000
	0.0000	0.00	0.000
			fractal_dimension_worst
0	0.2654	0.4601	0.11890
1	0.1860	0.2750	0.08902
	0.2430	0.3613	0.08758
2 3 4	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]		

# Feature Engineering

ı ca	itule Lii	giricci	1119							
data	= pd.get	_dummies	(data,	drop_first=	=True	e)				
data										
0	id 842302		_mean 17.99	texture_mea 10.3		perimete	er_mea 122.8		rea_mean 1001.0	\
1 2 3	842517 84300903		20.57 19.69	17.7 21.2			132.9 130.0		1326.0 1203.0	
3 4	84348301 84358402		11.42 20.29	20.3 14.3			77.5 135.1		386.1 1297.0	
 564	926424		 21.56	22.3			142.0		1479.0	
565 566	926682 926954		20.13 16.60	28.2 28.0	98		131.2 108.3	0	1261.0 858.1	
567 568	927241 92751		20.60 7.76	29.3 24.5			140.1 47.9		1265.0 181.0	
	smoothne	ss_mean	compa	ctness_mean	COI	ncavity_	_mean	con	cave	
0		0.11840		0.27760		0.3	30010			
0.14		0.08474		0.07864		0.0	98690			
0.07		0.10960		0.15990		0.1	19740			
0.12		0.14250		0.28390		0.2	24140			
0.10		0.10030		0.13280		0.1	19800			
0.10	430									

 564	0 11100	0 11500	0.24200	
564 0.13890	0.11100	0.11590	0.24390	
565	0.09780	0.10340	0.14400	
0.09791				
566	0.08455	0.10230	0.09251	
0.05302	0 11700	0 27700	0.25140	
567 0.15200	0.11780	0.27700	0.35140	
568	0.05263	0.04362	0.00000	
0.00000				
0 Symme	etry_mean t 0.2419	exture_worst per 17.33	imeter_worst aı 184.60	rea_worst \ 2019.0
1	0.1812	23.41	158.80	1956.0
1 2 3	0.2069	25.53	152.50	1709.0
	0.2597	26.50	98.87	567.7
4	0.1809	16.67	152.20	1575.0
564	0.1726	26.40	166.10	2027.0
565	0.1752	38.25	155.00	1731.0
566	0.1590	34.12	126.70	1124.0
567	0.2397	39.42	184.60	1821.0
568	0.1587	30.37	59.16	268.6
smoot	thness worst com	pactness worst c	oncavity 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 0.20500	0.6869 0.4000	
	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	
conca	ave points_worst	symmetry_worst	fractal_dimension	on_worst \
0	$\overline{0}.2654$	$\overline{0}.4601$	_	0.11890
1	0.1860	0.2750		0.08902
2	0.2430 0.2575	0.3613 0.6638		0.08758 0.17300
0 1 2 3 4	0.2575	0.2364		0.07678
i.	0.1025	0.2501		
564	0.2216	0.2060		0.07115
565	0.1628	0.2572		0.06637
566 567	0.1418 0.2650	0.2218 0.4087		0.07820 0.12400
507	0.2030	0.400/		0.12400

568	0.0	000	0.2871		0.07039
diagnos 0 1 2 3 4  564 565 566 567 568	True True True True True True True True	]			
data.descri	be()				
area mean `		adius_mean	texture_mear	n perimeter_	_mean
_		569.000000	569.000000	569.00	90000
mean 3.03	7183e+07	14.127292	19.289649	91.96	59033
	9206e+08	3.524049	4.301036	5 24.29	98981
351.914129 min 8.670	9000e+03	6.981000	9.710000	) 43.79	90000
143.500000 25% 8.692	2180e+05	11.700000	16.170000	75.17	70000
420.300000 50% 9.060	9240e+05	13.370000	18.84000	86.24	40000
551.100000		15.780000			
782.700000	3129e+06		21.800000		
max 9.113 2501.000000	3205e+08	28.110000	39.280000	188.50	90000
	thness_mean	compactne	ss_mean cond	cavity_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	Θ	.019380	0.000000	
0.000000 25% 0.020310	0.086370		.064920	0.029560	

50%	0.095870	0.09	2630 0.00	51540
0.033500 75%	0.105300	0.13	0400 0.13	30700
0.074000 max	0.163400	A 34	5400 0.42	26800
0.201200	01105400	0.54	5400 0142	
symm	etry_mean .	radius wo	rst texture wo	rst
perimeter_w	orst \	_	_	
count 5	69.000000 .	569.000	000 569.000	900
mean	0.181162	16.269	190 25.6772	223
107.261213 std	0.027414	4.833	242 6.1462	258
33.602542	01027111	11055	212 01110	-50
min 50.410000	0.106000	7.930	000 12.020	900
25%	0.161900	13.010	000 21.080	900
84.110000	0 170200	14 070	000 25 410	200
50% 97.660000	0.179200 .	14.970	000 25.410	900
75%	0.195700 .	18.790	000 29.720	900
125.400000 max	0.304000 .	36.040	000 49.540	900
251.200000				
are	a_worst smo	othness_worst	compactness_w	orst
concavity_w count 569	orst \ .000000	569.000000	569.000	2000
569.000000	.000000	309.00000	309.000	9000
mean 880 0.272188	.583128	0.132369	0.25	1265
	. 356993	0.022832	0.15	7336
0.208624 min 185	. 200000	0.071170	0.02	7200
0.000000	. 200000	0.0/11/0	0.02	7290
25% 515 0.114500	.300000	0.116600	0.14	7200
50% 686	.500000	0.131300	0.21	1900
0.226700 75% 1084		0 146000	0.22	
750 1001	000000	0 146000	(1) 550	2100
0.382900	.000000	0.146000		9100
	. 000000	0.222600		
max 4254 1.252000	.000000 ave points_v 569.00 0.11 0.00	0.222600 worst symmetr 00000 569 14606 0	1.058	

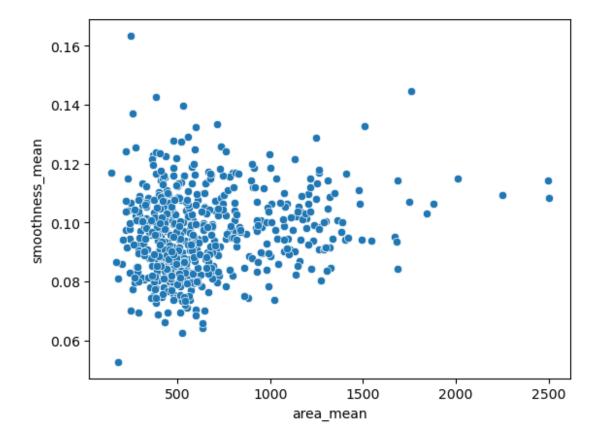
```
25%
                    0.064930
                                     0.250400
                                                               0.071460
                                                               0.080040
50%
                    0.099930
                                     0.282200
75%
                    0.161400
                                     0.317900
                                                               0.092080
                    0.291000
                                     0.663800
                                                               0.207500
max
[8 rows x 31 columns]
```

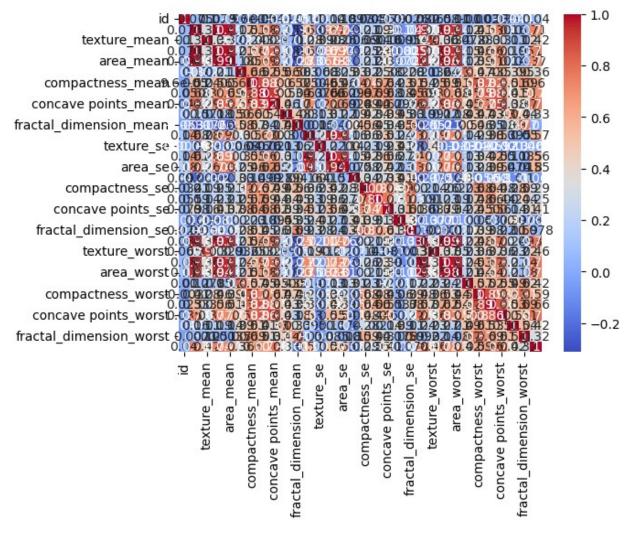
## Data Analysis and Visualization

```
import matplotlib.pyplot as plt
import seaborn as sns

sns.scatterplot(x='area_mean', y='smoothness_mean', data=data)
plt.show()

sns.heatmap(data.corr(), annot=True, cmap='coolwarm')
plt.show()
```





```
data.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 32 columns):
#
     Column
                               Non-Null Count
                                                Dtype
 0
     id
                               569 non-null
                                                int64
 1
                               569 non-null
                                                float64
     radius mean
 2
                                                float64
     texture mean
                               569 non-null
 3
                                                float64
     perimeter mean
                               569 non-null
 4
     area mean
                               569 non-null
                                                float64
 5
                                                float64
     smoothness mean
                               569 non-null
 6
     compactness mean
                               569 non-null
                                                float64
 7
                                                float64
     concavity mean
                               569 non-null
 8
     concave points mean
                               569 non-null
                                                float64
 9
     symmetry mean
                               569 non-null
                                                float64
     fractal dimension mean
                                                float64
 10
                               569 non-null
```

```
569 non-null
                                                                                                          float64
  11 radius se
                                                                     569 non-null
                                                                                                          float64
  12 texture se
  13 perimeter se
                                                                     569 non-null
                                                                                                          float64
                                                                 569 non-null
  14 area se
                                                                                                          float64
                                                                 569 non-null
                                                                                                          float64
  15 smoothness se
                                                              569 non-null
569 non-null
  16 compactness_se
 16 compactness_so
17 concavity_se 569 non-nutt
18 concave points_se 569 non-null
569 non-null
                                                                                                          float64
                                                                                                          float64
                                                                                                          float64
                                                                                                          float64
 20 fractal_dimension_se 569 non-null 21 radius_worst 569 non-null
                                                                                                          float64
  21 radius worst
                                                                                                          float64
                                                                     569 non-null
                                                                                                          float64
  22 texture worst
                                                          569 non-null
  23 perimeter_worst
                                                                                                          float64
  24 area worst
                                                                  569 non-null
                                                                                                          float64
 compactness_worst 569 non-null 
                                                                                                          float64
                                                                                                          float64
                                                                                                          float64
                                                                                                          float64
                                                                                                          float64
  30 fractal_dimension_worst 569 non-null
                                                                                                          float64
           diagnosis M
                                                                     569 non-null
                                                                                                          bool
  31
dtypes: bool(\overline{1}), float64(30), int64(1)
memory usage: 138.5 KB
import pandas as pd
import numpy as np
from sklearn.preprocessing import OneHotEncoder, LabelEncoder
file path = r"C:\Users\Kruthi Mule\Downloads\archive\breast-
cancer.csv"
data = pd.read csv(file path)
# Matrix
if len(data.select dtypes(include=[np.number]).columns) > 1:
         matrix = data.select dtypes(include=[np.number]).values
         matrix transpose = np.transpose(matrix)
         matrix product = np.dot(matrix, matrix transpose)
         print("\nMatrix product:\n", matrix_product)
Matrix product:
   [[7.09477812e+11 7.09659089e+11 7.10068239e+13 ... 7.80778382e+11
    7.81021958e+11 7.81250972e+10]
  [7.09659089e+11 7.09840530e+11 7.10249489e+13 ... 7.80977880e+11
    7.81221602e+11 7.81450784e+10]
  [7.10068239e+13 7.10249489e+13 7.10664225e+15 ... 7.81430622e+13
    7.81672583e+13 7.81899375e+12]
   [7.80778382e+11 7.80977880e+11 7.81430622e+13 ... 8.59245751e+11
    8.59512932e+11 8.59763833e+10]
```

```
[7.81021958e+11 7.81221602e+11 7.81672583e+13 ... 8.59512932e+11
  8.59780853e+11 8.60032697e+101
 [7.81250972e+10 7.81450784e+10 7.81899375e+12 ... 8.59763833e+10
  8.60032697e+10 8.60286075e+0911
# One-Hot Encoding
encoder = OneHotEncoder()
encoded data =
encoder.fit transform(data.select dtypes(include=[object])).toarray()
print("\n0ne-Hot Encoded data:\n", encoded_data)
One-Hot Encoded data:
 [[0. 1.]
 [0. 1.]
 [0. 1.]
 [0.1.]
 [0. 1.]
 [1. 0.]
# Label Encoding
label encoder = LabelEncoder()
for column in data.select dtypes(include=[object]).columns:
    data[column] = label encoder.fit transform(data[column])
print("\nLabel Encoded data:\n", data)
Label Encoded data:
            id diagnosis
                            radius mean texture mean
perimeter mean
       842302
                                  17.99
                                                 10.38
                                                                122.80
                                                 17.77
                                  20.57
1
       842517
                        1
                                                                132.90
2
                        1
                                                21.25
     84300903
                                  19.69
                                                                130.00
3
     84348301
                        1
                                  11.42
                                                 20.38
                                                                 77.58
4
                        1
                                  20.29
                                                 14.34
                                                                135.10
     84358402
564
       926424
                        1
                                  21.56
                                                 22.39
                                                                142.00
565
       926682
                        1
                                  20.13
                                                28.25
                                                                131.20
                        1
                                  16.60
                                                28.08
566
       926954
                                                                108.30
                        1
                                                29.33
567
       927241
                                  20.60
                                                                140.10
                                   7.76
                                                24.54
                                                                 47.92
568
        92751
                smoothness_mean
     area mean
                                   compactness mean
                                                      concavity_mean \
                                            0.\overline{2}7760
                                                             0.\overline{3}0010
                         0.11840
0
        1001.0
1
        1326.0
                         0.08474
                                            0.07864
                                                             0.08690
2
        1203.0
                         0.10960
                                            0.15990
                                                             0.19740
3
                         0.14250
                                            0.28390
                                                             0.24140
         386.1
4
        1297.0
                         0.10030
                                            0.13280
                                                             0.19800
```

564 565 566 567 568	1479.0 1261.0 858.1 1265.0 181.0	0 0 0	.11100 .09780 .08455 .11780 .05263	0. 0. 0.	11590 10340 10230 27700 04362	0 0 0	0.24390 0.14400 0.09251 0.35140 0.00000
	•	nts_mean	rad	ius_worst	texture_	_worst	
perimet 0	er_worst	\ 0.14710		25.380		17.33	
184.60 1		0.07017		24.990		23.41	
158.80							
2 152.50		0.12790		23.570		25.53	
3		0.10520		14.910		26.50	
98.87 4		0.10430		22.540		16.67	
152.20							
564 166.10		0.13890		25.450		26.40	
565		0.09791		23.690		38.25	
155.00 566		0.05302		18.980		34.12	
126.70							
567 184.60		0.15200		25.740		39.42	
568		0.00000		9.456		30.37	
59.16							
ar \	ea_worst	smoothne	ss_worst	compactne	ss_worst	conca	vity_worst
0	2019.0		0.16220		0.66560		0.7119
1	1956.0		0.12380		0.18660		0.2416
2	1709.0		0.14440		0.42450		0.4504
3	567.7		0.20980		0.86630		0.6869
4	1575.0		0.13740		0.20500		0.4000
564	2027.0		0.14100		0.21130		0.4107
565	1731.0		0.11660		0.19220		0.3215
566	1124.0		0.11390		0.30940		0.3403

```
0.86810
567
         1821.0
                           0.16500
                                                                  0.9387
568
          268.6
                           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
                                    0.2572
                    0.1628
                                                             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]
# mean
mean values = data.mean() # Mean calculation
# Display the results
print("Mean values:\n", mean values)
Mean values:
id
                             3.037183e+07
diagnosis
                            3.725835e-01
radius mean
                            1.412729e+01
texture mean
                            1.928965e+01
perimeter mean
                            9.196903e+01
area mean
                            6.548891e+02
smoothness mean
                            9.636028e-02
compactness mean
                            1.043410e-01
concavity mean
                            8.879932e-02
concave points mean
                            4.891915e-02
symmetry_mean
                            1.811619e-01
fractal_dimension_mean
                            6.279761e-02
                            4.051721e-01
radius se
texture_se
                            1.216853e+00
                            2.866059e+00
perimeter se
area se
                            4.033708e+01
smoothness se
                            7.040979e-03
compactness se
                            2.547814e-02
concavity se
                            3.189372e-02
concave points se
                            1.179614e-02
symmetry_se
                            2.054230e-02
fractal dimension se
                            3.794904e-03
```

```
radius worst
                           1.626919e+01
                           2.567722e+01
texture worst
perimeter_worst
                           1.072612e+02
area worst
                           8.805831e+02
smoothness worst
                           1.323686e-01
compactness worst
                           2.542650e-01
concavity worst
                           2.721885e-01
concave points worst
                         1.146062e-01
symmetry worst
                           2.900756e-01
fractal dimension worst 8.394582e-02
dtype: float64
# median
median values = data.median() # Median calculation
# Display the results
print("Median values:\n", median_values)
Median values:
id
                            906024.000000
diagnosis
                                0.000000
radius mean
                                13.370000
texture mean
                               18.840000
perimeter mean
                               86.240000
                              551.100000
area mean
smoothness mean
                                0.095870
compactness mean
                                0.092630
concavity_mean
                                0.061540
concave points mean
                                0.033500
symmetry_mean
                                0.179200
fractal dimension mean
                                0.061540
radius se
                                0.324200
                                1.108000
texture se
perimeter se
                                2.287000
area se
                               24.530000
smoothness se
                                0.006380
compactness se
                                0.020450
concavity se
                                0.025890
concave points se
                                0.010930
                                0.018730
symmetry_se
fractal dimension se
                                0.003187
radius worst
                               14.970000
texture worst
                               25.410000
perimeter worst
                               97.660000
area worst
                              686.500000
smoothness_worst
                                0.131300
compactness worst
                                0.211900
concavity worst
                                0.226700
concave points worst
                                0.099930
symmetry worst
                                0.282200
```

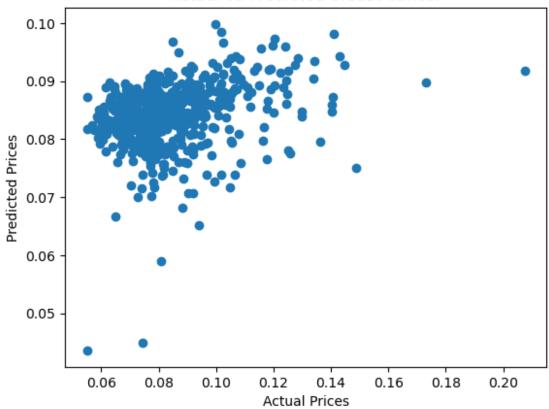
```
0.080040
fractal dimension worst
dtype: float64
# mode
mode values = data.mode().iloc[0] # Mode can have multiple values;
picks the first row
# Display the results
print("Mode values:\n", mode values)
Mode values:
id
                            8670.000000
diagnosis
                              0.000000
radius mean
                             12.340000
                             14.930000
texture mean
perimeter_mean
                             82.610000
                            512.200000
area mean
                              0.100700
smoothness mean
compactness mean
                              0.114700
concavity mean
                              0.000000
concave points mean
                              0.000000
symmetry_mean
                              0.160100
fractal dimension mean
                              0.056670
                              0.220400
radius se
texture se
                              0.856100
perimeter_se
                              1.778000
                             16.640000
area se
smoothness_se
                              0.005080
compactness se
                              0.011040
concavity_se
                              0.000000
concave points_se
                              0.000000
symmetry se
                              0.013440
fractal dimension se
                              0.001784
radius worst
                             12.360000
                             17.700000
texture worst
                            101.700000
perimeter worst
area worst
                            284.400000
smoothness worst
                              0.121600
compactness worst
                              0.148600
concavity worst
                              0.000000
concave points worst
                              0.000000
symmetry_worst
                              0.222600
fractal dimension worst
                              0.074270
Name: 0, dtype: float64
```

#### **Linear Regression**

```
from sklearn.linear_model import LinearRegression
x = data[['texture_mean', 'perimeter_mean', 'area_mean']]
```

```
y = data['fractal dimension worst']
model = LinearRegression()
model.fit(x, y)
print(f'Intercept: {model.intercept_}')
print(f'Coefficients: {model.coef_}')
Intercept: 0.015935031786171824
Coefficients: [ 4.49897191e-04 1.27454699e-03 -8.83911909e-05]
predicted prices = model.predict(x)
comparison = pd.DataFrame({'Actual': y, 'Predicted':
predicted prices})
print(comparison.head())
   Actual Predicted
0 0.11890 0.088640
1 0.08902 0.076110
2 0.08758 0.084852
3 0.17300 0.089855
4 0.07678 0.079934
plt.scatter(y, predicted prices)
plt.xlabel('Actual Prices')
plt.ylabel('Predicted Prices')
plt.title('Actual vs Predicted breast-cancer')
plt.show()
```





## **Data Visulization**

import numpy as np

import pandas as pd

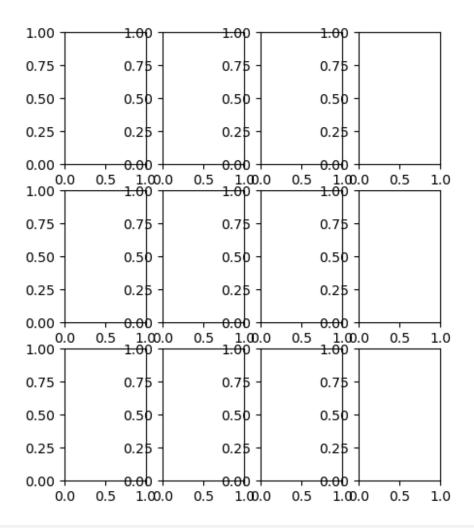
df=pd.read\_csv(r"C:\Users\Kruthi Mule\Downloads\archive\breastcancer.csv")

df

a i					
	i	d diagnosis	radius_mean	texture_mean	perimeter_mean
area	_mean \				
0	84230	2 M	17.99	10.38	122.80
1001	0				
1	84251	7 M	20.57	17.77	132.90
1326	5.0				
2	8430090	3 M	19.69	21.25	130.00
1203	3.0				
3	8434830	1 M	11.42	20.38	77.58
386.	1				
4	8435840	2 M	20.29	14.34	135.10
1297	'. 0				

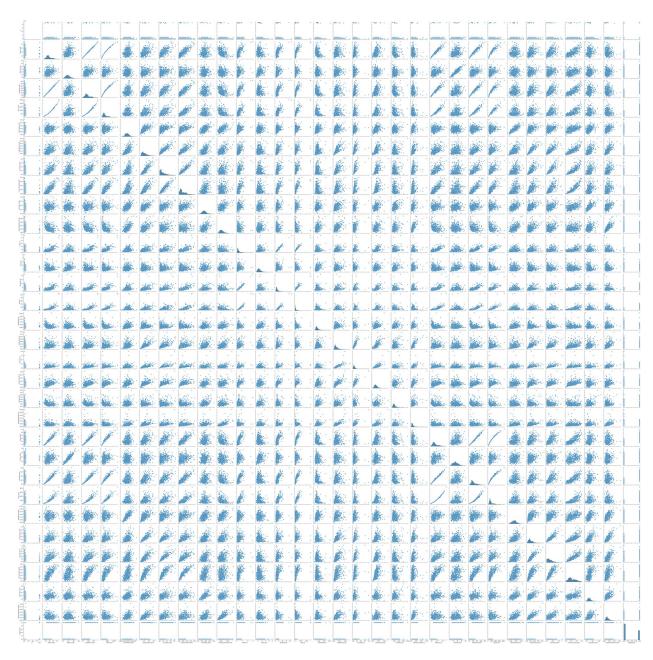
 564	926424	1	М	21.56	22.39	142.00	
1479.0	32042	7			22.39		
565 1261.0	926682	2	М	20.13	28.25	131.20	
566	926954	4	М	16.60	28.08	108.30	
858.1 567	92724	1	М	20.60	29.33	140.10	
1265.0 568	9275	1	В	7.76	24.54	47.92	
181.0	0_70	_	_			.,	
cr	noothna	ess mean	compactn	acc maan	concavity mean	concave	
points		\ \	Compactin	ess_illeali	concavity_mean	Concave	
0	_	0.11840		0.27760	0.30010		
0.14710 1		0.08474		0.07864	0.08690		
0.07017 2	7	0.10960		0.15990	0.19740		
0.12790 3	9	0 14250		0 20200	0 24140		
0.10520	9	0.14250		0.28390	0.24140		
4		0.10030		0.13280	0.19800		
0.10430	9						
564 0.13890	3	0.11100		0.11590	0.24390		
565	9	0.09780		0.10340	0.14400		
0.09793	1	0 00455		0 10220	0 00251		
566 0.05302	2	0.08455		0.10230	0.09251		
567		0.11780		0.27700	0.35140		
0.15200 568	•)	0.05263		0.04362	0.00000		
0.00000	9	0.00200		0.0.00	0.0000		
	rad	dius worst	textur	e 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	
F. 6.4		25 450	`	26.40	166 10	2027 0	
564		25.450 23.690		26.40 38.25	166.10 155.00	2027.0	
566 .		18.986		34.12	126.70	1731.0 1124.0	
567 .	•	25.740		39.42	184.60	1821.0	
ECO.	 	9.456		39.42	59.16	268.6	
200	•	31.30		30137	33110	200.0	

```
smoothness_worst
                        compactness worst
                                             concavity_worst
               0.16220
0
                                   0.66560
                                                       0.7119
1
               0.12380
                                   0.18660
                                                       0.2416
2
                                                       0.4504
               0.14440
                                   0.42450
3
               0.20980
                                   0.86630
                                                       0.6869
4
               0.13740
                                   0.20500
                                                       0.4000
564
               0.14100
                                   0.21130
                                                       0.4107
                                                       0.3215
565
               0.11660
                                   0.19220
566
               0.11390
                                   0.30940
                                                       0.3403
               0.16500
567
                                   0.86810
                                                       0.9387
568
               0.08996
                                   0.06444
                                                       0.0000
     concave points_worst
                                              fractal dimension worst
                             symmetry worst
                                                               0.11890
0
                    0.2654
                                     0.4601
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
                    0.2216
                                     0.2060
564
                                                               0.07115
                                                               0.06637
565
                    0.1628
                                     0.2572
                                     0.2218
566
                    0.1418
                                                               0.07820
                                     0.4087
                    0.2650
567
                                                               0.12400
                    0.0000
568
                                     0.2871
                                                               0.07039
[569 rows x 32 columns]
import matplotlib.pyplot as plt
fig, axs = plt.subplots(3, 4, figsize=(5,6))
```



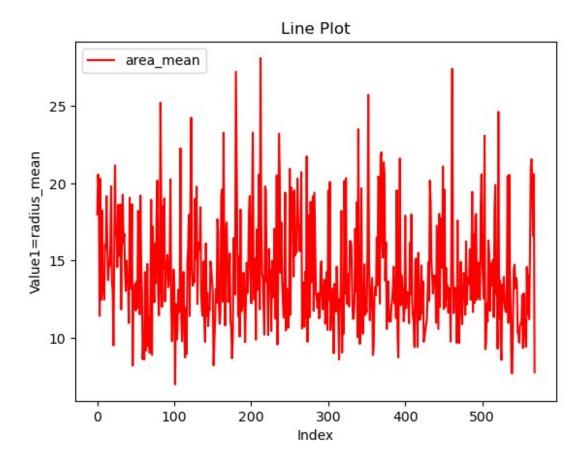
```
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 32 columns):
#
     Column
                                Non-Null Count
                                                 Dtype
 0
     id
                                569 non-null
                                                 int64
 1
     diagnosis
                                569 non-null
                                                 object
 2
     radius mean
                                569 non-null
                                                 float64
 3
     texture mean
                                569 non-null
                                                 float64
 4
                                                 float64
     perimeter mean
                                569 non-null
 5
     area mean
                                569 non-null
                                                 float64
 6
                                569 non-null
                                                 float64
     smoothness mean
 7
     compactness_mean
                                                 float64
                                569 non-null
 8
                                                 float64
     concavity mean
                                569 non-null
 9
     concave points mean
                                                 float64
                                569 non-null
 10
     symmetry_mean
                                569 non-null
                                                 float64
 11
     fractal dimension mean
                                569 non-null
                                                 float64
 12
                                                 float64
     radius se
                                569 non-null
```

```
13
                              569 non-null
                                              float64
    texture se
                                              float64
 14
    perimeter se
                              569 non-null
 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
                                              float64
                              569 non-null
20 symmetry se
                              569 non-null
                                              float64
 21 fractal dimension se
                              569 non-null
                                              float64
22 radius worst
                              569 non-null
                                              float64
                                              float64
 23
    texture worst
                              569 non-null
24 perimeter worst
                              569 non-null
                                              float64
 25 area worst
                              569 non-null
                                              float64
 26 smoothness worst
                                              float64
                              569 non-null
27 compactness worst
                              569 non-null
                                              float64
28 concavity worst
                              569 non-null
                                              float64
                                              float64
29 concave points worst
                              569 non-null
30 symmetry_worst
                              569 non-null
                                              float64
                                              float64
31 fractal dimension worst 569 non-null
dtypes: float64(30), int64(1), object(1)
memory usage: 142.4+ KB
import seaborn as sns
sns.pairplot(data)
<seaborn.axisgrid.PairGrid at 0x15b96d57d40>
```



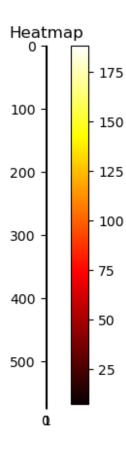
## Line Plot

```
plt.plot(df.index, df['radius_mean'], label='area_mean', color='r')
plt.title('Line Plot')
plt.xlabel('Index')
plt.ylabel('Valuel=radius_mean')
plt.legend()
plt.show()
```



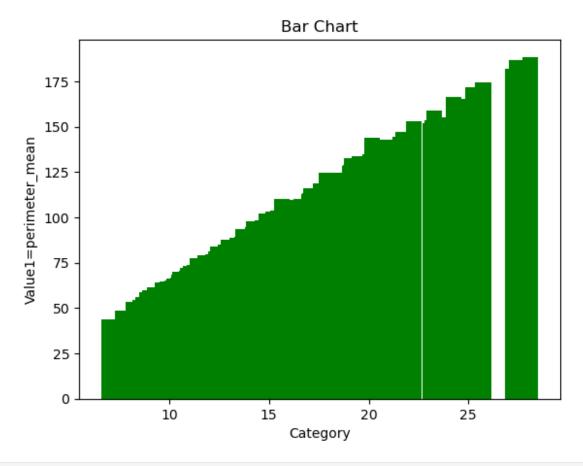
# Heatmap

```
data =df[['radius_mean', 'perimeter_mean']].values
plt.imshow(data, cmap='hot')
plt.title('Heatmap')
plt.colorbar()
plt.show()
```



## **Bar Chart**

```
plt.bar(df['radius_mean'], df['perimeter_mean'], color='g')
plt.title('Bar Chart')
plt.xlabel('Category')
plt.ylabel('Value1=perimeter_mean')
plt.show()
```



```
import matplotlib.pyplot as plt
import numpy as np
# Data
x = np.linspace(1, 10, 100)
y = np.sin(x)
print("x=",x)
                                    ")
print("
print("Y",y)
# Line Plot
plt.plot(x, y)
plt.title('Line Plot')
plt.xlabel("X- AXIS")
plt.ylabel("Y- AXIS")
plt.show()
                 1.09090909 1.18181818 1.27272727 1.36363636
x=[1.
1.45454545
  1.54545455
              1.63636364
                          1.72727273
                                      1.81818182
                                                  1.90909091 2.
             2.18181818
                         2.27272727 2.36363636 2.45454545
  2.09090909
2.54545455
  2.63636364
             2.72727273 2.81818182 2.90909091 3.
3.09090909
```

```
3.18181818 3.27272727 3.36363636 3.45454545 3.54545455
3.63636364
 3.72727273 3.81818182 3.90909091 4.
                                              4.09090909
4.18181818
 4.27272727 4.36363636 4.45454545 4.54545455 4.63636364
4.72727273
            4.90909091 5.
 4.81818182
                                   5.09090909 5.18181818
5.27272727
 5.36363636 5.45454545 5.54545455 5.63636364 5.72727273
5.81818182
 5.90909091
                       6.09090909 6.18181818 6.27272727
            6.
6.36363636
 6.45454545 6.54545455 6.63636364 6.72727273 6.81818182
6.90909091
 7.
            7.09090909 7.18181818 7.27272727 7.36363636
7.45454545
 7.54545455
            7.63636364
                       7.72727273 7.81818182 7.90909091
                                                         8.
 8.09090909
            8.18181818 8.27272727 8.36363636 8.45454545
8.54545455
            8.72727273 8.81818182 8.90909091 9.
 8.63636364
9.09090909
 9.18181818 9.27272727 9.36363636 9.45454545 9.54545455
9.63636364
 9.72727273 9.81818182 9.90909091 10.
0.99325047
 0.99967891 0.99785123 0.98778253 0.96955595 0.94332203
0.90929743
 0.86776314 0.8190622 0.76359681 0.70182505 0.63425707
0.56145091
 0.48400786 0.40256749 0.31780241 0.23041267 0.14112001
0.05066187
 -0.04021468 -0.1307591 -0.22022362 -0.30786935 -0.39297247 -
0.47483011
 -0.55276624 -0.6261372 -0.69433703 -0.7568025 -0.8130177 -
0.86251837
-0.9048957 -0.93979971 -0.96694212 -0.98609877 -0.99711147 -
0.99988924
 -0.99440916 -0.98071647 -0.95892427 -0.92921254 -0.89182665 -
0.84707537
 -0.79532828 -0.73701276 -0.67261042 -0.60265314 -0.52771868 -
0.44842592
-0.36542971 -0.2794155 -0.19109366 -0.10119362 -0.01045784
0.0803643
 0.17052273 0.25927286 0.34588171 0.429634 0.50983804
0.58583144
            0.72271585  0.78247636  0.83577457  0.88217031
 0.6569866
0.92128041
```

```
0.95278186 0.9764145 0.99198316 0.99935926 0.99848187

0.98935825

0.97206374 0.94674118 0.9135997 0.87291301 0.82501713

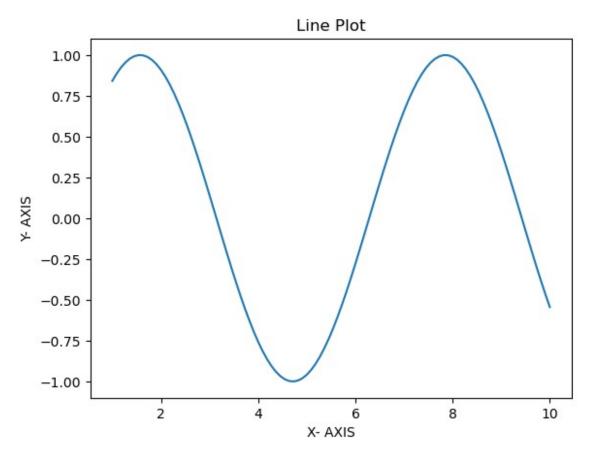
0.77030762

0.70923631 0.64230758 0.57007418 0.49313267 0.41211849

0.32770071

0.24057653 0.15146548 0.06110351 -0.0297631 -0.1203839 -0.21001048

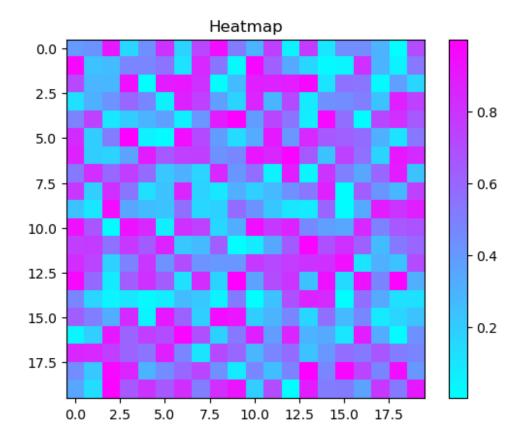
-0.29790263 -0.38333447 -0.46560043 -0.54402111]
```



```
import matplotlib.pyplot as plt
import numpy as np

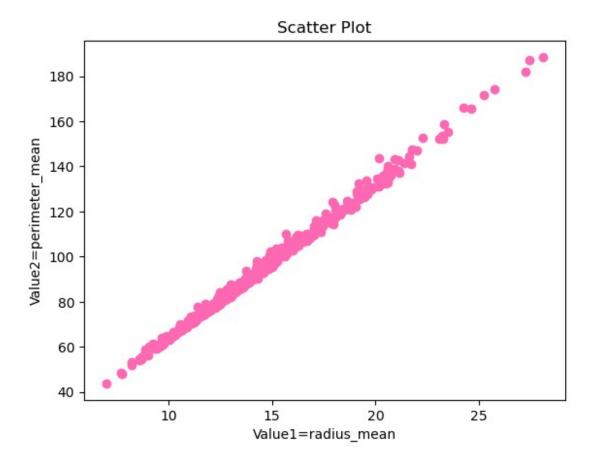
# Data
data = np.random.rand(20, 20)

# Heatmap
plt.imshow(data, cmap='cool', interpolation='nearest')
plt.title('Heatmap')
plt.colorbar()
plt.show()
```



#### Scatter Plot

```
plt.scatter(df['radius_mean'], df['perimeter_mean'], color="#ff69b4")
plt.title('Scatter Plot')
plt.xlabel('Value1=radius_mean')
plt.ylabel('Value2=perimeter_mean')
plt.show()
```



## **Bar Chart**

```
import matplotlib.pyplot as plt

# Data
categories = ['A', 'B', 'C', 'D', 'E',]
values = [4, 7, 8, 2, 1]

# Bar Chart
plt.bar(categories, values)
plt.title('Bar Chart')
plt.show()
```

