Naive Bayes Model

February 10, 2024

[1]:
```
import pandas as pd
```

[2]:
```
bc = pd.read_csv(r"C:\Users\User\Downloads\breast-cancer.csv")
```

[3]:
```
bc
```

[3]:

	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]
```

[4]:
```
bc = bc.drop('id', axis=1)
```

[5]:
```
bc
```

[5]:
```
    diagnosis  radius_mean  texture_mean  perimeter_mean  area_mean  \
0           M        17.99         10.38          122.80     1001.0
1           M        20.57         17.77          132.90     1326.0
2           M        19.69         21.25          130.00     1203.0
3           M        11.42         20.38           77.58      386.1
4           M        20.29         14.34          135.10     1297.0
..        …            …             …               …          …
564         M        21.56         22.39          142.00     1479.0
```

```
565         M        20.13         28.25          131.20     1261.0
566         M        16.60         28.08          108.30      858.1
567         M        20.60         29.33          140.10     1265.0
568         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

     symmetry_mean  …  radius_worst  texture_worst  perimeter_worst  \
0           0.2419  …        25.380          17.33           184.60
1           0.1812  …        24.990          23.41           158.80
2           0.2069  …        23.570          25.53           152.50
3           0.2597  …        14.910          26.50            98.87
4           0.1809  …        22.540          16.67           152.20
..             …  …             …              …                …
564         0.1726  …        25.450          26.40           166.10
565         0.1752  …        23.690          38.25           155.00
566         0.1590  …        18.980          34.12           126.70
567         0.2397  …        25.740          39.42           184.60
568         0.1587  …         9.456          30.37            59.16

     area_worst  smoothness_worst  compactness_worst  concavity_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
567      1821.0           0.16500            0.86810           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              0.1628          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 31 columns]
```

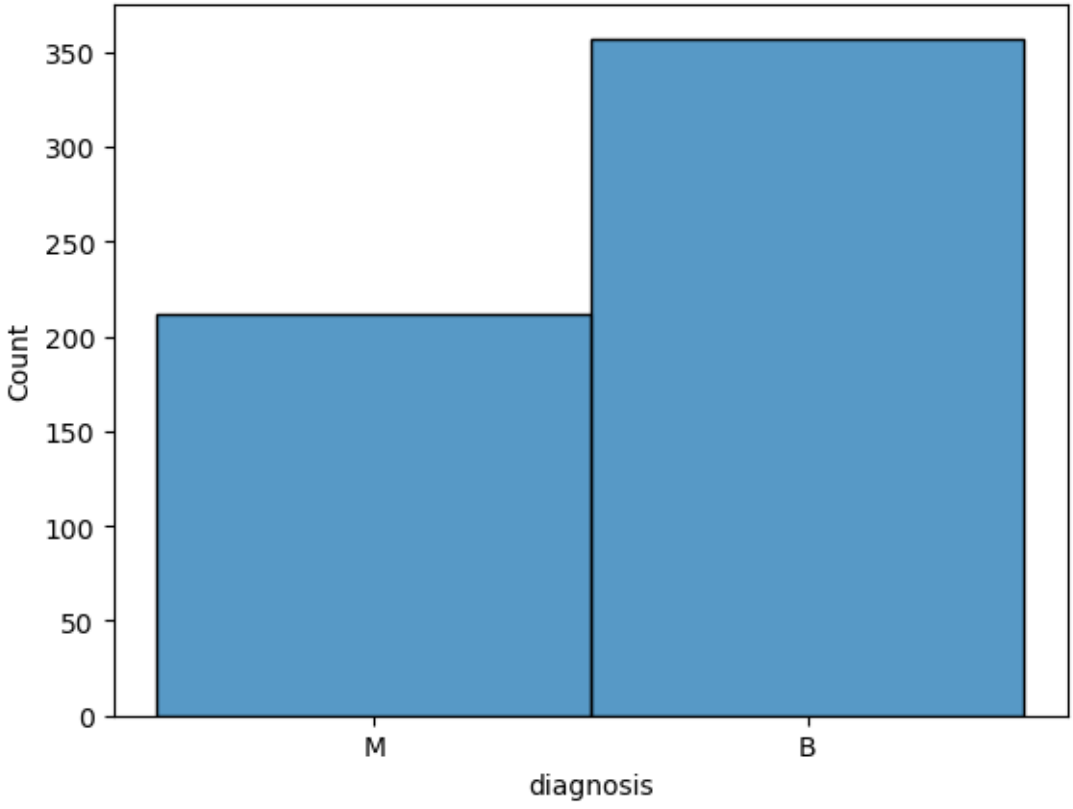
[6]:
```
bc['diagnosis'].value_counts()
```

[6]:
```
diagnosis
B    357
M    212
Name: count, dtype: int64
```

[7]:
```
import seaborn as sns
```

[8]:
```
sns.histplot(bc['diagnosis'])
```

[8]:
```
<Axes: xlabel='diagnosis', ylabel='Count'>
```



[9]:
```
bc['diagnosis'] = bc['diagnosis'].replace({'B':0 ,'M':1 })
```

[10]:
```
from sklearn import naive_bayes
from sklearn.model_selection import train_test_split
from sklearn import metrics
```

[11]:
```
bc.shape
```

[11]:
```
(569, 31)
```

[12]:
```
bc.size
```

[12]:
```
17639
```

[13]:
```
x = bc.drop('diagnosis', axis= 1)
y = bc['diagnosis']



x_test , x_train, y_test, y_train = train_test_split(x,y, test_size=0.3,␣
 ↪random_state=32)
```

[14]:
```
nb = naive_bayes.GaussianNB()
```

[15]:
```
nb.fit(x_train, y_train)
```

[15]:
```
GaussianNB()
```

[16]:
```
y_pred = nb.predict(x_test)
```

[17]:
```
y_pred
```

[17]:
```
array([1, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 0,
       0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0,
       0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0,
       0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1,
       0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0,
       1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0,
       0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0,
       1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1,
       0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0,
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       0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1,
```

```
       0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0,
       0, 1, 1, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0,
       1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0,
       0, 0], dtype=int64)
```

[18]:
```
y_pred1 = nb.predict_proba(x_test)
```

[19]:
```
y_pred1
```

[19]:
```
array([[7.55324184e-034, 1.00000000e+000],
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       [1.86647640e-080, 1.00000000e+000],
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       [1.00000000e+000, 3.50578437e-012],
       [1.00000000e+000, 4.69402774e-011],
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       [1.00000000e+000, 2.56935439e-014],
       [1.00000000e+000, 4.85212330e-010],
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[20]:
```
metrics.accuracy_score(y_test, y_pred )
```

[20]: 0.9447236180904522

[21]:
```
metrics.recall_score(y_test, y_pred )
```

[21]: 0.9041095890410958

[22]:
```
metrics.f1_score(y_test, y_pred )
```

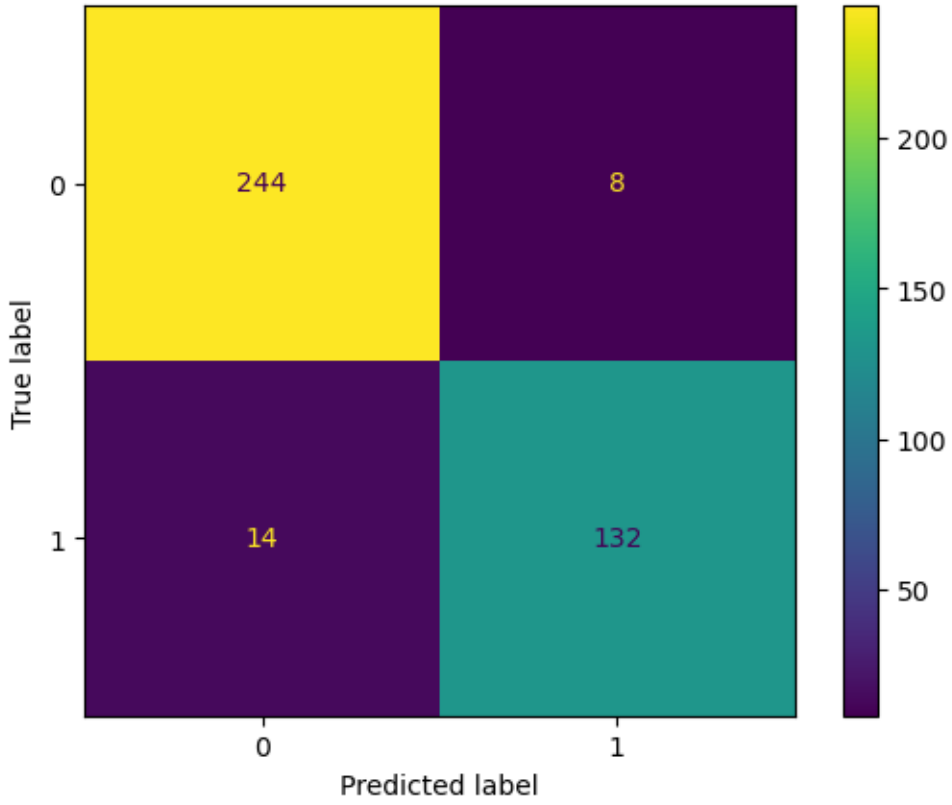
[22]: 0.923076923076923

[23]:
```
metrics.precision_score(y_test, y_pred )
```

[23]: 0.9428571428571428

[24]:
```
cm = metrics.confusion_matrix(y_test, y_pred)
disp = metrics.ConfusionMatrixDisplay(confusion_matrix= cm , display_labels= nb.
 ↪classes_)
disp.plot()
```

[24]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1d0b55db850>



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