## October 16, 2020

```
Question 1)
      a)
[1]: import os
     import numpy as np
     import pandas as pd
     import matplotlib.pyplot as plt
     from sklearn.decomposition import PCA
     from sklearn.datasets import load_iris
     from sklearn.preprocessing import MinMaxScaler, StandardScaler
     from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
     from scipy.io import loadmat
     import warnings
     warnings.filterwarnings('ignore')
    Import and read in the iris dataset
[2]: iris = load_iris()
     iris_df = pd.DataFrame(data=iris.data, columns=iris.feature_names)
     convert_species = np.vectorize(lambda x : "setosa" if x==0 else ("versicolor"

→if x==1 else "virginica"))
     iris_unnamed = iris_df
     iris_df["target"] = convert_species(iris.target)
     iris_unnamed["target"] = iris.target
[3]: iris_unnamed.head()
[3]:
        sepal length (cm) sepal width (cm) petal length (cm) petal width (cm) \
     0
                      5.1
                                         3.5
                                                            1.4
                                                                               0.2
                      4.9
     1
                                         3.0
                                                            1.4
                                                                               0.2
     2
                      4.7
                                         3.2
                                                            1.3
                                                                               0.2
     3
                      4.6
                                         3.1
                                                            1.5
                                                                               0.2
     4
                      5.0
                                         3.6
                                                            1.4
                                                                               0.2
        target
     0
             0
             0
     1
             0
```

```
4
             0
[4]: iris_df.head()
        sepal length (cm)
                            sepal width (cm)
                                               petal length (cm)
[4]:
                                                                   petal width (cm)
                       5.1
                                          3.5
                                                              1.4
                                                                                 0.2
     1
                       4.9
                                          3.0
                                                              1.4
                                                                                 0.2
                       4.7
     2
                                          3.2
                                                              1.3
                                                                                 0.2
     3
                       4.6
                                          3.1
                                                              1.5
                                                                                 0.2
                       5.0
     4
                                          3.6
                                                              1.4
                                                                                 0.2
        target
     0
             0
     1
             0
     2
             0
     3
             0
     4
             0
    Import and read in the indian pines dataset
[5]: indian = loadmat(os.path.join(os.getcwd(), "indianR.mat"))
     data = np.array(indian["X"]).T
     targets = np.array(indian["gth"])[0]
     indian_df = pd.DataFrame(data=data)
     indian_df["target"] = targets
[6]: np.unique(indian_df["target"], return_counts=True)
[6]: (array([ 0, 1,
                       2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16],
            dtype=uint8),
      array([10776,
                                      830,
                                             237,
                                                            730,
                        46,
                             1428,
                                                    483,
                                                                    28,
                                                                           478,
                20,
                       972,
                             2455,
                                      593,
                                             205,
                                                    1265,
                                                            386,
                                                                    93],
            dtype=int64))
[7]: iris_df.head()
[7]:
        sepal length (cm)
                            sepal width (cm) petal length (cm)
                                                                   petal width (cm)
                       5.1
                                          3.5
                                                              1.4
                                                                                 0.2
     0
     1
                       4.9
                                          3.0
                                                              1.4
                                                                                 0.2
     2
                       4.7
                                                              1.3
                                          3.2
                                                                                 0.2
     3
                       4.6
                                          3.1
                                                              1.5
                                                                                 0.2
     4
                       5.0
                                          3.6
                                                                                 0.2
                                                              1.4
        target
     0
             0
     1
             0
```

3

0

2 0 3 0 4 0

# [8]: indian\_df.describe()

| [8]: |  | 0  | 1   | 2  | 3   | 4   | \ |
|------|--|--|---|--|---|---|---|
|      | count  | 21025.000000   | 21025.000000  | 21025.000000   | 21025.000000  | 21025.000000  |   |
|      | mean   | 3341.313103  | 4091.957765   | 4277.523662  | 4170.075672   | 4516.685375   |   |
|      | std  | 212.254014   | 227.885060  | 257.819760   | 280.381316  | 346.041777  |   |
|      | min  | 2632.000000  | 3477.000000   | 3649.000000  | 3578.000000   | 3840.000000   |   |
|      | 25%  | 3179.000000  | 3889.000000   | 4066.000000  | 3954.000000   | 4214.000000   |   |
|      | 50%  | 3343.000000  | 4107.000000   | 4237.000000  | 4126.000000   | 4478.000000   |   |
|      | 75%  | 3510.000000  | 4247.000000   | 4479.000000  | 4350.000000   | 4772.000000   |   |
|      | max  | 4536.000000  | 5744.000000   | 6361.000000  | 6362.000000   | 7153.000000   |   |
|      |  | 5  | 6   | 7  | 8   | 9   | \ |
|      | count  | 21025.000000   | 21025.000000  | 21025.000000   | 21025.000000  | 21025.000000  | • |
|      | mean   | 4790.607134  | 4848.334269   | 4714.739073  | 4668.916528   | 4439.259453   |   |
|      | std  | 414.386445   | 469.244664  | 491.731609   | 533.233484  | 539.486030  |   |
|      | min  | 4056.000000  | 4004.000000   | 3865.000000  | 3775.000000   | 3560.000000   |   |
|      | 25%  | 4425.000000  | 4421.000000   | 4263.000000  | 4173.000000   | 3940.000000   |   |
|      | 50%  | 4754.000000  | 4808.000000   | 4666.000000  | 4632.000000   | 4404.000000   |   |
|      | 75%  | 5093.000000  | 5198.000000   | 5100.000000  | 5084.000000   | 4860.000000   |   |
|      | max  | 7980.000000  | 8284.000000   | 8128.000000  | 8194.000000   | 7928.000000   |   |
|      |  |  | 02 4  |  |   |   |   |
|      |  | 1  | .93 1   | .94 1  | .95 1   | .96 \   |   |
|      | count  | 21025.0000   |   |  |   | 96 \<br>00  |   |
|      | count<br>mean  |  | 21025.0000  | 000 21025.0000   | 000 21025.0000  | 000   |   |
|      |  | 21025.0000   | 21025.0000<br>383 1063.2992   | 21025.0000<br>215 1050.0729  | 21025.0000<br>13 1040.2275  | 00<br>39  |   |
|      | mean   | 21025.0000<br>1060.2383  | 21025.0000<br>383 1063.2992<br>237 41.9061  | 21025.0000<br>215 1050.0729<br>16 34.2323  | 21025.0000<br>13 1040.2275<br>448 26.4479   | 00<br>39<br>67  |   |
|      | mean<br>std  | 21025.0000<br>1060.2383<br>38.6942   | 21025.0000<br>21025.0000<br>283 1063.2992<br>237 41.9061<br>999.0000  | 21025.0000<br>215 1050.0729<br>16 34.2323<br>993.0000  | 21025.0000<br>213 1040.2275<br>48 26.4479<br>990.0000   | 00<br>39<br>67<br>00  |   |
|      | mean<br>std<br>min                                       | 21025.0000<br>1060.2383<br>38.6942<br>999.0000   | 21025.0000<br>21025.0000<br>283 1063.2992<br>237 41.9061<br>200 999.0000<br>200 1024.0000   | 21025.0000<br>215 1050.0729<br>16 34.2323<br>000 993.0000<br>1019.0000   | 21025.0000<br>13 1040.2275<br>48 26.4479<br>900 990.0000<br>1016.0000   | 00<br>39<br>67<br>00  |   |
|      | mean<br>std<br>min<br>25%                                | 21025.0000<br>1060.2383<br>38.6942<br>999.0000<br>1024.0000  | 21025.0000<br>21025.0000<br>283 1063.2992<br>237 41.9061<br>900 999.0000<br>1024.0000<br>1054.0000  | 21025.0000<br>215 1050.0729<br>16 34.2323<br>00 993.0000<br>00 1019.0000<br>100 1043.0000  | 21025.0000<br>13 1040.2275<br>48 26.4479<br>00 990.0000<br>00 1016.0000<br>100 1033.0000  | 00<br>39<br>67<br>00<br>00  |   |
|      | mean<br>std<br>min<br>25%<br>50%                         | 21025.0000<br>1060.2383<br>38.6942<br>999.0000<br>1024.0000<br>1052.0000   | 21025.0000<br>21025.0000<br>283   | 21025.0000<br>215 1050.0729<br>16 34.2323<br>000 993.0000<br>000 1019.0000<br>000 1043.0000<br>1000 1083.0000  | 21025.0000<br>13 1040.2275<br>48 26.4479<br>990.0000<br>100 1016.0000<br>100 1033.0000<br>100 1066.0000   | 00<br>39<br>67<br>00<br>00<br>00  |   |
|      | mean<br>std<br>min<br>25%<br>50%<br>75%                  | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000  | 21025.0000<br>21025.0000<br>237 41.9061<br>999.0000<br>1024.0000<br>1054.0000<br>1104.0000<br>1315.0000   | 21025.0000<br>215 1050.0729<br>16 34.2323<br>993.0000<br>100 1019.0000<br>100 1043.0000<br>100 1258.0000   | 21025.0000<br>13 1040.2275<br>48 26.4479<br>990.0000<br>100 1016.0000<br>100 1033.0000<br>100 1066.0000<br>100 1201.0000  | 00<br>39<br>67<br>00<br>00<br>00<br>00  | , |
|      | mean<br>std<br>min<br>25%<br>50%<br>75%<br>max           | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000  | 21025.0000<br>21025.0000<br>283 1063.2992<br>237 41.9061<br>200 999.0000<br>1024.0000<br>1054.0000<br>1104.0000<br>1315.0000  | 21025.0000<br>215 1050.0729<br>16 34.2323<br>993.0000<br>100 1019.0000<br>100 1043.0000<br>100 1258.0000   | 21025.0000<br>13 1040.2275<br>448 26.4479<br>990.0000<br>100 1016.0000<br>100 1066.0000<br>100 1201.0000  | 00<br>39<br>67<br>00<br>00<br>00<br>00<br>00<br>00  | \ |
|      | mean<br>std<br>min<br>25%<br>50%<br>75%<br>max           | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 197 21025.000000   | 21025.0000<br>21025.0000<br>237 41.9061<br>999.0000<br>1024.0000<br>1054.0000<br>1104.0000<br>1315.0000   | 21025.0000<br>215 1050.0729<br>16 34.2323<br>993.0000<br>100 1019.0000<br>100 1043.0000<br>100 1258.0000   | 21025.0000<br>21025.0000<br>213 1040.2275<br>248 26.4479<br>200 990.0000<br>200 1016.0000<br>200 1066.0000<br>200 21025.000000  | 00<br>39<br>67<br>00<br>00<br>00<br>00<br>00<br>201<br>21025.000000   | \ |
|      | mean std min 25% 50% 75% max count mean                  | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 197 21025.000000 1043.391011                             | 21025.0000<br>21025.0000<br>237 41.9061<br>200 999.0000<br>200 1024.0000<br>200 1054.0000<br>200 1315.0000<br>198<br>21025.000000<br>1030.223496  | 21025.0000<br>21025.0000<br>215 1050.0729<br>16 34.2323<br>200 993.0000<br>200 1019.0000<br>200 1043.0000<br>200 1258.0000<br>199<br>21025.000000<br>1015.600856                             | 21025.0000<br>13 1040.2275<br>148 26.4479<br>100 990.0000<br>100 1016.0000<br>100 1066.0000<br>100 1201.0000<br>200<br>21025.000000<br>1008.513864  | 000<br>339<br>667<br>000<br>000<br>000<br>000<br>000<br>201<br>21025.000000<br>1006.791011  | \ |
|      | mean std min 25% 50% 75% max  count mean std             | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 197 21025.000000 1043.391011 29.788944                   | 21025.0000<br>21025.0000<br>237 41.9061<br>200 999.0000<br>200 1024.0000<br>200 1054.0000<br>200 1315.0000<br>198<br>21025.000000<br>1030.223496<br>20.872378   | 21025.0000<br>215 1050.0729<br>16 34.2323<br>200 993.0000<br>200 1019.0000<br>200 1043.0000<br>200 1083.0000<br>200 1258.0000<br>199<br>21025.000000<br>1015.600856<br>11.437696             | 21025.0000<br>21025.0000<br>213 1040.2275<br>248 26.4479<br>200 990.0000<br>200 1016.0000<br>200 1066.0000<br>200 21025.000000<br>1008.513864<br>7.052013   | 00<br>39<br>67<br>00<br>00<br>00<br>00<br>00<br>201<br>21025.000000<br>1006.791011<br>6.995153  | \ |
|      | mean std min 25% 50% 75% max count mean                  | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 197 21025.000000 1043.391011                             | 21025.0000<br>21025.0000<br>237 41.9061<br>200 999.0000<br>200 1024.0000<br>200 1054.0000<br>200 1315.0000<br>198<br>21025.000000<br>1030.223496  | 21025.0000<br>21025.0000<br>215 1050.0729<br>16 34.2323<br>200 993.0000<br>200 1019.0000<br>200 1043.0000<br>200 1258.0000<br>199<br>21025.000000<br>1015.600856                             | 21025.0000<br>13 1040.2275<br>148 26.4479<br>100 990.0000<br>100 1016.0000<br>100 1066.0000<br>100 1201.0000<br>200<br>21025.000000<br>1008.513864  | 000<br>339<br>667<br>000<br>000<br>000<br>000<br>000<br>201<br>21025.000000<br>1006.791011  | \ |
|      | mean std min 25% 50% 75% max  count mean std min         | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 197 21025.000000 1043.391011 29.788944 992.000000        | 21025.0000<br>21025.0000<br>237 41.9061<br>200 999.0000<br>200 1024.0000<br>200 1054.0000<br>200 1104.0000<br>1315.0000<br>198<br>21025.000000<br>1030.223496<br>20.872378<br>989.000000                  | 21025.0000<br>215 1050.0729<br>16 34.2323<br>200 993.0000<br>200 1019.0000<br>200 1083.0000<br>200 1258.0000<br>199<br>21025.000000<br>1015.600856<br>11.437696<br>986.000000                | 21025.0000<br>13 1040.2275<br>148 26.4479<br>100 990.0000<br>100 1016.0000<br>100 1066.0000<br>100 1201.0000<br>200<br>21025.000000<br>1008.513864<br>7.052013<br>981.000000                          | 00<br>39<br>67<br>00<br>00<br>00<br>00<br>00<br>201<br>21025.000000<br>1006.791011<br>6.995153<br>980.000000                                | \ |
|      | mean std min 25% 50% 75% max  count mean std min 25%     | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 1289.0000 1043.391011 29.788944 992.000000 1016.000000   | 21025.0000<br>21025.0000<br>237 41.9061<br>200 999.0000<br>200 1024.0000<br>200 1054.0000<br>200 1315.0000<br>198<br>21025.000000<br>1030.223496<br>20.872378<br>989.000000<br>1012.000000                | 21025.0000<br>215 1050.0729<br>16 34.2323<br>200 993.0000<br>200 1019.0000<br>200 1083.0000<br>200 1258.0000<br>199<br>21025.000000<br>1015.600856<br>11.437696<br>986.000000<br>1006.000000 | 21025.0000<br>13 1040.2275<br>148 26.4479<br>100 990.0000<br>100 1016.0000<br>100 1066.0000<br>100 1201.0000<br>200<br>21025.000000<br>1008.513864<br>7.052013<br>981.000000<br>1004.000000           | 201<br>21025.000000<br>1006.791011<br>6.995153<br>980.000000  | \ |
|      | mean std min 25% 50% 75% max  count mean std min 25% 50% | 21025.0000 1060.2383 38.6942 999.0000 1024.0000 1052.0000 1098.0000 1289.0000 1043.391011 29.788944 992.000000 1016.000000 1037.000000 | 21025.0000<br>21025.0000<br>237 41.9061<br>200 999.0000<br>200 1024.0000<br>200 1054.0000<br>200 1315.0000<br>198<br>21025.000000<br>1030.223496<br>20.872378<br>989.000000<br>1012.000000<br>1026.000000 | 21025.0000<br>215 1050.0729<br>16 34.2323<br>200 993.0000<br>200 1019.0000<br>200 1083.0000<br>200 1258.0000<br>1015.600856<br>11.437696<br>986.000000<br>1014.000000                        | 21025.0000<br>21025.0000<br>213 1040.2275<br>248 26.4479<br>200 990.0000<br>200 1016.0000<br>200 1066.0000<br>200 21025.000000<br>1008.513864<br>7.052013<br>981.000000<br>1004.000000<br>1009.000000 | 000<br>399<br>667<br>000<br>000<br>000<br>000<br>201<br>21025.000000<br>1006.791011<br>6.995153<br>980.000000<br>1003.000000<br>1005.000000 | \ |

target

```
21025.000000
      count
      mean
                  4.224923
      std
                  5.281972
                  0.00000
      min
      25%
                  0.000000
      50%
                  0.00000
      75%
                 10.000000
                 16.000000
      max
      [8 rows x 203 columns]
 [9]: | indexDrop = indian_df[indian_df["target"] == 0].index
      indian_df.drop(indexDrop, inplace=True)
      indian_df.reset_index(inplace=True)
[10]: indian_df.describe()
                                                                       2
                     index
                                         0
                                                       1
                                                                                      3
              10249.000000
                             10249.000000
                                            10249.000000
                                                           10249.000000
                                                                          10249.000000
      count
                                                            4355.246073
              9322.297200
                              3382.435847
                                             4152.747292
                                                                           4257.888184
      mean
      std
              5218.036087
                               210.366658
                                              224.041937
                                                             256.879124
                                                                            281.800019
                              2640.000000
                                             3491.000000
                                                            3739.000000
                                                                           3601.000000
      min
                  0.000000
      25%
               5016.000000
                              3196.000000
                                             3990.000000
                                                            4137.000000
                                                                           4029.000000
      50%
              8723.000000
                              3358.000000
                                             4130.000000
                                                            4394.000000
                                                                           4270.000000
      75%
                              3526.000000
                                             4264.000000
                                                            4510.000000
                                                                           4431.000000
              13560.000000
              20214.000000
                              4536.000000
                                             5526.000000
                                                            6080.000000
                                                                           6139.000000
      max
                                         5
                                                       6
                                                                      7
                         4
                                                                                      8
                                                                                         \
      count
              10249.000000
                             10249.000000
                                            10249.000000
                                                           10249.000000
                                                                          10249.000000
              4630.182750
                              4930.287931
                                             5010.664357
                                                            4887.468241
                                                                           4859.082349
      mean
      std
                348.119919
                               417.197677
                                              473.771399
                                                             497.665315
                                                                            539.681324
      min
              3911.000000
                              4123.000000
                                             4138.000000
                                                            3997.000000
                                                                           3883.000000
      25%
                              4536.000000
                                             4560.000000
                                                            4415.000000
              4327.000000
                                                                           4337.000000
      50%
               4661.000000
                              4993.000000
                                             5091.000000
                                                            4976.000000
                                                                           4958.000000
      75%
               4881.000000
                              5202.000000
                                             5335.000000
                                                            5234.000000
                                                                           5227.000000
              7070.000000
                              7809.000000
                                             8000.00000
                                                            7980.000000
                                                                           8106.000000
      max
                          193
                                          194
                                                         195
                                                                        196
                 10249.000000
                                10249.000000
                                               10249.000000
                                                              10249.000000
      count
                                                1066.017855
      mean
                  1078.458874
                                 1083.158845
                                                               1052.516928
      std
                    38.994331
                                   42.108992
                                                  34.516822
                                                                 26.723702
             •••
      min
                  1000.000000
                                  999.000000
                                                 993.000000
                                                                995.000000
             •••
      25%
                  1039.000000
                                 1040.000000
                                                1031.000000
                                                               1026.000000
             •••
      50%
                  1093.000000
                                 1099.000000
                                                1078.000000
                                                               1062.000000
```

[10]:

75%

max

1094.000000

1141.000000

1074.000000

1110.000000

1117.000000

1180.000000

1110.000000

1163.000000

```
197
                                198
                                               199
                                                              200
                                                                             201
       10249.000000
                      10249.000000
                                     10249.000000
                                                    10249.000000
                                                                   10249.000000
count
mean
        1057.192799
                       1039.704459
                                      1020.304322
                                                     1010.365499
                                                                    1008.517416
std
           30.055980
                         21.030831
                                         11.539938
                                                        7.034534
                                                                       7.080302
         992.000000
                        989.000000
                                       986.000000
                                                      985.000000
                                                                     985.000000
min
25%
        1027.000000
                       1020.000000
                                      1010.000000
                                                     1005.000000
                                                                    1004.000000
50%
        1067.000000
                       1045.000000
                                      1022.000000
                                                     1010.000000
                                                                    1009.000000
75%
        1081.000000
                       1055.000000
                                      1029.000000
                                                     1015.000000
                                                                    1014.000000
        1130.000000
                       1088.000000
                                      1048.000000
                                                     1037.000000
                                                                    1034.000000
max
              target
       10249.000000
count
mean
           8.667089
std
            4.327987
            1.000000
min
25%
            5.000000
50%
           10.000000
75%
           11.000000
max
           16.000000
```

Both indian and iris datasets have successfully been loaded. Now, we need to setup PCA and LDA First is PCA. PCA needs to scale the data first and then deconstruct the data into its principal components

[8 rows x 204 columns]

```
[11]: def scale(df, scaler="MinMax"):
    inputs = df.iloc[:, :-1].to_numpy()
    if scaler == "MinMax":
        scale = MinMaxScaler()
    elif scaler == "Standard":
        scale = StandardScaler()
    else:
        raise ValueError(f"Unsupported scaler {scaler}")
    scale.fit(inputs.astype(float))
    inputs = scale.transform(inputs)

    scaled_df = pd.DataFrame(data=inputs)

    scaled_df["target"] = df["target"]
    return scaled_df
[12]: def fit_pca(df, **kwargs):
```

n\_components = kwargs.get("n\_components", len(df.columns)-1)

```
inputs = df.iloc[:, :-1].to_numpy()
          pca = PCA(n_components=n_components)
          pc = pca.fit(inputs)
          return pc
[13]: def transform_pca(df, pc):
          inputs = df.iloc[:, :-1].to_numpy()
          transformed_df = pd.DataFrame(data=pc.transform(inputs))
          transformed_df.columns = [*map(lambda y : f"PC-{y}", list(range(1, pc.
       \rightarrown_components + 1)))]
          transformed_df["target"] = df["target"]
          return transformed_df
[55]: def plot_variance(pc, n_components=None):
          pc_{cols} = lambda x : [*map(lambda y : f"PC-{y}", list(range(1, x+1)))]
          n_comps = n_components if n_components is not None else pc.n_components
          plt.figure(figsize=(18,12))
          plt.style.use("ggplot")
          plt.rcParams.update({'font.size': 18})
          plt.bar(pc_cols(n_comps), pc.explained_variance_ratio_[:n_comps])
          plt.title("Explained Variance Ratio vs. Principal Component")
          plt.ylabel("Explained Variance Ratio")
          plt.xlabel("Principal Component")
          plt.ylim([0, 1])
          return
[15]: def plot_pca_lda(df, **kwargs):
          title = kwargs.get("title", "Plot of Data With First Two Components")
          xlabel = kwargs.get("xlabel", "First Component")
          ylabel = kwargs.get("ylabel", "Second Component")
          eigens = kwargs.get("eigens", None)
          alpha = kwargs.get("alpha", 0.75)
          labels = np.unique(df["target"])
          fig = plt.figure(figsize=(18,12))
          plt.style.use("ggplot")
          plt.rcParams.update({'font.size': 18})
          #fig, ax = plt.subplots(1,1, figsize=(18,12), style="ggplot")
          ax = fig.add_subplot(111)
          ax.set_xlabel(xlabel)
          ax.set_ylabel(ylabel)
```

```
ax.set_title(title)
  colors = ['r', 'g', 'b', 'y', 'm', 'c', 'k', 'r', 'g', 'b', 'y', 'm', 'c', _
\hookrightarrow 'k', 'r', 'g', 'b']
  \hookrightarrow '+', '+', '+', '+']
  for i, label in enumerate(labels):
      first_two = df.loc[df["target"] == label].iloc[:, 0:2].to_numpy()
      ax.scatter(first_two[:, 0], first_two[:, 1], label=label, alpha=alpha, __
if eigens is not None:
      eig_vec = eigens[0][:2]
      eig_val = eigens[1][:2]
      for vec, val in zip(eig_vec, eig_val.T):
          ax.plot([0, np.sqrt(vec)*val[0]], [0, np.sqrt(vec)*val[1]], "k-", [
\rightarrow1w=2)
  ax.legend()
  return
```

```
def get_eigens(df):
    inputs = df.iloc[:, :-1].to_numpy()
    cov = np.cov(inputs.T)
    eig_vec, eig_val = np.linalg.eig(cov)

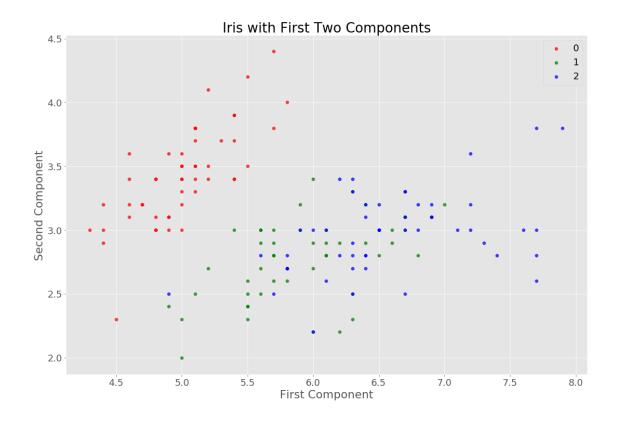
    print(f"Eigen Values:\n{eig_val}")
    print(f"Eigen Vectors:\n{eig_vec}")

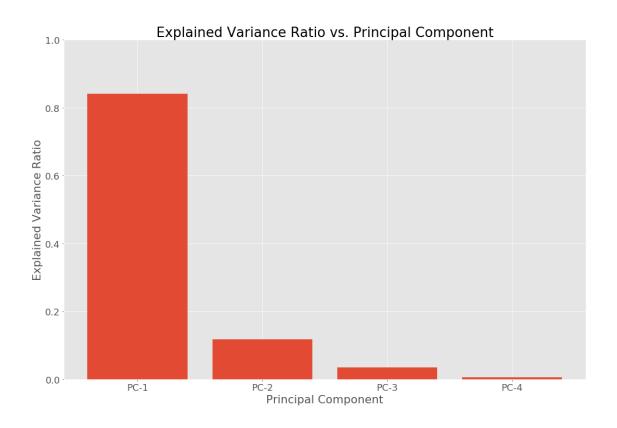
    return eig_vec, eig_val
```

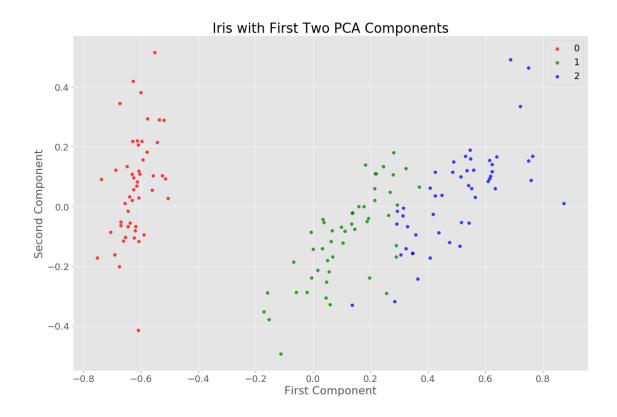
```
[17]: def perform_pca(df, **kwargs):
    df_scaled = scale(df)
    pc = fit_pca(df_scaled, **kwargs)
    df_pca = transform_pca(df_scaled, pc)
    return df_pca
```

Now to create the same functionality for LDA.

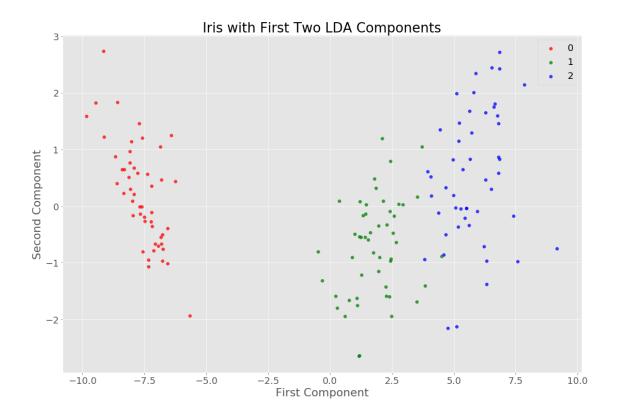
```
targets = np.array(df["target"].values)
         lda = LinearDiscriminantAnalysis(n_components=n_components)
         transform_df = pd.DataFrame(data=lda.fit(inputs, targets).transform(inputs))
         transform_df["target"] = df["target"]
         return transform_df
[56]: plot_pca_lda(iris_df, title="Iris with First Two Components")
      iris_scaled = scale(iris_df)
      pc = fit_pca(iris_scaled)
      print(f"Explained Variance Ratio:\n{pc.explained_variance_ratio_}")
      plot_variance(pc)
      iris_pc = transform_pca(iris_scaled, pc)
      eigens = get_eigens(iris_pc)
      plot_pca_lda(iris_pc, title="Iris with First Two PCA Components")
     Explained Variance Ratio:
     [0.84136038 0.11751808 0.03473561 0.00638592]
     Eigen Values:
     [[ 1.00000000e+00 2.27117367e-16 1.58067971e-16 8.17929707e-17]
      [ 0.00000000e+00 1.00000000e+00 -3.34545298e-16 -3.45648222e-17]
      [ 0.00000000e+00 3.46217222e-16 1.00000000e+00 8.87035040e-17]
      [ 0.00000000e+00 4.27653296e-17 -1.11519743e-16 1.00000000e+00]]
     Eigen Vectors:
     [0.23245325 0.0324682 0.00959685 0.00176432]
```







```
[99]: iris_lda = perform_lda(iris_df)
plot_pca_lda(iris_lda, title="Iris with First Two LDA Components")
```



```
[57]: plot_pca_lda(indian_df, title="Indian Pines with First Two Components")
      indian_scaled = scale(indian_df, scaler="MinMax")
      pc = fit_pca(indian_scaled, n_components=10)
      print(f"Explained Variance Ratio:\n{pc.explained_variance_ratio_}")
      plot_variance(pc)
      plot_variance(pc, n_components=10)
      indian_pc = transform_pca(indian_scaled, pc)
      eigens = get_eigens(indian_pc)
      plot_pca_lda(indian_pc, title="Indian Pines with First Two PCA Components")
```

### Explained Variance Ratio:

-2.00112835e-17 5.60125718e-17]

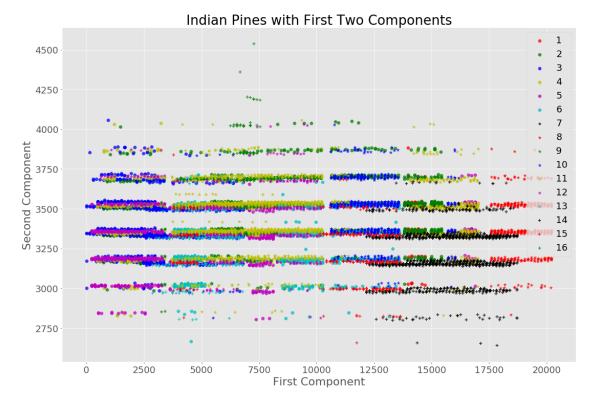
 $\begin{bmatrix} 0.84769736 & 0.0979396 & 0.01467606 & 0.00926067 & 0.00496592 & 0.00250275 \\ \end{bmatrix}$ 0.00205987 0.00193326 0.00187837 0.00145054]

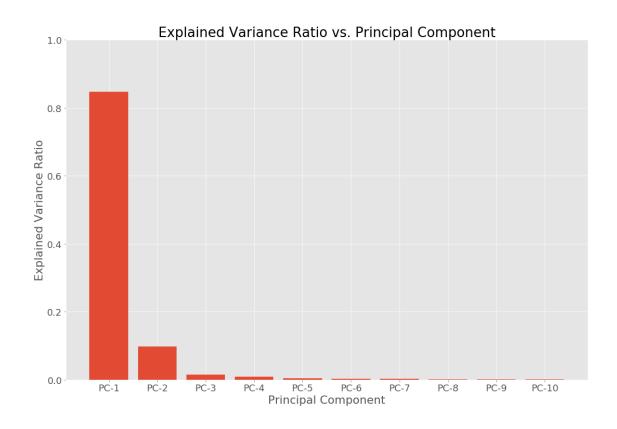
```
Eigen Values:
[[-1.00000000e+00 -1.10880946e-14 -1.40330785e-16 4.85082057e-16
 -5.21843460e-17 7.91244887e-18 1.77887767e-17 4.99162322e-18
 -1.18330066e-17 6.43894374e-18]
 [ 1.09451092e-14 -1.00000000e+00 -2.64710375e-15 -4.82564896e-17
 -1.79793213e-17 -1.88014807e-18 2.17592495e-17 -7.42968871e-17
 -1.69549214e-17 1.06717568e-16]
 3.55477068e-16 -6.68949838e-17 -2.55609923e-17 -1.68382381e-17
```

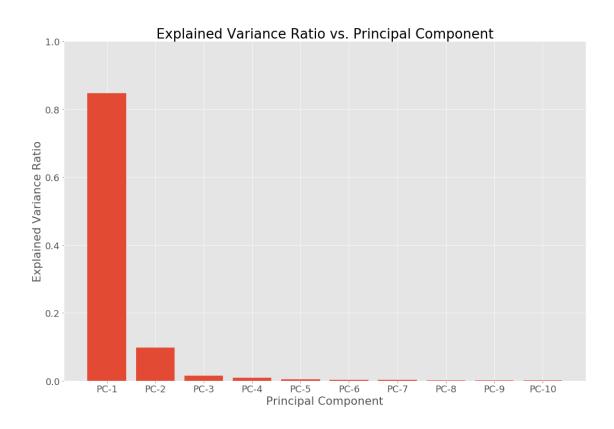
```
[ 4.85045236e-16 -8.59690482e-17 -2.27078014e-15 1.00000000e+00
 5.88837499e-16 2.33399434e-17 -4.54690348e-15 -2.30954762e-16
-3.68794125e-16 3.39257181e-16]
[-5.21836566e-17 -1.83984740e-17 -7.68094097e-17 -8.51038433e-16
 1.00000000e+00 -5.18415414e-15 -3.04761817e-13 -1.10657704e-14
-2.2272638e-14 2.42962006e-14]
[-7.91244474e-18 8.93207144e-19 4.36666978e-17 -3.17809477e-17
-5.03406042e-15 -1.00000000e+00 -1.05699219e-10 -8.48933554e-12
-1.68542306e-11 1.06431567e-11]
[ 4.99162301e-18 -7.35152431e-17 -5.13873478e-17 2.33400125e-16
 1.11017702e-14 -8.48958110e-12 -1.24637505e-09 1.00000000e+00
-5.05969454e-10 2.45900340e-10]
-2.23725540e-14 1.68533959e-11 3.88778810e-09 -5.05968335e-10
-1.00000000e+00 -1.94585398e-09]
[-6.43894382e-18 -1.07635194e-16 -4.21677319e-17 3.08769410e-16
 2.43087216e-14 -1.06429512e-11 -3.28060483e-09 2.45900736e-10
 1.94585304e-09 -1.00000000e+00]
3.05012776e-13 -1.05698449e-10 1.00000000e+00 1.24637467e-09
 3.88778805e-09 -3.28060503e-09]]
```

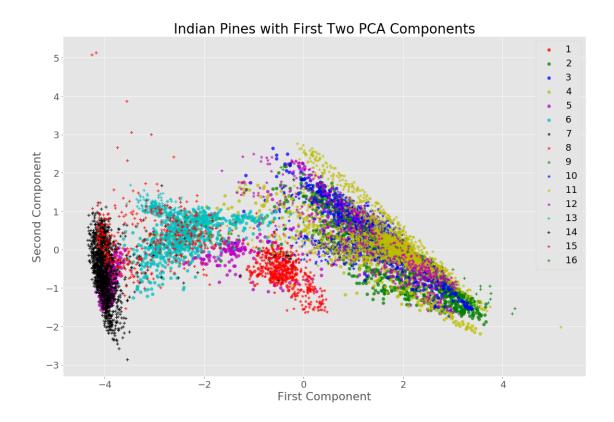
### Eigen Vectors:

[5.49293297 0.63463172 0.09509832 0.06000752 0.03217833 0.01621739 0.00939925 0.01334759 0.0125272 0.01217151]

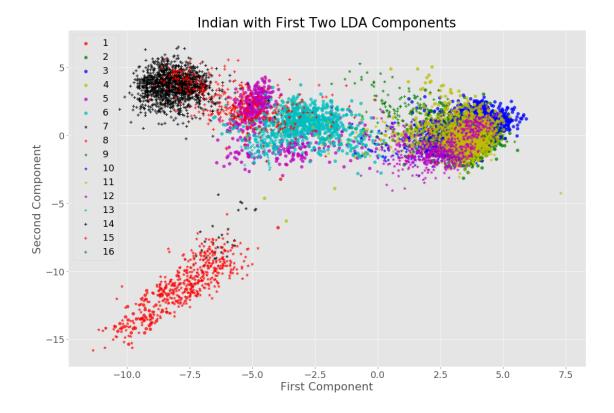








```
[105]: indian_lda = perform_lda(indian_df, n_components=2) plot_pca_lda(indian_lda, title="Indian with First Two LDA Components")
```



b)

i) The three plots of the first two components with no, pca and lda dimensionality reduction for both the iris and indian datasets demonstrate the usefulness of dimensionality reduction and preojection. First, with the iris, with no projection there is a lot of overlap between the first and second classes. It is not clear how to delineate between the two. After performing either LDA or PCA, the separability because much clearer and easier. This separation also only requires two components/dimensions to be readily apparent. This is further supported by the variances plot which shows that the first two principal components contain over 90% of the iris' data variance.

Looking at the indian pines dataset and plots we see a similar pattern. The first plot shows no dimensionality reduction or projection. There is a lot of overlap between classes. Note that this plot just shows the first two components of the data, and not the best two. The PCA's and LDA's first two components do a much better job of separating the classes. There is still overlap between classes in the plot but we are starting to separate the classes out. It is not surprising that there is still some overlap between the data since we are only taking 2 of 202 components to try and separate all the data. However, the first two components show significant improvement and could make things much better once including several more components. From the variance plot, we see once again that the first two principal components are able to capture over 90% of the indian's data variance. This suggests we can severely decrease the number of components from 202 to a much more reasonable number. This should greatly reduce runtimes of learners on the data (as demonstrated later in question two).

The number of principal components to use for the classifiers seems to suggest 2 for the iris dataset,

and possibly around 5-10 for the indian. We only need two for the iris because we can already see the three classes are separated in its plot. However, the indian dataset, while improved, would still need more components since the classes are not able to be completely separated with just the first two components. The same could be said for the LDA analyses.

The LDA and PCA worked about the same for the iris dataset. Most likely since it is a simple dataset and the variance does a good job of explaining the data's separate classes. The LDA appears to perform better on the indian dataset. PCA still works but there appears to still be significant overlap in some regions. The explained variance plot also shows that minimal variance is explained by principal components greater than 2, but we can see from our plot that we will need more than just two principal components to explain the data. LDA seems to perform slightly better. This is most likely because it is able to take the classes into consideration when finding the best basis for projection to increase separability. PCA can sometimes struggle because it looks for overall variances, and does not consider intra- and inter- class means and variances.

```
Question 2)
```

a)

```
[60]: from sklearn.model_selection import train_test_split, StratifiedKFold from sklearn.neighbors import KNeighborsClassifier from sklearn.naive_bayes import GaussianNB from sklearn.svm import SVC import time
```

```
[74]: def perform_performance(classifications):
    def get_spec_sens(confusion_matrix):
        specificities = []
```

```
sensitivities = []
       for iLabel in list(range(len(confusion_matrix))):
           tp, tn, fn, fp = 0, 0, 0, 0
           for i in range(len(confusion_matrix)):
               for j in range(len(confusion_matrix)):
                   if j == iLabel and i == j:
                       tp += confusion_matrix[i, j]
                   elif j == iLabel:
                       fp += confusion_matrix[i, j]
                   elif iLabel == i:
                       fn += confusion_matrix[i, j]
                   else:
                       tn += confusion_matrix[i, j]
           sensitivity = tp / (tp+fn)
           specificity = tn / (tn+fp)
           sensitivities.append( sensitivity)
           specificities.append( specificity)
       return specificities, sensitivities
   def get_score(actual, predictions):
       correct = 0
       for i in range(len(actual)):
           if actual[i] == predictions[i]:
               correct += 1
       return correct / len(actual)
   def confusion_matrix(actual, predict, targets):
       def get_target_index(target):
           for i in range(len(targets)):
               if targets[i] == target:
                   found = True
                   break
           if found == False:
               raise ValueError(f"Target {target} not found in targets⊔
→{targets}")
           return i
       conf_mat = np.zeros((len(targets), len(targets)), dtype=int)
       for i in range(len(actual)):
           iActual = get_target_index(actual[i])
           iPredict = get_target_index(predict[i])
           conf_mat[iActual, iPredict] += 1
       return conf_mat
```

```
performance = {}
        targets = np.unique(list(np.unique(classifications["train"])) + list(np.
     performance["conf_mat_train"] = confusion_matrix(classifications["train"],__
     performance["specificity_train"], performance["sensitivity_train"] =
     performance["accuracy_train"] = get_score(classifications["train"],__
     →classifications["predict_train"])
        performance["conf mat_test"] = confusion_matrix(classifications["test"],_
     performance["specificity_test"], performance["sensitivity_test"] =__
     performance["accuracy_test"] = get_score(classifications["test"],_
     return performance
[26]: def print_conf_mat(conf_mat, labels):
        spacer=4
        width = " "*spacer
        print("Act /" + " Predictions ")
        line = width
        for label in labels:
           line += " | " + label
        print(line)
        for i, label in enumerate(labels):
           line = label
           for j in range(len(conf_mat)):
              line += f" | {conf_mat[i,j]:<4}"</pre>
           print(line)
[27]: def get_targets(dataset, targets):
        def convert(val):
           if val == 0:
              ret = "Seto"
           elif val == 1:
              ret = "Vers"
              ret = "Virg"
           return ret
```

ret\_targets = np.empty(len(targets), dtype=object)

if dataset == "iris":

```
for i in range(len(targets)):
        ret_targets[i] = convert(targets[i])
else:
    for i in range(len(targets)):
        ret_targets[i] = str(targets[i]).ljust(4)
return ret_targets
```

```
[28]: def run_model(dataset, df, model, testing_sizes):
          def get_training_sizes(testing_sizes):
              training_sizes = []
              for i in range(len(testing_sizes)):
                  training_size = np.round((1-testing_sizes[i])*10)/10
                  training_sizes.append(training_size)
              return training_sizes
          output = {}
          start = time.time()
          output["targets"] = get_targets(dataset, np.unique(df.target))
          output["specs_train"] = np.zeros((len(testing_sizes),__
       →len(output["targets"])))
          output["senss_train"] = np.zeros((len(testing_sizes),__
       →len(output["targets"])))
          output["specs_test"] = np.zeros((len(testing_sizes),__
       →len(output["targets"])))
          output["senss_test"] = np.zeros((len(testing_sizes),__
       →len(output["targets"])))
          output["train scores"] = []
          output["test_scores"] = []
          output["training_sizes"] = get_training_sizes(testing_sizes)
          for i, size in enumerate(testing_sizes):
              print(size)
              classifications = perform_classification(df, model, size)
              performance = perform_performance(classifications)
              output["test_scores"].append(performance["accuracy_test"])
              output["train_scores"].append(performance["accuracy_train"])
              output["specs_train"][i, :] = performance["specificity_train"]
              output["senss_train"][i, :] = performance["sensitivity_train"]
              output["specs_test"][i, :] = performance["specificity_test"]
              output["senss_test"][i, :] = performance["sensitivity_test"]
              if size == 0.7:
                  output["conf_mat_train"] = performance["conf_mat_train"]
                  output["conf mat test"] = performance["conf mat test"]
          output["runtime"] = time.time() - start
          return output
```

Now loop over all possible cases, and run the models.

```
[61]: testing sizes = np.array([*range(90, 0, -10)])/100
      models = \{\}
      models["svm_rbf"] = SVC(kernel="rbf", gamma="auto")
      models["svm_poly"] = SVC(kernel="poly", gamma="auto")
      models["svm linear"] = SVC(kernel="linear", gamma="auto")
      models["knn"] = KNeighborsClassifier()
      models["naive_bayes"] = GaussianNB()
      dim_reds = [("PCA", 3), ("LDA", 6), (None, None)]
[88]: iris_pca = perform_pca(iris_unnamed, n_components=2)
      iris_lda = perform_lda(iris_unnamed, n_components=2)
      indian_pca = perform_pca(indian_df, n_components=4)
      indian_lda = perform_lda(indian_df, n_components=15)
      dfs = {"iris_PCA_2": iris_pca,
            "iris_LDA_2": iris_lda,
            "iris_None_None": iris_unnamed,
            "indian_PCA_4": indian_pca,
            "indian_LDA_15": indian_lda,
            "indian_None_None": indian_df
          }
[89]: total_output = {}
      for key, df in dfs.items():
          data, dim_red, dim_num = key.split("_")
          output_classifier = {}
          for classifier, model in models.items():
              print(f"==== {data} - {classifier} - {dim_red} ====")
              output_classifier[classifier] = run_model(data, df, model,__
       \hookrightarrowtesting_sizes)
          total_output[key] = output_classifier
      print("finished")
     ==== iris - svm rbf - PCA ====
     0.9
     0.8
     0.7
     0.6
     0.5
     0.4
     0.3
     0.2
     ==== iris - svm_poly - PCA ====
     0.9
     0.8
```

```
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - svm_linear - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - knn - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - naive_bayes - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
==== iris - svm_rbf - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - svm_poly - LDA ====
```

```
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - svm_linear - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - knn - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - naive_bayes - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
==== iris - svm_rbf - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
```

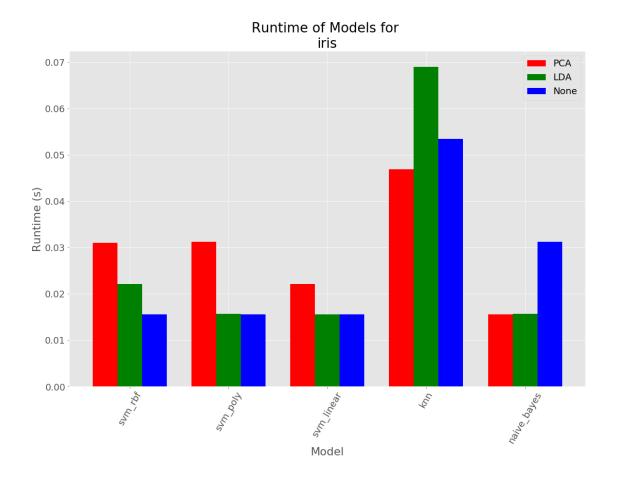
```
0.1
==== iris - svm_poly - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - svm_linear - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== iris - knn - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
==== iris - naive_bayes - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - svm_rbf - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
```

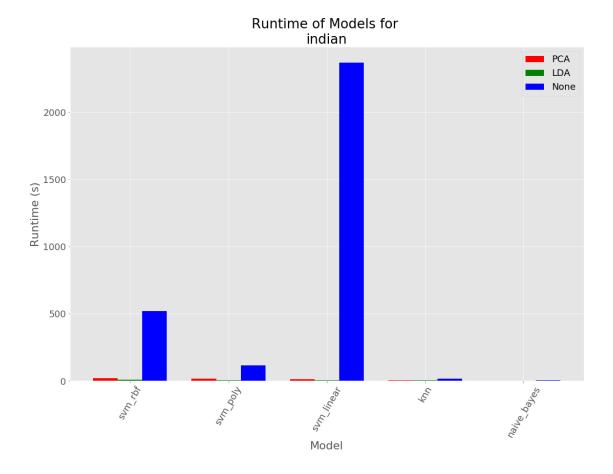
```
0.3
0.2
0.1
==== indian - svm_poly - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - svm_linear - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - knn - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - naive_bayes - PCA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
==== indian - svm_rbf - LDA ====
0.9
0.8
0.7
0.6
```

```
0.5
0.4
0.3
0.2
0.1
==== indian - svm_poly - LDA ====
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - svm_linear - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - knn - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - naive_bayes - LDA ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
==== indian - svm_rbf - None ====
0.9
0.8
```

```
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - svm_poly - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - svm_linear - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
==== indian - knn - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
==== indian - naive_bayes - None ====
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
finished
```

```
[78]: for dataset in ["iris", "indian"]:
          count = 0
          fig = plt.figure(figsize=(18,12))
          ax = fig.add_subplot(111)
          ax.set_title(f"Runtime of Models for \n{dataset}")
          ax.set_xlabel("Model")
          ax.set_ylabel("Runtime (s)")
          colors = ["r", "g", "b"]
          for key, df in dfs.items():
              data, dim_red, dim_num = key.split("_")
              if data != dataset:
                  continue
              runtimes = []
              classifiers = []
              for classifier, model in models.items():
                  runtimes.append(total_output[key][classifier]["runtime"])
                  classifiers.append(classifier)
              X = np.arange(len(classifiers))
              ax.bar(X -0.25 + count*0.25, runtimes, color=colors[count], width=0.25,
       →label=dim_red)
              count +=1
          classifiers = [""] + classifiers
          ax.set_xticklabels(classifiers, Rotation=60)
          ax.legend()
```





```
[72]: def get_header(data, dim_red, dim_num, classifier, length):
    mid = f" {data} - {dim_red} - {dim_num} - {classifier} "
    excess = length - len(mid)
    if excess > 0:
        output = "=" * (excess // 2 + excess % 2)
        output += mid
        output += "=" * (excess // 2)
    else:
        output = mid
    return output
```

```
[90]: for dataset in ["iris", "indian"]:
    fig_scores, ax_scores = plt.subplots(3, 2, figsize=(24,18))
    fig_scores.suptitle(f"{dataset}\nTraining/Testing Scores vs. Training Size")
    fig_sens, ax_sens = plt.subplots(3, 2, figsize=(24,18))
    fig_sens.suptitle(f"{dataset}\nSensisitivity vs Target for each Classifier")
    fig_specs, ax_specs = plt.subplots(3, 2, figsize=(24,18))
    fig_specs.suptitle(f"{dataset}\nSpecificity vs Target for each Classifier")

    for axes in [ax_scores, ax_sens, ax_specs]:
```

```
for axis, dim reduction in zip(range(3), ["None", "PCA", "LDA"]):
          axes[axis, 0].set_title(f"{dim_reduction} Train")
          axes[axis, 1].set_title(f"{dim_reduction} Test")
  for key, df in dfs.items():
      data, dim_red, dim_num = key.split("_")
      if data != dataset:
          continue
      if dim red == "PCA":
          axis = 1
      elif dim red == "LDA":
          axis = 2
      else:
          axis = 0
      senss_train = []
      senss_test = []
      specs_train = []
      specs_test = []
      classifiers = []
      for classifier, model in models.items():
          run_output = total_output[key][classifier]
          if True:
              print("======"")
              print(get_header(data, dim_red, dim_num, classifier, 44))
              print("======"")
                                Train Size: 30%
                                                       ======")
              print(f"=====
              print("---- Training Confusion Matrix ----")
              print_conf_mat(run_output["conf_mat_train"],__
→run_output["targets"])
              print("----
                             Testing Confusion Matrix ----")
              print_conf_mat(run_output["conf_mat_test"],__

¬run_output["targets"])
          label = f"{classifier}"
          ax_scores[axis, 0].plot(run_output["training_sizes"],
                                 run_output["train_scores"], label=label)
          ax_scores[axis, 1].plot(run_output["training_sizes"],
                                 run_output["test_scores"], label=label)
          classifiers.append(classifier)
          senss_train.append(run_output["senss_train"][2,:])
          senss_test.append(run_output["senss_test"][2,:])
          specs_train.append(run_output["specs_train"][2,:])
          specs_test.append(run_output["specs_test"][2,:])
      X = np.arange(1, len(run_output["targets"])+1)
      if dataset == "indian":
```

```
pass
        #breakpoint()
    width = 1/(len(classifiers)+1)
    offset = width*(len(classifiers)//2) + width*(len(classifiers)%2)/2
    for iClassifier, classifier in enumerate(classifiers):
        ax_sens[axis, 0].bar(X+offset-width*iClassifier,
                               senss_train[iClassifier],
                               label=classifier,
                               width=width)
        ax_sens[axis, 1].bar(X+offset-width*iClassifier,
                               senss_test[iClassifier],
                               label=classifier,
                               width=width)
        ax_specs[axis, 0].bar(X+offset-width*iClassifier,
                               specs_train[iClassifier],
                               label=classifier,
                               width=width)
        ax_specs[axis, 1].bar(X+offset-width*iClassifier,
                               specs_test[iClassifier],
                               label=classifier,
                               width=width)
    targets = [""] + run_output["targets"]
    for i in range(3):
        for j in range(2):
            ax_sens[i, j].set_xticks(X)
            ax_specs[i, j].set_xticks(X)
            ax_sens[i, j].set_xticklabels(targets, Rotation=60)
            ax_specs[i, j].set_xticklabels(targets, Rotation=60)
for axes, yax, xax in [(ax_scores, "Score", "Training Size"),
                       (ax_sens, "Sensitivity", "Target Class"),
                       (ax_specs, " Specificity", "Target Class")]:
    for i in range(3):
        for j, te_tr in [(0, "Train"), (1, "Test")]:
            axes[i, j].set_ylim([0, 1.1])
            axes[i, j].legend(loc="lower right")
            axes[i, j].set_xlabel(xax)
            axes[i, j].set_ylabel(te_tr + yax)
for fig in [fig_scores, fig_sens, fig_specs]:
    fig.tight_layout()
```

```
| Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0
       | 16
             | 1
Virg | 0 | 4 | 14
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40
       1 0
Vers | 0
        1 32
              1
        I 8
             | 24
Virg | 0
_____
====== iris - PCA - 2 - svm_poly ======
_____
         Train Size: 30%
       Training Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
       1 0
Seto | 0
              | 10
Vers | 0
        | 0
              | 17
Virg | 0
        0 | 18
       Testing Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 0
       | 0
Vers | 0
        1 0
              1 33
Virg | 0
        | 0
            | 32
_____
====== iris - PCA - 2 - svm_linear ======
Train Size: 30%
----
       Training Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 10 | 0
            10
Vers | 0
        | 16 | 1
Virg | 0
       | 4 | 14
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
Vers | 0
        | 32
              1 1
Virg | 0
        1 5
              | 27
_____
====== iris - PCA - 2 - knn ========
_____
         Train Size: 30%
       Training Confusion Matrix
Act /
     Predictions
```

```
| Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0
        | 17
            1 0
Virg | 0 | 1 | 17
       Testing Confusion Matrix
    Predictions
   | Seto | Vers | Virg
Seto | 40
       1 0
Vers | 0
        I 30
              13
             | 31
Virg | 0
        | 1
_____
====== iris - PCA - 2 - naive_bayes ======
______
         Train Size: 30%
       Training Confusion Matrix
      Predictions
Act /
   | Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0 | 15
Virg | 0
        | 2 | 16
       Testing Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
Vers | 0
        l 28
             l 5
Virg | 0
        | 4
            | 28
_____
====== iris - LDA - 2 - svm_rbf =======
Train Size: 30%
----
       Training Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 10 | 0
            10
Vers | 0
        | 17 | 0
Virg | 0
        | 0 | 18
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
              1 0
Vers | 0
        | 29
              14
Virg | 0
        1 0
              | 32
_____
====== iris - LDA - 2 - svm_poly ======
______
         Train Size: 30%
       Training Confusion Matrix
Act /
     Predictions
```

```
| Seto | Vers | Virg
Seto | 10 | 0
             1 0
Vers | 0 | 17
            1 0
Virg | 0 | 0 | 18
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40
       1 0
Vers | 0
        1 29
              14
            | 32
Virg | 0
        1 0
_____
====== iris - LDA - 2 - svm_linear ======
______
         Train Size: 30%
       Training Confusion Matrix
      Predictions
Act /
   | Seto | Vers | Virg
Seto | 10 | 0
             1 0
Vers | 0 | 17
             1 0
Virg | 0
        0 | 18
      Testing Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
            10
            I 3
Vers | 0
        I 30
Virg | 0
        | 0 | 32
====== iris - LDA - 2 - knn ========
Train Size: 30%
----
       Training Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 10 | 0
            10
Vers | 0
        | 17 | 0
Virg | 0
       | 0 | 18
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
Vers | 0
        | 31
            | 2
Virg | 0
        1 0
            | 32
_____
====== iris - LDA - 2 - naive bayes ======
Train Size: 30%
       Training Confusion Matrix
Act /
     Predictions
```

```
| Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0
        | 17
            1 0
Virg | 0 | 0 | 18
       Testing Confusion Matrix
    Predictions
   | Seto | Vers | Virg
Seto | 40
       1 0
Vers | 0
        I 30
              13
             | 31
Virg | 0
        | 1
_____
====== iris - None - None - svm_rbf ======
______
         Train Size: 30%
       Training Confusion Matrix
      Predictions
Act /
   | Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0 | 17
              1 0
Virg | 0
        | 1 | 17
       Testing Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
        | 30
Vers | 0
             1 3
Virg | 0
        10
            | 32
_____
====== iris - None - None - svm_poly ======
Train Size: 30%
----
       Training Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 10 | 0
            10
Vers | 0
        | 17 | 0
Virg | 0
       | 0 | 18
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
              1 0
Vers | 0
        | 29
              14
        1 0
              | 32
Virg | 0
_____
===== iris - None - None - svm linear =====
Train Size: 30%
       Training Confusion Matrix
Act /
     Predictions
```

```
| Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0
        | 17
            1 0
Virg | 0 | 0 | 18
       Testing Confusion Matrix
    Predictions
   | Seto | Vers | Virg
Seto | 40
       1 0
Vers | 0
        l 31
              1 2
Virg | 0
        1 0
             | 32
_____
====== iris - None - None - knn =======
______
         Train Size: 30%
       Training Confusion Matrix
      Predictions
Act /
   | Seto | Vers | Virg
Seto | 10 | 0
              1 0
Vers | 0 | 17
              1 0
Virg | 0
        | 2 | 16
      Testing Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
Vers | 0
        l 31
            1 2
Virg | 0
        | 1
            | 31
_____
==== iris - None - None - naive_bayes =====
Train Size: 30%
----
       Training Confusion Matrix
Act /
      Predictions
   | Seto | Vers | Virg
Seto | 10 | 0
            10
Vers | 0
        | 16 | 1
Virg | 0
       | 1
             | 17
       Testing Confusion Matrix
Act / Predictions
   | Seto | Vers | Virg
Seto | 40 | 0
              1 0
Vers | 0
        | 29
              14
        1 2
              | 30
Virg | 0
_____
====== indian - PCA - 4 - svm rbf =======
Train Size: 30%
       Training Confusion Matrix
Act /
     Predictions
```

|           | 1          |                        |          | 4         |    | 5   | ١ | 6   | I | 7 | I | 8   | ı | 9   | I | 10  | I | 11  |
|-----------|------------|------------------------|----------|-----------|----|-----|---|-----|---|---|---|-----|---|-----|---|-----|---|-----|
| 1   12    |            | 14                     |          | 16<br>  0 |    | 0   | I | 0   | I | 0 | I | 14  | I | 0   | ı | 0   | I | 1   |
| 0<br>2    | 0<br> <br> | 0<br>  187             | 0<br>11  | 0<br>  0  | I  | 1   | I | 1   | ı | 0 | ı | 1   | 1 | 0   |   | 16  | 1 | 195 |
| 23<br>  3 | 1 0<br>0   | 0<br>  10              | 0<br>151 | 0<br>  1  | ı  | 0   | I | 0   | ı | 0 | ı | 0   | 1 | 0   |   | 1   | 1 | 70  |
| 9<br>  4  | 0<br>0     | 0<br>  0               | 0<br>13  | 0<br>  42 | ı  | 0   | ı | 2   | ı | 0 | 1 | 0   | 1 | 0   |   | 0   | 1 | 1   |
| 1<br>5    | 0<br>0     | 0<br>  0               | 0<br>0   | 0<br>  2  | ı  | 140 | ı | 7   | ı | 0 | ı | 4   | l | 0   |   | 0   | ı | 0   |
| 10        | 1 0        | 1 0                    | 1        | 1 0       |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           | 0          | 0                      |          | 0         | ١  | 3   |   | 209 |   | 0 | ı | 0   | I | 0   |   | 0   | I | 0   |
| 0<br>7    | 0<br>0     | 1                      | 5<br>0   | 0<br>  0  | ı  | 1   | ı | 0   | ı | 0 | ı | 8   | 1 | 0   | ı | 0   | ı | 0   |
| 10        | 1 0        | 0                      | 10       | 0         | '  | -   | ' | V   | ' | O | ' | O   | ' | V   | ' | V   | ' | Ü   |
| 8         | 0          |                        |          | 0         |    | 0   | - | 0   | ١ | 0 | - | 154 | ١ | 0   | 1 | 0   |   | 0   |
| 1 0       | 1 0        | 0                      | 10       | 0         |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           | 0          |                        |          | 0         | ١  | 1   | ١ | 3   | ١ | 0 | ١ | 0   | ı | 0   | ١ | 0   | I | 0   |
| 0<br>10   | 0<br>0     | 0<br>  6               | 0<br>0   | 0<br>  0  | 1  | 0   |   | 1   |   | 0 | 1 | 1   |   | 0   |   | 212 | 1 | 70  |
| 15        | 1 0        | 10                     | 0        | 0         | 1  | U   | ' | 1   | ' | U | ' | 1   | ı | U   | ' | 212 | ı | 70  |
| 11        |            | 22                     |          | 10        | ١  | 2   | ı | 4   | ١ | 0 | ı | 0   | ١ | 0   | Ι | 26  | I | 673 |
| 6         | 1 0        | 1 0                    | 10       | 0         |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           | 0          | ,                      |          | 0         |    | 0   | - | 1   | I | 0 |   | 0   |   | 0   |   | 9   |   | 40  |
| 58        | 0          | 0                      | 0        | 0         |    | •   |   |     |   | • |   | •   |   |     |   | •   |   | •   |
| 13        |            | 0                      |          | 0         | ı  | 0   | ı | 3   | ı | 0 | ١ | 0   | ı | 0   | ı | 0   | ı | 0   |
| 0<br>14   | 54<br>0    | 0                      | 0<br>0   | 0<br>  0  | 1  | 1   | ı | 1   | ı | 0 | ı | 0   | ı | 0   | ı | 0   | ı | 0   |
|           | 1 0        | 370                    | 2        | 0         | '  | -   | ' | -   | ' | O | ' | O   | ' | · · | ' | V   | ' | Ü   |
|           | 0          | 10 1                   |          | 1 0       | -  | 1   | 1 | 46  | ١ | 0 | - | 0   |   | 0   | 1 | 0   |   | 0   |
| 1 0       | 9          | 31                     | 35       | 0         |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           |            | 0                      |          |           |    | 0   |   | 0   | I | 0 |   | 0   |   | 0   |   | 2   |   | 0   |
|           |            |                        |          | 19        |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           |            | esting Co<br>edictions |          | n Matr    | ΊX |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           |            | 2                      |          | I 4       | 1  | 5   | ı | 6   | ı | 7 | ı | 8   | ı | 9   | ı | 10  | ı | 11  |
|           |            | 14                     |          |           |    |     | • |     | • | • | Ċ |     | • |     | • |     | • |     |
|           | 0          |                        |          | 0         |    | 0   | 1 | 0   | ١ | 0 | - | 31  |   | 0   | 1 | 0   |   | 0   |
| 1 0       | 1 0        | 1 0                    | 10       | 0         |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           | 0          |                        |          | 0         | ١  | 1   | ١ | 1   | ı | 0 | ١ | 2   | ١ | 0   | ١ | 36  | ı | 454 |
| 88<br>3   |            |                        | 0<br>362 | 0<br>  16 |    | 0   | ı | 0   |   | 0 |   | 0   |   | 0   |   | 1   | 1 | 171 |
| 18        | 0          | 0                      | 0        | 10        | ı  | U   | 1 | U   | ' | U | ' | U   | ı | U   | ' | 1   | ı | 1/1 |
| 4         |            |                        |          | 118       | -  | 0   | ı | 7   |   | 0 | 1 | 0   | I | 0   |   | 1   | I | 1   |
| 2         | 1 0        | 0                      | 0        | 0         |    |     |   |     |   |   |   |     |   |     |   |     |   |     |
|           | 0          |                        |          | 4         |    | 288 | I | 13  |   | 0 | - | 10  | 1 | 0   |   | 6   |   | 6   |
| 1 0       | 0          | 1 0                    | 2        | 0         |    |     |   |     |   |   |   |     |   |     |   |     |   |     |

| 0  | 6 I                             | 0   | 0  | 0   | ı   | 0   | I                      | 5                                 | ı              | 484                                     | I    | 0                     | I                          | 0                                       | 0                             | 1 0                                     | )            | I | 4                                    |
|--|---------------------------------|---|--|---|---|---|------------------------|-----------------------------------|----------------|---|------|-----------------------|----------------------------|---|-------------------------------|---|--------------|---|--------------------------------------|
| 8   0  | 7                               | 0   | 0  | 0   | I   | 0   | I                      | 0                                 | I              | 0                                       | 1    | 0                     | I                          | 19                                      | 1 0                           | 1 0                                     | )            | I | 0                                    |
| 9   0  | 8                               | 0   | 0  | 0   | I   | 0   |                        | 0                                 | I              | 0                                       |      | 0                     | 1                          | 324                                     | 1 0                           | 1 0                                     | )            | I | 0                                    |
| 10   | 9                               | 0   | 0  | 0   | I   | 0   | 1                      | 1                                 | I              | 15                                      |      | 0                     | 1                          | 0                                       | 1 0                           | 1 0                                     | )            | l | 0                                    |
| 11   | 10                              | 0   | 8  | 0   | 1   | 0   | ١                      | 1                                 | I              | 0                                       | ١    | 0                     | I                          | 2                                       | 1 0                           | 4                                       | 171          |   | 140                                  |
| 12   | 11                              | 0   | 55   | 21  | •   | 1   | I                      |                                   | I              | 11                                      | I    | 0                     | I                          | 0                                       | 1 0                           | 6                                       | 88           | I |                                      |
| 13   | 12                              | 0   | 144  | 14  |   | 0   |                        |                                   | I              | 0                                       | I    | 0                     | I                          | 0                                       | 1 0                           | 1                                       | .9           | I | 135                                  |
| 14   | 13                              | 0   | 0  | 0   | I   | 0   | I                      | 0                                 | I              | 12                                      | I    | 0                     | I                          | 0                                       | 1 0                           | 1 0                                     | )            | I | 1                                    |
| 15   | 14 l                            | 0   | 0  | 0   | I   | 0   | I                      | 0                                 | I              | 10                                      | ı    | 0                     | I                          | 0                                       | 1 0                           | 1 0                                     | )            | 1 | 0                                    |
| 16   | 15                              | 0   | 0  | 0   | I   | 0   | ı                      | 8                                 | I              | 116                                     | I    | 0                     | I                          | 0                                       | 1 0                           | 3                                       | 3            | 1 | 2                                    |
| ======================================   | 16                              | 0   |  |   | I   | 0   | I                      | 0                                 | ı              | 0                                       | I    | 0                     | I                          | 0                                       | 1 0                           | 1                                       | =            | 1 | 4                                    |
| Train Size: 30%  | ======                          |   | ======   |   |   |   |                        |                                   |                |   |      |                       |                            |   |                               |   |              |   |                                      |
| Training Confusion Matrix Act / Predictions    1   | ======                          | = indi  | an - P(  | CA - 4  | _   | svm 1   | oc                     | Lv ===                            | ===            | ===                                     |      |                       |                            |   |                               |   |              |   |                                      |
| Act / Predictions   1  | ======                          | =====   | ======   |   |   | _   |                        | •                                 |                |   |      |                       |                            |   |                               |   |              |   |                                      |
| 12   |                                 | ,   | Train S  | ======<br>Size: 3   | ===<br>30%                                | :====:<br>,   | ===                    | ====                              | -==            |   |      |                       |                            |   |                               |   |              |   |                                      |
| 1         0         0         0         0         0         0         14         0         0         1           0         10         15         0         0         1         0         0         0         10         241           9         0         10         0         0         0         0         0         10         124           1         0         9         122         2         0         0         0         0         0         108           1         0         1         8         18         0         2         0         0         0         1         29           0 <td></td> <td>Tra</td> <td>Train Sining (</td> <td>Size: 3</td> <td>===<br/>30%</td> <td>:====:<br/>,</td> <td>===</td> <td>====</td> <td>-==</td> <td></td>   |                                 | Tra   | Train Sining (   | Size: 3   | ===<br>30%                                | :====:<br>,   | ===                    | ====                              | -==            |   |      |                       |                            |   |                               |   |              |   |                                      |
| 0  | =====<br><br>Act /              | Tra<br>Pred<br>1  | Train Sining (ictions  | Size: 3<br>Confus:  | ===<br>30%<br>ion                         | ;<br>;<br>Mat:  | -=-<br>riz             | =====                             | ===            | ===                                     | 1    | 7                     | 1                          | 8                                       | 9                             | 1                                       | .0           | I | 11                                   |
| 2         0         159         15         0         0         1         0         0         0         241           9         0         0         0         0         0         0         0         0         10         10         108           1         0         0         0         0         0         0         0         108         109   | =====<br><br>Act /<br> <br>  12 | Tra<br>Pred<br>1  <br>  13  | Train Sining (ictions 2   14   | Size: 3<br>Confus:<br>S<br>  3<br>  15  | ===<br>30%<br>ion<br>                     | Mat: 4   16   | -==<br>ri2             | ====<br>c<br>5                    | <br>           | ===<br>===<br><br>6                     |      |                       |                            |   |                               |   |              |   |                                      |
| 9  | <br>Act /                       | Tra<br>Pred<br>1  <br>  13  | Train Sining (ictions 2   14 0   | Size: 3<br>Confus:<br>3<br>  3<br>  15  | ===<br>30%<br>ion<br>                     | 4<br>  16   | -==<br>ri2             | ====<br>c<br>5                    | <br>           | ===<br>===<br><br>6                     |      |                       |                            |   |                               |   |              |   |                                      |
| 3         0         9         122         2         0         0         0         0         0         0         108           1         0         0         0         0         0         0         0         108           1         0         1       <  | <br>Act /                       | Tra<br>Pred<br>1  <br>  13<br>0   | Train Sining (ictions 2   14 0   0   | Size: 3 Confus: 3   3   15   0   0  | ===<br>30%<br>ion<br> <br>                | 4<br>  16<br>  0  | rix<br>                | 5<br>0                            | <br> <br>      | 6                                       | I    | 0                     | I                          | 14                                      | 1 0                           | 1 0                                     | )            | 1 | 1                                    |
| 1  | <br>Act /                       | Tra<br>Pred<br>1  <br>  13<br>0  <br>  0  | Train Sining (ictions 2   14 0   0 159   | Size: 3 Confus:  3   15   0   15  | ===<br>30%<br>ion<br> <br>                | 4   16   0   0  | rix<br>                | 5<br>0                            | <br>           | 6                                       | I    | 0                     | I                          | 14                                      | 1 0                           | 1 0                                     | )            | 1 | 1                                    |
| 4         0         1         8         18         0         2         0         0         0         1         29           0         0         0         0         124         19         0         4         0         1         6           0 <t< td=""><td>=====<br/><br/>Act /</td><td>Tra Pred 1   13   0   10   0  </td><td>Train Sining (ictions 2   14 0   159   0</td><td>Size: 3 Confus: 3   3   15   0   10   15   0</td><td>===<br/>30%<br/> <br/> <br/> </td><td>4   16   0   0   0  </td><td>rix<br/> <br/> </td><td>5<br/>5<br/>0</td><td><br/> <br/> </td><td>6<br/>0</td><td>1</td><td>0</td><td>1</td><td>14<br/>0</td><td>I 0</td><td>  0</td><td>.0</td><td>1</td><td>1<br/>241</td></t<> | =====<br><br>Act /              | Tra Pred 1   13   0   10   0  | Train Sining (ictions 2   14 0   159   0   | Size: 3 Confus: 3   3   15   0   10   15   0  | ===<br>30%<br> <br> <br>                  | 4   16   0   0   0  | rix<br> <br>           | 5<br>5<br>0                       | <br> <br>      | 6<br>0                                  | 1    | 0                     | 1                          | 14<br>0                                 | I 0                           | 0                                       | .0           | 1 | 1<br>241                             |
| 0  | Act /                           | Tra Pred 1   13   0   0   0   1 0   | Train S ining ( ictions 2   14 0   0 159   0 9   | Size: 3 Confus: 3   3   15   0   0   15   0   | ===<br>30%<br>ion<br> <br> <br>           | 4   16   0   0   0   2                                      | rix<br> <br>           | 5<br>5<br>0                       | <br> <br>      | 6<br>0                                  | 1    | 0                     | 1                          | 14<br>0                                 | I 0                           | 0                                       | .0           | 1 | 1<br>241                             |
| 5         0         0         0         124         19         0         4         0         1         6           0   | <br>Act /                       | Tra Pred 1   13   0   0   0   0   0   | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   15   0   15   0  | ===<br>30%<br>ion<br> <br> <br>           | 4   16   0   0   0   2   0                                  | rix<br> <br> <br>      | 5<br>0<br>0                       | <br> <br> <br> | 6<br>0<br>1                             | 1    | 0<br>0<br>0           | 1<br>1                     | 14<br>0<br>0                            | 0<br>  0<br>  0               | 0<br>  1<br>  0                         | 0            |   | 1<br>241<br>108                      |
| 0  | =====<br><br>Act /              | Tra Pred 1   13   0   0   0   0   1 0 0   0   0   | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   15   0   15   0   18                                     | ===<br>30%<br>ion<br> <br> <br>           | 4   16   0   0   0   2   0   18                             | rix<br> <br> <br>      | 5<br>0<br>0                       | <br> <br> <br> | 6<br>0<br>1                             | 1    | 0<br>0<br>0           | 1<br>1                     | 14<br>0<br>0                            | 0<br>  0<br>  0               | 0<br>  1<br>  0                         | 0            |   | 1<br>241<br>108                      |
| 6  |                                 | Tra Pred 1   13   0   0   0   1 0 0   1 0 0   1 0   | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   0   15   0   122   0   8   0                             | ====<br>30%<br>ion<br> <br> <br>          | 4   16   0   0   0   2   0   18   0                         | rix<br> <br> <br>      | 5<br>0<br>0                       | <br><br>       | 6<br>0<br>1<br>0                        | <br> | 0 0 0 0               | <br>                       | 14<br>0<br>0                            | 0<br>  0<br>  0<br>  0        | 0<br>  1<br>  0                         | .0           |   | 1<br>241<br>108<br>29                |
| 0  |                                 | Tra Pred 1   13   0   0   0   0   0   0   0   0   0   0   | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   15   0   15   0   18   0   8   0                         | ====<br>30%<br>ion<br> <br> <br>          | 4   16   0   0   0   18   0   0   0                         | rix<br> <br> <br>      | 5<br>0<br>0                       | <br><br>       | 6<br>0<br>1<br>0                        | <br> | 0 0 0 0               | <br>                       | 14<br>0<br>0                            | 0<br>  0<br>  0<br>  0        | 0<br>  1<br>  0                         | .0           |   | 1<br>241<br>108<br>29                |
| 7  |                                 | Tra Pred 1   13   0   0   0   0   0   0   0   0   1 0   | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   15   0   15   0   122   0   8   0   0                    | ===<br>30%<br>ion<br> <br> <br>           | 4   16   0   0   0   18   0   0   0   0   0   0   0   0   0 | rix<br> <br> <br> <br> | 5<br>0<br>0<br>0<br>0             |                | 6<br>0<br>1<br>0<br>2                   | <br> | 0<br>0<br>0<br>0      | <br>                       | 14<br>0<br>0<br>0                       | 0<br>  0<br>  0<br>  0        | 0<br>  1<br>  0<br>  1                  | .0           |   | 1<br>241<br>108<br>29<br>6           |
| 0  |                                 | Tra Pred 1   13   0   0   0   0   0   0   1 0 0   1 0 0   1 0   | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   0   15   0   122   0   8   0   0   0                     | ===<br>30%<br> <br> <br> <br> <br>        | 4   16   0   0   0   18   0   0   0   0   0   0   0   0   0 | rix<br> <br> <br> <br> | 5<br>0<br>0<br>0<br>0             |                | 6<br>0<br>1<br>0<br>2                   | <br> | 0<br>0<br>0<br>0      | <br>                       | 14<br>0<br>0<br>0                       | 0<br>  0<br>  0<br>  0        | 0<br>  1<br>  0<br>  1                  | .0           |   | 1<br>241<br>108<br>29<br>6           |
| 8  |                                 | Tra Pred  1   13   0   0   0   0   0   0   0   0   0   0  | Train S ining () ictions 2   14 0   0 159   0 9   0 1   0 0   0 0   0  | Size: 3 Confus: 3   3   15   0   15   0   122   0   8   0   0   10                        | ===<br>30%<br> <br> <br> <br> <br>        | 4   16   0   0   0   0   0   0   0   0   0                  |                        | 5<br>0<br>0<br>0<br>0<br>124      |                | 6<br>0<br>1<br>0<br>2<br>19             | <br> | 0<br>0<br>0<br>0      |                            | 14<br>0<br>0<br>0<br>4                  | 0<br>  0<br>  0<br>  0<br>  0 | 0                                       | .00          |   | 1<br>241<br>108<br>29<br>6           |
| 0  |                                 | Tra Pred  1    13    0    0    0    0    0    0    0  | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   15   0   122   0   8   0   0   10   0                    | ===<br>30%<br> <br> <br> <br> <br> <br>   | 4   16   0   0   0   0   0   0   0   0   0                  |                        | 5<br>0<br>0<br>0<br>0<br>124      |                | 6<br>0<br>1<br>0<br>2<br>19             | <br> | 0<br>0<br>0<br>0      |                            | 14<br>0<br>0<br>0<br>4                  | 0<br>  0<br>  0<br>  0<br>  0 | 0                                       | .00          |   | 1<br>241<br>108<br>29<br>6           |
|  |                                 | Tra Pred 1   13   0   0   0   0   0   0   1 0   0   1 0   0   1 0   | Train S ining ( ictions 2   14 0   0 159   0 0 1   0 0 0   0 0   0 | Size: 3 Confus: 3   3   15   0   0   15   0   122   0   8   0   0   10   0   0   10       | ===<br>30%<br>ion<br> <br> <br> <br> <br> | 4   16   0   0   0   0   0   0   0   0   0                  |                        | 5<br>0<br>0<br>0<br>124<br>3      |                | 6<br>0<br>1<br>0<br>2<br>19<br>196      |      | 0<br>0<br>0<br>0<br>0 |                            | 14<br>0<br>0<br>0<br>4<br>0             |                               | 0<br>  1<br>  0<br>  1<br>  1<br>  0    | .0           |   | 1<br>241<br>108<br>29<br>6<br>9      |
|  |                                 | Tra Pred  1    13    0    0    0    0    0    0    0  | Train S ining ( ictions 2   14 0   0 159   0 9   0 1   0 0 0   0 0 0   0 0 0 0 0 0 0 0   | Size: 3 Confus: 3   3   15   0   15   0   122   0   8   0   0   10   0   0   10           | ===<br>30%<br>ion<br> <br> <br> <br> <br> | 4   16   0   0   0   0   0   0   0   0   0                  |                        | 5<br>0<br>0<br>0<br>124<br>3      |                | 6<br>0<br>1<br>0<br>2<br>19<br>196      |      | 0<br>0<br>0<br>0<br>0 |                            | 14<br>0<br>0<br>0<br>4<br>0             |                               | 0<br>  1<br>  0<br>  1<br>  1<br>  0    | .0           |   | 1<br>241<br>108<br>29<br>6<br>9      |
|  |                                 | Tra Pred  1    13  0    0 | Train S ining ( ictions 2  | Size: 3 Confus: 3   3   15   0   15   0   122   0   8   0   0   0   0   0   0   0   0   0 | ===<br>30%<br>ion<br> <br> <br> <br> <br> | 4   16   0   0   0   0   0   0   0   0   0                  |                        | 5<br>0<br>0<br>0<br>0<br>124<br>3 |                | 6<br>0<br>1<br>0<br>2<br>19<br>196<br>0 |      | 0<br>0<br>0<br>0<br>0 | 1<br>1<br>1<br>1<br>1<br>1 | 14<br>0<br>0<br>0<br>4<br>0<br>1<br>144 |                               | 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | )<br>.0<br>) |   | 1<br>241<br>108<br>29<br>6<br>9<br>8 |

| 10         | 0        |                 | 0          | _        | I  | 0   | I | 0   | I | 0 | ١ | 0   | I | 0 | I   | 181 | ١ | 114 |
|------------|----------|-----------------|------------|----------|----|-----|---|-----|---|---|---|-----|---|---|-----|-----|---|-----|
| 10<br>  11 |          | 0<br>  19       |            |          | ı  | 0   | 1 | 2   | 1 | 0 | I | 0   | ١ | 0 | I   | 26  | ١ | 692 |
| 0<br>12    | 1 0<br>0 | 0<br>  19       | 0<br>17    | 0<br>0   | ı  | 0   | ı | 5   | ı | 0 |   | 0   | ı | 0 | 1   | 3   |   | 79  |
| 39<br>13   | 0<br>0   | 0<br>  0        | 0<br>  0   | 0<br>0   | ı  | 0   | ı | 3   | ı | 0 |   | 0   | ı | 0 | ı   | 0   |   | 0   |
| 0<br>14    | 54<br>0  | 0<br>  0        | 0<br>  0   | 0<br>0   | ı  | 0   | I | 1   | I | 0 | I | 0   | ı | 0 | I   | 0   | ١ | 0   |
| 0<br>15    | 0<br>0   | 366<br>  0      | 7<br>  0   | 0<br>0   | ı  | 1   | ı | 43  | ı | 0 | I | 0   | ı | 0 | ı   | 0   | l | 0   |
| 1 0        | 6        | 12              | 60         | 1 0      |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
| 16         |          | 0               | •          | -        | -  | 0   | - | 0   | - | 0 |   | 0   |   | 0 | -   | 0   |   | 0   |
| 0          | 0        | 0               | 0          | 21       |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
|            |          | sting Co        |            | Matr:    | ix |     | - |     |   |   |   |     |   |   |     |     |   |     |
| Act /      |          | dictions<br>  2 |            | 4        |    | 5   |   | 6   |   | 7 | ı | 8   |   | 9 | ı   | 10  | ı | 11  |
| 12         | 13       | 14              | 15         | 16       | '  | 5   | ' | O   | ' | , | 1 | O   | ' | 9 | '   | 10  | 1 | 11  |
| 1          |          | 10 1            |            |          | ı  | 0   | ı | 0   | ı | 0 | ı | 29  | ı | 0 | ı   | 0   | ı | 2   |
| <br>  0    | 1 0      | 10              | 10         | 0        | •  |     | • |     | • |   | • |     | · |   | •   |     | • |     |
| 2          | 0        | 334             | 32         | 0        | 1  | 1   | - | 2   | - | 0 |   | 0   | ١ | 0 | - [ | 14  | ١ | 583 |
| 27         | 1 0      | 1 0             | 1 0        | 0        |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
| 3 l        | 0        | 15              | 317        | 20       |    | 0   | - | 0   | - | 0 |   | 0   |   | 0 | -   | 1   |   | 231 |
| 4          | 1 0      | 0               | 0          | 0        |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
|            |          | 7               |            | 83       | ı  | 0   | ı | 11  | ı | 0 | ١ | 1   | ı | 0 | ı   | 2   | ı | 51  |
| 0          | 0        | 0               | 0          | 0        |    | 046 |   | 40  |   | 0 |   | 0   |   | 0 |     | 0   |   | 00  |
| 5  <br>  0 | 0<br>  0 | 0               | 1  <br>  0 | 1<br>  0 | ı  | 246 | ı | 43  | ı | 0 | ı | 8   | ı | 0 | 1   | 2   | ı | 28  |
| 6 I        |          | 10 1            |            | _        | ı  | 11  | ı | 455 | ı | 0 | ı | 0   | ı | 0 | 1   | 0   | ı | 17  |
| 10         | 1        | 10              | 28         | 10       | •  |     | • |     | • |   | • | Ū   | • |   | •   |     | • |     |
| 7          |          | 10 1            |            | 0        | 1  | 0   | ١ | 0   | ١ | 0 | ١ | 1   | ١ | 0 | 1   | 0   | ١ | 18  |
| 1 0        | 1 0      | 1 0             | 1 0        | 1 0      |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
| 8          | 0        | 0               | 0 l        | 0        |    | 0   | - | 0   | - | 0 |   | 293 |   | 0 | -   | 0   |   | 31  |
|            |          |                 |            | 0        |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
|            |          |                 |            | 0        | ١  | 6   | ١ | 10  | ١ | 0 | ١ | 0   | I | 0 | ١   | 0   | I | 0   |
|            |          |                 |            | 0        |    | 4   |   | 0   |   | 0 |   | ^   |   | 0 |     | 445 |   | 000 |
|            |          |                 | 0          | 0<br>  0 | ı  | 1   | ı | 0   | ı | 0 | ı | 0   | ı | 0 | ı   | 415 | ı | 222 |
|            |          |                 |            | 0        | ı  | 0   | ı | 11  | ı | 0 | ı | 0   | 1 | 0 | 1   | 75  | ı |     |
| 1585       |          | 0               |            | 0        |    | 0   | ' |     | ' | O | ' | Ü   | ' | O | '   | 10  | • |     |
| 12         |          |                 |            | 0        |    | 0   | ١ | 8   | ١ | 0 | ١ | 0   | ١ | 0 | ١   | 5   | ١ | 193 |
| 139        | 1 0      | 1 0             |            | 10       |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
| 13         | 0        | I 0 I           | 0 I        | 0        | -  | 0   | - | 11  | - | 0 |   | 0   | - | 0 | - [ | 0   | ١ | 1   |
|            | 136      |                 |            | 1 0      |    |     |   |     |   |   |   |     |   |   |     |     |   |     |
|            | 0        |                 |            | 0        | I  | 0   | I | 3   | I | 0 |   | 0   |   | 0 |     | 0   |   | 0   |
|            | 0        | 863             |            | 0        |    | 0   |   | 440 |   | 0 | , |     |   | 0 |     | 0   |   | 7   |
|            |          | 0  <br>  31     |            | 0<br>  0 | ı  | 2   | ı | 113 | ı | U | ١ | 1   | I | 0 | ١   | 0   | ı | 7   |
| 1 0        | 1 0      | 1 21            | 1 102      | 1 0      |    |     |   |     |   |   |   |     |   |   |     |     |   |     |

| 16  <br>  2 | 0<br>  0       | 1          | 4<br>  0        | I   | 0<br>  0  | I          | 0<br>  60 | I   | 0              | I  | 0   | I   | 0 | I | 0   | I | 0 | I | 2   | I | 4   |
|-------------|----------------|------------|-----------------|-----|-----------|------------|-----------|-----|----------------|----|-----|-----|---|---|-----|---|---|---|-----|---|-----|
| =====       | =====<br>= ind | ===<br>iar | =====<br>n - PC | :=: | <br>- 4 - | ==:<br>- ; |           |     | =====<br>ear = |    |     |     |   |   |     |   |   |   |     |   |     |
| =====       | ====           |            |                 | =:  |           | -=:        |           | ==  | ====           | == | === |     |   |   |     |   |   |   |     |   |     |
| =====       |                |            |                 |     | ize: 3    |            |           |     | ==             | == | === |     |   |   |     |   |   |   |     |   |     |
|             |                |            | _               |     | onfusi    | LOI        | n Mati    | ri: | X              | _  |     |     |   |   |     |   |   |   |     |   |     |
| Act /       |                |            |                 |     | 2         | 1          | 1         |     | E              |    | 6   |     | 7 |   | 0   |   | 9 |   | 10  |   | 11  |
| 12          | 1<br>  13      |            | 14              |     | 3<br>  15 |            | 4<br>  16 | '   | 5              | '  | O   | '   | ' | ' | 8   | ' | 9 | ' | 10  | ' | 11  |
|             | 0              | 1          |                 | ı   |           |            | 0         | ı   | 1              | ı  | 0   | ı   | 0 | ı | 13  | ı | 0 | ı | 0   | ı | 0   |
| 10          | 1 0            | •          | 1 0             | •   | 0         | '          | 1 0       | •   | -              |    | Ū   | •   | Ū | • | 10  | • | Ŭ |   | Ü   |   | Ŭ   |
| 2           | 0              | 1          | 166             | I   | 25        |            | 0         | Τ   | 1              | -  | 1   | ١   | 0 | Ι | 1   | ı | 0 | ı | 17  | ı | 210 |
| 14          | 1 0            |            | 1 0             |     | 0         |            | 1 0       |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
| 3 l         | 0              | -          | 2               |     | 160       |            | 4         | -   | 0              |    | 0   | - [ | 0 | - | 0   | - | 0 |   | 0   |   | 76  |
| 1 0         | 1 0            |            | 1 0             |     | 0         |            | 0         |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
| 4 l         | 0              | -          | 0               |     | 13        |            | 45        | -   | 0              |    | 1   |     | 0 |   | 0   |   | 0 |   | 0   |   | 0   |
| 1 0         | 0              |            | 1 0             |     | 0         |            | 0         |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
| 5 l         |                | 1          | 0               |     |           |            | 1         | ١   | 134            | ١  | 15  | ١   | 0 | ١ | 0   | ١ | 0 |   | 0   |   | 1   |
| 0           | 0              |            | 0               |     | 0         |            | 0         |     | 4 =            |    | 400 |     | • |   | •   |   | • |   | ^   |   | •   |
| 6 I         | 0              | ١          |                 | ١   |           | ١          | 0         | ı   | 15             | ١  | 192 | ı   | 0 | ١ | 0   | ı | 0 | ı | 0   | ı | 0   |
| 0           | 0              | 1          | 0               | ı   | 110       | 1          | 0         |     | 1              |    | 0   |     | 0 |   | 0   |   | 0 |   | 0   |   | 0   |
| 7  <br>  0  | 1 0            | 1          | 0               | '   | 10        |            | 1 0       | '   | 1              | '  | U   | '   | U | ' | 8   | ' | U | ' | 0   | ' | U   |
|             | 0              | ı          |                 | I   |           | ı          | 0         | ı   | 0              | ı  | 0   | ı   | 0 | ı | 154 | ı | 0 | ı | 0   | ı | 0   |
| 10          | 1 0            | '          | 0               | '   | 10        | '          | 1 0       | '   | Ü              | '  | Ü   | '   | v | ' | 101 | ' | Ü | ' | v   | ' | v   |
| 9 I         |                | ı          | 0               | ı   | 0         | ı          |           | Ι   | 2              | ı  | 2   | ١   | 0 | ı | 0   | Ι | 0 | ı | 0   | ı | 0   |
| 10          | 10             |            | 10              |     | 10        |            | 1 0       |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
| 10 l        | 0              | -          | 13              | 1   | 0         |            | 2         | -   | 0              | -  | 1   | -   | 0 | - | 1   | 1 | 0 | 1 | 211 | 1 | 74  |
| 3           | 0              |            | 1 0             |     | 0         |            | 0         |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
| 11          | 0              | -          | 43              |     | 10        |            | 6         | -   | 2              |    | 4   | -   | 0 | - | 0   |   | 0 |   | 67  |   | 610 |
| 1           | 0              |            | 1 0             |     | 0         |            | 0         |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
|             | 0              |            |                 | •   | 31        | •          |           | -   | 0              |    | 5   |     | 0 |   | 0   |   | 0 |   | 12  |   | 75  |
|             |                |            |                 |     |           |            | 0         |     | _              |    | _   |     |   |   | _   |   | _ |   | _   |   | _   |
|             | 0              |            |                 |     | 0         |            |           | ١   | 0              | ١  | 3   | ı   | 0 | ١ | 0   | ı | 0 | ı | 0   | ı | 0   |
| 0           | 54             |            |                 |     |           |            | 1 0       |     | 4              |    | 0   |     | 0 |   | 0   |   | 0 |   | ^   |   | 0   |
|             | 0<br>  0       |            | 0   370         |     |           |            | 0<br>  0  | 1   | 1              | ١  | 0   | ı   | 0 | ١ | 0   | ı | 0 | ١ | 0   | ١ | 0   |
|             | 0              |            | 0               |     |           |            | 0         | 1   | 9              | ı  | 38  | 1   | 0 | ı | 0   | 1 | 0 | ı | 0   | ı | 0   |
|             | 9              |            |                 |     | 38        |            | 0         | '   | 5              | '  | 50  | '   | O | ' | O   | ' | O | ' | U   | ' | O   |
|             | 0              |            | 0               |     |           |            | 0         | 1   | 0              | ı  | 0   | ı   | 0 | ı | 0   | 1 | 0 | ı | 1   | ı | 0   |
|             |                |            | 1 0             |     |           |            | 20        | •   |                | •  |     | •   |   | • |     | • |   | • |     | • |     |
|             |                |            |                 |     | nfusio    |            |           | ix  |                | _  |     |     |   |   |     |   |   |   |     |   |     |
| Act /       |                |            |                 |     |           |            |           |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
| 1           | 1              | -          | 2               | 1   | 3         |            | 4         |     | 5              | -  | 6   | -   | 7 | - | 8   |   | 9 |   | 10  |   | 11  |
|             |                |            |                 |     | 15        |            |           |     |                |    |     |     |   |   |     |   |   |   |     |   |     |
|             |                |            |                 |     | 0         |            |           |     | 0              |    | 0   |     | 0 |   | 31  |   | 0 |   | 0   |   | 0   |
| 1 0         | 0              |            | 1 0             |     | 0         |            | 0         |     |                |    |     |     |   |   |     |   |   |   |     |   |     |

| 2   0  | 2      | I 0 | l 221 | I 07    | 1 ( | `   |     | 2    | 1  | 1       |   | 0 |   | 0   | , | 0 |   | 22  |   | E2/             |
|--|--------|-----|-------|---------|-----|-----|-----|------|----|---------|---|---|---|-----|---|---|---|-----|---|-----------------|
| 3  |        |     |       |         |     |     | '   | J    | '  | 1       | ' | U | ' | U   | ' | U | ' | 55  | ' | J2 <del>4</del> |
| 3  |        |     |       |         |     |     | 1   | 0    | ı  | 0       | ı | 0 | ı | 0   | ı | 0 | 1 | 0   | ı | 164             |
| 4   0   6   48   114   1   4   0   0   0   0   1   0   0   1   0   1   0   1   0   1   1   |        |     |       |         |     |     | •   |      | •  |         | • |   | • |     | • |   | · |     | • |                 |
| 5  | 4      | 0   | 6     |         | 1   | L14 | 1   | 1    | ١  | 4       | ١ | 0 | ١ | 0   | 1 | 0 | ١ | 1   | ١ | 0               |
| 3  | 4      | 1 0 | 0     | 10      |     | 0   |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 6  | 5      | 4   | 1     | 0       | 3   | 3   | -   | 264  | -  | 42      | - | 0 | - | 5   | - | 0 | - | 5   | - | 2               |
| 0  | 3      | 1 0 | 0     | 1 0     |     | 0   |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 7  | 6      |     | 0     |         | (   | )   | -   | 54   |    | 418     | - | 0 | - | 0   |   | 0 |   | 2   |   | 1               |
| 0  | 1 0    |     |       | 35      |     |     |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 8  |        |     |       |         | (   |     | ١   | 0    | ١  | 0       | ١ | 0 | ١ | 19  | ١ | 0 | ١ | 0   | ı | 0               |
| 0  |        |     |       |         |     |     |     | •    |    | ^       |   | • |   | 004 |   | • |   | •   |   | •               |
| 9  |        |     |       |         |     |     | ı   | 0    | ı  | 0       | ı | 0 | ı | 324 | ı | 0 | ı | 0   | ı | 0               |
| 0  |        |     |       |         |     |     |     | 0    | 1  | 0       |   | 0 |   | 0   | , | 0 |   | 0   |   | 0               |
| 10   |        |     |       |         | 1 ( |     | 1   | 0    | '  | 0       | ' | U | ' | U   | ' | U | ı | U   | ı | U               |
| 4  |        |     |       |         | l ( |     | 1   | 0    | ı  | 1       | ı | 1 | ı | 1   | ı | 0 | 1 | 444 | ı | 186             |
| 11    0  |        |     |       |         |     |     | '   | Ü    | '  | -       | ' | - | ' | -   | ' | V | ' | 111 | ' | 100             |
| 1425   14  |        |     |       |         |     |     | 1   | 10   | ı  | 8       | ı | 0 | ı | 0   | ı | 0 | 1 | 175 | ı |                 |
| 12    0  |        |     | •     |         | •   |     | i   |      | ·  |         | · | - | · | -   | · |   | · |     | · |                 |
| 13   |        |     | 63    | 111     | (   | )   | i   | 0    | ١  | 7       | ١ | 0 | ١ | 0   | Ι | 0 | 1 | 31  | ı | 174             |
| 0  | 45     | 10  | 1 0   | 10      |     | 0   |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 14   | 13     | 0   | l 0   | 0       | 1   | L   | -   | 0    | -  | 9       | - | 0 | - | 0   | - | 0 | 1 | 0   | ١ | 0               |
| 0  | 10     | 138 | 1 0   | 1 0     |     | 0   |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 15   | 14     | 0   | 0     | 0       | (   | )   | -   | 2    |    | 3       |   | 0 |   | 0   |   | 0 | - | 0   |   | 0               |
| 3  |        | 1 0 |       |         |     | 0   |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 16   0   7   0   0   0   0   0   0   0   0   |        |     |       |         |     |     |     | 26   |    | 97      |   | 0 |   | 0   |   | 0 | ı | 1   |   | 0               |
| 1  |        |     |       |         |     |     |     | _    |    | _       |   | _ |   |     |   |   |   | _   |   |                 |
| ======================================   |        |     |       |         |     |     | ١   | 0    | ı  | 0       | ı | 0 | ı | 0   | ı | 0 | ı | 5   | ı | 1               |
| ======================================   | 1      |     |       |         |     |     |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| ====== Train Size: 30% ===================================   | ====== |     |       |         |     |     |     |      | == | <br>=== |   |   |   |     |   |   |   |     |   |                 |
| Training Confusion Matrix Act / Predictions    1   |        |     |       |         |     |     |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| Training Confusion Matrix Act / Predictions    1   | =====  | =   | Train | Size: 3 | 30% |     |     | ==   | == | ===     |   |   |   |     |   |   |   |     |   |                 |
| Act / Predictions    1   |        | Tra |       |         |     | Mat | ri: | x    | _  |         |   |   |   |     |   |   |   |     |   |                 |
| 12   | Act /  |     | _     |         |     |     |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 1         14         0         0         0         0         0         0         0         0         0         0         0         0         0         0         1         0         0         1         0         1         0         1         0         1         0         1         0         1         0 |        | 1 1 | 1 2   | 3       | 4   | 1   | -   | 5    | -  | 6       | - | 7 | - | 8   | - | 9 | - | 10  | - | 11              |
| 0  | 12     | 13  | 14    | 15      |     | 16  |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 2         0         361         10         0         1         2         0         1         0         8         42           10         0         0         0         0         0         0         0         1         24           6         0         0         0         0         0         0         1         24           4         0         0         2         0         0         0         1         0           1         0                           | 1      |     |       |         | (   | )   | -   | 0    |    | 0       | - | 0 | - | 0   |   | 0 |   | 1   |   | 0               |
| 10   |        |     |       |         |     |     |     |      |    |         |   |   |   |     |   |   |   |     |   |                 |
| 3         0         11         196         4         0         0         0         0         0         1         24           6         0         0         0         0         0         0         0         1         1         0         4         0         0         8         47         0         2         0         0         0         1         0           1         0                       |        |     |       |         |     |     |     | 1    | ١  | 2       | ١ | 0 | ١ | 1   | ١ | 0 | ı | 8   | ı | 42              |
| 6  | •      |     |       |         |     |     |     | •    |    | •       |   | • |   | •   |   | • | , |     |   | 0.1             |
| 4   0   0   8   47   0   2   0   0   0   1   0   1   0   1   0   0   |        |     |       |         |     |     | ı   | 0    | ı  | 0       | ١ | 0 | ١ | 0   | ı | 0 | ı | 1   | ı | 24              |
| 1   0   0   0   0  |        |     |       |         |     |     | ı   | 0    | ı  | 2       | ı | 0 | ı | 0   | ı | 0 | ı | 1   | ı | 0               |
|  |        |     |       |         |     |     | 1   | U    | ı  | ۷       | ı | U | ı | U   | ı | U | ı | T   | ı | U               |
| 5   1   0   0   2   148   0   1   2   0   0   0  | 5      |     |       | 10      |     |     | ı   | 148  | ı  | 0       | ı | 1 | ı | 2   | ı | 0 | ı | 0   | ı | 0               |
|  |        |     |       |         |     |     | '   | _ 10 | '  | -       | ' | _ | ' | _   | ' | - | ' | -   | ' | -               |

| 6                  | 0  | 1 0  | 1 0   | 1 0  | 3   | 211  | 1 0  | 1 0   | 1 0   | 1 0  | 1 0   |
|--------------------|--|--|---|--|---|--|--|---|---|--|---|
|                    | 0  | 1  | 3   | 0  | 1   | 1 0  | 6  | 2   | 1 0   | 1 0  | 0   |
|                    | 0  | 0  | 0   | 0  | 0   | 1 0  | 1 0  | 154   | 1 0   | 0  | 0   |
|                    | 0  | 0  | 0   | 0  | 1   | 3  | 1 0  | 1 0   | 1 0   | 1 0  | 0   |
| 0<br>  10  <br>  3 | 0<br>  0<br>  0  | 0<br>  6<br>  0  | 0<br>  2<br>  0   | 0  | 0   | 2  | 1 0  | 1   | 1 0   | 280  | 10  |
|                    | 0  | 19   | 11  | 1  | 2   | 3  | 1 0  | 1 0   | 1 0   | 28   | 673   |
| 12  <br>  101      | 0  | 30   | 4   | 10   | 0   | 1 0  | 1 0  | 1 0   | 1 0   | 8  | 18  |
| 13                 | 0<br>  55  | 0  | 10  | 10   | 0   | 2  | 1 0  | 1 0   | 1 0   | 0  | 0   |
|                    | 0   1  | 0  | 1 0   | 0  | 1   | 1  | 1 0  | 1 0   | 1 0   | 1 0  | 0   |
| 15  <br>  0        | 0<br>  7   | 0   11   | 0<br>  66   | 0<br>  0   | 1   | 37   | 1 0  | 1 0   | 1 0   | 0  | 0   |
| 16  <br>  1        | 0<br>  0   | 0<br>  0   | 0<br>  0  | 0<br>  19  | 0   | 1 0  | 1 0  | 1 0   | 1 0   | 0  | 1   |
|                    | Te   | sting C  | onfusio   | n Matr   | ix  |  |  |   |   |  |   |
|                    |  |  |   |  |   |  |  |   |   |  |   |
| Act /              | Pre  | diction  | S   |  |   |  |  |   |   |  |   |
|                    | 1  | 1 2  | 3   | 4  |   | 6  | 7  | 8   | 9   | 10   | 11  |
| 12                 | 1<br>  13  | 2<br>  14  |   | 4<br>  16<br>  0   |   | 6<br>  0   | 7<br>  0   | 8   | 9<br>  0  | 10<br>  0  | 11<br>  0   |
| 12                 | 1<br>  13  | 2<br>  14  | 3<br>  15   | 16   |   |  |  |   |   |  |   |
| 12<br>1            | 1<br>  13<br>  27<br>  0   | 2<br>  14<br>  0<br>  0<br>  731   | 3<br>  15<br>  0<br>  0<br>  35   | 16<br>  0<br>  0<br>  1  |   |  |  |   |   |  |   |
| 12<br>1   0        | 1<br>  13<br>  27<br>  0   | 2<br>  14<br>  0<br>  0  | 3<br>  15<br>  0<br>  0   | 16<br>  0<br>  0   | 1 0   | 0  | 1 0  | 4   | 0   | 1 0  | 0   |
| 12<br>1            | 1<br>  13<br>  27<br>  0<br>  0                                    | 2<br>  14<br>  0<br>  0<br>  731<br>  0  | 3<br>  15<br>  0<br>  0<br>  35<br>  0  | 16<br>  0<br>  0<br>  1<br>  0   | 0<br>  3  | 0  | 0<br>  1   | 4   | I 0<br>I 0  | 0<br>  25  | 0<br>  148  |
| 12<br>1            | 1<br>  13<br>  27<br>  0<br>  0<br>  0<br>  0<br>  1               | 2<br>  14<br>  0<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20  | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129   | 0<br>  3  | 0  | 0<br>  1   | 4   | I 0<br>I 0  | 0<br>  25  | 0<br>  148  |
| 12<br>1            | 1<br>  13<br>  27<br>  0<br>  0<br>  0<br>  0<br>  1<br>  0        | 2<br>  14<br>  0<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0   | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0  | 0<br>  3<br>  1<br>  2                                | 0<br>  1<br>  0<br>  7                               | 0<br>  1<br>  0<br>  0                                     | 4<br>  0<br>  0<br>  0                                      | 0<br>  0<br>  0<br>  0                                    | 0<br>  25<br>  8<br>  13                             | 0<br>  148<br>  69<br>  4                             |
| 12<br>1            | 1<br>  13<br>  27<br>  0<br>  0<br>  0<br>  0<br>  1<br>  0<br>  5 | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0   | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0  | 0<br>  3<br>  1<br>  2                                | 0<br>  1<br>  0<br>  7                               | 0<br>  1<br>  0<br>  0                                     | 4<br>  0<br>  0   | 0<br>  0<br>  0<br>  0                                    | 0<br>  25<br>  8                                     | 0<br>  148<br>  69                                    |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0   | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0   | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0  | 0<br>  3<br>  1<br>  2<br>  298                       | 0<br>  1<br>  0<br>  7                               | 0<br>  1<br>  0<br>  0                                     | 4<br>  0<br>  0<br>  0                                      | 0<br>  0<br>  0<br>  0                                    | 0<br>  25<br>  8<br>  13                             | 0<br>  148<br>  69<br>  4                             |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0   | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0  | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0  | 0<br>  3<br>  1<br>  2<br>  298                       | 0<br>  1<br>  0<br>  7<br>  5                        | 0<br>  1<br>  0<br>  0<br>  0                              | 4<br>  0<br>  0<br>  0<br>  3                               | 0<br>  0<br>  0<br>  0                                    | 0<br>  25<br>  8<br>  13<br>  9                      | 0<br>  148<br>  69<br>  4<br>  3                      |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  3<br>  0  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17   | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0   | 0<br>  3<br>  1<br>  2<br>  298                       | 0<br>  1<br>  0<br>  7<br>  5                        | 0<br>  1<br>  0<br>  0<br>  0                              | 4<br>  0<br>  0<br>  0<br>  3                               | 0<br>  0<br>  0<br>  0                                    | 0<br>  25<br>  8<br>  13<br>  9                      | 0<br>  148<br>  69<br>  4<br>  3                      |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  3<br>  0  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17   | 16<br>  0<br>  1<br>  0<br>  126<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0  | 0<br>  3<br>  1<br>  2<br>  298<br>  12<br>  0        | 0<br>  1<br>  0<br>  7<br>  5<br>  476<br>  0        | 0<br>  1<br>  0<br>  0<br>  0<br>  14                      | 4<br>  0<br>  0<br>  0<br>  3<br>  0<br>  5                 | 0<br>  0<br>  0<br>  0<br>  0<br>  0                      | 0<br>  25<br>  8<br>  13<br>  9<br>  0<br>  0        | 0<br>  148<br>  69<br>  4<br>  3<br>  0               |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  3<br>  0  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17<br>  0                                    | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0<br>  0   | 0<br>  3<br>  1<br>  2<br>  298<br>  12               | 0<br>  1<br>  0<br>  7<br>  5<br>  476               | 0<br>  1<br>  0<br>  0<br>  0                              | 4<br>  0<br>  0<br>  0<br>  3<br>  0                        | 0<br>  0<br>  0<br>  0<br>  0                             | 0<br>  25<br>  8<br>  13<br>  9<br>  0               | 0<br>  148<br>  69<br>  4<br>  3<br>  0               |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  3<br>  0<br>  0   | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17<br>  0<br>  0                             | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0<br>  0   | 0<br>  3<br>  1<br>  2<br>  298<br>  12<br>  0<br>  0 | 0<br>  1<br>  0<br>  7<br>  5<br>  476<br>  0        | 0<br>  1<br>  0<br>  0<br>  0<br>  14<br>  0               | 4<br>  0<br>  0<br>  0<br>  3<br>  0<br>  5<br>  324        | 0<br>  0<br>  0<br>  0<br>  0<br>  0                      | 0<br>  25<br>  8<br>  13<br>  9<br>  0<br>  0        | 0<br>  148<br>  69<br>  4<br>  3<br>  0<br>  0        |
| 12                 | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  3<br>  0<br>  0<br>  0                                      | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17<br>  0<br>  0<br>  0                      | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0<br>  0<br>  0                                    | 0<br>  3<br>  1<br>  2<br>  298<br>  12<br>  0        | 0<br>  1<br>  0<br>  7<br>  5<br>  476<br>  0        | 0<br>  1<br>  0<br>  0<br>  0<br>  14                      | 4<br>  0<br>  0<br>  0<br>  3<br>  0<br>  5                 | 0<br>  0<br>  0<br>  0<br>  0<br>  0                      | 0<br>  25<br>  8<br>  13<br>  9<br>  0<br>  0        | 0<br>  148<br>  69<br>  4<br>  3<br>  0               |
| 12<br>1            | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  3<br>  0<br>  0<br>  0<br>  0                               | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17<br>  0<br>  0<br>  0<br>  0               | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0                             | 0<br>  3<br>  1<br>  2<br>  298<br>  12<br>  0<br>  0 | 0<br>  1<br>  0<br>  7<br>  5<br>  476<br>  0<br>  0 | 0<br>  1<br>  0<br>  0<br>  0<br>  14<br>  0               | 4<br>  0<br>  0<br>  0<br>  3<br>  0<br>  5<br>  324<br>  0 | 0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  2        | 0<br>  25<br>  8<br>  13<br>  9<br>  0<br>  0<br>  0 | 0<br>  148<br>  69<br>  4<br>  3<br>  0<br>  0<br>  0 |
| 12<br>1            | 1  | 2  | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17<br>  0<br>  0<br>  0<br>  0<br>  0        | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0               | 0<br>  3<br>  1<br>  2<br>  298<br>  12<br>  0<br>  0 | 0<br>  1<br>  0<br>  7<br>  5<br>  476<br>  0        | 0<br>  1<br>  0<br>  0<br>  0<br>  14<br>  0               | 4<br>  0<br>  0<br>  0<br>  3<br>  0<br>  5<br>  324        | 0<br>  0<br>  0<br>  0<br>  0<br>  0                      | 0<br>  25<br>  8<br>  13<br>  9<br>  0<br>  0        | 0<br>  148<br>  69<br>  4<br>  3<br>  0<br>  0<br>  0 |
| 12                 | 1  | 2<br>  14<br>  0<br>  731<br>  0<br>  35<br>  0<br>  2<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  10<br>  0<br>  10<br>  1 | 3<br>  15<br>  0<br>  0<br>  35<br>  0<br>  431<br>  0<br>  20<br>  0<br>  0<br>  0<br>  17<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0 | 16<br>  0<br>  0<br>  1<br>  0<br>  26<br>  0<br>  129<br>  0<br>  6<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0 | 0<br>  3<br>  1<br>  2<br>  298<br>  12<br>  0<br>  0 | 0<br>  1<br>  0<br>  7<br>  5<br>  476<br>  0<br>  0 | 0<br>  1<br>  0<br>  0<br>  0<br>  14<br>  0<br>  0<br>  5 | 4<br>  0<br>  0<br>  0<br>  3<br>  0<br>  5<br>  324<br>  0 | 0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  2<br>  0 | 0<br>  25<br>  8<br>  13<br>  9<br>  0<br>  0<br>  0 | 0<br>  148<br>  69<br>  4<br>  3<br>  0<br>  0<br>  1 |

| 12           | 0        | 103               | 15         | 0         | I  | 3   | 1   | 1   |   | 0 |   | 0   | 1 | 0 | I | 28  | ١ | 64  |
|--------------|----------|-------------------|------------|-----------|----|-----|-----|-----|---|---|---|-----|---|---|---|-----|---|-----|
| 217          | 1 0      | 0                 | 0          | 0         |    | _   |     |     |   | _ |   | _   |   | _ |   | _   |   |     |
| 13           | 0        | 10 1              | 0          | 0         | ı  | 0   | ı   | 6   | ١ | 0 | ١ | 0   | ı | 0 | ı | 0   | ı | 1   |
| 0<br>  14    | 141<br>0 | 0<br>  0          | 0<br>0     | 0<br>  0  | ı  | 2   | ı   | 6   | ı | 0 | ı | 0   | ı | 0 | ı | 0   | ı | 0   |
| 0            | 10       | 870               | 13         | 0         | •  | _   | •   | Ü   | ' | Ü | ' | Ü   | • | Ů | • | Ü   | ' | Ü   |
| 15           | _        | 10 1              | 0          | 1 0       | Ι  | 6   | 1   | 103 | - | 0 | 1 | 0   | 1 | 0 | I | 4   | ١ | 0   |
| 1 2          | 11       | 37                | 101        | 0         |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
| 16           |          | 5                 |            | 1 0       |    | 0   | I   | 0   | - | 0 |   | 0   |   | 0 |   | 1   |   | 5   |
| 1            | 0        | 1 0               | 0          | 60        |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
|              |          | ======<br>n - PCA |            |           |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
|              |          | =======           |            |           | -  |     |     |     |   |   |   |     |   |   |   |     |   |     |
|              | =        | Train S           | ize: 3     | 0%        |    | ==: | === | === |   |   |   |     |   |   |   |     |   |     |
|              | Tra      | aining C          |            |           | ix |     |     |     |   |   |   |     |   |   |   |     |   |     |
| Act /        | Pre      | dictions          |            |           |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
| ı            | 1        | 2                 | 3          | 4         |    | 5   | -   | 6   |   | 7 | - | 8   | 1 | 9 |   | 10  |   | 11  |
| 12           | 13       | 14                | 15         | 16        |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
| 1            | 14       | 10 1              | 0          | 0         |    | 0   |     | 0   |   | 0 | ١ | 0   |   | 0 |   | 0   |   | 1   |
| 0            | 1 0      | 0                 | 0          | 0         |    | •   |     | 4   |   | ^ |   | •   |   | • |   | 0.0 |   | 400 |
|              |          |                   |            | 1 2       |    | 0   | ı   | 1   | ١ | 0 | ١ | 0   | ı | 0 | ı | 26  | ı | 199 |
| 9            | 0        | 0                 | 120        | 0         |    | ^   |     | 0   |   | ^ |   | 0   |   | ^ |   | ^   |   | 60  |
| 3            | 0<br>  0 | 22  <br>  0       | 132<br>  0 | 16<br>  0 |    | U   | ١   | 0   | ١ | 0 | 1 | 0   | 1 | 0 | ı | 0   | 1 | 68  |
| 4            | 0        |                   | 13         | 29        | ı  | 0   | ı   | 1   | ı | 0 | ī | 0   | ı | 0 | ı | 0   | ı | 7   |
| 1            | 10       | 10                | 0          | 0         | '  | Ü   | '   | -   | ' | Ü | ' | v   | • | v | ' | v   | ' | •   |
| 5 I          | 1        | 2                 | 0          | 1         | ı  | 107 | ı   | 26  | ı | 1 | ī | 0   | Ι | 0 | ı | 1   | ı | 0   |
| 5            | 10       |                   | 10         | . 1 0     | •  |     | •   |     | • |   | • |     | • |   | • |     | • |     |
| 6 I          | 0        | I 0 I             | 0          | 1 0       | 1  | 12  | 1   | 196 | - | 0 | 1 | 0   | 1 | 0 | 1 | 4   | Ι | 0   |
| 1 0          | 10       | 1 0               | 6          | 1 0       |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
| 7            | 0        | 0                 | 0          | 0         | 1  | 0   | -   | 0   |   | 9 |   | 0   | - | 0 |   | 0   | 1 | 0   |
| 1 0          | 1 0      | 1 0               | 10         | 0         |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
|              |          | 0                 |            |           |    | 0   |     | 0   |   | 3 | ١ | 150 |   | 0 |   | 0   | ı | 0   |
|              |          |                   | 0          | 0         |    | _   |     |     |   |   |   |     |   | _ |   |     |   |     |
|              |          |                   |            |           | I  | 0   | ı   | 1   | ١ | 0 | ı | 0   | ı | 3 | ı | 0   | ı | 0   |
|              |          |                   | 0          | 0         |    | ^   |     | 0   |   | 0 |   | 0   |   | 0 |   | 170 |   | 00  |
| 10  <br>  15 | 0<br>  0 | 36  <br>  0       | 0<br>  0   | 0<br>  0  |    | U   | ı   | 0   | ١ | 0 | ١ | 0   | ı | 0 | ı | 172 | 1 | 82  |
|              |          |                   |            | 0         | ı  | 0   | ı   | 6   | ı | 0 | ī | 0   | ı | 0 | ı | 32  | ı | 588 |
|              | 10       | 10                | 0          | 0         | '  | O   | '   | O   | ' | O | ' | O   | ' | O | ' | 02  | ' | 500 |
| 12           |          |                   |            | 1 0       | ı  | 0   | ı   | 3   | ı | 0 | ı | 0   | ı | 0 | ı | 2   | ı | 66  |
|              | 1 0      | 10                |            | 0         | •  | •   | •   |     |   |   | • |     | • |   | • | _   | • |     |
|              |          |                   |            | 1 0       | Ι  | 0   | ı   | 1   | ı | 0 | ı | 0   | Ι | 0 | ı | 0   | ı | 0   |
|              |          |                   |            | 10        |    |     | -   |     | - |   |   |     |   |   |   |     |   |     |
|              |          |                   |            | 1 0       | 1  | 0   | 1   | 0   | - | 0 |   | 0   | 1 | 0 | I | 0   |   | 0   |
| 1 0          | 10       | 359               | 15         | 1 0       |    |     |     |     |   |   |   |     |   |   |   |     |   |     |
|              |          | 0                 |            |           | 1  | 5   | -   | 35  |   | 0 |   | 0   | 1 | 0 | I | 0   |   | 0   |
| 10           | 4        | 38                | 40         | 0         |    |     |     |     |   |   |   |     |   |   |   |     |   |     |

| 16   0        |           |        | 0     | I        | 0      | I   | 0   | I | 0  | I | 0   | I | 0  | I | 0   |   | 0   |
|---------------|-----------|--------|-------|----------|--------|-----|-----|---|----|---|-----|---|----|---|-----|---|-----|
| 10 10         | 0         | 0      | 20    | <u>.</u> |        |     |     |   |    |   |     |   |    |   |     |   |     |
| T<br>Act / Pr | esting Co |        | Maur. | ΙX       |        | _   |     |   |    |   |     |   |    |   |     |   |     |
| _             |           |        | 4     |          | 5      |     | 6   |   | 7  |   | 8   | ı | 0  |   | 10  |   | 11  |
| 1             |           |        | 4     | ı        | 5      | ı   | 6   | 1 | ,  | 1 | 0   | ı | 9  | 1 | 10  | ı | 11  |
| 12   13       |           | 15     | 16    |          | ^      |     | ^   |   | 0  |   | 0   |   | ^  |   | ^   |   | ^   |
| 1   31        | 0         |        | 0     | ı        | 0      | ı   | 0   | ı | 0  | ١ | 0   | I | U  | ı | 0   | ı | 0   |
|               | 0         | 0      | 0     |          |        |     | 0   |   | •  |   | •   |   | •  |   | 0.0 |   | 450 |
| 2   0         |           |        | 0     | ı        | 1      | ı   | 2   | ı | 0  | ١ | 0   | I | 0  | ı | 66  | ı | 453 |
| 35   0        | 0         | 10     | 1 0   |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 3   0         | 53        |        | 30    | ١        | 0      | ١   | 0   | ı | 0  | ١ | 0   | ı | 0  | ı | 0   | ı | 154 |
| 10   0        | 0         | 0      | 1 0   |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 4   0         | 34        |        | 78    | ١        | 0      | ı   | 4   | ı | 0  |   | 0   |   | 0  | ı | 0   | ı | 9   |
| 7   0         | 1 0       | 1 0    | 1 0   |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 5   4         | 8         |        |       |          | 214    |     | 57  | ı | 4  |   | 0   |   | 0  |   | 3   | ı | 0   |
| 9   0         | 0         | 24     | 1     |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 6   0         | 0         | 0 I    | 0     |          | 38     |     | 442 |   | 0  |   | 0   |   | 0  |   | 7   |   | 1   |
| 3   1         | 1         | 19     | 1 0   |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 7   0         | 0         | 0 I    | 0     |          | 0      |     | 0   |   | 18 |   | 1   |   | 0  |   | 0   |   | 0   |
| 0   0         | 0         | 0      | 10    |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 8   0         | 0         | 0 I    | 0     |          | 0      |     | 0   |   | 8  |   | 316 |   | 0  |   | 0   |   | 0   |
| 0   0         | 0         | 1 0    | 10    |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 9   0         | 0         | 0 I    | 0     |          | 1      | -   | 3   | - | 0  | - | 0   |   | 12 |   | 0   |   | 0   |
| 0   0         | 1 0       | 1 0    | 10    |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 10   0        | 83        | 4 l    | 0     | -        | 0      | -   | 1   | - | 2  | - | 0   |   | 0  | 1 | 369 | 1 | 179 |
| 29   0        | 10        | 10     | 10    |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 11   0        | 144       | 60 l   | 1     | 1        | 0      | 1   | 15  | 1 | 0  | 1 | 0   | I | 0  | Ι | 84  | Ι |     |
| 1342   66     | 0         | 0      | 0     | Ι        | 0      |     |     |   |    |   |     |   |    |   |     |   |     |
| 12   0        | 126       | 62 l   | 0     | Ι        | 0      | Ι   | 4   | Ι | 0  | Ι | 0   | I | 0  | Ι | 3   | ı | 163 |
| 71   0        | 10        | 1      | 1     |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| 13   0        | 0         | 0      | 0     | Ι        | 0      | Ι   | 1   | Ι | 0  | Ι | 0   | I | 0  | Ι | 0   | Ι | 0   |
| 1   14        |           | 5      | 1 0   |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
|               | 10 1      |        | •     | ı        | 1      | ı   | 1   | ı | 0  | ı | 0   | I | 0  | ı | 0   | ı | 0   |
| 10 10         | 857       |        |       | ·        |        | ·   |     | • |    | • |     | • |    | • |     | • |     |
| 15   0        |           |        |       | ı        | 14     | ı   | 88  | ī | 0  | ī | 0   | ı | 0  | ī | 2   | ī | 0   |
| 4   5         | 69        |        |       | •        |        | ·   |     | · |    | Ċ |     | • |    | Ċ |     | · |     |
| 16   0        | 10        |        |       | 1        | 0      | ı   | 0   | ı | 0  | ı | 0   | ı | 0  | ı | 0   | ı | 0   |
| 1   0         | 0         |        | 61    | •        | •      | ·   | •   | · |    | Ċ |     | • | -  | Ċ | •   | · |     |
| ========      |           |        |       | ===      |        | ==: | === |   |    |   |     |   |    |   |     |   |     |
| ====== in     | dian - LD | A - 15 | - svm | rł       | of === | ==: | === |   |    |   |     |   |    |   |     |   |     |
| ========      |           |        | -     | _        |        |     |     |   |    |   |     |   |    |   |     |   |     |
| =====         | Train S   |        |       |          | ===    |     |     |   |    |   |     |   |    |   |     |   |     |
| Т             |           |        |       |          |        |     |     |   |    |   |     |   |    |   |     |   |     |
| Act / Pr      | _         |        |       |          | -      |     |     |   |    |   |     |   |    |   |     |   |     |
|               | 2         |        | 4     | ı        | 5      | ı   | 6   | ı | 7  | ı | 8   | ı | g  | ı | 10  | ı | 11  |
|               | 1 2 1     |        |       | '        | J      | '   | J   | ' | '  | ' | 5   | ' | J  | ' | 10  | ' | 11  |
|               | 0         |        |       | ı        | 0      | ı   | 0   | ı | ٥  | ı | ٥   | ı | ٥  | ı | 0   | ı | 0   |
| 0   0         | 10        |        |       | '        | v      | '   | v   | 1 | V  | ' | J   | ' | •  | ' | J   | 1 | J   |
| 1010          | 1 0       | 1 0    | 1 0   |          |        |     |     |   |    |   |     |   |    |   |     |   |     |

| 2 l           |          | 410        | 5          | (    | )         | ١  | 0   | ١ | 0   | ١ | 0  | ١ | 0   | I | 0 | I | 7   | I | 12  |
|---------------|----------|------------|------------|------|-----------|----|-----|---|-----|---|----|---|-----|---|---|---|-----|---|-----|
| 1<br>3        | 0<br>0   | 0<br>  9   | 0<br>  219 |      | 0<br>2    | ı  | 0   | ı | 0   | ı | 0  | ı | 0   | 1 | 0 | ı | 0   | 1 | 11  |
| 1             | 1 0      | 0          | 0          |      | 0         |    | Ü   | ' | Ü   |   |    | ' | Ü   | ' | Ü |   | Ü   |   |     |
| 4  <br>  0    | 0<br>  0 | 0<br>  0   | 1          | !    | 58<br>  0 |    | 0   |   | 0   | ١ | 0  |   | 0   |   | 0 |   | 0   |   | 0   |
| 5 I           |          | 10         | 10         |      | )         | I  | 152 | I | 1   | ١ | 0  | I | 0   | ١ | 0 | I | 0   | 1 | 0   |
| 1<br>6        | 0<br>0   | 0<br>  0   | 0<br>  0   |      | ) 0<br>)  |    | 0   |   | 218 |   | 0  |   | 0   | 1 | 0 |   | 0   | 1 | 0   |
| 0             | 1 0      | 0          | 10         |      | 0         | '  | U   | ' | 210 | ' | O  | ' | U   | ' | O | ' | O   | ' | U   |
| •             | 0        | 0          | 0          |      | )         |    | 0   |   | 0   | ١ | 9  |   | 0   |   | 0 |   | 0   |   | 0   |
| 0<br>  8      | 0<br>0   | 0<br>  0   | 0<br>  0   |      | 0         | ١  | 0   | ١ | 0   | ١ | 0  | ١ | 154 | ١ | 0 | ١ | 0   | 1 | 0   |
| 0             | 0        | 0          | 0          |      | 0         |    | •   |   | •   |   | •  |   | •   |   | 4 |   | •   |   | •   |
| 9  <br>  0    | 0<br>  0 | 0<br>  0   | 0          |      | )<br>  0  | ١  | 0   | ı | 0   | ١ | 0  | ı | 0   | ı | 4 | ı | 0   | ı | 0   |
| 10            | 0        | 1          | 1 0        |      | )         | ١  | 0   | ١ | 0   | ١ | 0  | ١ | 0   | ١ | 0 | I | 289 |   | 15  |
| 0<br>11       | 0<br>0   | 0<br>  15  | 0<br>  0   |      | )         | ı  | 1   | ı | 0   | ı | 0  | ı | 0   | 1 | 0 | ı | 12  | 1 | 715 |
| 10            | 1 0      | 0          | 10         |      | 0         | '  | -   | ' | Ü   |   | Ü  | ' | Ü   | ' | Ü | ' | 12  | ' | 110 |
| 12  <br>  157 | 0<br>  0 | 1          | 4          |      | )<br>  0  | ١  | 0   |   | 0   | ١ | 0  |   | 0   |   | 0 | I | 0   |   | 0   |
| 13            | 0        | 0          | 10         |      | )         | ı  | 0   | ١ | 0   | ١ | 0  | ١ | 0   | ١ | 0 | ı | 0   | I | 0   |
| 0             | 57       | 0          | 0          |      | 0         |    | •   |   | •   |   |    |   |     |   |   |   | •   |   | •   |
| 14  <br>  0   | 0<br>  0 | 0<br>  374 | 0<br>:     |      | )<br>  0  | ١  | 0   | ı | 0   | ١ | 0  | ı | 0   | ı | 0 | ı | 0   | ١ | 0   |
|               | 0        | 10         | 0          |      | )         | ı  | 0   | ı | 0   | ١ | 0  | ı | 0   | ı | 0 | Ι | 0   | I | 0   |
| 10            | 10       | 5          | 11         |      | I 0       |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| 16            | 0        | 0          | 1 0        |      | )         | 1  | 0   | ١ | 0   | ١ | 0  | ١ | 0   | Ι | 0 | 1 | 0   | Ι | 0   |
| 10            | 1 0      | 1 0        | 10         |      | 21        |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
|               |          | sting C    |            | on l |           | ix |     | - |     |   |    |   |     |   |   |   |     |   |     |
| Act /         |          | diction    |            |      |           |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| I             | 1        | 2          | 3          | 4    | 4         | -  | 5   | - | 6   | - | 7  | - | 8   | - | 9 | - | 10  | 1 | 11  |
| 12            | 13       | 14         | 15         |      | 16        |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| 1             | 31       | 1 0        | 1 0        | (    | 0         |    | 0   |   | 0   | - | 0  |   | 0   |   | 0 | - | 0   | - | 0   |
| 1 0           | 10       | 0          | 10         |      | 0         |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| 2             | 0        |            | 11         | !    | 5         | -  | 0   | - | 0   | - | 0  | - | 0   |   | 0 | - | 24  | - | 56  |
| 7             | 10       | 0          | 1          |      | 0         |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| 3             | 0        | 34         | 488        |      | 15        |    | 0   |   | 0   | - | 0  |   | 0   |   | 0 | - | 1   |   | 46  |
| 4             | 10       | 0          | 10         |      |           |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| 4             | 0        | 5          | 24         | :    | 141       |    | 4   |   | 0   | - | 0  |   | 0   |   | 0 | - | 0   |   | 2   |
| 10            | 10       | 0          | 2          |      | 0         |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
| 5             | 0        | 0          | 0          | (    | )         |    | 316 |   | 3   |   | 0  |   | 0   |   | 0 | - | 0   |   | 4   |
| 3             |          |            | 3          |      |           |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
|               |          | 0          | 1 0        |      | 0         |    | 0   | - | 504 |   | 0  | - | 0   |   | 0 | - | 3   |   | 0   |
|               | 10       |            | 4          |      | 0         |    |     |   |     |   |    |   |     |   |   |   |     |   |     |
|               |          |            | 1 0        |      |           | -  | 0   |   | 0   |   | 18 |   | 0   |   | 0 | - | 0   |   | 0   |
| 1 0           | 0        | 0          | 1          |      | 0         |    |     |   |     |   |    |   |     |   |   |   |     |   |     |

| 8             | 1 0      |     | I  | 0  |     |    | 0       |     |     | 0     | I   | 0              | 1   | 0   | ١ | 0 | I | 324 | I | 0  | I | 0   | I | 0   |
|---------------|----------|-----|----|----|-----|----|---------|-----|-----|-------|-----|----------------|-----|-----|---|---|---|-----|---|----|---|-----|---|-----|
| 0<br>9<br>  0 | 0        | 0   | I  |    |     | I  | 0 0     |     | I   | 0 0   | I   | 0              | I   | 0   | I | 0 | I | 0   | I | 16 | I | 0   | I | 0   |
| 10            | 0        |     |    | 8  |     | l  | 0       |     | I   | 0     | I   | 0              | I   | 2   | I | 0 | I | 0   | I | 0  | I | 587 | I | 68  |
| 2<br>  11     | 0        |     |    | 45 |     |    | 13      | ,   |     | 0     | 1   | 12             | I   | 0   | I | 0 | I | 0   | I | 0  | ١ | 55  | I |     |
| 1579<br>12    | 6<br>  0 |     |    | 9  | 0   |    | 0<br>38 |     |     | 2     |     | 0              | I   | 0   | I | 0 | I | 0   | I | 0  | ١ | 1   | I | 5   |
| 13            | 1 0      |     |    | 0  |     | I  | 0       |     | I   | 0     | I   | 0              | I   | 0   | I | 0 | I | 0   | I | 0  | I | 0   | I | 1   |
| 14            | 0        |     |    | 0  |     | I  | 0       |     |     | 0     | I   | 0              | I   | 1   | I | 0 | I | 0   | I | 0  |   | 0   | 1 | 0   |
| 0<br>15       | 1 0      |     | I  |    |     |    | 0       |     |     | 0     | I   | 0              | I   | 0   | I | 0 | 1 | 0   | I | 0  | I | 0   | 1 | 0   |
| 0<br>16       | 0        |     | ı  | 7  | 10  | ı  | 0       | 254 |     | 0     | 1   | 0              |     | 0   | ı | 0 | ı | 0   | ı | 0  | 1 | 0   | 1 | 3   |
| 0             |          | 0   | 1  |    | 0   | '  |         | 20  | 1   | 47    |     | U              | '   | U   | ' | U | 1 | U   | ' | U  | ' | U   | ' | 3   |
|               |          |     |    |    |     |    |         |     |     |       |     | =====<br>ly == |     |     |   |   |   |     |   |    |   |     |   |     |
|               |          |     | == | == |     | == |         | ==  | ==  | ====  | -   |                |     |     |   |   |   |     |   |    |   |     |   |     |
| =====         | =        | Τ~  |    |    | nin |    |         |     |     |       | i   |                | ==: | === |   |   |   |     |   |    |   |     |   |     |
| <br>Act /     |          | Pre |    |    | _   |    | oni u   | ISI | OI. | ı Mat | LT. | X              |     |     |   |   |   |     |   |    |   |     |   |     |
| 1100 ,        | 1        |     |    |    |     |    | 3       |     | ı   | 4     | ١   | 5              | ı   | 6   | ı | 7 | ı | 8   | ı | 9  | ı | 10  | Ι | 11  |
| 12            | 1        | 13  |    | 1  |     |    | 1       |     |     | 16    |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 1             | 1        | 5   | 1  | 0  |     | I  | 0       |     |     | 0     |     | 0              | 1   | 0   | - | 0 |   | 0   |   | 0  | 1 | 0   | 1 | 0   |
| 10            | - 1      | 0   |    |    | 0   |    | 1 0     | )   |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 2             | 0        |     |    | 41 | .8  |    | 2       |     |     | 0     | -   | 0              | -   | 0   | - | 0 |   | 0   |   | 0  | - | 5   | 1 | 9   |
| 1             | - 1      | 0   |    |    | 0   |    | 0       | )   |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 3             | 0        |     |    | 4  |     |    | 231     |     |     | 0     |     | 0              | -   | 0   | - | 0 |   | 0   |   | 0  |   | 0   | 1 | 7   |
| 10            | - 1      | 0   |    |    | 0   |    | 0       | )   |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 4             | 0        |     |    | 0  |     |    | 0       |     |     | 59    |     | 0              |     | 0   | - | 0 |   | 0   |   | 0  |   | 0   | 1 | 0   |
| 10            | - 1      | 0   |    |    | 0   |    | 0       | )   |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 5             | 0        |     |    | 0  |     |    | 0       |     |     | 0     | -   | 153            |     | 0   |   | 0 |   | 0   |   | 0  |   | 0   | 1 | 0   |
| 1             |          | 0   |    |    | 0   |    | 0       | )   |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 6             | 0        |     |    | 0  |     |    | 0       |     |     | 0     | -   | 0              |     | 218 |   | 0 |   | 0   |   | 0  |   | 0   | 1 | 0   |
| 10            | -        | 0   |    |    | 0   |    | 0       | )   |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 7             | 0        |     |    | 0  |     |    | 0       |     |     | 0     | -   | 0              |     | 0   |   | 9 |   | 0   |   | 0  |   | 0   | 1 | 0   |
| 10            |          | 0   |    |    |     |    | 0       | )   |     | 0     |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 8             | 0        |     |    | 0  |     |    | 0       |     |     | 0     | -   | 0              |     | 0   |   | 0 |   | 154 |   | 0  |   | 0   |   | 0   |
| 10            |          | 0   |    |    |     |    | 0       |     |     | 0     |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 9             | 0        |     |    | 0  |     |    | 0       |     |     | 0     | -   | 0              |     | 0   |   | 0 |   | 0   |   | 4  |   | 0   |   | 0   |
| 0             |          | 0   |    |    |     |    | 1 0     |     |     | 1 0   |     |                |     |     |   |   |   |     |   |    |   |     |   |     |
| 10            | 0        |     |    | 1  |     |    | 0       |     |     | 0     |     | 0              |     | 0   |   | 0 |   | 0   |   | 0  |   | 296 |   | 8   |
| 0             |          |     |    |    |     |    | 0       |     |     | 0     |     | _              |     | _   |   |   |   | _   |   | _  |   |     |   |     |
| 11            | 1 0      |     | ı  |    |     | ı  | 1       |     |     | 0     |     | 0              |     | 0   | ı | 0 | ١ | 0   | ı | 0  |   | 10  | 1 | 723 |
| 1 0           | - 1      | 0   |    |    | 0   |    | 1 0     | )   |     | 0     |     |                |     |     |   |   |   |     |   |    |   |     |   |     |

| 12        | (   | )         | ı | 1            | l      | 0         | ı | 0      | ı  | 0   | ı | 0   | ı | 0  | ı | 0   | ı | 0   | ı | 0   | ı | 0  |
|-----------|-----|-----------|---|--------------|--------|-----------|---|--------|----|-----|---|-----|---|----|---|-----|---|-----|---|-----|---|----|
| 161       |     | 0         | · | 1 0          | •      | 1 0       | • | 1 0    | ·  |     | • |     | • |    | · |     | • |     | • |     | • |    |
| 13        | (   | )         | 1 | 0            | ١      | 0         | ١ | 0      |    | 0   | - | 0   | - | 0  |   | 0   | 1 | 0   |   | 0   |   | 0  |
| 10        |     | 57        |   | 1 0          |        | 1 0       |   | 1 0    |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
| 14        | (   | )         |   | 0            |        | 0         |   | 0      |    | 0   |   | 0   | - | 0  | - | 0   | - | 0   | - | 0   | - | 0  |
| 10        |     | 0         |   | 374          |        | 1 0       |   | 0      |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
|           | (   |           |   | 0            |        | 0         |   | 0      |    | 0   |   | 0   | ١ | 0  |   | 0   |   | 0   | I | 0   | ı | 0  |
| 0         | .   | 0         |   | 0            |        | 122       |   | 0      |    | _   |   | _   |   | _  |   | _   |   | _   |   | _   |   | _  |
|           | (   |           | ı |              |        |           | l | 0      | ı  | 0   | ١ | 0   | ١ | 0  | ı | 0   | ı | 0   | ı | 0   | ı | 0  |
| 0         |     | 0         |   | 0            |        | 0         |   | 21     |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
|           |     |           |   | ting C       |        | niusio:   | n | Matr:  | LX |     | _ |     |   |    |   |     |   |     |   |     |   |    |
| Act /     |     |           |   | iction:<br>2 | s<br>I | 2         |   | 1      |    | _   |   | 6   |   | 7  |   | 0   |   | 0   |   | 10  |   | 11 |
| 12        | -   | l<br>  13 | ı | 14           | 1      | 3<br>  15 | ı | 4   16 | ı  | 5   | - | 0   | ' | 7  | 1 | 8   | ١ | 9   | ' | 10  | 1 | 11 |
|           | 1 3 | 31        | ı |              | ı      | 0         | ı | 0      | ı  | 0   | ı | 0   | ı | 0  | ı | 0   | ı | 0   | ı | 0   | ı | 0  |
| 1 0       |     | 0         | ' | 1 0          | '      | 1 0       | ' | 1 0    | '  | O   | ' | O   | ' | O  | ' | U   | ' | U   | ' | U   | ' | U  |
| 2         | (   |           | ı |              | l      | 18        | ı | 2      | ī  | 0   | ı | 0   | ı | 0  | ī | 0   | ı | 0   | ı | 30  | ı | 51 |
| 4         |     | 0         | ' | 0            | '      | 1         | ' | 1 0    | '  | · · |   | v   | ' | Ü  | ' | Ü   | ' | Ü   | ' | 00  | ' | 01 |
| 3         | (   |           | ı |              | ı      |           | ı | 13     | 1  | 0   | ı | 0   | ı | 0  | ī | 0   | ı | 0   | ī | 3   | ı | 34 |
| 6         |     | 0         | · | 1 0          | •      | 1 0       | • | 0      | ·  |     | • |     | • |    | • |     | • |     | • |     | • |    |
| 4         | (   |           | ١ |              | ١      |           | ١ | 129    | ١  | 4   | - | 0   | Ι | 0  | Ι | 0   | Ι | 0   | Ι | 2   | Ι | 0  |
| 1         |     | 0         |   | 10           |        | 10        |   | 10     |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
| 5         | (   | )         |   | 1            | l      | 0         | l | 0      | -  | 303 | - | 4   | - | 0  | - | 0   | - | 0   | - | 13  | 1 | 3  |
| 4         |     | 0         |   | 1 0          |        | 1         |   | 1 0    |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
| 6         | (   | )         |   | 0            |        | 0         |   | 0      |    | 6   |   | 501 | - | 0  |   | 0   | - | 0   |   | 4   | - | 0  |
| 1 0       |     | 0         |   | 1 0          |        | 1         |   | 1 0    |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
| 7         | (   |           |   |              |        |           |   | 0      |    | 0   |   | 0   |   | 19 |   | 0   |   | 0   |   | 0   |   | 0  |
| 1 0       |     | 0         |   | 1 0          |        | 1 0       |   | 0      |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
| 8         | 1   |           | ı |              | ı      | 0         | l | 0      | ı  | 0   | ١ | 0   | ١ | 0  | ı | 323 | ١ | 0   | ı | 0   | ı | 0  |
| 0         |     | 0         |   | 0            |        | 0         |   | 1 0    |    |     |   | •   |   | •  |   |     |   | 4.0 |   | •   |   | _  |
| 9         | (   |           | ı | 0            | ı      | 0         | ı | 1      | I  | 2   | ١ | 0   | ١ | 0  | ı | 0   | ı | 13  | ı | 0   | ı | 0  |
| 10        | 1 ( | 0         |   | 0            |        | 0         |   | 0      |    | ^   |   | 2   |   | ^  |   | 0   |   | ^   |   | FOF |   | co |
| 10<br>  1 |     | )<br>  0  |   | 14<br>  0    |        | 1 0       |   |        | ı  | U   | ١ | 3   | 1 | 0  | 1 | U   | 1 | U   | ١ | 585 | 1 | 03 |
|           | (   |           |   |              |        |           |   | 0      | ī  | 6   | 1 | 0   |   | 0  | 1 | 0   | 1 | 0   | ı | 91  | ı |    |
| 1536      |     |           | 1 |              | l<br>I |           |   | 1      |    | 0   | ' | U   | ' | U  | ' | U   | ' | U   | ' | 91  | ' |    |
| 12        |     |           | • |              | <br>   |           |   | 0      |    | 0   | ı | 0   | ı | 0  | ī | 0   | ı | 0   | ı | 5   | ı | 3  |
| 385       |     | 0         | ' | 0            | '      | 0         | ' | 1      | '  |     |   | v   | ' | Ü  | ' | Ü   | ' | Ü   | ' | Ü   | ' | Ü  |
|           | (   |           | ı |              | ı      |           | ı | 0      | ı  | 0   | ı | 0   | ı | 0  | ı | 0   | ı | 0   | ı | 0   | ı | 2  |
| 0         |     | 146       |   | 0            |        | 0         |   | 1 0    | •  | ·   |   | ·   | • | ·  | • | ·   | • | •   |   | ·   | • | _  |
|           |     | )         |   |              | ı      |           | ı | 0      | 1  | 0   | ı | 1   | ı | 0  | ı | 0   | Ι | 0   | Ι | 0   | Ι | 0  |
|           |     | 0         |   | 869          |        | 21        |   | 1 0    |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
|           |     | )         | ١ | 1            |        |           | l | 0      | 1  | 1   | - | 7   | 1 | 0  | 1 | 0   | ١ | 0   | 1 | 2   | I | 0  |
|           |     | 0         |   |              |        | 236       |   | 1 0    |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
| 16        | (   | )         |   | 4            |        | 0         | ١ | 0      |    | 0   | - | 0   | 1 | 0  |   | 0   | 1 | 0   |   | 0   | 1 | 1  |
| 4         |     | 0         |   | 1 0          |        | 1 0       |   | 63     |    |     |   |     |   |    |   |     |   |     |   |     |   |    |
|           |     |           |   |              |        |           |   |        |    |     |   |     |   |    |   |     |   |     |   |     |   |    |

====== indian - LDA - 15 - svm\_linear ======

| ===== | ===== |      | ====  |    | =====  |     | ===== | == |     | == | === |   |   |     |     |   |     |   |     |
|-------|-------|------|-------|----|--------|-----|-------|----|-----|----|-----|---|---|-----|-----|---|-----|---|-----|
| ===== | =     | T    | rain  | S  | ize: 3 | 30  | %     |    | ==  | == | === |   |   |     |     |   |     |   |     |
|       | T:    | raiı | ning  | C  | onfusi | LO: | n Mat | ri | X   | _  |     |   |   |     |     |   |     |   |     |
| Act / | Pr    | edi  | ction | าธ |        |     |       |    |     |    |     |   |   |     |     |   |     |   |     |
| I     | 1     | :    | 2     | -  | 3      |     | 4     |    | 5   | -  | 6   |   | 7 | 8   | 9   | - | 10  | - | 11  |
| 12    | 13    |      | 14    |    | 15     |     | 16    |    |     |    |     |   |   |     |     |   |     |   |     |
| 1     | 15    | (    | 0     | -  | 0      |     | 0     |    | 0   | -  | 0   |   | 0 | 10  | I 0 | - | 0   | - | 0   |
| 1 0   | 10    |      | 0     |    | 10     |     | 0     |    |     |    |     |   |   |     |     |   |     |   |     |
| 2 l   | 0     | ;    | 382   | -  | 12     |     | 1     |    | 0   | -  | 0   | - | 0 | 1 0 | I 0 | - | 17  |   | 21  |
| 2     | 10    |      | 0     |    | 1 0    |     | 0     |    |     |    |     |   |   |     |     |   |     |   |     |
| 3 l   | 0     | :    | 12    | -  | 210    |     | 5     |    | 0   | -  | 0   | - | 0 | 0   | I 0 | - | 0   |   | 11  |
| 4     | 10    |      | 0     |    | 1 0    |     | 0     |    |     |    |     |   |   |     |     |   |     |   |     |
| 4     | 0     | (    | 0     | -  | 1      | -   | 58    |    | 0   | -  | 0   | - | 0 | 0   | I 0 | - | 0   |   | 0   |
| 0     | 10    |      | 0     |    | 1 0    |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |
| 5 l   | 0     | (    | 0     | -  | 0      | -   | 0     |    | 152 | -  | 1   | - | 0 | 0   | I 0 | - | 0   |   | 0   |
| 1     | 10    |      | 0     |    | 10     |     | 1 0   |    |     |    |     |   |   |     |     |   |     |   |     |
| 6 l   | 0     | (    | 0     | -  | 0      | -   | 0     | ١  | 0   | 1  | 218 | ١ | 0 | 1 0 | l 0 | - | 0   | 1 | 0   |
| 1 0   | 1 0   |      | 0     |    | 1 0    |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |
| 7     | 0     | (    | 0     | 1  | 0      | 1   | 0     | -  | 0   | -  | 0   | - | 9 | 10  | 0   | - | 0   | - | 0   |
| 0     | 10    |      | 0     |    | 10     |     | 1 0   |    |     |    |     |   |   |     |     |   |     |   |     |
| 8 l   | 0     | (    | 0     | -  | 0      |     | 0     | -  | 0   | -  | 0   | - | 0 | 154 | I 0 | - | 0   | - | 0   |
| 0     | 10    |      | 0     |    | 10     |     | 1 0   |    |     |    |     |   |   |     |     |   |     |   |     |
| 9     | 0     | (    | 0     | 1  | 0      | 1   | 0     | -  | 0   | -  | 0   | - | 0 | 10  | 4   | - | 0   | - | 0   |
| 1 0   | 10    |      | 0     |    | 10     |     | 0     |    |     |    |     |   |   |     |     |   |     |   |     |
| 10 l  | 0     | 1:   | 12    | 1  | 1      | 1   | 0     | -  | 0   | -  | 0   | - | 0 | 10  | I 0 | - | 246 | - | 46  |
| 1 0   | 10    |      | 0     |    | 10     |     | 0     |    |     |    |     |   |   |     |     |   |     |   |     |
| 11    | 0     | !    | 51    | 1  | 5      | 1   | 0     | -  | 3   | -  | 0   | - | 0 | 10  | I 0 | - | 30  | - | 654 |
| 0     | 10    |      | 0     |    | 10     |     | 0     |    |     |    |     |   |   |     |     |   |     |   |     |
| 12    | 0     | :    | 1     | -  | 6      |     | 0     | -  | 0   | -  | 0   | - | 0 | 0   | I 0 | - | 0   | - | 3   |
| 152   | 10    |      | 0     |    | 1 0    |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |
| 13    | 0     | (    | 0     | -  | 0      | -   | 0     |    | 0   | -  | 0   | - | 0 | 0   | I 0 | - | 0   |   | 0   |
| 0     | 57    |      | 0     |    | 1 0    |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |
| 14 l  | 0     | (    | 0     | -  | 0      | -   | 0     |    | 0   | -  | 0   | - | 0 | 0   | I 0 | - | 0   |   | 0   |
| 0     | 10    |      | 37:   | 1  | 3      |     | 1 0   |    |     |    |     |   |   |     |     |   |     |   |     |
| 15    | 0     | (    | 0     | 1  | 0      | 1   | 0     | -  | 0   | -  | 0   | - | 0 | 10  | 0   | - | 0   | - | 0   |
| 0     | 0     |      | 3     |    | 119    | 9   | 1 0   |    |     |    |     |   |   |     |     |   |     |   |     |
| 16    | 0     | (    |       | 1  | 0      |     |       | -  | 0   |    | 0   |   | 0 | 10  | 0   | - | 0   | - | 0   |
| 1 0   | 0     |      |       |    |        |     | 21    |    |     |    |     |   |   |     |     |   |     |   |     |
|       | T     |      |       |    |        | n   | Matr  | ix |     | _  |     |   |   |     |     |   |     |   |     |
| Act / |       |      | _     |    |        |     |       |    |     |    |     |   |   |     |     |   |     |   |     |
|       | 1     |      |       |    |        | 1   | 4     | -  | 5   |    | 6   |   | 7 | 8   | 9   | - | 10  | - | 11  |
| 12    |       |      |       |    | 15     |     |       |    |     |    |     |   |   |     |     |   |     |   |     |
|       | 31    |      |       |    | 0      |     | 0     |    | 0   | ١  | 0   | ١ | 0 | 10  | I 0 | 1 | 0   | ١ | 0   |
|       | 0     |      |       |    | 10     |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |
|       | 0     |      |       |    | 29     | 1   | 6     | ١  | 0   | ١  | 0   | ١ | 0 | 10  | I 0 | 1 | 35  | ١ | 53  |
| 7     | 0     |      | I 0   |    | 1      |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |
| 3     | 0     |      | 40    | 1  |        | 1   | 17    | ١  | 0   | ١  | 0   |   | 0 | 10  | l 0 | 1 | 0   | ١ | 31  |
| 7     | 10    |      | 0     |    | 10     |     | 10    |    |     |    |     |   |   |     |     |   |     |   |     |

| 4            | 0        | 4        | 15        | 154              | 3        | 1 0   | 1 0  | 1   | 1 0 | 1 0  | 1 0  |
|--------------|----------|----------|-----------|------------------|----------|-------|------|-----|-----|------|------|
| 1            | 10       | 0        | 0         | 0                |          |       |      |     |     |      |      |
| 5            | 0        | 1        | 10        | 2                | 317      | 3     | 1 0  | 1 0 | 1 0 | 3    | 1    |
| 1            | 0        | 0        | 1         | 0                | 1.40     | 1 400 | 1 0  | 1.0 |     | 1.4  | 1 0  |
| 6  <br>  0   | 0<br>  0 | 10       | 0         | 0<br>  0         | 12       | 498   | 0    | 1 0 | 0   | 1    | 0    |
|              | 0<br>  0 | 0<br>  0 | 0         | 0                | 1 0      | 1 0   | 19   | 1 0 | 1 0 | 1 0  | 0    |
| 10           | 10       | 0        | 10        | 10               | 1 0      | 1 0   | 1 13 | 1 0 | 1 0 | 1 0  | 1 0  |
|              | 0        | 10       | 10        | 10               | 1 0      | 1 0   | 1 0  | 324 | 1 0 | 1 0  | 1 0  |
| 1 0          | 10       | 10       | 10        | 1 0              |          |       |      |     |     |      |      |
| 9            | 0        | 1 0      | 1 0       | 1 0              | 10       | 1 0   | 0    | 1 0 | 16  | 1 0  | 1 0  |
| 1 0          | 1 0      | 1 0      | 1 0       | 0                |          |       |      |     |     |      |      |
|              |          | 24       | 1         | 1 0              | 1 0      | 2     | 0    | 0   | 1 0 | 517  | 122  |
| 1            | 0        | 0        | 0         | 0                |          |       |      |     |     |      |      |
| 11           | 0        | 86       | 36        | 1                | 14       | 1 0   | 0    | 1 0 | 0   | 76   | I    |
| 1496  <br>12 | 3<br>  0 | 0<br>  6 | 0<br>  45 | 0<br>  1         | 0<br>  0 | 1 0   | 1 0  | 1 0 | 1 0 | l 5  | 10   |
| 363          | 0        | 10       | 0         | 1                | 1 0      | 1 0   | 1 0  | 1 0 | 1 0 | 1 3  | 1 10 |
| 13           | 0        | 10       | 10        | 10               | 1 0      | 1 0   | 1 0  | 1 0 | 1 0 | 1 0  | 1    |
| 0            | 147      |          | 0         | 0                |          | , -   | , -  | , - |     |      | . –  |
| 14           | 0        | 1 0      | 1 0       | 1 0              | 10       | 1     | 1 0  | 1 0 | 10  | 10   | 1 0  |
| 1 0          | 10       | 876      | 6   14    | 0                |          |       |      |     |     |      |      |
| 15 l         | 0        | 0        | 1 0       | 0                | 4        | 6     | 0    | 1 0 | 1 0 | 1    | 1    |
| 3            | 10       | 13       | 23        |                  |          |       |      |     |     |      |      |
|              | 0        | 3        | 10        | 0                | 10       | 1 0   | 0    | 1 0 | 1 0 | 1 0  | 1 0  |
| 4            | 1 0      | 0        | 1 0       | 65               |          |       |      |     |     |      |      |
|              |          |          |           | ======<br>15 - k |          |       |      |     |     |      |      |
|              |          |          |           |                  |          |       |      |     |     |      |      |
| =====        | =        | Train    | Size:     | 30%              | =        | ===== |      |     |     |      |      |
|              | Tra      | aining   | Confus    | ion Mat          | rix      |       |      |     |     |      |      |
| Act /        |          | dictio   |           |                  |          |       |      |     |     |      |      |
| I            |          |          |           | 4                | 5        | 6     | 7    | 8   | 9   | 10   | 11   |
|              |          |          | 15        |                  |          |       |      |     |     |      |      |
|              |          | 10       | , -       |                  | 1        | 1 0   | 0    | 2   | 0   | 1 0  | 1 0  |
|              |          | 0        | 0         | 0                | 1.0      | 1.0   | 1.0  | 1.0 | 1.0 | 1 11 | 1 15 |
|              | 0<br>  0 | 399      | 4         | 0<br>  0         | 1 0      | 1 0   | 1 0  | 1 0 | 1 0 | 14   | 15   |
|              |          | 13       | 201       | 5                | 1 0      | 1 0   | 1 0  | 1 0 | 1 0 | 1    | 19   |
| 3            | 10       | 0        | 0         | 10               | , ,      | 1 0   | 1 0  | 1 0 | 1 0 | ' -  | 1 10 |
| •            |          | 1        | 17        | 51               | 1 0      | 1 0   | 1 0  | 1 0 | 10  | 1 0  | 1 0  |
|              | 10       | 10       | 10        | 10               |          |       |      |     |     |      |      |
| 5 I          | 0        | 0        | 1 0       | 1 0              | 150      | 3     | 1 0  | 1 0 | 1 0 | 1 0  | 1 0  |
| 1            |          | 1 0      | 1 0       | 0                |          |       |      |     |     |      |      |
|              |          | 0        | 1 0       | 1 0              | 0        | 218   | 1 0  | 1 0 | 1 0 | 1 0  | 0    |
| 0            | 0        | 0        | 0         | 0                |          |       |      |     |     |      |      |
|              |          | 0        | 0         | 0                | 1 0      | 1 0   | 9    | 1 0 | 0   | 1 0  | 1 0  |
| 1 0          | 1 0      | 1 0      | 1 0       | 0                |          |       |      |     |     |      |      |

| 8         | 0        |             | 1 0        | 1 0          | 1   | 0   | ١ | 0   | I | 0  | 1 : | 154 | I | 0  | I | 0   | l | 0   |
|-----------|----------|-------------|------------|--------------|-----|-----|---|-----|---|----|-----|-----|---|----|---|-----|---|-----|
|           | 0        |             | 0          | 0            | I   | 0   | I | 0   | ı | 0  | (   | 0   | I | 4  | I | 0   | I | 0   |
|           | 0        | 0<br>  4    | 0<br>  0   | 0            | I   | 0   | I | 1   | I | 0  | (   | 0   | I | 0  | I | 274 | I | 26  |
|           | 0        | •           | 0<br>  2   | 0<br>  0     | I   | 3   | I | 1   | ı | 0  | (   | 0   | I | 0  | I | 17  | l | 702 |
| 0<br>12   | 0<br>0   | 0<br>  4    | 0<br>  5   | 0            | I   | 0   | I | 0   | 1 | 0  | (   | 0   | ı | 0  | 1 | 0   | l | 7   |
| 145<br>13 | 0<br>0   | 0<br>  0    | 1<br>  0   | 0            | I   | 0   | ı | 0   | ı | 0  | (   | 0   | I | 0  | 1 | 0   |   | 0   |
| 1 0       | 57       | 1 0         | 1 0        | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
|           | 0        | 0           | 10         | 0            | ١   | 0   | ١ | 0   | ١ | 0  | (   | 0   |   | 0  | ı | 0   |   | 0   |
| 0         | 1        | 372         | 1          | 0            |     | 0   |   | 0   |   | 0  | 1 . | ^   |   | 0  |   | ^   |   | ^   |
|           | 0<br>  1 |             | 0          | 0            | ı   | 0   | ı | 2   | ١ | 0  | (   | U   |   | 0  | ı | 0   | ı | 0   |
| 0<br>16   | 0        | •           | 111<br>  0 | L   0<br>  0 | 1   | 0   |   | 0   | 1 | 0  | (   | Λ   | ı | Λ  |   | 0   | ı | 0   |
| 0         | 1 0      | 0           | 0          | 2:           |     | U   | ı | U   | ' | U  | ' ' | U   | ı | U  | ı | U   | 1 | U   |
|           |          | sting C     |            |              |     |     | _ |     |   |    |     |     |   |    |   |     |   |     |
| Act /     |          | diction     |            | on nau       | LIA |     |   |     |   |    |     |     |   |    |   |     |   |     |
|           | 1        |             | 3          | 4            | ı   | 5   | ı | 6   | ı | 7  | 8   | 8   | 1 | 9  | ı | 10  | ı | 11  |
|           | 13       | . –<br>  14 | 15         | 10           |     |     | • | _   | Ċ |    | •   | _   | • |    | • | _,  | • |     |
|           | 30       |             | 1 0        | 0            |     | 0   | Ι | 0   | ı | 0  | 1 : | 1   |   | 0  | ١ | 0   | ı | 0   |
| 10        | 1 0      | 10          | 10         | 0            | •   |     | • |     | • |    | •   |     | • |    | • |     | • |     |
|           | 0        |             | 18         | 4            | -   | 0   | ١ | 1   | - | 0  | (   | 0   |   | 0  | ı | 24  | Ι | 87  |
| 3         | 1 0      | 10          | 1 0        | 1 0          |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
|           | 0        |             | 467        | 13           | -   | 0   | ١ | 0   | - | 0  | (   | 0   |   | 0  | ı | 1   | Ι | 65  |
| 5         | 1 0      | 10          | 10         | 10           |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
| 4 l       | 0        | 11          | 38         | 123          | -   | 3   | 1 | 0   | - | 0  |     | 1   |   | 0  | ١ | 0   | Ι | 2   |
| 1 0       | 10       | 10          | 10         | 10           |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
| 5 l       | 0        | 1           | 1          | 1 0          | -   | 311 | - | 6   | - | 0  | (   | 0   |   | 0  | 1 | 5   | Ι | 1   |
| 3         | 10       | 0           | 1          | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
| 6 l       | 0        | 0           | l 0        | 1 0          |     | 1   | - | 511 | - | 0  | (   | 0   |   | 0  | 1 | 0   | 1 | 0   |
| 0         | 1 0      | 1 0         | 0          | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
| 7         | 0        | 1 0         | l 0        | 1 0          |     | 0   | - | 0   | - | 19 | (   | 0   |   | 0  |   | 0   | 1 | 0   |
| 1 0       | 1 0      | 10          | 1 0        | 1 0          |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
| 8         | 0        | 0           | l 0        | 1 0          |     | 0   |   | 0   |   | 0  | ;   | 324 |   | 0  |   | 0   | 1 | 0   |
| 0         | 1 0      | 0           | 0          | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
| 9 l       | 0        | 0           | <b>I</b> 0 | 1 0          | -   | 0   | - | 0   |   | 0  | (   | 0   |   | 16 |   | 0   | 1 | 0   |
| 0         | 1 0      | 1 0         | 1 0        | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
|           | 0        |             | 1          | 1 0          |     | 0   |   | 4   |   | 0  | (   | 0   |   | 0  |   | 567 | I | 79  |
|           | 1 0      | 1 0         | 1 0        | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |
|           | 0        |             | 12         | 1 0          |     | 13  |   | 0   |   | 0  | (   | 0   |   | 0  |   | 79  | I |     |
|           | 7        | •           | 0          | 0            |     | 0   |   |     |   |    |     |     |   |    |   |     |   |     |
| 12        |          |             |            | 0            |     | 0   |   | 0   |   | 0  | (   | 0   |   | 0  |   | 2   |   | 15  |
|           |          | 0           | 0          | 1            |     | _   |   | _   |   | _  |     | _   |   |    |   | _   |   |     |
| 13        |          |             | 0          | 0            | ١   | 0   | ı | 0   | ١ | 0  | (   | U   | I | U  | ı | 0   | l | 1   |
| 0         | 147      | 1 0         | 0          | 0            |     |     |   |     |   |    |     |     |   |    |   |     |   |     |

| 14   0        | 10                       |                     | 0         | 0   1   | 1 0    | 1 0 | 1 0 | 1 0 | 1 0 |
|---------------|--------------------------|---------------------|-----------|---------|--------|-----|-----|-----|-----|
| 15   0        | 1 0                      | 0                   | 0         | 5   9   | 1 0    | 1 0 | 1 0 | 1 0 | 1 0 |
| 1             | 1   17<br>  5<br>  0   0 | 231<br>  0  <br>  0 | 0<br>  0  | 0   0   | 1 0    | 1 0 | 0   | 1 0 | 1 2 |
|               | ======                   |                     |           |         | :      |     |     |     |     |
|               | ndian - LD<br>=======    |                     |           | •       |        |     |     |     |     |
| =====         |                          | Size: 30            |           | ======  |        |     |     |     |     |
|               | Training                 | Confusio            | on Matrix |         | -      |     |     |     |     |
| Act /         | Predictio                |                     |           |         |        |     |     |     |     |
| 1             |                          |                     | 4         | 5   6   | 7      | 8   | 9   | 10  | 11  |
| 1 12          |                          | 15<br>  0           | 16<br>0   | 0   0   | 1 0    | 1   | 0   | 1 0 | 1 0 |
| 0             |                          | 1                   | 10        | 0 10    | 1 0    | 1 1 | 1 0 | 1 0 | 1 0 |
| 2   0         | 370                      |                     | 1         | 0   0   | 0      | 1 0 | 1 0 | 20  | 23  |
| 3             | 0   0                    | 1                   | 1         |         |        |     |     |     |     |
| 3   0         | 17                       |                     | 6 l       | 0   0   | 0      | 1 0 | 1 0 | 1 0 | 20  |
| 3             | 0   0                    | 0                   | 0         |         |        |     |     |     |     |
| 4   0         | 10                       |                     | 55        | 0   0   | 0      | 1 0 | 0   | 1 0 | 0   |
| 0             | 0   0                    | 0<br>  0            | 0<br>2    | 142   4 | 1 0    | 1 0 | 0   | 1 0 | 1   |
| 12 1          | 0   0                    | 3                   | 0         | 142   4 | 1 0    | 1 0 | 1 0 | 1 0 | 1 1 |
| 6   0         | 10                       |                     | 0 1       | 0   21  | .5   0 | 1 0 | 1 0 | 1 0 | 1 0 |
| 10 1          | 0   0                    | 3                   | 1 0       |         |        |     |     |     |     |
| 7   0         | 1 0                      | 0                   | 0         | 0   0   | 9      | 1 0 | 0   | 1 0 | 10  |
| 0             | 0   0                    | 0                   | 0         |         |        |     |     |     |     |
| 8   0         | 0                        |                     | 0         | 0   0   | 0      | 154 | 0   | 1 0 | 1 0 |
|               | 0   0                    | 0                   | 0         | 0 10    | Lo     | 1 0 | 1 4 | 1.0 | 1.0 |
| 9   0         | 0 10                     | 0                   | 0         | 0   0   | 0      | 0   | 4   | 0   | 1 0 |
|               | 8                        |                     |           | 0   1   | 1 0    | 1 0 | 0   | 251 | 38  |
| 3             |                          |                     | 2         | •       | •      | •   | •   | •   |     |
| 11   0        | 61                       | 4                   | 0         | 4   1   | 0      | 1 0 | 0   | 42  | 624 |
|               | 0   0                    | 6                   | 0         |         |        |     |     |     |     |
| 12   0        |                          |                     | 0         | 0   0   | 0      | 1 0 | 1 0 | 1 0 | 4   |
| 135           |                          | 1                   | 2         | 0 1 0   | 1.0    | 1 0 | 1 0 | 1.0 | 1.0 |
| 13   0<br>  0 | 0<br>57   0              | 0                   | 0         | 0   0   | 1 0    | 1 0 | 0   | 0   | 0   |
| 14   0        |                          |                     | 0         | 0   0   | 1 0    | 1 0 | 0   | 1 0 | 0   |
|               | 0   36                   |                     | 10        |         | 1 0    | 1 0 | , • | 1 0 | 1 0 |
| 15   0        |                          |                     | 0         | 1   0   | 1 0    | 1 0 | 1 0 | 1 0 | 1 0 |
| 0             | 0   21                   |                     |           |         |        |     |     |     |     |
| 16   0        |                          | 0                   |           | 0   0   | 0      | 1 0 | 1 0 | 1 0 | 1 0 |
|               | 0   0                    | 0                   | 21        |         |        |     |     |     |     |
| <br>^c+ /     | _                        | Confusion           | ı Matrıx  |         | -      |     |     |     |     |
| ACL /         | Predictio                | пр                  |           |         |        |     |     |     |     |

| I           | 1             | 2                  | 3                | 4                 | 5         | 6   | 7   | 8   | 9   | 10  | 11  |
|-------------|---------------|--------------------|------------------|-------------------|-----------|-----|-----|-----|-----|-----|-----|
|             |               | •                  |                  | 16                | 1 0       | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 | 0   |
|             |               | •                  |                  | 0                 | 0         | 1   | 1 0 | 1 0 | 1 0 | 39  | 44  |
|             |               |                    |                  | 2                 | 1 0       | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 | 55  |
| 2<br>  4    | 0<br> <br>  0 | 0<br>  4<br>  0    | 0<br>  34<br>  6 | 0<br>  132<br>  0 | 0         | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 |
|             | _             |                    |                  | 2                 | 277       | 21  | 1 0 | 1 0 | 1 0 | 1   | 1 0 |
|             | _             | 0                  |                  | 0                 | 2         | 500 | 1 0 | 1 0 | 1 0 | 3   | 1 0 |
|             |               |                    |                  | 0                 | 1 0       | 1 0 | 19  | 1 0 | 1 0 | 1 0 | 1 0 |
|             |               |                    |                  | 0                 | 1 0       | 1 0 | 1 0 | 323 | 1 0 | 1 0 | 1 0 |
| 9  <br>  0  | 0<br>  0      | 0<br>  0           | 0<br>  3         | 4<br>  0          | 0         | 1   | 1 0 | 1 0 | 8   | 1 0 | 1 0 |
| 10  <br>  3 | 0<br>  0      | 15<br>  0          | 2<br>  0         | 0<br>  1          | 0         | 2   | 1 0 | 1 0 | 1 0 | 518 | 126 |
|             | 0<br>15       | 116<br>  0         | 38<br>  0        | 0<br>  4          | 11<br>  1 | 1   | 1 0 | 0   | 1 0 | 96  | I   |
| 12          | 0             | 5                  |                  | 1                 | 1 0       | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 | 7   |
| 338<br>13   | 0<br>0        | 0<br>  0           | 0<br>  0         | 1                 | 1         | 0   | 1 0 | 1 0 | 0   | 1 0 | 0   |
| 0           | 147           | 0                  | 0                | 0                 |           |     |     |     |     |     |     |
| 14  <br>  0 | 0<br>  0      | 0<br>  863         | 0<br>  24        | 0<br>  0          | 3         | 1   | 0   | 0   | 0   | 1 0 | 0   |
|             |               | 0                  |                  | 0                 | 1 0       | 6   | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 |
| 0           | 1 0           | 28                 | 229              | 1                 |           |     | , - | , - | , - |     |     |
| 16          | 0             | I 0                | 0                | 0                 | 10        | 10  | 10  | 10  | 10  | 10  | 1 0 |
| 8           | 1 0           | 1 0                | 1 0              | 64                |           |     |     |     |     |     |     |
| =====       | india         | ======<br>n - None | e - None         | e - svi           | m_rbf     |     |     |     |     |     |     |
|             |               | Train S            |                  |                   | ======    |     |     |     |     |     |     |
|             |               | aining (           |                  |                   | rix       |     |     |     |     |     |     |
|             |               | dictions           |                  |                   |           |     |     |     |     |     |     |
|             |               | 2                  |                  |                   |           | 6   | 7   | 8   | 9   | 10  | 11  |
|             |               | 14                 |                  |                   |           |     |     |     |     |     |     |
|             |               | 0                  |                  |                   | 1 0       | 1 0 | 1 0 | 1 0 | 0   | 1 0 | 1 0 |
| 10          |               |                    | 0<br>  0         | 0                 | ΙΛ        | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 | 0   |
| 2  <br>  0  | l 0           |                    |                  | 0                 | ı U       | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 |
|             | 0             |                    |                  | 0                 | 1 0       | 0   | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 |
| 10          | 1 0           |                    |                  | 0                 | • -       |     |     |     |     |     |     |

| 4 1  |   |                                  |  |  |                                  |                      |  |         |  |  |      |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
|--|---|----------------------------------|--|--|----------------------------------|----------------------|--|---------|--|--|------|-----------------------|-------------|-----------------------|-------------|-----------------------|------|-----------------------|-----|-----------------------|-------------|-----------------------|------|---|
| 4  | 0   |                                  | (  | )  | I                                | (                    | )  | I       | 59   | 9  |      | 0                     | I           | 0                     | I           | 0                     |      | 0                     | 1   | 0                     | I           | 0                     | I    | 0   |
| 0  |   | 0                                |  |  | 0                                |                      | 0  |         |  | 0  |      | 454                   |             | •                     |             | •                     |      | •                     |     | •                     |             | •                     |      | •   |
| 5  <br>  0   | 0   | 0                                | (  |  | 0<br>0                           | (                    | 0  | I       |  | 0  | ı    | 154                   | ı           | 0                     | ı           | 0                     | ı    | 0                     | 1 ( | O                     | ı           | 0                     | ı    | 0   |
|  | 0   |                                  | (  |  |                                  | (                    |  | ١       |  | Ü  | ı    | 0                     | I           | 218                   | I           | 0                     | I    | 0                     | (   | 0                     | I           | 0                     | I    | 0   |
| 10   | - 1   | 0                                |  |  | 0                                | ١                    | 0  |         |  | 0  |      |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
| 7  <br>  0   | 0   | 0                                | (  |  | 0<br>0                           | (                    | 0  | ı       |  | 0  | ı    | 0                     | ı           | 0                     | ı           | 9                     | ı    | 0                     | 1 ( | 0                     | ı           | 0                     | ı    | 0   |
|  | 0   |                                  | (  |  |                                  | (                    |  | ١       |  | U  | ı    | 0                     | ı           | 0                     | ı           | 0                     | ı    | 154                   | 1   | 0                     | ı           | 0                     | I    | 0   |
| 1 0  | - 1   | 0                                |  |  | 0                                | ١                    | 0  |         |  | 0  |      |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
|  | 0   | 0                                | (  |  | ا<br>م                           | (                    |  |         |  | ^  |      | 0                     |             | 0                     |             | 0                     |      | 0                     | '   | 4                     |             | 0                     |      | 0   |
| 0<br>10  | 0   | 0                                | (  |  | 0<br>I                           | (                    | 0  | ı       |  | 0  | ı    | 0                     | ı           | 0                     | ı           | 0                     | ı    | 0                     | 1 ( | 0                     | ı           | 305                   | ı    | 0   |
| 10   | Ī   |                                  |  |  | 0                                |                      | 0  | ·       |  | 0  | •    |                       | ·           |                       | ·           |                       | •    |                       | •   |                       |             |                       | •    |   |
|  | 0   |                                  | (  |  | ١                                | (                    |  |         |  | _  | 1    | 0                     |             | 0                     |             | 0                     |      | 0                     | 1   | 0                     |             | 0                     |      | 743   |
| 0<br>12  | 0   |                                  | (  |  | 0                                | (                    | 0  | ı       |  | 0  | ı    | 0                     | ı           | 0                     | ı           | 0                     | ı    | 0                     | 1   | Ω                     | ı           | 0                     | ı    | 0   |
| 162  | I   | 0                                |  |  | 0                                |                      | 0  | '       |  | 0  | '    | O                     | 1           | O                     | 1           | O                     | '    | O                     | '   | O                     | '           | O                     | '    | U   |
| 13   | 0   |                                  | (  | )  | ١                                | (                    | )  | 1       | 0  |  | 1    | 0                     | 1           | 0                     | 1           | 0                     | 1    | 0                     | (   | 0                     | I           | 0                     | ١    | 0   |
| 10   |   | 57                               |  |  | 0                                | ا                    | 0  |         |  | 0  |      |                       |             |                       |             | •                     |      | •                     |     | •                     |             | •                     |      |   |
| 14  <br>  0  | 0<br>1  |                                  | (  |  | ا<br>374                         | (                    | 0  | l       |  | 0  | ı    | 0                     | ı           | 0                     | ı           | 0                     | ı    | 0                     | 1 ( | O                     | ı           | 0                     | ı    | 0   |
|  | 0   |                                  | (  |  |                                  | (                    |  | ı       | 0  | Ü  | Ι    | 0                     | I           | 0                     | I           | 0                     | I    | 0                     | 1 ( | 0                     | I           | 0                     | ı    | 0   |
| 1 0  | - 1   |                                  |  |  | 0                                | -                    | 122                                      | 2       |  | 0  |      |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
|  | 0   |                                  | (  |  | _                                | (                    |  |         | 0  |  |      | 0                     |             | 0                     |             | 0                     |      | 0                     | (   | 0                     |             | 0                     |      | 0   |
| 0<br>  | ı   | 0<br>Te                          |  | <br>i n  | o<br>g Co                        | n f                  | 0  | n.      | l<br>Ma                                    | 21<br>etri   | v    |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
|  |   | 10                               |  |  | g 00                             | ,111                 | ubi                                      | 711     | 110  | 1011   | . 1  |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
| Act /  |   | Pre                              |  |  | ions                             | 3                    |  |         |  |  |      |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
| I  |   |                                  |  | ct<br>2  | ١                                |                      | 3  | I       | 4  |  |      | 5                     | I           | 6                     | I           | 7                     | 1    | 8                     | !   | 9                     | I           | 10                    |      | 11  |
| 12   | 1<br>   | 13                               | dio  | ct<br>2<br>  | 14                               | 3                    | 15                                       |         | 1  | 16   |      |                       |             |                       |             |                       |      |                       |     |                       |             |                       |      |   |
| <br>  12<br>1  |   | 13                               | di@<br>  2<br>  (                            | ct<br>2<br> <br>   | <br>14<br>                       | 3<br> <br>           | 15                                       | 1       | 0  | 16   |      | 5<br>0                |             | 6                     |             | 7                     |      | 8                     | :   |                       |             | 10                    |      | 11<br>31                                    |
| 12<br>1   0  | 1<br>0<br>1   | 13                               | di<br>  2<br>  (                             | ct<br>2<br> <br>0  | 14<br>14<br>0                    | 3<br> <br> <br>      | 15<br>0                                  | I       | <br> <br> <br>                             | 16<br>0  | I    | 0                     | I           | 0                     | I           | 0                     | I    |                       | 1   | 0                     | I           | 0                     | I    |   |
| 12<br>1  | 1<br>0<br>1<br>0  | 13<br>0<br>0                     | di@<br>  2<br>  (                            | ct<br>2<br> <br> <br> <br> <br> <br>                           | 14<br>  0<br>  0                 | 3<br> <br> <br> <br> | 15<br>0<br>0<br>0                        | 1       | <br> 0<br> <br> 0<br>                      | <ul><li>16</li><li>0</li><li>0</li></ul>   | 1    | 0                     | 1           | 0                     | 1           | 0                     | 1    | 0                     | (   | 0                     | 1           | 0                     | <br> | 31<br>993                                   |
| 1 12 1 1 0 2 1 0 3 1   | 1<br>0<br>1<br>0<br>1   | 13<br>0<br>0                     | di@<br>  2<br>  (                            | ct<br>2<br> <br>0<br> <br>0                                    | 14<br>0<br>0<br>1                |                      | 15 0 0 0 0                               | 1       | <br>  0<br>  0<br>  0                      | <ul><li>16</li><li>0</li><li>0</li></ul>   | 1    | 0                     | 1           | 0                     | 1           | 0                     | 1    | 0                     | 1   | 0                     | 1           | 0                     | <br> | 31  |
| 1 12 1 1 0 2 1 0 3 1 0   | 1<br>0<br>1<br>0<br>1   | 13<br>0<br>0                     | did<br>  2<br>  (                            | ct<br>2<br> <br>0<br> <br>0                                    | 14<br>0<br>0<br>1<br>0           | 3<br>                | 15<br>0<br>0<br>0<br>0                   | 1       | <br>  0<br>  0<br>  0<br>  1               | <ul><li>16</li><li>0</li><li>0</li><li>0</li></ul>                               | <br> | 0<br>0<br>0           | 1 1         | 0<br>0<br>0           | <br>        | 0<br>0<br>0           | <br> | 0<br>0<br>0           | 1 ( | 0<br>0<br>0           | 1 1         | 0<br>0<br>0           | <br> | 31<br>993<br>588                            |
| 1 12 1 1 0 2 1 0 3 1 0   | 1<br>0<br>0<br>1<br>0<br>1<br>0   | 13<br>0<br>0                     | did   2                                      | ct<br>2<br> <br>0<br> <br>0                                    | 14<br>0<br>0<br>0<br>1           |                      | 15<br>0<br>0<br>0<br>0                   | 1       | <br>  0<br>  0<br>  0                      | <ul><li>16</li><li>0</li><li>0</li><li>0</li></ul>                               | <br> | 0                     | 1 1         | 0                     | <br>        | 0                     | <br> | 0                     | (   | 0<br>0<br>0           | 1 1         | 0                     | <br> | 31<br>993                                   |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1   | 1<br>0<br>0<br>0<br>1<br>0<br>0<br>1<br>0<br>0                          | 13<br>0<br>0<br>0<br>0           | did   2                                      | ct<br>2<br>1<br>0<br>1<br>0<br>1<br>0<br>1                     | 14<br>0<br>0<br>0<br>1<br>0<br>0 |                      | 15                                       | <br>    | <br>  0<br>  0<br>  0<br>  0<br>  0        | 16<br>0<br>0<br>0  | <br> | 0<br>0<br>0           | 1<br>1<br>1 | 0<br>0<br>0           | 1<br>1<br>1 | 0<br>0<br>0           | <br> | 0<br>0<br>0           | 1 ( | 0<br>0<br>0           | 1<br>1<br>1 | 0<br>0<br>0           | <br> | 31<br>993<br>588                            |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1 0   | 1<br>0<br>0<br>0<br>0<br>1<br>0<br>0<br>1                               | 13<br>0<br>0<br>0<br>0           | did   2   ()   ()   ()   ()                  | ct<br>2<br>1<br>0<br>1<br>0<br>1<br>0<br>1                     | 14                               |                      | 15 0 0 0 0 0 0 0                         |         | <br>  0<br>  0<br>  0<br>  0<br>  0<br>  1 | 16<br>0<br>0<br>0<br>0   |      | 0<br>0<br>0<br>0      |             | 0<br>0<br>0<br>0      | <br>        | 0<br>0<br>0<br>0      |      | 0<br>0<br>0<br>0      |     | 0<br>0<br>0<br>0      |             | 0<br>0<br>0<br>0      |      | 31<br>993<br>588<br>178<br>329              |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1 0 6 1   | 1<br>0<br>0<br>0<br>0<br>1<br>0<br>0<br>1<br>0<br>0                     | 13<br>0<br>0<br>0<br>0           | di(  | 2   0   0   0   0   0   0   0   0   0                          | 14                               |                      | 15                                       |         | <br>  0<br>  0<br>  0<br>  0<br>  0<br>  0 | <ul><li>16</li><li>0</li><li>0</li><li>0</li><li>0</li><li>0</li></ul>           |      | 0<br>0<br>0           |             | 0<br>0<br>0           | <br>        | 0 0 0 0               | <br> | 0 0 0 0               | I ( | 0<br>0<br>0<br>0      |             | 0 0 0 0               |      | 31<br>993<br>588<br>178                     |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1 0 6 1 0 0   | 1<br>0<br>0<br>0<br>0<br>1<br>0<br>0<br>1<br>0<br>0                     | 13<br>0<br>0<br>0<br>0<br>0      | di(  | ct<br>2<br>1<br>0<br>1<br>0<br>1<br>0<br>1<br>0<br>1           | 114                              |                      | 15                                       | 1 1 1 1 | <br>  0<br>  0<br>  0<br>  0<br>  0<br>  1 | <ul><li>16</li><li>0</li><li>0</li><li>0</li><li>0</li><li>0</li><li>0</li></ul> |      | 0<br>0<br>0<br>0      | 1 1 1 1     | 0<br>0<br>0<br>0      | 1 1 1 1 1   | 0<br>0<br>0<br>0      |      | 0<br>0<br>0<br>0      |     | 0<br>0<br>0<br>0      | 1 1 1 1     | 0<br>0<br>0<br>0      |      | 31<br>993<br>588<br>178<br>329              |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1 0 6 1 0 7 1 0   | 1   | 13<br>0<br>0<br>0<br>0<br>0<br>0 | dical () () () () () () () () () () () () () | ct<br>2<br>1<br>0<br>1<br>0<br>1<br>0<br>1<br>0<br>1<br>0<br>1 |                                  |                      | 15 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |         |  | 16<br>0<br>0<br>0<br>0<br>0  |      | 0<br>0<br>0<br>0<br>0 |             | 0<br>0<br>0<br>0<br>0 |             | 0<br>0<br>0<br>0<br>0 |      | 0<br>0<br>0<br>0<br>0 |     | 0<br>0<br>0<br>0<br>0 |             | 0<br>0<br>0<br>0<br>0 |      | 31<br>993<br>588<br>178<br>329<br>512<br>19 |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1 0 6 1 0 7 1 0 8 1                                     | 1<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0 | 13<br>0<br>0<br>0<br>0<br>0<br>0 | di(  | 2   0   0   0   0   0   0   0   0   0                          | 114                              |                      | 15                                       | 1 1 1 1 |  | 16<br>0<br>0<br>0<br>0<br>0  |      | 0<br>0<br>0<br>0      |             | 0<br>0<br>0<br>0      |             | 0<br>0<br>0<br>0      |      | 0<br>0<br>0<br>0      |     | 0<br>0<br>0<br>0<br>0 |             | 0<br>0<br>0<br>0      |      | 31<br>993<br>588<br>178<br>329<br>512       |
| 1 12 1 1 0 2 1 0 3 1 0 4 1 0 5 1 0 6 1 0 7 1 0 8 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 1 1 | 1<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0<br>  0 | 13<br>0<br>0<br>0<br>0<br>0<br>0 | di(  | 2   0   0   0   0   0   0   0   0   0                          | 114                              |                      | 15 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |         |  | 16<br>0<br>0<br>0<br>0<br>0<br>0   |      | 0<br>0<br>0<br>0<br>0 |             | 0<br>0<br>0<br>0<br>0 |             | 0<br>0<br>0<br>0<br>0 |      | 0<br>0<br>0<br>0<br>0 |     |                       |             | 0<br>0<br>0<br>0<br>0 |      | 31<br>993<br>588<br>178<br>329<br>512<br>19 |

| 10  <br>  0<br>11  <br>1712  <br>12 | 0<br>  0<br>0<br>0 | 0<br>  0<br>  0<br>  0<br>  0 | 0<br>  0<br>  0 | 0<br> <br> <br> <br> <br> | 0<br>  0<br>0<br>0<br>0 |     | 0<br>0<br>0<br>0 | I   | 0<br>0<br>0 | I | 0<br>0<br>0 | 1 | 0<br>0<br>0 | I | 0<br>0<br>0 | I | 0<br>0<br>0 | I | 667<br>431 |
|-------------------------------------|--------------------|-------------------------------|-----------------|---------------------------|-------------------------|-----|------------------|-----|-------------|---|-------------|---|-------------|---|-------------|---|-------------|---|------------|
| 13                                  | 0                  | 1 0                           | 1 0             | 1                         | 0                       | I   | 0                | I   | 0           | I | 0           | I | 0           | I | 0           | I | 0           | I | 148        |
| 0<br>14                             | 0<br>0             | 0<br>  0                      | 0               | 0<br>                     | 0                       | ı   | 0                | ı   | 0           | ı | 0           | ı | 0           | ı | 0           |   | 0           |   | 891        |
| 0<br>15                             | 0<br>0             | 0<br>  0                      | <br>  0         | 0                         | 0<br>0                  |     | 0                | 1   | 0           | 1 | 0           | ı | 0           |   | 0           | ı | 0           | ı | 264        |
| 0                                   | 0                  | 0                             | •               | 0                         | 0                       | '   | U                | '   | U           | ' | U           | 1 | U           | ' | U           | ' | U           | ' | 204        |
| 16                                  |                    | 0                             | 0               | Ī                         | 0                       | ī   | 0                | ī   | 0           | ī | 0           | ı | 0           | ı | 0           | ı | 0           | ı | 72         |
| 10                                  | 1 0                | 10                            |                 | 0                         | 1 0                     | •   | Ü                |     | Ü           |   | Ŭ           | • | Ŭ           | • | Ü           | • | Ŭ           | • |            |
| =====                               |                    | =====                         | •               |                           | •                       |     | ====             |     | ===         |   |             |   |             |   |             |   |             |   |            |
|                                     | india              | n - No                        | ne -            | None                      | - svi                   | n_j | poly             | === | ===         |   |             |   |             |   |             |   |             |   |            |
| =====                               |                    | =====                         | =====           | ====                      | =====                   | ==: | ====             | ==: | ===         |   |             |   |             |   |             |   |             |   |            |
| =====                               |                    | Train                         |                 |                           |                         |     |                  | ==: | ===         |   |             |   |             |   |             |   |             |   |            |
|                                     |                    | aining                        |                 | usio                      | n Mati                  | ri  | X                |     |             |   |             |   |             |   |             |   |             |   |            |
| Act /                               |                    | dictio                        |                 |                           | 4                       |     | _                |     | c           |   | 7           |   | 0           |   | 0           |   | 10          |   | 4.4        |
| 12                                  |                    |                               | 3               |                           | 4                       | ı   | 5                | ١   | 6           | ١ | 7           | ı | 8           | ı | 9           |   | 10          | ı | 11         |
|                                     | 13<br>15           | 14<br>  0                     | 0               | 15<br>I                   | 16<br>0                 | ı   | 0                | 1   | 0           | 1 | 0           | ı | 0           | 1 | 0           | ı | 0           | ı | 0          |
| 1                                   | 0                  | 0                             |                 | 0                         | 1 0                     | '   | O                | '   | U           | ' | U           | ' | U           | ' | U           | ' | U           | ' | O          |
| 2                                   |                    | 435                           | 10              | Ĭ                         | 0                       | ı   | 0                | ı   | 0           | ı | 0           | ı | 0           | ı | 0           | ı | 0           | ı | 0          |
| 10                                  | 1 0                | 0                             | i               | 0                         | 0                       | •   |                  | •   |             | • |             | • |             | · |             | • |             | • |            |
| 3                                   | 0                  | 1 0                           | 24              | 2                         | 0                       | ١   | 0                | -   | 0           | - | 0           | 1 | 0           | 1 | 0           | 1 | 0           | 1 | 0          |
| 1 0                                 | 1 0                | 1 0                           | - 1             | 0                         | 10                      |     |                  |     |             |   |             |   |             |   |             |   |             |   |            |
| 4                                   | 0                  | 1 0                           | 1 0             | - 1                       | 59                      |     | 0                |     | 0           |   | 0           |   | 0           |   | 0           | - | 0           | - | 0          |
| 10                                  | 1 0                | 0                             |                 | 0                         | 1 0                     |     |                  |     |             |   |             |   |             |   |             |   |             |   |            |
| 5                                   | 0                  | 10                            | 10              |                           | 0                       | ı   | 154              | ١   | 0           | ١ | 0           | ١ | 0           | ı | 0           | ı | 0           | ı | 0          |
| 0                                   | 0                  | 0                             |                 |                           | 0                       |     | ^                |     | 010         |   | 0           |   | 0           |   | ^           |   | 0           |   | 0          |
|                                     | 0<br>  0           | 0<br>  0                      | 0               |                           | 0                       | ı   | 0                | ١   | 218         | ١ | 0           | ı | 0           | ı | 0           | ı | 0           | ı | 0          |
| 0<br>7                              |                    | 0                             |                 |                           | 0                       | ī   | 0                | ı   | 0           | ı | 9           | ı | 0           | ı | 0           | ı | 0           | ı | 0          |
| 10                                  |                    | 0                             |                 |                           | 10                      | '   | Ü                | '   | Ü           | ' | Ü           | ' | v           | ' | Ü           | • | Ü           | • | v          |
|                                     |                    | 0                             |                 |                           | 0                       | ١   | 0                | ı   | 0           | ı | 0           | ١ | 154         | ı | 0           | ı | 0           | ı | 0          |
| 10                                  | 10                 | 10                            | 1               |                           | 10                      |     |                  |     |             |   |             |   |             |   |             |   |             |   |            |
| 9                                   | 0                  | 0                             | 1 0             | - 1                       | 0                       | -   | 0                | -   | 0           | - | 0           |   | 0           | - | 4           | 1 | 0           | 1 | 0          |
| 1 0                                 | 1 0                | 1 0                           | -               | 0                         | 0                       |     |                  |     |             |   |             |   |             |   |             |   |             |   |            |
| 10                                  | 0                  | 1 0                           | 1 0             | - 1                       | 0                       |     | 0                |     | 0           |   | 0           |   | 0           |   | 0           | - | 305         | - | 0          |
| 1 0                                 | 1 0                | 1 0                           | 1               |                           | 0                       |     |                  |     |             |   |             |   |             |   |             |   |             |   |            |
|                                     |                    | 0                             | •               |                           | 0                       | I   | 0                |     | 0           |   | 0           |   | 0           |   | 0           |   | 0           |   | 743        |
|                                     | 0                  | 0                             |                 |                           | 0                       |     | 0                |     | 0           |   | 0           |   | 0           |   | ^           |   | 0           |   | 0          |
|                                     |                    | 1 0                           | •               | 1                         |                         | 1   | 0                | 1   | 0           | 1 | 0           | 1 | 0           | 1 | 0           | ı | 0           | ı | 0          |
| 162<br>  13                         | 0                  | 0<br>  0                      | <br>  0         |                           | 0<br>0                  | ı   | 0                | ı   | 0           | ı | 0           | ı | 0           | ı | 0           | ı | 0           | ı | 0          |
| 0                                   | 57                 | 0                             | 1 0             |                           | 1 0                     | 1   | J                | 1   | •           | 1 | v           | 1 | V           | 1 | V           | ' | V           | ' | Ü          |

| 14       | I | 0  | 0   | I  | 0   | 27/  | 1     | 0    |     | l | 0     | I | 0   |   | 0          | I | 0  | I | 0   | I | 0  | ١ | 0   |   | 0  |
|----------|---|----|-----|----|-----|------|-------|------|-----|---|-------|---|-----|---|------------|---|----|---|-----|---|----|---|-----|---|----|
| 0<br>15  | ī | 0  | 0   | ı  | 0   | 374  | :<br> | 0    |     | ı | 0     | ı | 0   | ı | 0          | ı | 0  | ı | 0   | ı | 0  | ı | 0   | ı | 0  |
| 0        | • |    | 0   | '  | Ī   | 0    |       |      | 122 |   | 0     | • | Ü   | ' | Ü          | • | Ü  | • | Ü   | • | Ü  | ' | Ŭ   | • | Ū  |
| 16       | Ι | 0  |     | ı  | 0   |      | ı     | 0    |     | ı | 0     | Ι | 0   | ı | 0          | I | 0  | I | 0   | Ι | 0  | Ι | 0   | ı | 0  |
| 10       |   |    | 0   |    |     | 0    |       | (    | )   |   | 21    |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
|          |   |    | Te  | st | ir  | ng C | or    | ıfus | sio | n | Matri | x |     |   |            |   |    |   |     |   |    |   |     |   |    |
| Act /    | / |    | Pre | di | ict | ion  | ເຮ    |      |     |   |       |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
|          |   | 1  |     |    | 2   |      | 1     | 3    |     |   | 4     | 1 | 5   | - | 6          | 1 | 7  | 1 | 8   |   | 9  |   | 10  |   | 11 |
| 12       |   |    | 13  |    |     | 14   |       | 1    | 15  |   | 16    |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 1        |   | 31 | -   |    | 0   |      | 1     | 0    |     |   | 0     | 1 | 0   | - | 0          |   | 0  |   | 0   | 1 | 0  |   | 0   |   | 0  |
| 1 0      |   |    | 0   |    |     | 0    |       | (    | )   |   | 0     |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 2        |   | 0  |     | I  |     |      |       | 10   |     |   | 2     | 1 | 2   |   | 0          |   | 0  |   | 0   |   | 0  |   | 14  |   | 23 |
| 4        |   |    | 0   |    |     | 0    |       | 1    |     |   | 0     |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 3        |   | 0  |     | ı  | 28  |      | ı     | 524  |     |   | 13    |   | 0   | ١ | 0          | ı | 0  | ı | 0   |   | 0  |   | 0   |   | 15 |
| 8        |   |    | 0   |    |     | 0    |       | (    | )   |   | 0     |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 4        |   | 0  |     | ı  | 1   |      | ı     | 5    |     |   | 171   | ı | 0   | ı | 0          | ı | 0  | ı | 0   | ı | 0  | ı | 0   | ı | 0  |
| 1        |   |    | 0   |    |     | 0    |       | (    |     |   | 0     |   |     |   | _          |   | _  |   | _   |   | _  |   | _   |   |    |
| 5        | ı | 0  | _   | ı  | 0   | _    | ı     | 0    |     | ı | 0     | ı | 312 | ı | 2          | ı | 5  | ı | 0   | ı | 0  | ı | 6   |   | 1  |
| 3        |   |    | 0   |    |     | 0    |       | (    | )   |   | 0     |   |     |   | <b>500</b> |   | ^  |   | •   |   | •  |   | •   |   | ^  |
| 6        | ı | 0  | ^   | ı  | 0   | ^    |       | 0    | 4   | ı | 0     | ı | 6   | ı | 502        | ı | 0  | ı | 0   | ı | 0  | ı | 0   |   | 0  |
| 0        |   |    | 0   |    | 1   | 0    |       | 4    | ¥   |   | 0     |   | ^   |   | ^          |   | 10 |   | ^   |   | ^  |   | ^   |   | ^  |
| 7        |   | 0  | ^   | ı  | 0   | ^    |       | 0    | `   | ı | 0     | ı | 0   | ı | 0          | ı | 19 | ı | 0   | ı | 0  | ı | 0   | ı | 0  |
| 0        | ı | 0  | 0   |    | 0   | 0    | ı     | 0    |     | ı | 0     |   | 0   |   | 0          |   | 0  |   | 324 |   | 0  |   | 0   |   | 0  |
| 8<br>  0 | ' |    | 0   | '  | ı   | 0    | '     | (    |     | 1 | 0     | 1 | U   | ' | U          | ı | U  | ı | 324 | ' | U  | ' | U   | ı | U  |
| 9        | ı | 0  | U   | ı  | 0   | U    | ı     | 0    |     | ı | 0     | ı | 0   | ı | 0          | ı | 0  | ı | 0   | ı | 16 | ı | 0   | ı | 0  |
| 0        | ' |    | 0   | '  |     | 0    | '     | (    |     | ' | 0     | ' | U   | ' | U          | ' | U  | ' | U   | ' | 10 | ' | O   | ' | U  |
| 10       | ı | 0  | •   | ı  | 19  |      | ı     | 1    | ,   | ı | 0     | ı | 0   | ı | 1          | ı | 0  | ı | 0   | ı | 0  | ı | 600 | ı | 44 |
| 2        | ' |    | 0   | '  |     | 0    | '     | (    | )   | ' | 0     | ' | Ū   | ' | _          | ' | v  | ' | •   | ' | ·  | ' | 000 | ' |    |
| 11       | ı | 0  | •   | ı  | 58  |      | ı     | 19   |     | ı | 0     | ı | 3   | ı | 0          | ı | 0  | ı | 0   | ı | 0  | ı | 56  | I |    |
| 1570     | i | 2  |     | i  | 0   |      | i     | 0    |     | İ | 4     | i | 0   | • |            | • |    | • |     | • |    | • |     | • |    |
| 12       | i | 0  |     | i  | 4   |      | i     | 21   |     | İ | 0     | i | 0   | ı | 0          | ı | 0  | ı | 0   | ı | 0  | ı | 2   | ı | 2  |
| 402      |   |    | 0   |    | Ι   | 0    |       | (    | )   |   | 1 0   |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
|          |   |    |     |    |     |      |       |      |     |   | 0     | Ι | 0   | Ι | 0          | ı | 0  | ı | 0   | Ι | 0  | Ι | 1   | I | 0  |
|          |   |    | 147 |    |     |      |       | (    |     |   | 1 0   |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 14       | 1 | 0  |     | 1  | 0   |      | 1     | 0    |     | ı | 0     | 1 | 0   | 1 | 1          | 1 | 0  | 1 | 0   | 1 | 0  | 1 | 0   | 1 | 0  |
| 10       |   |    | 0   |    | 1   | 881  |       | 9    | 9   |   | 1 0   |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 15       |   | 0  |     | 1  | 0   |      | 1     | 0    |     |   | 0     | 1 | 0   | 1 | 8          |   | 0  |   | 0   | 1 | 2  |   | 3   |   | 0  |
| 10       |   | 1  |     |    |     |      |       | 2    |     |   | 1 0   |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
| 16       |   | 0  |     |    | 0   |      |       | 0    |     |   | 0     |   | 0   |   | 0          |   | 0  |   | 0   | 1 | 0  |   | 1   | 1 | 0  |
| 7        |   |    | 0   |    |     | 0    |       | (    | )   |   | 64    |   |     |   |            |   |    |   |     |   |    |   |     |   |    |
|          |   |    |     |    |     |      |       |      |     |   |       |   |     |   |            |   |    |   |     |   |    |   |     |   |    |

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==== indian - None - None - svm\_linear ====

===== Train Size: 30% ======

---- Training Confusion Matrix ----

Act / Predictions

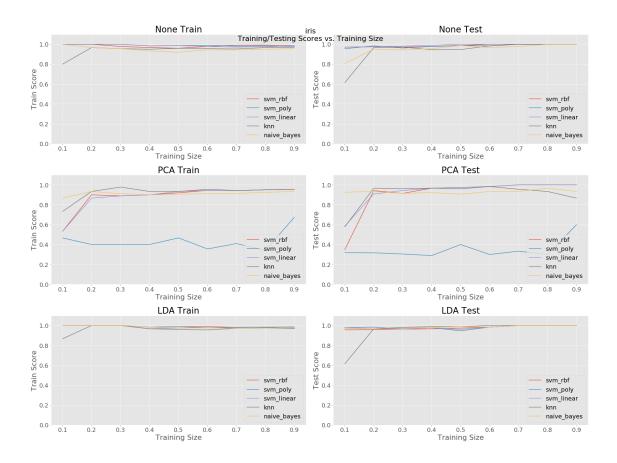
| I           |          |            | 3          | 4          | 1   | 5   | 1 | 6   | I | 7   | ١ | 8     | I | 9 | ı | 10  | I | 11  |
|-------------|----------|------------|------------|------------|-----|-----|---|-----|---|-----|---|-------|---|---|---|-----|---|-----|
| 12<br>1     | 13<br>15 | 14<br>  0  | 15<br>  0  | 1          |     | 0   | 1 | 0   | ı | 0   | ı | 0     | 1 | 0 | 1 | 0   | 1 | 0   |
| 0<br>2      | 0<br>0   | 0<br>  417 | 0<br>  0   | 0<br>  0   |     | 0   | ı | 0   | ı | 0   | ı | 0     | 1 | 0 | ı | 0   | ı | 18  |
| 10          | 0<br>0   | 0<br>  0   | 0<br>  242 | 0          |     | 0   | ı |     |   | 0   |   | 0     |   | 0 |   | 0   |   | 0   |
| 10          | 1 0      | 0          | 1 0        | 1 0        |     |     |   |     |   |     |   |       |   |   |   |     |   |     |
| 4  <br>  0  | 0<br>  0 | 0<br>  0   | 0<br>  0   | 59<br>  0  |     | 0   |   | 0   | ١ | 0   | ١ | 0     | ı | 0 | ı | 0   | ١ | 0   |
| 5  <br>  0  | 0<br>  0 | 0<br>  0   | 0<br>  0   | 0<br>  0   |     | 154 |   | 0   |   | 0   | ١ | 0     | I | 0 | I | 0   | I | 0   |
| 6 I         | 0        | 1 0        | 1 0        | 1 0        | -   | 0   | I | 218 | I | 0   | ١ | 0     | I | 0 | I | 0   | I | 0   |
| 0<br>7      | 0<br>0   | 0<br>  0   | 0<br>  0   | 0<br>  0   |     | 0   | ı | 0   | ı | 9   | I | 0     | ı | 0 | ı | 0   | I | 0   |
| 0           | 0        | 0          | 0          | 0          |     | 0   |   | ^   |   | 0   |   | 1 = 1 |   | 0 |   | 0   |   | ^   |
| 8  <br>  0  | 0<br>  0 | 0<br>  0   | 0<br>  0   | 0          |     | 0   |   | U   | ١ | 0   | ı | 154   | ı | 0 | 1 | 0   | ı | 0   |
|             | 0        | 1 0        | 1 0        | 1 0        | 1   | 0   | - | 0   |   | 0   | 1 | 0     | I | 4 | 1 | 0   | 1 | 0   |
| 0           | 0        | 0          | 0          | 0          |     |     |   | _   |   |     |   |       |   |   |   |     |   |     |
| 10  <br>  0 | 0<br>  0 | 2<br>  0   | 0          | 0          |     | 1   |   | 0   | ١ | 0   | ı | 0     | ı | 0 | ١ | 280 | ı | 22  |
|             |          | 37         | 1 2        | 10         |     | 2   | I | 0   | ı | 0   | ı | 0     | ı | 0 | ı | 32  | ı | 670 |
| 0           | 1 0      | 0          | 0          | 0          |     | _   | • |     | • | -   | • | -     | • |   | • |     | • |     |
|             | 0        | I 0        | 1 0        | 1 0        | - 1 | 0   | - | 0   | - | 0   | - | 0     | ١ | 0 | 1 | 0   | 1 | 0   |
| 162         | 1 0      | 10         | 1 0        | 1 0        |     |     |   |     |   |     |   |       |   |   |   |     |   |     |
| 13          | -        | 1 0        | 1 0        | 1 0        | -   | 0   |   | 0   |   | 0   |   | 0     |   | 0 |   | 0   |   | 0   |
| 10          | 57       | 0          | 0          | 0          |     |     |   | _   |   | _   |   | _     |   | _ |   |     |   |     |
|             | 0        | 0          | 10         | 10         |     | 0   |   | 0   | ı | 0   | ı | 0     | ı | 0 | ı | 0   | ı | 0   |
| 0           | 1 0      | 374        |            | 0          |     | 0   |   | ^   |   | ^   |   | ^     |   | ^ |   | 0   |   | 0   |
| 15  <br>  0 | 0<br>  0 | 0          | 0<br>  12  | 0<br>2   0 |     | 0   |   | U   | ı | 0   | ı | 0     | ı | 0 | ı | 0   | ı | 0   |
|             | 0        | 0<br>  0   |            |            |     | 0   | ı | 0   | ı | 0   | ı | 0     | ı | 0 | ı | 0   | ı | 0   |
|             | 0        |            |            | 2          |     | Ü   | ' | Ü   | ' | · · | ' | O     | ' | O | ' | Ü   | ' | O   |
|             | Tes      |            |            |            |     |     |   |     |   |     |   |       |   |   |   |     |   |     |
|             | Pred     | _          |            |            |     |     |   |     |   |     |   |       |   |   |   |     |   |     |
| I           | 1        | 2          | 3          | 4          |     | 5   |   | 6   | - | 7   | - | 8     | 1 | 9 | 1 | 10  | Ι | 11  |
| 12          | 13       | 14         | 15         | 1          | 6   |     |   |     |   |     |   |       |   |   |   |     |   |     |
| 1 l         |          | 0          | 0          | 1 0        | -   | 0   |   | 0   | - | 0   |   | 0     |   | 0 |   | 0   |   | 0   |
| 1 0         | 1 0      | 10         | 1 0        | 1 0        |     |     |   |     |   |     |   |       |   |   |   |     |   |     |
|             |          |            | 22         | 2          |     | 3   |   | 0   | ١ | 0   |   | 0     |   | 0 | ı | 25  |   | 82  |
|             |          |            | 0          | 0          |     | _   |   | _   |   | _   |   | _     |   | _ |   | _   |   |     |
| 3           |          |            | 520        | 16         |     | 0   |   | 0   | ١ | 0   | ı | 0     | ı | 0 | ı | 0   | ı | 13  |
| 10<br>  4   | 0<br>0   | 0<br>  1   | 0<br>  6   | 0<br>  169 |     | 0   | ı | 0   | ı | 0   | ı | 0     | ı | 0 | ı | 0   | ı | 0   |
| 1 2         | 1 0      | 0          | 0          | 109        |     | U   | 1 | J   | 1 | U   | ı | U     | 1 | U | 1 | U   | ı | U   |
|             |          | 1          | 10         | 10         |     | 312 |   | 5   | ı | 4   | 1 | 0     | ı | 0 | ı | 3   | ı | 1   |
| 3           | 1 0      | 0          | 10         | 0          |     |     | • | •   | • |     | • | -     | • | - | · | -   | • |     |

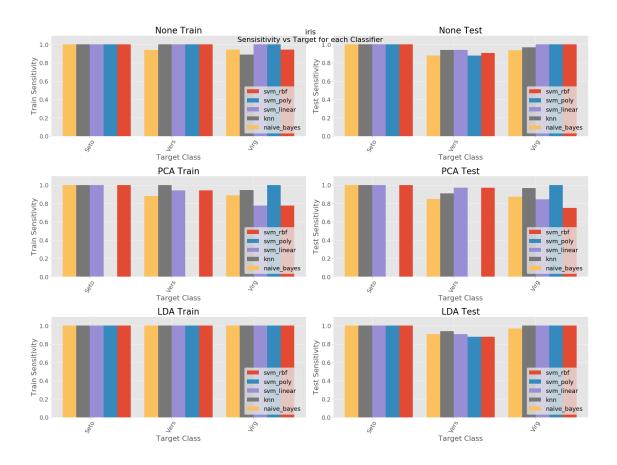
| 6 l  | 0   |   | 0   |                 | 0   |  | 0                                 |                             | -   | 4                                 | 1              | 499   | -    | 0                     | 1    | 0                     |      | 0                     |           | 4                          |      | 0                           |
|--|---|---|---|-----------------|---|--|-----------------------------------|-----------------------------|---|-----------------------------------|----------------|---|------|-----------------------|------|-----------------------|------|-----------------------|-----------|----------------------------|------|-----------------------------|
| 1 0  | 10  |   | 10  |                 | 5   |  | 1                                 | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 7  | 0   |   | 0   |                 | 0   |  | 0                                 |                             | -   | 0                                 | -              | 0   | -    | 19                    | -    | 0                     |      | 0                     |           | 0                          |      | 0                           |
| 1 0  | 10  |   | 10  |                 | 1 0   |  |                                   | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 8  | 0   |   | 0   |                 | 0   | 1  | 0                                 |                             | 1   | 0                                 | -              | 0   | 1    | 0                     | -    | 324                   |      | 0                     |           | 0                          | 1    | 0                           |
| 1 0  | 10  |   | 10  |                 | 1 0   |  |                                   | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 9  | 0   |   | 0   |                 | 0   |  | 0                                 |                             | 1   | 0                                 | 1              | 0   | 1    | 0                     | 1    | 0                     |      | 16                    |           | 0                          | 1    | 0                           |
| 1 0  | 10  |   | 10  |                 | 1 0   |  |                                   | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 10   | 0   |   | 47  |                 | 2   |  | 0                                 |                             | 1   | 1                                 | -              | 0   | -    | 0                     | -    | 0                     |      | 0                     |           | 497                        |      | 118                         |
| 2  | 10  |   | 10  |                 | 1 0   |  |                                   | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 11   | 0   |   | 179   |                 | 29  | 1  | 0                                 |                             | 1   | 13                                | -              | 0   | 1    | 0                     | -    | 1                     |      | 0                     |           | 132                        | 1    |                             |
| 1347   | 8   |   | 0   |                 | 0   |  | 3                                 |                             | -   | 0                                 |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 12   | 0   | -   | 5   |                 | 21  |  | 0                                 |                             | -   | 1                                 | -              | 5   | -    | 0                     | -    | 0                     |      | 0                     |           | 5                          |      | 3                           |
| 391  | 10  |   | 10  |                 | 1 0   |  |                                   | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 13   | 0   |   | 0   |                 | 0   |  | 0                                 |                             | -   | 0                                 | -              | 0   | -    | 0                     | -    | 0                     |      | 0                     |           | 1                          |      | 0                           |
| 1 0  | 14  | 7   | 10  |                 | 0   |  | 1                                 | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 14   | 0   |   | 0   |                 | 0   |  | 0                                 |                             |   | 0                                 | -              | 0   | -    | 0                     | -    | 0                     |      | 0                     |           | 0                          |      | 0                           |
| 1 0  | 10  |   | 88  | 2               | 9   |  | 1                                 | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 15   | 0   |   | 2   |                 | 0   | 1  | 0                                 |                             | 1   | 4                                 | -              | 12  | 1    | 0                     | -    | 0                     |      | 1                     |           | 4                          | 1    | 0                           |
| 6  | 10  |   | 6   |                 | 229   | 9  |                                   | 0                           |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| 16   | 0   |   | 2   |                 | 0   |  | 0                                 |                             | -   | 0                                 | -              | 0   | -    | 0                     | -    | 0                     |      | 0                     |           | 0                          |      | 0                           |
| 7  | 10  |   | 10  |                 | 1 0   |  |                                   | 63                          |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
| =====  |   |   | ====  | ===             |   | ===  | ===                               | ===                         |   |                                   |                | ===   |      |                       |      |                       |      |                       |           |                            |      |                             |
| =====  | == ind  | dia   | n - 1   | Ma              | 1   | Tor  |                                   | _ 1,                        |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
|  |   |   |   | MOI             | ne - r  | IOI  | тe                                | _ r                         | 7111                                      | 1 ====                            |                | ===   |      |                       |      |                       |      |                       |           |                            |      |                             |
| =====  | =====   |   |   |                 |   |  |                                   |                             |   |                                   |                |   |      |                       |      |                       |      |                       |           |                            |      |                             |
|  | :====:<br>:   |   | ====  |                 |   |  |                                   |                             |   |                                   | -=-            | ===   |      |                       |      |                       |      |                       |           |                            |      |                             |
| =====  | :   | ===<br>T  | rain  | ===<br>S:       |   | ===<br>30%                                 | ===<br>/ <sub>6</sub>             |                             | ==  | ====                              | -=-            | ===   |      |                       |      |                       |      |                       |           |                            |      |                             |
| =====<br>=====<br><br>Act /                        | :<br>T:   | T<br>Tai  | rain  | S:<br>Co        | =====<br>ize: 3   | ===<br>30%                                 | ===<br>/ <sub>6</sub>             |                             | ==  | ====                              | -=-            | ===   |      |                       |      |                       |      |                       |           |                            |      |                             |
|  | :<br>T:<br>Pro  | T<br>Tai  | rain<br>ning<br>ction   | S:<br>Co<br>ns  | =====<br>ize: 3   | ===<br>30%<br>i.or                         | ===<br>%<br>n M                   |                             | ===<br>::::                               | =====<br>===<br>x                 |                | ===   | ı    | 7                     | 1    | 8                     | I    | 9                     | I         | 10                         | I    | 11                          |
|  | :<br>T:<br>Pro  | Trairedi  | rain<br>ning<br>ction   | S:<br>Co<br>ns  | =====<br>ize: 3<br>onfusi   | ===<br>30%<br>ior<br>                      | ===<br>%<br>n M                   | ===<br>ſatr                 | ===<br>::::                               | =====<br>===<br>x                 |                | ===   | ı    | 7                     | 1    | 8                     | I    | 9                     | I         | 10                         | I    | 11                          |
| =====<br><br>Act /<br>  12                         | :<br>T:<br>Pr(  | Trairedi  | rain<br>ning<br>ction<br>2  | S:<br>Co<br>ns  | ======<br>ize: 3<br>onfusi<br>3<br>  15                             | ===<br>30%<br>i.or<br>                     | ===<br>%<br>n M<br>4<br>          | ====<br>latr                | -=-<br>:i:                                | =====<br>===<br>x                 | ===<br>===<br> | ===   |      | 7                     |      | 8                     |      | 9                     | I<br>I    |                            |      | 11<br>0                     |
| =====<br><br>Act /<br>  12                         | T:<br>Pro<br>1<br>  13                                    | Tai:<br>edi                                     | rain<br>ning<br>ction<br>2  | S:<br>Cons      | ======<br>ize: 3<br>onfusi<br>3<br>  15                             | ===<br>30%<br>i.or<br>                     | ===<br>%<br>n M<br>4<br>          | atr<br>16                   | -=-<br>:i:                                | =====<br>===<br>x<br>5            | ===<br>===<br> | ===<br>===<br><br>6                             |      |                       |      |                       |      |                       |           |                            |      |                             |
| =====<br><br>Act /<br>  12<br>1                    | T: Pro 1   13   14   0                                    | Tai<br>rai<br>edi<br>                           | rain ning ction 2   14 0   0  | S:<br>Cons<br>I | 3<br>  15<br>  0  | ===<br>30%<br>ior<br>                      | 4<br>0                            | 16<br>0                     | ri:                                       | =====<br>===<br>x<br>5            | <br><br>       | 6<br>0  | I    |                       | I    |                       | I    |                       | I         |                            | l    |                             |
| Act /   12 1     0 2                               | T: Pro 1   13   14   0                                    | Tairairedi                                      | rain ning ction 2   14 0   0 387   0  | S:<br>Cons      | 3<br>  15<br>0<br>  0   | ===<br>30%<br>ior<br> <br>                 | 4<br>0                            | 16<br>0                     | ri:                                       | =====<br>===<br>x<br>5            | <br><br>       | 6<br>0  | I    | 0                     | I    | 0                     | I    | 0                     | I         | 1                          | l    | 0                           |
| ======<br><br>Act /<br>  12<br>1   0<br>2  <br>  6 | T: Pro 1   13   14   0 0                                  | Tairairedi                                      | rain ning ction 2   14 0   0 387  | S:<br>Coms<br>  | 3<br>  15<br>0<br>  0<br>  0  | ===<br>30%<br>ior<br> <br>                 | <br>%<br>4<br>1<br>0<br>1         | 16<br>0                     | :=:<br>:::::::::::::::::::::::::::::::::: | =====<br>===<br>x<br>5            | <br> <br>      | 6<br>0  | 1    | 0                     | 1    | 0                     | 1    | 0                     | <br>      | 1                          | <br> | 0                           |
| Act /   12 1                                       | T: Pro  1   13   14   0 0   0 0                           | Trai  | rain ning ction 2   14 0   0 387   0  | S:<br>Coms<br>  | 3<br>  15<br>0<br>  0<br>  0<br>13<br>  0<br>222                    | ===<br>30%<br>ior<br> <br> <br>            | <br>%<br>4<br>1<br>0<br>1         | 16<br>0                     | :=:<br>:::::::::::::::::::::::::::::::::: | 5<br>0                            | <br> <br>      | 6 0   | 1    | 0                     | 1    | 0                     | 1    | 0                     | <br>      | 1                          | <br> | 0<br>25                     |
| Act /   12 1                                       | T: Pro  1   13   14   0 0   0 0                           | Trai  | rain ning ction 2   14 0   0 387   0 7   0  | S: Cons         | 3<br>  15<br>0<br>  0<br>  0<br>13<br>  0<br>222                    | ===<br>30%<br> <br> <br> <br>              | 4<br>0<br>0<br>6                  | 16<br>0                     | :=::<br> <br> <br>                        | 5<br>0                            | <br>           | 6 0   | 1    | 0                     | 1    | 0                     | <br> | 0                     | <br>      | 1<br>3<br>2                |      | 0<br>25                     |
| Act /   12 1                                       | T: Pro  1   13 14   0 0   0 0   0                         | Trai<br>edi                                     | rain ning ction 2   14 0   0 387   0 7   0  | S: Cons         | 3<br>  15<br>0<br>  0<br>  0<br>13<br>  0<br>222                    | ===<br>30%<br> <br> <br> <br>              | 4<br>0<br>0<br>6<br>1             | 16<br>0<br>0                | :=::<br>::::::::::::::::::::::::::::::::: | 5<br>0                            | <br>           | 6<br>0<br>1                                     | 1    | 0<br>0<br>0           | 1    | 0<br>0<br>0           | <br> | 0<br>0<br>0           | <br> <br> | 1<br>3<br>2                |      | 0<br>25<br>4                |
|  | T: Pro  1 1 13 14 1 0 0 1 0 0 1 0 0                       | Trai<br>edi<br>                                 | ====:<br>rain<br>ning<br>ction<br>2<br>  14<br>0<br>  0<br>387<br>  0<br>7<br>  0 | S: Cons         | 3   15 0   0 13   0 222   0 3                                       | ===<br>30%<br>ior<br> <br> <br>            | 4   0   6   56                    | 16<br>0<br>0<br>0           | :i:                                       | 5<br>0                            |                | 6<br>0<br>1                                     | <br> | 0<br>0<br>0           |      | 0<br>0<br>0           | <br> | 0<br>0<br>0           | <br> <br> | 1<br>3<br>2<br>0           |      | 0<br>25<br>4                |
|  | T: Pro  1   13 14   0 0   0 0   0 0   0 0 0 0             | Traiiedi  | rain ning ction 2   14 0   0 387   0 7   0 0   0                                  | S: Cons         | 3<br>  15<br>0<br>  0<br>  0<br>13<br>  0<br>222<br>  0<br>3<br>  0 | ===<br>30%<br>ior<br> <br> <br>            | 4<br>1 0 1 0 1 6 1 56             | 16<br>0<br>0<br>0           | :i:                                       | 5<br>0<br>0                       |                | 6<br>0<br>1<br>0                                | <br> | 0 0 0 0               |      | 0 0 0 0               | <br> | 0<br>0<br>0           |           | 1<br>3<br>2<br>0           |      | 0<br>25<br>4                |
| Act /  | T: Pro  1   13 14   0 0   0 0   0 0   0 0   0 0   0       | Trailedi  | rain ning ction 2   14 0   0 387   0 7   0 0   0                                  | S: Cons         | 3   15 0   0 13   0 222   0 3   0 0   0   0                         | ====<br>30%<br>ior<br> <br> <br>           | 4   0   6   56   0                | 16<br>0<br>0<br>0<br>0      | <br> <br> <br> <br>                       | 5<br>0<br>0                       |                | 6<br>0<br>1<br>0                                | <br> | 0 0 0 0               |      | 0 0 0 0               | <br> | 0<br>0<br>0           |           | 1<br>3<br>2<br>0           |      | 0<br>25<br>4                |
|  | T: Pro  1   13 14   0 0   0 0   0 0   0 0   0 0   0       | ===<br>Trai<br>edi<br> <br> <br>                | rain ning ction 2   14 0   0 387   0 7   0 0   0   0                              | S: Coms         | 3   15 0   0 13   0 222   0 3   0 0   0   0                         | ====<br>30%<br>ior<br> <br> <br> <br>      | 4   0   0   6   56   0            | 16<br>0<br>0<br>0<br>0      | <br> <br> <br> <br>                       | 5<br>0<br>0<br>0<br>0             |                | 6<br>0<br>1<br>0<br>0                           | <br> | 0<br>0<br>0<br>0      |      | 0<br>0<br>0<br>0      | <br> | 0<br>0<br>0<br>0      |           | 1<br>3<br>2<br>0           |      | 0<br>25<br>4<br>0           |
| Act /  | T: Pro  1   | Trailedi  | rain ning ction 2   14 0   0 387   0 7   0 0   0 0   0                            | S: Coms         | 3   15   0   13   0   222   0   3   0   0   0   0   0   0   0       | ===<br>30%<br>ior<br> <br> <br> <br>       | === % M 4                         | 16<br>0<br>0<br>0<br>0      | <br> <br> <br> <br> <br>                  | 5<br>0<br>0<br>0<br>0             |                | 6<br>0<br>1<br>0<br>0                           |      | 0<br>0<br>0<br>0      | <br> | 0<br>0<br>0<br>0      | <br> | 0<br>0<br>0<br>0      |           | 1<br>3<br>2<br>0<br>1      |      | 0<br>25<br>4<br>0           |
| Act /    12 1                                      | T: Pro  1   13 14   0 0   0 0   0 0   0 0   0 0   0 0 0 0 | ===<br>Trai<br>rai<br> <br> <br> <br> <br> <br> | rain ning ction 2   14 0   0 387   0 7   0 0   0 0   0 0   0                      | S: Coms         | 3   15 0   0 13   0 222   0 3   0 0   0 0   0 0   2                 | ===<br>30%<br>ior<br> <br> <br> <br> <br>  | === % M 4                         | 16<br>0<br>0<br>0<br>0      | <br> <br> <br> <br> <br>                  | 5<br>0<br>0<br>0<br>0<br>153      |                | ===<br>===<br>6<br>0<br>1<br>0<br>0<br>0        |      | 0<br>0<br>0<br>0      | <br> | 0<br>0<br>0<br>0      | <br> | 0<br>0<br>0<br>0      |           | 1<br>3<br>2<br>0<br>1      |      | 0<br>25<br>4<br>0<br>0      |
|  | T: Pro  1   13 14   0 0   0 0   0 0   0 0   0 0   0 0 0 0 | ===<br>Trai<br>edi<br> <br> <br> <br>           | rain ning ction 2   14   0   0   0   0   0   0   0   0   0                        | S: Cons         | 3   15   0   13   0   0   0   0   0   0   0   0   0                 | ===<br>30%<br>ior<br> <br> <br> <br> <br>  | === % M 4                         | 16<br>0<br>0<br>0<br>0<br>0 |   | 5<br>0<br>0<br>0<br>0<br>153      |                | ===<br>===<br>6<br>0<br>1<br>0<br>0<br>0        |      | 0<br>0<br>0<br>0      |      | 0<br>0<br>0<br>0      | <br> | 0<br>0<br>0<br>0<br>0 |           | 1<br>3<br>2<br>0<br>1<br>0 |      | 0<br>25<br>4<br>0<br>0      |
|  | T: Pro  1   | ===<br>Trai<br>edi<br> <br> <br> <br>           | rain ning ction 2   14 0   0 387   0 7   0 0   0 0   0 0   0 0   0 0   0          | S: Cons         | 3   15   0   13   0   0   0   0   0   0   0   0   0                 | ===<br>30%<br>ior<br> <br> <br> <br> <br>  |                                   | 16<br>0<br>0<br>0<br>0<br>0 |   | 5<br>0<br>0<br>0<br>0<br>153      |                | ===<br>===<br>6<br>0<br>1<br>0<br>0<br>0<br>215 |      | 0<br>0<br>0<br>0<br>0 |      | 0<br>0<br>0<br>0<br>0 |      | 0<br>0<br>0<br>0<br>0 |           | 1<br>3<br>2<br>0<br>1<br>0 |      | 0<br>25<br>4<br>0<br>0<br>0 |
| Act /    12 1                                      | T: Pro  1 13 14 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0       | ===<br>Trai<br>rai<br>edi<br> <br> <br> <br>    | rain ning ction 2   14   0   0   0   0   0   0   0   0   0                        | S: Cons         | 3   15   0   13   0   0   0   0   0   0   0   0   0                 | ====<br>30%<br>ior<br> <br> <br> <br> <br> | 4   0   0   6   5   0   0   0   0 | 16 0 0 0 0 0 0 0 0 0 0      |   | 5<br>0<br>0<br>0<br>0<br>153<br>1 |                | ===<br>===<br>6<br>0<br>1<br>0<br>0<br>0<br>215 |      | 0<br>0<br>0<br>0<br>0 |      | 0<br>0<br>0<br>0<br>0 |      | 0<br>0<br>0<br>0<br>0 |           | 1<br>3<br>2<br>0<br>1<br>0 |      | 0<br>25<br>4<br>0<br>0<br>0 |

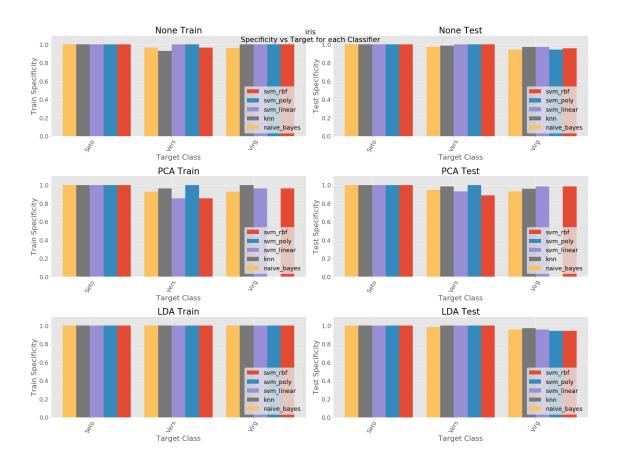
| 10   0   5   4   0   1                               | 0   0   0   0   286 | 7   |
|--|---------------------|-----|
| 11   0   17   8   0   1                              | 3  0  0  0  8       | 706 |
| 0  | 1                   | 14  |
| 133   0   0   0   0                                  |                     | 14  |
| 13   0   0   0   0   0                               |                     | 0   |
| 0  | 10 10 10 10 10 1    | 0   |
| 0   0   369   5   0                                  |                     |     |
| 15   0   0   0   0   0                               |                     | 2   |
| 0  | 10 10 10 10 10 1    | 0   |
|  |                     | O   |
| Testing Confusion Matrix                             |                     |     |
| Act / Predictions                                    |                     |     |
| 1   2   3   4   5                                    | 6   7   8   9   10  | 11  |
| 12   13   14   15   16                               |                     |     |
| 1   31   0   0   0   0   0   0   0                   |                     | 0   |
| 0  | 0   0   0   0   1   | 81  |
| 31   0   0   0   0                                   |                     | 01  |
| 3   0   30   485   22   0                            | 0   0   0   6       | 35  |
|  |                     |     |
| 4   0   0   16   162   0                             |                     | 0   |
| 0  | 3   1   0   0   13  | 3   |
|  |                     | 3   |
| 6   0   0   0   5                                    | 495   0   0   0   0 | 0   |
| 0 0 0 10 12 0  |                     |     |
| 7   1   0   0   0   0                                |                     | 0   |
|  |                     | 0   |
| 8   0   0   0   0   0                                | 0   0   324   0   0 | 0   |
|  | 10   0   0   5   0  | 0   |
|  |                     | · · |
| 10   0   7   8   0   0                               | 3   5   0   0   618 | 23  |
| 3   0   0   0   0                                    |                     |     |
| 11   0   42   28   1   8                             | 9   0   0   0   25  |     |
| 1590   9   0   0   0   0<br>12   0   58   12   0   0 | 1                   | 50  |
| 12   0   58   12   0   0   1   308   0   0   0   0   |                     | 50  |
| 13   0   0   0   0   0                               | 2   0   0   0   1   | 1   |
| 0   144   0   0   0                                  |                     |     |
| 14   0   0   0   0   0                               |                     | 0   |
| 0 0 873 17 0   |                     | •   |
| 15   0   5   2   0   0   13   3   10   171   0       | 65   0   0   0   2  | 3   |
| 19 19 110 1111 10                                    |                     |     |

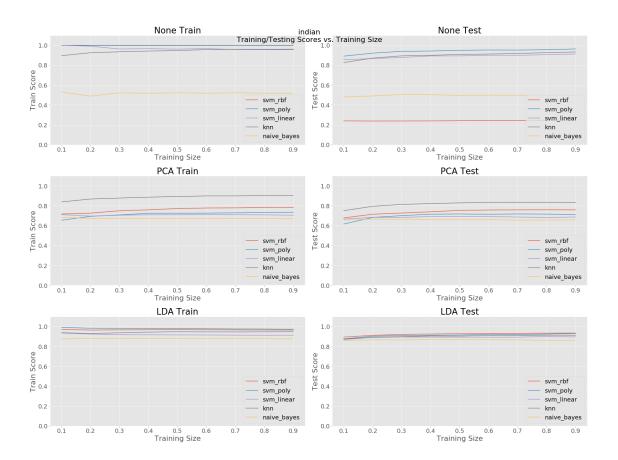
| 16  <br>  0  | 0<br>  0 | 9<br>  0   |   | 0        |   | 0<br>  60 |     |       |     | 0   | I   | 0 |   | 0   | I | 0 | I | 0   |   | 3   |
|--------------|----------|------------|---|----------|---|-----------|-----|-------|-----|-----|-----|---|---|-----|---|---|---|-----|---|-----|
| ===== i      |          |            |   | None     | - | naiv      | e_1 |       | =   |     |     |   |   |     |   |   |   |     |   |     |
| ======       |          | Trair      |   |          |   |           | ==: | ===== | ==: | === |     |   |   |     |   |   |   |     |   |     |
|              | Tı       | aining     |   |          |   |           | ri: | X     | _   |     |     |   |   |     |   |   |   |     |   |     |
| Act /        |          |            |   |          |   |           |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
|              | 1        |            |   | 3        |   | 4         |     | 5     |     | 6   | -   | 7 |   | 8   |   | 9 |   | 10  |   | 11  |
| 12           | 13       | 14         |   | 15       |   | 16        |     | _     |     | _   |     |   |   |     |   | _ |   |     |   | _   |
| •            | 13       | 1 0        |   | 0        | ı | 0         | ١   | 0     | ١   | 0   | ı   | 0 | ı | 1   | ١ | 0 | ı | 0   | 1 | 0   |
| 1<br>2       | 0<br>0   | 0<br>  226 | 1 | 0        | ı | 0         | 1   | 0     | ı   | 1   | ı   | 0 | ı | 2   | ı | 0 | ı | 107 | ı | 75  |
| 24           | 0        | 0          | ' | 0        | ' | 1 0       | '   | O     | '   | 1   | '   | O | ' | ۷   | ' | O | ' | 101 | ' | 70  |
| 3            | 0        | 46         | 1 | 3        | ı | 0         | ı   | 0     | Ι   | 0   | ı   | 0 | ı | 0   | ı | 0 | Ι | 104 | ı | 58  |
| 31           | 0        | 10         |   | 0        |   | 1 0       |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
| 4 l          | 0        | 20         |   | 6        |   | 12        | -   | 0     | -   | 3   | -   | 0 |   | 0   |   | 0 | - | 5   |   | 3   |
| 10           | 0        | 1 0        |   | 0        |   | 1 0       |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
| 5 l          | 0        | 10         |   | 0        |   | 6         |     | 4     | ١   | 33  | ١   | 0 | ١ | 3   |   | 0 | ı | 0   |   | 0   |
| 1            | 0        | 10         |   | 1        |   | 1 0       |     | 0     |     | 470 |     | 0 |   | 0   |   | 0 |   | 0   |   | 0   |
| 6            | 0<br>I 1 | 0          |   | 0   22   | ı | 1   0     | ١   | 9     | ı   | 176 | ı   | 0 | ı | 0   | ١ | 3 | ı | 0   | ı | 0   |
| 6<br>7       | 1<br>0   | 10         |   | 0        | ī |           | 1   | 0     | ı   | 0   | ı   | 8 | ı | 1   | ı | 0 | ı | 0   | ı | 0   |
| 10           | 0        | 0          |   | 0        | ' | 1 0       |     | Ü     | '   | Ü   | '   | O | ' | _   | ' | O | ' | V   | ' | O   |
|              | 0        | 1 0        |   | 0        | 1 | •         | 1   | 0     | ı   | 1   | 1   | 1 | 1 | 152 | 1 | 0 | ı | 0   |   | 0   |
| 1 0          | 0        | 1 0        |   | 0        |   | 1 0       |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
| 9            | 0        | 1 0        |   | 0        |   | 0         | -   | 0     | -   | 0   | -   | 0 | - | 0   |   | 4 | 1 | 0   |   | 0   |
| 10           | 0        | 0          |   | 0        |   | 1 0       |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
| 10           | 0        | 27         |   | 0        | ı | 2         | ١   | 0     | ı   | 0   | ١   | 0 | ı | 1   | ١ | 0 | ı | 174 | ı | 67  |
| 34           | 0        | 0          |   | 0        |   | 0         |     | ^     |     | 2   |     | 0 |   | 0   |   | ^ |   | 011 |   | 312 |
| 11  <br>  55 | 0<br>  0 | 150        |   | 4<br>  1 | ı | 8<br>  0  | 1   | 0     | 1   | 2   | ı   | 0 | ı | 0   | I | 0 | 1 | 211 | ı | 312 |
|              |          | 54         |   |          | ı |           | ı   | 0     | ı   | 4   | ı   | 0 | ı | 0   | ı | 0 | ı | 39  | ı | 10  |
| 51           |          | 0          |   |          |   | 1 0       | •   |       | •   |     | •   |   | · |     | • |   | • |     | • |     |
| 13           |          | 1 0        |   | 0        |   |           | 1   | 0     | 1   | 3   | -   | 0 | - | 0   |   | 0 | 1 | 0   |   | 0   |
| 1 0          | 53       | 1 0        |   | 1        |   | 1 0       |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
|              |          | 1 0        |   |          |   | 0         |     | 6     |     | 0   |     | 0 |   | 0   |   | 0 | - | 0   |   | 0   |
|              |          | 36         |   |          |   | 0         |     |       |     |     |     |   |   | _   |   | _ |   |     |   | _   |
|              |          | 0          |   |          |   | 0         | ١   | 11    | ı   | 32  | ı   | 0 | ı | 0   | ١ | 0 | ı | 0   | ١ | 0   |
|              | 9<br>0   | 37         |   |          |   | 0         | 1   | 0     |     | 0   |     | 0 |   | 0   | 1 | 0 |   | 0   | 1 | 0   |
|              |          |            | 1 |          |   | 19        | '   | U     | '   | O   | '   | U | ' | U   | ' | U | ' | U   | ' | U   |
|              |          | esting     |   |          |   |           | ix  |       | _   |     |     |   |   |     |   |   |   |     |   |     |
| Act /        |          |            |   |          | _ |           |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
|              |          | 1 2        |   | 3        |   | 4         |     | 5     |     | 6   | - [ | 7 |   | 8   |   | 9 |   | 10  |   | 11  |
|              |          | 14         |   |          |   |           |     |       |     |     |     |   |   |     |   |   |   |     |   |     |
|              |          | 10         |   |          |   |           |     | 0     |     | 0   | I   | 0 | I | 1   |   | 0 |   | 0   |   | 0   |
| 1 0          | 10       | 1 0        |   | 0        |   | 0         |     |       |     |     |     |   |   |     |   |   |   |     |   |     |

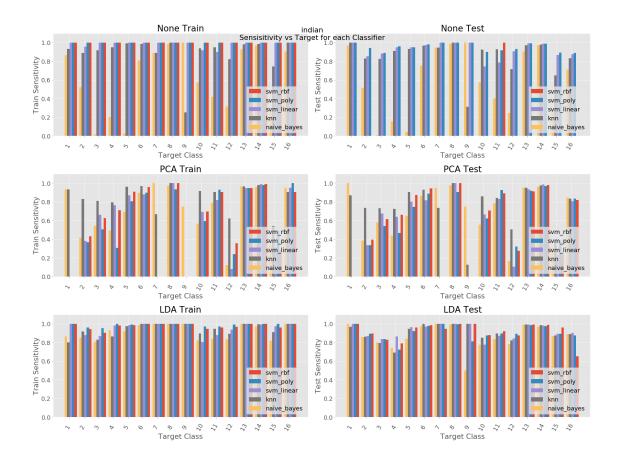
| 2   | 0   | 509 | 0  | 1 2 | 0   | 2   | 0   | 1 2 | 1 0 | 234 | 161 |
|-----|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| 83  | 1 0 | 1 0 | 10 | 0   |     |     |     |     |     |     |     |
| 3   | 0   | 131 | 4  | 5   | 0   | 1   | 0   | 0   | 0   | 269 | 126 |
| 52  | 0   | 1 0 | 10 | 0   |     |     |     |     |     |     |     |
| 4   | 0   | 91  | 4  | 28  | 1 0 | 12  | 1 0 | 1 0 | 1 0 | 21  | 12  |
| 10  | 0   | 1 0 | 10 | 0   |     |     |     |     |     |     |     |
| 5 l | 1   | 1   | 0  | 24  | 14  | 62  | 1   | 10  | 0   | 1   | 1 0 |
| 4   | 1 0 | 210 | 1  | 0   |     |     |     |     |     |     |     |
| 6   | 0   | 0   | 0  | 1   | 31  | 385 | 0   | 0   | 1   | 0   | 1 0 |
| 14  | 6   | 1   | 73 | 0   |     |     |     |     |     |     |     |
| 7   | 1   | 0 l | 0  | 1 0 | 1 0 | 1 0 | 18  | 1 0 | 1 0 | 1 0 | 10  |
| 1 0 | 10  | 1 0 | 0  | 1 0 |     |     |     |     |     |     |     |
| 8   | 1   | 0 l | 0  | 1 0 | 1 0 | 1 0 | 1 2 | 320 | 1 0 | 1 0 | 10  |
| 1   | 10  | 1 0 | 10 | 1 0 |     |     |     |     |     |     |     |
| 9   | 0   | 0 l | 0  | 1 0 | 1 0 | 1 0 | 1 0 | 0   | 16  | 1 0 | 1 0 |
| 1 0 | 10  | 1 0 | 10 | 1 0 |     |     |     |     |     |     |     |
| 10  | 0   | 65  | 0  | 1   | 1 0 | 1   | 1 2 | 4   | 1 0 | 382 | 144 |
| 68  | 10  | 1 0 | 10 | 1 0 |     |     |     |     |     |     |     |
| 11  | 0   | 390 | 8  | 17  | 1 0 | 10  | 1 0 | 2   | 1 0 | 466 | 694 |
| 123 | 1 0 | 1 0 | 2  | 1 0 |     |     |     |     |     |     |     |
| 12  | 0   | 168 | 1  | 1 0 | 1 0 | 5   | 1 0 | 0   | 1 0 | 121 | 29  |
| 106 | 10  | 1 0 | 1  | 1 0 |     |     |     |     |     |     |     |
| 13  | 0   | 0 l | 0  | 1   | 1 0 | 10  | 1 0 | 1 0 | 1   | 1 0 | 10  |
| 0   | 134 | 1 0 | 2  | 1 0 |     |     |     |     |     |     |     |
| 14  | 0   | 0   | 0  | 1 0 | 11  | 1 2 | 1 0 | 1 0 | 1 0 | 1 0 | 1 0 |
| 0   | 1 0 | 864 | 14 | 0   |     |     |     |     |     |     |     |
| 15  | 0   | 0   | 0  | 3   | 20  | 82  | 0   | 0   | 3   | 1 0 | 10  |
| 8   | 11  | 66  | 71 | 0   |     |     |     |     |     |     |     |
| 16  | 0   | 12  | 0  | 4   | 1 0 | 1 0 | 1 0 | 0   | 1 0 | 1 0 | 1 0 |
| 5   | 1 0 | 1 0 | 10 | 51  |     |     |     |     |     |     |     |

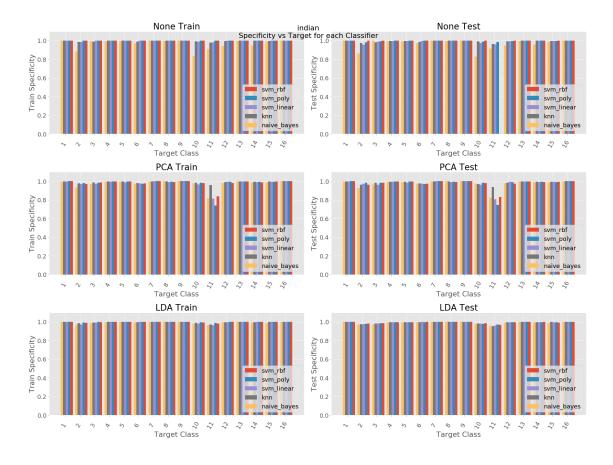












b) iris) A PCA of 2 components and LDA of 2 components were chosen based on the information from question 1.

With the iris dataset, there is not a huge difference in performances and runtimes with and without data reduction (apart from the sym-poly on pca data). As long as the train size is over 20%, the performance reaches above 95%. In the end, it is up to personal preference on which learning method to use. Personally, I would choose LDA with 2 dimensions and use a simple knn model to predict. It is simple, easy to understand, fast and highly accurate for the iris dataset. The sym-poly dataset is completely failing with pca and I cannot determine quite determine why. It appears to select everything as Virginica (based on the confusion matrix). All the others perform adequately enough that I do not feel that it is necessary to alter the methods much to improve performance.

indian) Initially I used a PCA and LDA of only 4 components, but the results were not impressive so I upped the number of components to 10, then 15. The PCA has minimal improvement with increased components, so I stuck with 4 (which is what would be expected based on the results from question 1). The LDA saw about 5-10% improvement with increased components from 4 to 15. I ended up choosing 15 components as that uses all of the classes for LDA, and its runtime is still quite fast.

With the indian dataset, we see a much more noticable difference in performance and runtime based on dimensionality reduction. Without dimensionality reduction, the runtimes for the sym learners on the dataset are quite intensive. I would not use any of the syms on the unreduced data. The learners sensitivity versus target appear much improved with LDA vs PCA or no dimensionality

reduction. The specificity seems to excel in most cases, except for the svm rbf and naive bayes with no dimensionality reduction in certain classes (class 11 being a bad instance) and svm poly appears to struggle in specificity with the PCA data. Based on the plots, PCA is not a good approach for the indian dataset for most learners (though it does seem to do quite well with knn). Most likely, there is significant overlap in the data (which is shown in the first question), and merely using variances to determine principal components is not enough. LDA is able to perform better because it takes into account target classes to try and maximize the inter- and intra- class means. LDA appears to be the right approach as it has drastically faster runtimes and comparable performance with using the whole dataset. The best classifier in terms of classification accuracy is svm\_rbf, but they all perform about the same. Looking at specificicity and sensitivity, they all seem to do similar as well. Each learner seems to have one or two classes it particularly struggles with (ie. naive bayes struggles with class 9). An ensemble majority vote learner using knn, naive bayes and svm\_rbf might me an interesting and more fruitful approach to combat this dilemma.