Homework 2

The code is submitted at github

<https://github.com/mas-dse/w9yan/blob/master/DSE220/homeworks/homework_2/generative.ipynb>

Answers:

1. Priors for all lables are:

prior probability for label 0 is 0.0987

prior probability for label 1 is 0.1118

prior probability for label 2 is 0.0968

prior probability for label 3 is 0.1013

prior probability for label 4 is 0.1038

prior probability for label 5 is 0.0857

prior probability for label 6 is 0.1013

prior probability for label 7 is 0.1085

prior probability for label 8 is 0.0918

prior probability for label 9 is 0.1002

1. Report highest Pji for each label j :

highest Pji for label 0 is 0.8519

highest Pji for label 1 is 0.9851

highest Pji for label 2 is 0.7290

highest Pji for label 3 is 0.8082

highest Pji for label 4 is 0.8496

highest Pji for label 5 is 0.7112

highest Pji for label 6 is 0.8492

highest Pji for label 7 is 0.7948

highest Pji for label 8 is 0.8752

highest Pji for label 9 is 0.8673

1. With Naïve Bayes classifier, the test accuracy is

test accuracy is: 0.8090

1. Compute the confusion matrix and report top 3 pairs with most incorrect classifier.

[[ 74 0 0 0 0 5 2 0 4 0]

[ 0 120 0 0 0 4 1 0 1 0]

[ 1 7 88 4 0 1 2 3 8 2]

[ 0 2 1 86 1 6 3 2 3 3]

[ 1 1 1 0 83 0 2 0 1 21]

[ 3 1 1 11 2 62 2 3 1 1]

[ 3 0 4 0 3 4 73 0 0 0]

[ 0 6 2 0 3 1 0 77 3 7]

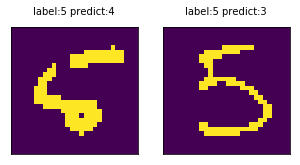
[ 0 2 2 9 4 3 1 2 61 5]

[ 0 1 0 1 4 0 0 0 3 85]]

top 3 pairs(true, predict) with most incorrect classification:

[(4, 9), (5, 3), (8, 3)]

1. Visualize mistakes: print 2 misclassified images.



1. Report selected covariance type and according test accuracy.

Best covariance type based on validation is: spherical

test accuracy is: 0.0482

1. Linear Discriminant Analysis model on the train+validation data and report the accuracy obtained on test data. Report the transformation matrix (w) along with the intercept.

Test accuracy = 0.9649

The transformation matrix(w) is:

[[ 1.34830116e+00 -1.27341243e-01 -1.35844403e-01 -2.44423845e-04

-2.24362884e+01 8.56018583e+01 1.38546510e+01 -1.22119406e+02

1.60043667e+01 7.42980762e+00 -1.47932822e+01 4.82925722e-01

1.73467322e+00 -1.63578761e-02 -4.69433577e+02 -1.95981999e+00

1.60421869e+01 -9.77881013e+01 -6.13801471e+01 5.59104687e+02

-1.26194721e+00 -1.99981038e-01 -2.62323627e-01 1.92964678e-02

3.19490554e+01 4.09464513e+00 -1.26545911e+01 -9.32147959e+00

-1.48664190e+01 -1.71510006e+02]]

The intercept is: [ 51.85532978]

1. Specificity, Sensitivity, TPR, TNR, FNR, FPR, Precision and Recall for Digit 3

specificity: 0.995507637017071

sensitivity: 0.916030534351145

TPR: 0.916030534351145

TNR: 0.995507637017071

FNR: 0.08396946564885499

FPR: 0.004492362982928988

precision: 0.96

recall: 0.916030534351145

1. Report the mean squared error and the mean absolute error on the test data

MSE: 2155.9646510319635

MAE: 36.31813369867867

1. Repeat the experiment from Question 10 for all possible values of ablation

MSE after removing feature 0 is : 2152.8066421806125

MSE after removing feature 1 is : 2259.133079371277

MSE after removing feature 2 is : 2783.514481845114

MSE after removing feature 3 is : 2424.772348004414

MSE after removing feature 4 is : 2187.599519380257

MSE after removing feature 5 is : 2167.5176061492357

MSE after removing feature 6 is : 2159.151482507473

MSE after removing feature 7 is : 2153.0631711282294

MSE after removing feature 8 is : 2335.1733846110847

MSE after removing feature 9 is : 2165.8661921931885

1. Based on the MSE values obtained from Question 10, the most/least significant feature are below.

most significant feature is index 2, because removing feature 2 will cause the largest MSE which means more errors were produced without this feature.

least significant feature is index 0, because without feature 0 we get comparatively smallest MSE.