

MNIST Classification using MLE, PCA, FDA and Discriminant Analysis

Report

Results of accuracy of LDA and QDA classifiers

- Part 1: FDA with LDA and QDA (95% variance):
 FDA + LDA:
 Train accuracy: 98.67%
 Test accuracy: 91.67%
 FDA + QDA:
 Train accuracy: 98.67%
 Test accuracy: 95.67%
- Part 2: PCA with LDA (95% variance):
 PCA + LDA:
 Train accuracy: 99.33%
 Test accuracy: 94.33%
- Part 3: PCA followed by FDA with LDA and QDA (90% variance):
 PCA + FDA + LDA:
 Train accuracy: 98.67%
 Test accuracy: 92.33%
 PCA + FDA + QDA:
 Train accuracy: 98.33%
 Test accuracy: 95.00%
- Part 4: PCA followed by FDA with LDA and QDA (First 2 components):
 PCA + FDA + LDA:
 Train accuracy: 95.67%
 Test accuracy: 90.33%
 PCA + FDA + QDA:
 Train accuracy: 97.67%
 Test accuracy: 95.00%

Analysis of PCA effects on classification performance:

- PCA improved performance when combined with LDA, achieving a higher test accuracy (94.33%) compared to FDA + LDA (91.67%).
- QDA generally performed better than LDA across all methods, especially when FDA was applied (FDA + QDA had the highest test accuracy of 95.67%).
- PCA followed by FDA (90% variance) performed slightly worse than PCA alone but still showed competitive results, indicating that FDA retains useful discriminative information even after PCA dimensionality reduction.

- When using only the first two principal components, the classification performance dropped, especially for LDA (90.33% test accuracy), confirming that more components are necessary for optimal performance.