Statistics and Data Analysis

Unit 05 – Lecture 04: Factor Analysis and Discriminant Analysis (LDA)

Tofik Ali

School of Computer Science, UPES Dehradun

February 14, 2026

https://github.com/tali7c/Statistics-and-Data-Analysis

Quick Links

Overview   Factor Analysis   LDA   Exercises   Demo   Summary

Agenda

1 Overview

2 Factor Analysis

3 LDA

4 Exercises

5 Demo

6 Summary

Learning Outcomes

- Explain factor analysis as latent-factor modeling (intuition)

Learning Outcomes

- Explain factor analysis as latent-factor modeling (intuition)
- Differentiate PCA vs factor analysis (goal/assumptions)

Learning Outcomes

- Explain factor analysis as latent-factor modeling (intuition)
- Differentiate PCA vs factor analysis (goal/assumptions)
- Explain LDA as supervised dimensionality reduction/classifier

Learning Outcomes

- Explain factor analysis as latent-factor modeling (intuition)
- Differentiate PCA vs factor analysis (goal/assumptions)
- Explain LDA as supervised dimensionality reduction/classifier
- Interpret a 2D LDA projection

Factor Analysis: Key Points

- Observed variables driven by a few latent factors

Factor Analysis: Key Points

- Observed variables driven by a few latent factors
- Goal: explain correlations via factors

Factor Analysis: Key Points

- Observed variables driven by a few latent factors
- Goal: explain correlations via factors
- Used for surveys/constructs

LDA: Key Points

- Supervised: uses labels

LDA: Key Points

- Supervised: uses labels
- Finds projection maximizing class separation

LDA: Key Points

- Supervised: uses labels
- Finds projection maximizing class separation
- Can classify and visualize

Exercise 1: Supervised?

Is PCA supervised? Is LDA supervised?

Solution 1

- PCA is unsupervised; LDA is supervised.

Exercise 2: Goal

What does PCA optimize vs LDA (intuition)?

Solution 2

- PCA: variance captured; LDA: class separability.

Exercise 3: Use case

Labeled A/B/C data, want 2D plot separating classes. PCA or LDA?

Solution 3

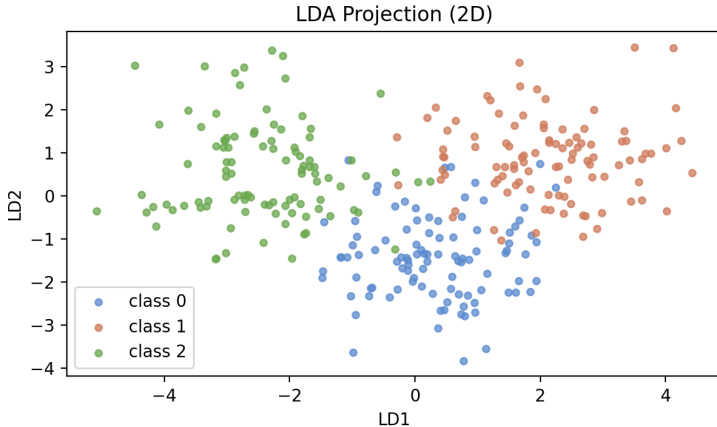- LDA (uses labels for separation).

Mini Demo (Python)

Run from the lecture folder:

```
python demo/demo.py
```

Outputs:

- `images/demo.png`
- `data/results.txt`

Demo Output (Example)

Summary

- Key definitions and the main formula.

Summary

- Key definitions and the main formula.
- How to interpret results in context.

Summary

- Key definitions and the main formula.
- How to interpret results in context.
- How the demo connects to the theory.

Exit Question

Why can LDA separate classes better than PCA on labeled data?