Final Report: PBMC Single-Cell RNA Sequencing Analysis

Project Overview

We analyzed single-cell RNA sequencing data from 10k Peripheral Blood Mononuclear Cells (PBMCs) to answer three business questions:

1. Identify distinct cell types within the dataset.

2. Understand gene expression patterns differentiating immune cell populations.

3. Explore potential biological insights, such as immune response mechanisms and inflammation markers.

Key Findings

1. Identified Distinct Cell Types

Using clustering and marker gene analysis, we identified six major immune cell types:

Cell Type	Cluster ID(s)	Marker Genes
T cells	0, 3, others	CD3D
B cells	2	MS4A1
Monocytes	0, others	LYZ
NK cells	4	GNLY
Dendritic cells	5	FCER1A
Platelets	6	PPBP

2. Gene Expression Patterns Across Cell Types

T cells expressed CD3D, a marker for T cell activation.

B cells expressed MS4A1, a key marker for B lymphocytes.

Monocytes showed high expression of LYZ, reflecting their role in innate immunity.

NK cells expressed GNLY, associated with cytotoxic activity.

Dendritic cells expressed FCER1A, indicating their regulatory role in antigen presentation.

Platelets expressed PPBP, reflecting their specialized function in blood clotting.

3. Explored Biological Insights (Inflammation Markers)

We analyzed inflammation-related genes across cell types, focusing on IL1B, TNF, CXCL8, CCL5, IFNG, and IL6:

Monocytes: Showed the highest expression of inflammatory cytokines: IL1B, CXCL8, TNF.

T cells: Expressed CCL5 and IFNG, highlighting their role in adaptive immune responses.

Dendritic cells: Expressed IL1B and TNF, facilitating immune regulation.

NK cells: Expressed CCL5, contributing to immune recruitment.

Potential Future Work

• Refine small, unannotated clusters to identify rare or less common cell types.

• Explore additional pathways related to immune activation, regenerative mechanisms, or disease markers.

This analysis provides a clear understanding of immune cell diversity and inflammation mechanisms within PBMCs, offering valuable insights for research in immunology, inflammation, and regenerative medicine.