

# Batch Effects

## **Technical Variation Problem**

Non-biological variations from different labs, instruments, or time periods can overwhelm true biological signals

### **Correction Methods**

- ComBat (most popular)
- Limma removeBatchEffect
- Harmony (single-cell)
- Seurat CCA integration
- Deep learning approaches

### **Best Practices**

- Randomize across batches
- Include batch in study design
- Balance classes per batch
- Use supervised correction
- Validate on independent data