NumPy arrays and linear inverse problems — review sheet

Use this after attempting the worked examples and practice. Explain each claim in words before calculating.

Key ideas

- Label axes before operating on arrays.
- Matrix multiplication sums over a shared dimension; elementwise multiplication does not.
- Solve a system instead of explicitly forming an inverse.
- Use independent hand/limit checks and report units.
- Residual checks the equations; sensitivity checks the effect of uncertain input.

Common errors and repairs

A square matrix product runs, so its axis convention must be correct. Equal dimension sizes can hide swapped roles. Check a hand-computed entry and axis labels.

Transposing a shape (2,) array makes it a column. A one-dimensional transpose has the same shape. Use an explicit (2, 1) or (1, 2) representation when needed.

The residual is tiny, so measurement error is negligible. An ill-conditioned model can fit noisy signals exactly while recovering inaccurate parameters.

Retrieve without your notes

- What shape results from (7, 2)@(2, 3)?
- What units does a detector residual have?
- What problem does a singular response reveal?

Readiness check

- Annotate specimen, component and detector axes before multiplying arrays.
- Predict the shape and units of a batch calculation.
- Use a linear solve to recover synthetic concentrations and check the residual.
- Distinguish a small solve residual from insensitivity to measurement error.