Linear observations and a two-compartment exchange model — review sheet

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

Key ideas

- The observation map and state evolution are different equations.
- One transfer creates equal-and-opposite mass rates.
- The sum is conserved while the difference decays.
- Conservation does not measure individual-state integration error.
- Fitting requires data informative about the parameter.
- Verification, fit and scientific validation support different claims.

Common errors and repairs

Use k rather than 2k in the difference decay. Both masses change toward each other, so subtracting derivatives gives -2k times the difference.

Call t_eval the fixed integration step. It specifies returned times; adaptive internal steps are separate.

Treat low fit residual as validation of the mechanism. It measures agreement under the selected model and objective only.

Retrieve without your notes

- What is the equilibrium for a closed equal-volume pair totaling 14 mg?
- What happens at k=0?
- What units does k h have?

Readiness check

- Recover two initial masses from a stated linear sensor map and check its residual.
- Translate one transfer rate into equal-and-opposite state derivatives with units.
- Compare an ODE solver and Euler steps against an exact solution and mass conservation.
- Fit one exchange parameter to synthetic observations while distinguishing fit residual from integration error.
- Identify a data configuration that cannot determine the exchange rate.