Population transfers: SIR dynamics, thresholds, and numerical conservation — review sheet

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

Key ideas

- Internal transfers change group composition while conserving a closed total.
- Infection flow βSI/N and recovery flow γI have units people/day.
- The initial direction of I follows the comparison βS/N versus γ.
- A sufficient nonnegative-step condition does not guarantee numerical accuracy.
- Synthetic scenarios and validated forecasts require different evidence.

Common errors and repairs

Subtracting recovered people from total N. R remains inside this closed population; recovery moves people between categories.

Calling β a probability with no time unit. In this model β is an effective rate in 1/day; a transfer also depends on current group sizes and interval length.

Treating a constant total as proof that the entire trajectory is correct. Check bounds, limiting cases and step refinement as well as conservation.

Retrieve without your notes

- Which two changes cancel for an infection transfer?
- Can a positive β start an outbreak when I0 = 0 in this closed model?
- Why compare solutions at common times when changing the step?

Readiness check

- Draw a closed-population transfer diagram with clearly defined categories.
- Compute infection and recovery transfers over a short interval.
- Check conservation and nonnegative group sizes in a numerical update.
- Predict whether the infectious group initially increases from the competing rates.
- Distinguish a controlled synthetic scenario from a validated population forecast.