Closed-system assumptions and model limitations

6 questions | 18 marks

Equivalent correct methods earn the corresponding marks.

1. Name two assumptions behind a six-month forecast $T^6 x_0$. [3 marks]

The periods must also be equal and state labels consistent.

Answer: A constant monthly transition rule and a closed set of states/population.

2. A matrix has columns totalling 1 but an entry -0.1. Why is it invalid as a transition-probability matrix? [3 marks]

Each entry must be between 0 and 1.

Answer: A probability cannot be negative.

3. Predicted counts are $(120, 80)$, observed $(112, 88)$. Find absolute errors and their sum. [3 marks]

Signed errors are $(-8, 8)$.

Take absolute values before adding.

Answer: $(8, 8)$, sum 16.

4. The same 30 travellers estimate a matrix and are then used to claim its forecast is perfect. Explain a weakness. [3 marks]

Use later or separate observations; the small original sample also limits precision.

Answer: The claimed check is not independent of the fitting data.

5. A model predicts proportions $(0.35, 0.65)$ for 1000 members. [3 marks]

(a) Find expected counts. [1 mark]

Multiply each proportion by 1000.

Answer: $(350, 650)$.

(b) Does observing $(340, 660)$ alone prove failure? Explain. [2 marks]

One difference of 10 in each state does not establish a changed underlying rule.

Answer: No; assess variation, sample uncertainty and repeated prediction errors.

6. A new bus route changes behaviour halfway through a year. How should the model respond? [3 marks]

Keep compatible state labels and check whether the population remains closed.

Answer: Estimate a new transition rule from suitable later data and apply old/new matrices in the correct chronological order.