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1. A population of 600 individuals experiences spatial heterogeneity in its discrete-time growth rate. If 2/3 of the population produces 1 individual per individual, and 1/3 of the population produces 2 per individual, what will population size be next year?
2. Two annual-plant species occupy the same environment. Species A responds to temporal variation as if years were of 2 types. The annual reproductive rate λ_A takes 2 values, with differing probabilities: $\Pr[\lambda_A = 2/3] = 1/3$; $\Pr[\lambda_A = 6] = 2/3$. Species B responds to the same environment as if years were of 3 types. That is: $\Pr[\lambda_B = 1] = 1/6$; $\Pr[\lambda_B = 4] = 3/6$; $\Pr[\lambda_B = 8] = 1/3$. Which species has the greater geometric mean growth rate?
3. In 2 of every three years, on average, the number of individuals produced per-individual in a population with non-overlapping generations is 8. Otherwise, the mean number of individuals produced per individual is 1/8. Will the population persist in this time-varying environment?
4. A population grows according to a logistic model where:

$$dN/dt = 0.2 N - 0.0002 N^2$$

What equation describes the individual's contribution to population growth, as a function of density N_t ? That is, find $(dN/dt)/N$. For the given logistic (*i.e.*, $r = 0.2$), show that the carrying capacity is 1000.

5. Two species with non-overlapping generations occupy the same environment. Warm years and cold years occur independently; each year is warm with probability 0.5. Species 1 produces 3.5 individuals per individual in a warm year, and 1.0 individual per individual in a cold year. Species 2 produces 8 individuals per individual in a warm year, and 0.25 individuals per individual in a cold year. Then:

- A) Species 1 has a lower arithmetic mean growth rate
- B) Species 1 has a lower geometric mean growth rate
- C) A & B are true
- D) neither A nor B is true

6. A density-dependent population grows according to $dN_t/dt = 0.4 N_t - 0.002 (N_t)^2$, where N_t is the population size at continuous time t . The carrying capacity is

- A) 50
- B) 80
- C) 200
- D) 800
- E) need further information