For Monday, 4 Oct 10

A population with non-overlapping generations (*e.g.*, an annual plant) exhibits geometric growth. Initial population size is 400. A time t = 2, population size is $N_2 = 625$. What is the annual growth rate?

Suppose that a population exhibits exponential growth, $d\,N_t/dt = rN_t$, where $r > 0$. Then the natural logarithm of population size, $\ln N_t$

A) is constant as time advances
B) increases at an increasing rate as time advances
C) increases linearly as time advances
D) increases at a decreasing rate as time advances

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[λ_A = 2/3] = 1/3; : Pr[λ_A = 6] = 2/3. Species B responds to the same environment as if years were of 3 types. That is: Pr[λ_B = 1] = 1/6; Pr[λ_B = 4] = 3/6; Pr[λ_B = 8] = 1/3. Which species has the greater geometric mean growth rate?

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?

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

A) 50 B) 80 C) 200 D) 800
E) unknown without further information

At time t a population has size N_t, where $0 \le N_t \le N_{maximum}$. Let $x_t = N_t/N_{maximum}$, so that $0 \le x_t \le 1$. In discrete time x_t has dynamics:

$$x_{t+1} = 2.5\, x_t\, (1 - x_t)$$

At positive equilibrium $x_{t+1} = x_t > 0$. (a) Find the positive equilibrium. (b) What will happen (briefly) if $x_{t+1} = 0.5\, x_t\, (1 - x_t)$?

Consider one form of the discrete time logistic:

$$N_{t+1} \;=\; N_t\, e^{r\left(1 - N_t/K\right)}$$

Show that $N = K$ at positive equilibrium.

Let g_x represent the proportion of x-year olds surviving to age (x + 1). Let b_x represent the mean, age-specific number of young produced. Find R_0 for:

Age	0	1	2	3
g_x	0.6	0.5	0.4	0
b_x	0.5	1.0	0.5	0.5