

1. Suppose that a population of deer grows logistically with an intrinsic growth rate of 20% and a carrying capacity of 500.

- (a) Determine a discrete dynamical system with initial value to model this deer population.

$$u(n) = u(n-1) + 0.2u(n-1) \left(1 - \frac{u(n-1)}{500}\right)$$

- (b) Determine the maximum interval of stability for this deer population.

$$(0, 3000)$$

2. Suppose we have the following discrete dynamical system.

$$u(n) = 0.1u^2(n-1) + 0.3u(n-1) + 1$$

- (a) Find each equilibrium value for this discrete dynamical system and state whether it appears to be stable or unstable.

$$E = 5 \text{ (unstable), } E = 2 \text{ (stable)}$$

- (b) For each stable equilibrium value, determine the maximum interval of stability.

For $E = 2$, the maximum interval of stability is $(-8, 5)$ (Note: for population models it may make more sense to say $(0, 5)$)

- (c) For each stable equilibrium value, suppose that $u(0)$ is within the maximum interval of stability. Approximate the rate at which $u(n)$ goes toward the equilibrium value.

For $E = 2$ and an appropriate choice for $u(0)$ we obtain $\lim_{n \rightarrow \infty} \frac{u(n) - E}{u(n-1) - E} = 0.7$. Thus for large enough n , $u(n)$ is about 30% closer to equilibrium than $u(n-1)$.