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Shreya Ghosh, 11/22/2021, Assignment 23

HW 23

1. a) Population is decreasing at rate three times its current value
   i) Continuous
   ii) $\frac{dx}{dt} = -3x$
   iii) $F = -3x$
   iv) $0 = -3x$
        $x = 0$
   v) $F'(x) = -3$
        $F'(0) = -3 \Rightarrow$ stable b/c $-3 < 0$

b) Value at a given generation is $\frac{1}{3}$ of its value at previous generation
   i) Discrete
   ii) $x(n) = \frac{1}{3} x(n-1)$
   iii) $F = \frac{1}{3} x$
   iv) $x = \frac{1}{3} x$
        $-\frac{2}{3} x = 0$
        $x = 0$
   v) $F'(x) = \frac{1}{3}$
        $F'(0) = \frac{1}{3} \Rightarrow$ stable b/c $\frac{1}{3} < 1$

c) Value at given generation is 3 times value of previous times (1 minus value at previous)
   i) Discrete
   ii) $x(n) = 3x(n-1)(1 - x(n-1))$
   iii) $F = 3x(1-x)$
   iv) $x = 3x(1-x)$
        $x = 3x - 3x^2$
        $3x^2 - 2x = 0$
        $x(3x-2) = 0 \Rightarrow x = 0, \frac{2}{3}$
   v) $F'(x) = 3 - 6x$
        $F'(0) = 3 \Rightarrow$ unstable b/c $3 > 1$
        $F'(\frac{2}{3}) = -1 \Rightarrow$ unstable b/c $-1 \not< -1 \not< 1$

d) Population is increasing at rate 3 times of current value times (1 minus current value.

i) continuous

ii) $\frac{dx}{dt} = 3x(1-x)$

iii) $F = 3x(1-x)$

iv) $0 = 3x(1-x)$

$x = 0, 1$

v) $F'(x) = 3 - 6x$

$F'(0) = 3 \Rightarrow$ unstable b/c $3 > 0$

$F'(1) = -3 \Rightarrow$ stable b/c $-3 < 0$