Attendance quiz for Lecture 23

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1. For the following scenarios,

(i) Decide whether it is discrete-time or continuous-time dynamical model

(ii) Set up the appropriate difference or differential equation (as the case may be)

(iii) Write explicitly the **underlying transformation** (recall that for one quantity, like in the models below, it is simply a function of one variable)

(iv) Find **all** the fixed points (if it is discrete-time) or equilibrium points (if it is continuous time). Explain! Use the criterion for finding them.

(v) Find **all** the **stable** fixed points (if it is discrete-time) or all the **stable** equilibrium points (if it is continuous time). Explain! Use the criterion for finding them.

Call the quantity $x(t)$ or $x(n)$ for the continuous-time and discrete-time respectively.

a The population of a certain species is **decreasing** at a rate that is twice its current value.

b The population of a certain species changes from one generation to the next. The value at a given generation is one-half of its value at the previous generation.

c The population of a certain species changes from one generation to the next. The value at a given generation is twice its value at the previous generation times (1 minus its value at the previous generation).

d The population of a certain species scaled such that the maximum possible is 1 is **increasing** at a rate that is twice its current value times (1 minus its current value).

a)

i) continuous-time dynamical model
ii) x'(t) = -2*x(t)
iii) F(x) = -2x
iv) When x'(t) = 0, x(t) is at an equilibrium point
x'(t) = 0 when x(t) = 0
v) F'(x) = -2
Unstable equilibrium

b)
i) discrete-time dynamical model
ii) x(n) = 0.5* x(n-1)
iii) f(x) = 0.5 * x where f(x) = f(x(n-1)
iv) x = 0.5*x
0.5 *x = 0
0 is a fixed point
v) A fixed point is stable if |f'(x)| <1
f'(x) = 0.5
0 is a stable fixed point

c)
i) discrete-time dynamical model
ii) x(n) = 2*x(n-1)*(1-x(n-1))
iii) f(x) = 2*x*(1-x)
iv) x = 2x-x^2
x^2-x = 0
x * (x-1) = 0
0 and 1 is a fixed point
v) f'(x) = 2-2x
f'(0) = 2
f'(1) = 0
1 is a stable fixed point

d)
i) continuous-time dynamical model
ii) x'(t) = 2*x(t)*(1-x(t))
iii) F(x) = 2*x*(1-x)
couldn't finish - ran out of time