L7 : Tuesday, Feb. 14.

House keeping: Find short assignment on Canvas, due Thursday

Last time:
- Exponential decay, half-lives
- Newton's Law of cooling / heating

Questions?

This time: Constrained Growth

Recall: When modelling unconstrained growth or decay ... there weren't ... constraints.

In that case, the differential eq'n to model was $\frac{dP}{dt} = kP$, whose solution we found analytically: $P(t) = P_0 e^{kt}$, where $P_0 = P(0)$ is the initial population.

We also used time-stepping schemes to simulate the solution numerically using the difference equation

$$\Delta P = P(t) - P(t - \Delta t)$$
$$= kP(t - \Delta t)\,\Delta t .$$

BUT... CAN A POPULATION REALLY GROW WITHOUT BOUND ?

Example: The Eurasian perch or ruffe (Gymnocephalus cernuus) is an invasive species in several parts of the world. It has decimated the eggs of salmon in Loch Lomond, Scotland, and was introduced into Lake Superior accidentally in the bilge water of a ship. They're very adaptable to habitat + food sources, have few to no predators, and don't compete with many other species for resources. What's to stop them from becoming our new fishy overlords ??

Example: Animal farming ... Why can't a single pasture support an unlimited number of alpacas in a year?

COMPETITION FOR FINITE RESOURCES usually ends up quashing (or... CONSTRAINING) popnlat'n growth!

DEF. The CARRYING CAPACITY for an organism in an area is the maximum number of organisms that the area can support.

Side note: Introducing this constraint on growth complicates the soln of the model — that's why "modelling the zombie apocalypse" is such a popular freshman math project — it's not so complicated when there aren't constraints?

QUICK REVIEW QUESTIONS, p. 35–36

These are to help us revise our model!