Using InsightMaker

Our problem: We have deer eating plants, and we know the following about annual growth through observations:

- The population of deer grows at a rate that is proportional to the biomass of the plants, with an estimated proportionality constant of 0.001.
- The population of deer decreases proportional to the number of deer present, with an estimated proportionality constant of 1.1.
- The plants grow steadily, but the maximum biomass of the plants is 3000, and when there are very few plants the growth factor is approximately 0.8.
- The deer eat the plants at a rate proportional to the number of deer present, with an estimated proportionality constant of 0.0006.
- We have 100 deer and the maximum biomass of plants (3000) to start.
- The constants 0.001 and 0.0006 are the least well understood and most in doubt. We think a time step of 1/12 (i.e., monthly) would be a reasonable step.

This gives the differential equations and initial conditions:

$$d'(t) = (0.001\,p)\,d - 1.1\,d, d(0) = 100$$

$$p'(t) = 0.8\,p\left(1 - \frac{p}{3000}\right) - (0.0006\,d)\,p, p(0) = 3000$$

We want to build this in excel and in a new online differential equation solver: InsightMaker.com

NOTE: In excel the equations will be rearranged as:

$$\frac{\mathrm{d_{new}} - \mathrm{d}}{\mathrm{dt}} = 0.001 * p * d - 1.1 * d$$
$$\mathrm{d_{new}} = d + (0.001 * p * d - 1.1 * d) * dt$$

$$\frac{p_{new} - p}{dt} = 0.8 * p * \left(1 - \frac{p}{3000}\right) - 0.00006 * d * p$$
$$p_{new} = p + \left(0.8 * p * \left(1 - \frac{p}{3000}\right) - 0.00006 * d * p\right) * dt$$

And these are in the class examples file.

In InsightMaker we will use the differential equations rather than these equations! We will build this together in Lab on Wednesday.

Steps:

1) Place the stocks – one for deer and one for plants – and initialize them.
2) Place any "variables" – one for each of the uncertain constants – and initialize them.
3) Create the flows – one in and one out of each stock.
4) Create the links – one from each variable to the appropriate flow.
5) Edit the flows to calculate the change using the right-hand sides of the differential equations.
6) Set the units and time step; save your model.
7) Simulate!