mth 256

Introduction to ODE Architect

We will consider the *logistic equation*,

$$\frac{dp}{dt} = k\,p\,\left(1 - \frac{p}{N}\right)$$

We will explore the behavior of the solutions by the use of the computer.

Begin: Start the program ODE Architect from the icon on the screen or from the startup menu.

1. Enter the equation in the blank panel on the upper left corner of the screen. Use an asterisk to indicate multiplication and an apostrophe ' to indicate derivative:

   p'=k * p * (1 - p/N)
   k=0.2
   N=4

   You must enter the values of the parameters. Those may be changed at a later time as you will see. **Then click on the enter button.**

2. Go to the **Initial Conditions** panel (lower left corner) and set p to the value 1. (Click in the box next to p and enter the desired value.)

3. Solve the equation by **clicking on the solve button**. Notice how the solution looks like a straight line. Extend the solution (by clicking on the **Extend** button) to see the value p for larger t. Now we see a more familiar pattern. Extend once more.

4. Repeat the previous step with the initial values $p = 0.4$ and $p = 0.2$. Notice how the program adjusts the scales automatically. To **set the scales** yourself point at the graphics window and **click on the right button** to get a menu, then **click on scales**. Set the scale for Y-values from -1 to 5 and the number of ticks to 12 (first you need to **click on the autoscale box** to disable autoscaling).

5. You can see the direction field as explained in class by clicking the right mouse button on the graphic screen and then selecting "Direction field". Selecting it again eliminates the direction field.

6. You can see an animation of the last graph as it is being drawn by selecting **Animate** from the **Solutions** menu at the top of the screen or by pressing F9.

7. You will now investigate the effect of changing the parameters k and N. Those can be changed directly in the upper left panel. You must **click enter** again whenever you change something in the panel. Observe the effect of changing k to 0.4 and to 0.5. What happens? Set again $k = 0.2$ and analyze what happens when $N = 7$. You may have to change the scaling again (use autoscale for the Y-axis if you are not sure of a good value).

8. Finally, select the **Explore** option from the **Solutions** menu (or press F10) to estimate the value of t for which the function p attains the value 4 (for $k = 0.2$, $N = 7$, the values of your last run). You can move the cross-hairs in the graphic window by moving the slider in the **Explore** sub-window.