**Fox v. Rabbit**

Build the Predator-Prey model in section 2.4.

As we all know, rabbits reproduce like rabbits. Clearly the only way to keep their population in check is to introduce a predator to their habitat. Enter the fox. The rabbit population grows exponentially with only the foxes to reduce their numbers. The fox population grows when there are plenty of rabbits to eat, but it drops when rabbits are scarce.

During each time period, each fox eats a number of rabbits equal to the total number of rabbits times a Prey Factor. Please note this is a simplification; since foxes will not increase their feeding without bound as rabbit numbers increase. However, it is a reasonable assumption when there are too few rabbits for the foxes to eat their fill.

**Change in Rabbits** = (Total Rabbits) [(Base Growth Rate) - (Foxes)(Prey Factor)]

Fox growth rate starts negative by subtracting Base Diminishing Rate, which is the rate the foxes will die with no rabbits at all. The fox growth rate is then boosted by the availability of rabbits; more rabbits implies healthier foxes and more baby foxes.

**Change in Foxes** = (Total Foxes) [(- Base Diminishing Rate) + (Feeding rate)(Rabbits)]

In your initial model, start with the following values:

- Initial rabbit population = 1000
- Initial fox population = 100
- Rabbit base growth rate = 0.04
- Prey Factor = 0.0004
- Fox base diminishing rate = 0.08
- Feeding rate = 0.0001

Make two graphs: one graphing Foxes and Rabbits over time and one with Rabbits on the x-axis and Foxes on the y-axis. See how these change as you adjust the rates. It takes a lot of time to see the patterns. Start with 500 time periods, maybe adding more if you think it would be helpful.

**Additional Questions**

- By analyzing the equations used to update the two populations, deduce the number of Foxes and Rabbits which would result in perfect equilibrium (neither population changes as time passes). Check your answer using the spreadsheet.
- Too many foxes scare the farmers. Introduce a hunt which kills off 30 foxes every time the fox population goes over 130. Make these two numbers adjustable by scroll bar.
- There’s a limit to how many rabbits a fox can eat. Put an adjustable max (start with 0.5) on the number of rabbits eaten per fox each period.
- Even in perfect conditions, there are only so many young a fox family can produce. Put an adjustable max (start with 0.02) on the fox growth rate ((feeding rate)*(rabbits)).