Practice 5

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Predator-prey Model

- **Definition equation model**

$$\frac{dx(t)}{dt} = R_1 x(t) - k_2 x(t) y(t)$$

$$\frac{dy(t)}{dt} = k_2 k_3 x(t) y(t) - k_4 y(t)$$

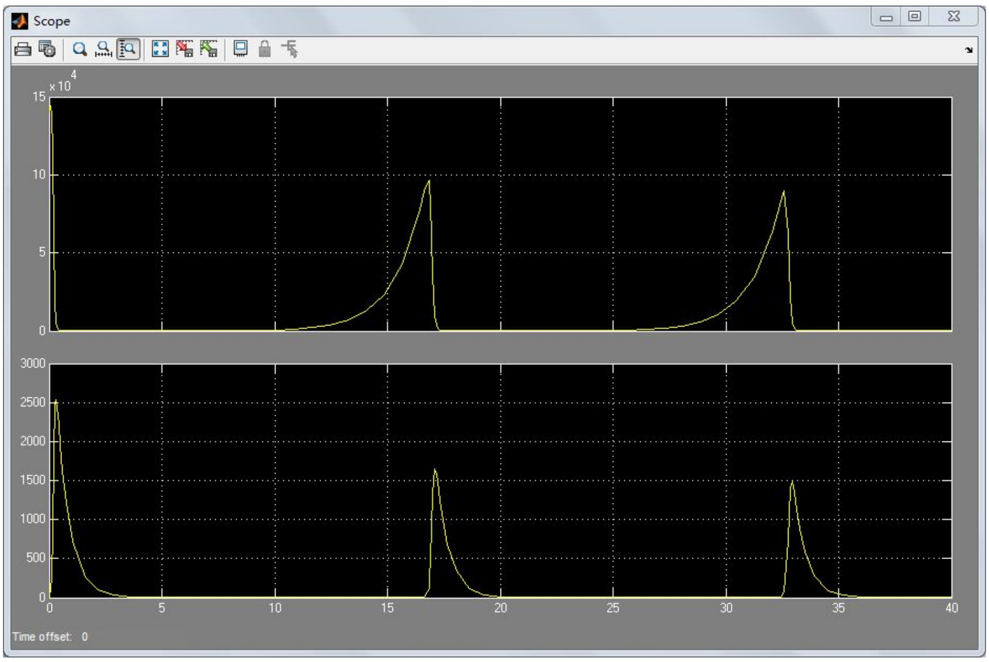
- **Table of all state variables of the model with columns**

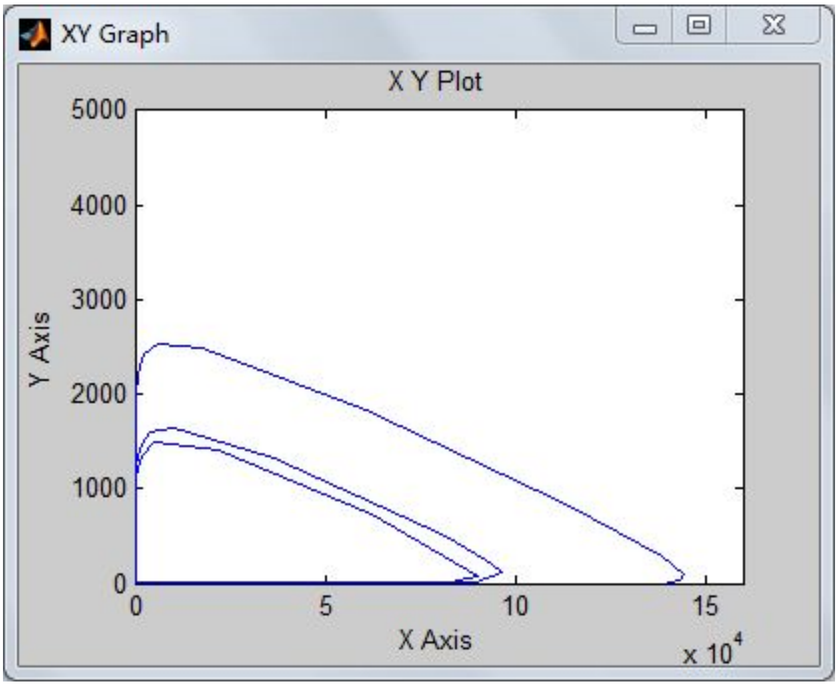
$x(t)$	$y(t)$
The population of the prey	**The population fo the predator**
$x(0) = 140000$	$y(0) = 10$
individuals	**individuals**

- **Table of all model parameters:**

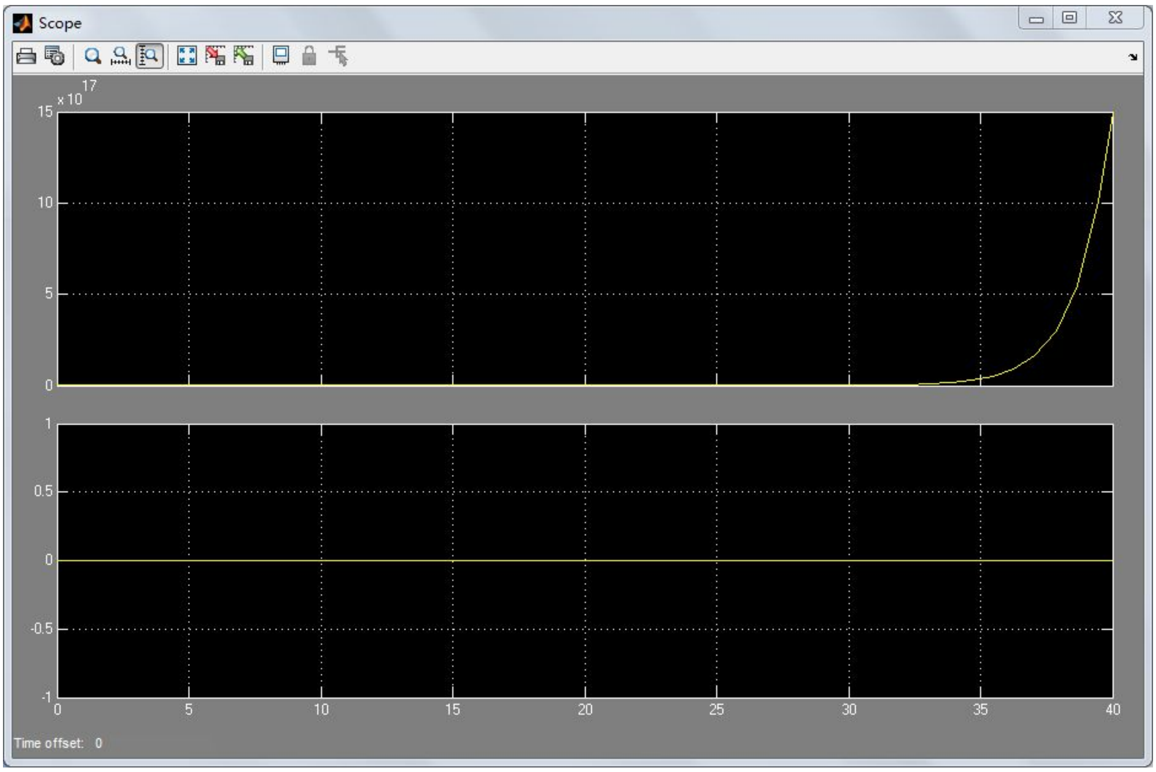
R_1	k_2	k_3	k_4
Relative fertility of prey	**Probability that predator will kill prey when they are meeting**	**Conversion efficiency of the biomass of prey to predator biomass**	**Relative mortality of predators**
0.5*3/2	**0.01**	**0.02**	**1.8**
\\.	**\\.**	**\\.**	**\\.**

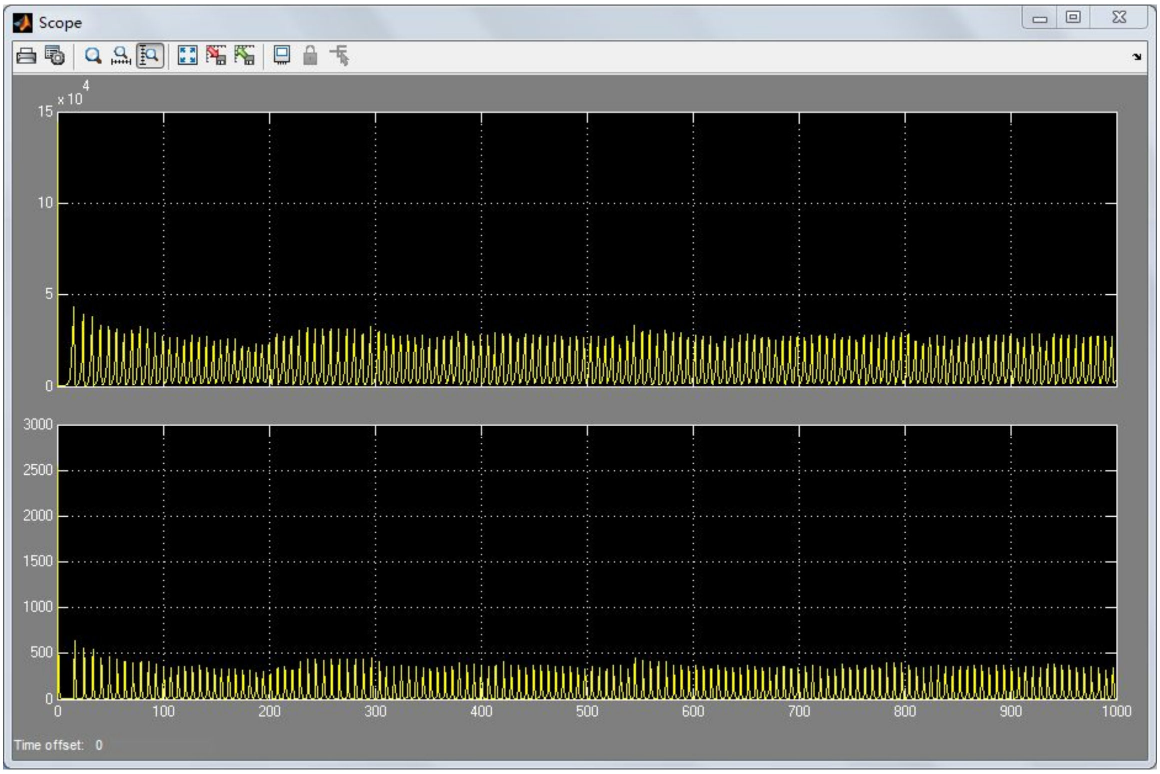
- **The results:**





While **<u>in the absence of predator</u>**,the population of prey will be stable in a while and then increase at a fast rate without limitations.The following graph can show the change of the number of prey.





It cannot occur extinction of predator or prey while I prolong the time to 1000 years.According to the graph,we can see that there is fluctuate in the population of predators and preys.

- **Phase diagram with description:**

We can see from the graph of prey and predators.While adding the predators into the prey system,the population of the prey began to decrease at once.And the population of the predators show a delay,which means it increase for a while and then decrease after the decrease of the preys.

- **Equilibrium states and stability:**

$$\frac{dx(t)}{dt} = R_1 x(t) - k_2 x(t) y(t)$$

$$\frac{dy(t)}{dt} = k_2 k_3 x(t) y(t) - k_4 y(t)$$

$$A = \begin{vmatrix} R_1 - k_2 y & -k_2 x \\ k_2 k_3 y & k_2 k_3 x - k_4 \end{vmatrix}$$

$$\lambda_1 = R_1 = 0.75$$

$\lambda_2 = -k_4 = -1.8$

stable.

$$(x, y) = (0,0)(0, \frac{R_1}{k_2})(\frac{k_4}{k_2 k_3}, 0)$$