Homework 4

Due: 11:59pm, Tue, Apr 28, 2020

1. **(Points=50)**
   The Lotka-Volterra system of chemical reactions describes an ecological predator-prey (fox-rabbit) model. The chemical reactions for this model are as below.
   - growth of prey population:
     prey $\rightarrow$ 2 prey
   - consumption of preys:
     predator + prey $\rightarrow$ predator
   - death of predators:
     predator $\rightarrow \varnothing$
   - increase of predator population:
     predator + prey $\rightarrow$ 2 predator + prey

   The Lotka-Volterra system assumes that:
   - the prey population ***x*** grows at a rate proportional to the current population (***A x dt***),
   - but when predators ***y*** are present, the prey population decreases at a rate proportional to the number of predator/prey encounters (***–B x y dt***)*;*
   - the predator population declines at a rate proportional to the current population (***–C y dt***),
   - but increases at a rate proportional to the predator/prey meetings (***D x y dt***),

   where ***A***, ***B***, ***C***, and ***D*** are positive constants.

   The differential equations for the Lotka-Volterra system:

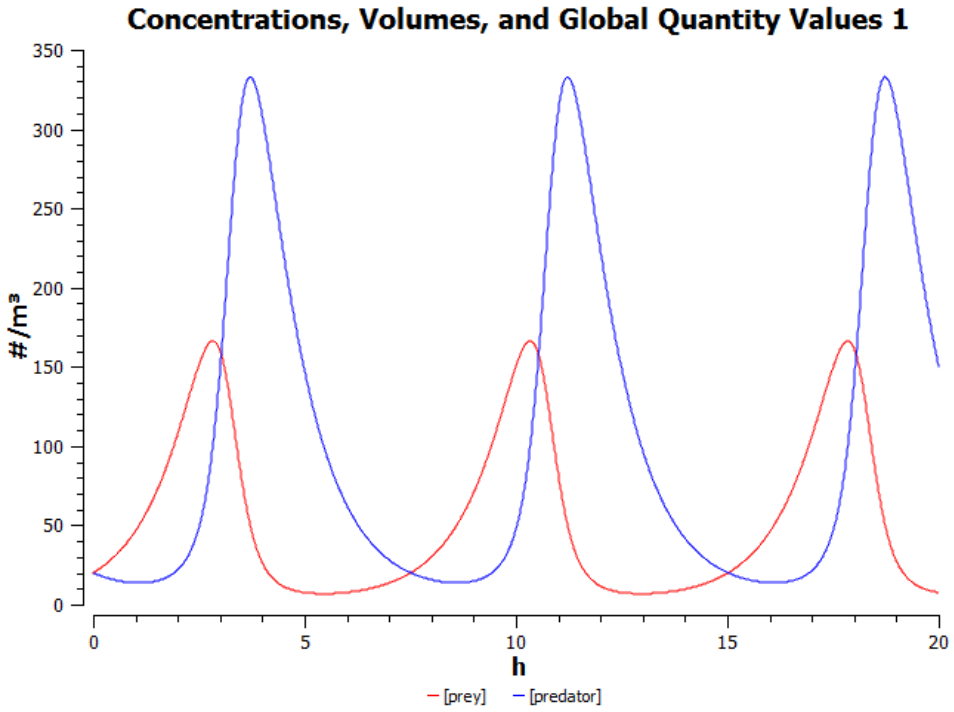
$$\frac{dx(t)}{dt} = A \cdot x(t) - B \cdot x(t) \cdot y(t)$$
$$\frac{dy(t)}{dt} = -C \cdot y(t) + D \cdot x(t) \cdot y(t)$$

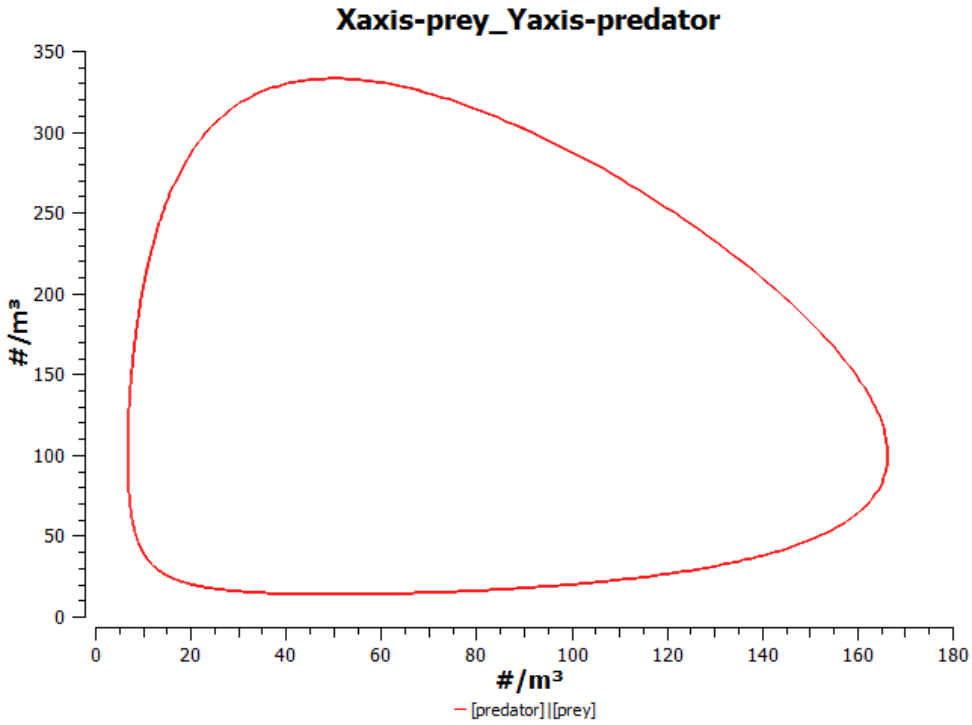
Then generate the model using COPASI with follow information.

- model
  - time units: *hours*
  - volume unit: m^3
  - quantity unit: *#*
- compartments: *forest*
- metabolites: *predator*, *prey*
- global quantities – rate constants of the reactions:
  - *A* initial value: 1
  - *B* initial value: 0.01
  - *C* initial value: 1
  - *D* initial value: 0.02
- initial concentrations of the metabolites:
  - predator: 20
  - prey: 20

Tasks → Time Course
- duration: 20 h
- interval size: 0.01
- define the plots by the 'Output Assistant'

After you create model, export SBML model and simulate the model to plot as below. Then submit the model and two plots (jpg, pdf, png, or any image file) with a compressed file (zip or tar.gz)


Concentrations, Volumes, and Global Quantity Values 1
350
300
250
200
150
100
50
0
#/m³
0
5
10
15
20
h
[prey]
[predator]


Xaxis-prey_Yaxis-predator
350
300
250
200
150
100
50
0
#/m³
0
20
40
60
80
100
120
140
160
180
#/m³
[predator]|[prey]