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:

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

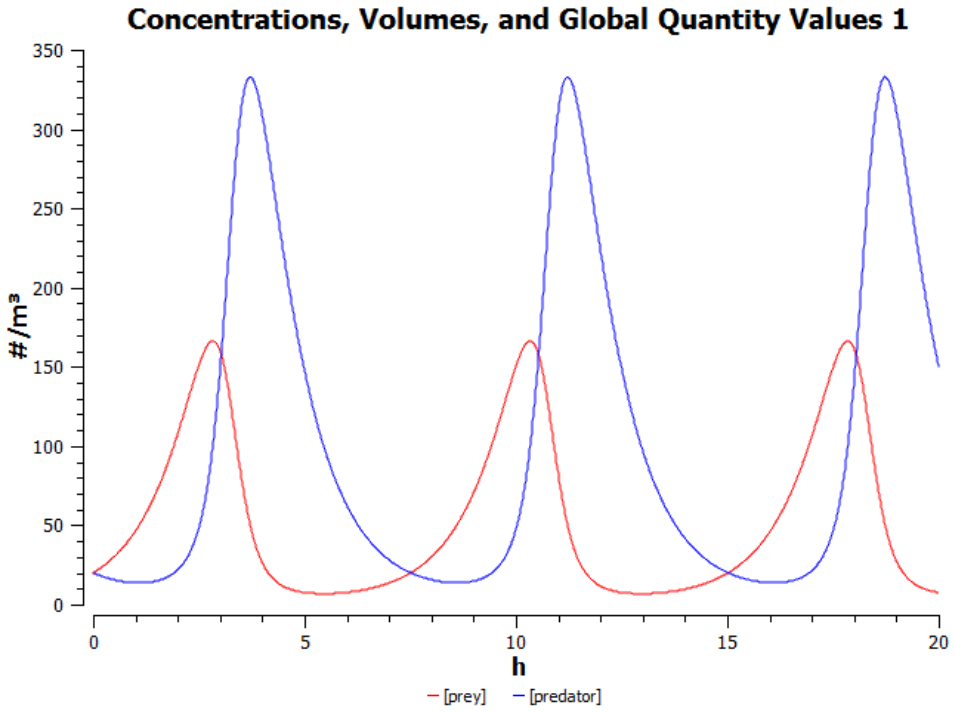
$$\frac{dy(t)}{dt} = -C \cdot y(t) + D \cdot x(t) \cdot y(t)$$

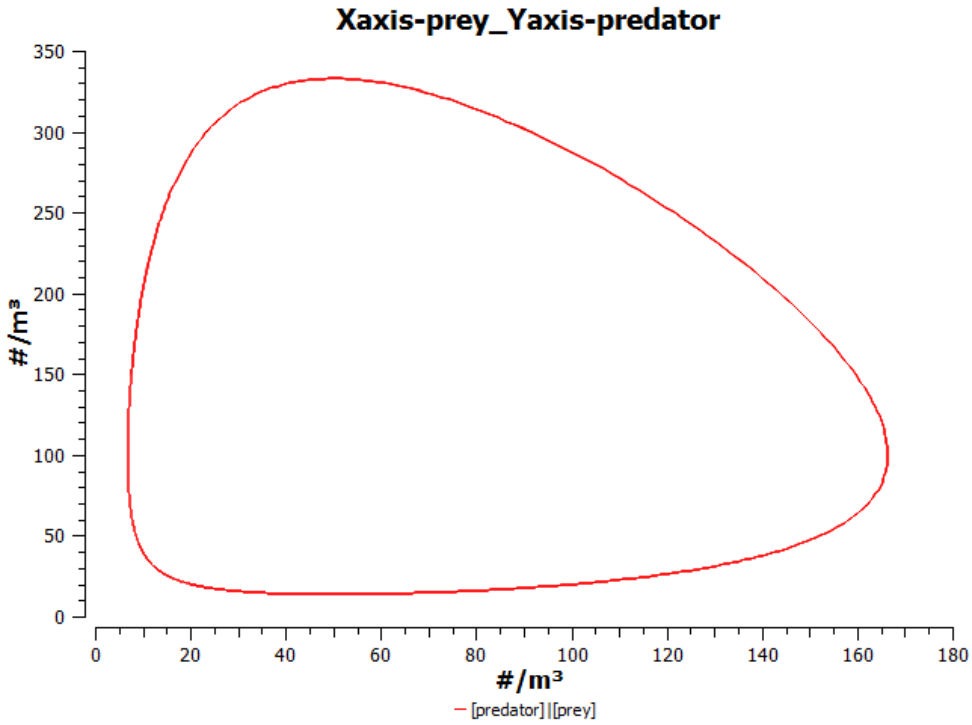
Then generate the model using COPASI with follow information.

- 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'

Return SBML model and plots as below. Then submit all of them 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]