Homework for Lecture 21 of Dr. Z.'s Dynamical Models in Biology class

Email the answers (either as .pdf file and/or .txt file) to

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by 8:00pm Monday, Dec. 1,, 2025.

Subject: hw21

with an attachment hw21FirstLast.pdf and/or hw21FirstLast.txt

1. By hand solve the system

$$\frac{dx}{dt} = x - y \quad , \frac{dy}{dt} = y - x \quad , \quad x(0) = 1 \quad , \quad y(0) = 1 \quad .$$

Plot, by hand, the phase-plane diagram.

2. Now use Maple with the command

```
S:=dsolve({diff(x(t),t)=x(t)-y(t),diff(y(t),t)=y(t)-x(t),x(0)=1,y(0)=0},{x(t),y(t)});
plot([subs(S,x(t)),subs(S,y(t)),t=0..10]);
```

did you get the same thing?

3. Use Maple to solve and then plot the phase-plane diagram for the system

$$\frac{dx}{dt} = a_{11}x + a_{12}y \quad , \frac{dy}{dt} = a_{21}x + a_{22}y \quad , \quad x(0) = 1 \quad , \quad y(0) = 1 \quad ,$$

for three randomly chosen matrices

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \quad .$$

4. Carefully read, and understand, the Maple code for the following procedures (type Help(ProcedureName); for instructions)

`Lotka, Volterra, VolterraM`

in the Maple package

`https://sites.math.rutgers.edu/~zeilberg/Bio25/DMB.txt` ,

For **each of them**, experiment with **three** randmom choices of parameters, and random initial conditions, using `Dis` (with $h = 0.01$), of *each* of the quantities in question.

Send me these nice plots.

Confirm the numerics by using `SEquP`.