Problems related to *Identifiability of Linear Compartmental Models*:

1. Construct a linear compartmental model and write the associated ODE system of equations. Check identifiability in COMBOS.
2. We say a graph is strongly connected if there exists a path from each vertex to every other vertex. Construct a strongly connected graph that has:
    a. 2 vertices
    b. 3 vertices
    c. 4 vertices
3. For a graph with n vertices, what is the minimal number of edges required for a graph to be strongly connected?
4. We say a graph is inductively strongly connected if there exists an ordering of the vertices, starting at vertex 1, such that each induced subgraph with vertex set {1,…,i}, for i=1,…n, is strongly connected. Construct an inductively strongly connected graph that has:
    a. 2 vertices, 2 edges
    b. 3 vertices, 4 edges
    c. 4 vertices, 6 edges
5. Construct a graph that is not inductively strongly connected and has:
    a. 3 vertices
    b. 4 vertices
6. For the models in Problem 4, add an input and output to the first compartment and n leaks. What are the identifiable monomial cycles?
7. For the models in Problem 6, try removing leaks and adding inputs/outputs and check identifiability in COMBOS.

Problems related to *Identifiability of Nonlinear Models*:

8. In the linear 2-compartment model, change the parameter $k_{01}$ to the function $\frac{V_M}{K_M+x_1}$, so that the model is:

$$\dot{x}_1 = -\left(k_{21} + \frac{V_M}{K_M + x_1}\right)x_1 + k_{12}x_2 + u$$

$$\dot{x}_2 = k_{21}x_1 - (k_{02} + k_{12})x_2$$

$$y = x_1$$

    Test the identifiability in COMBOS.

9. Test the identifiability of the SIR model using COMBOS. What are the identifiable combinations?

10. Create your own nonlinear model and try it out in COMBOS.