Lecture 1 - Introduction, overview and review

I. Personal information sheets

II. Course descriptions and syllabi.
   A. Syllabi in detail.

   B. Project descriptions
   C. 724 modeling project
   D. Goal: model-based policy analysis of a dynamic problem of the student's choice
   E. Readings: In Richardson, *Modelling for Management,* expected in February. Others xeroxed if necessary.
   F. Exercises: Go through on syllabus
   G. Software and hardware:
      1. Vensim DSS, handed out in class. Copy onto home machines, but must erase at end of term. We are honor-bound to observe this. Use Vensim PLE or order your own copy if you want a more powerful version.

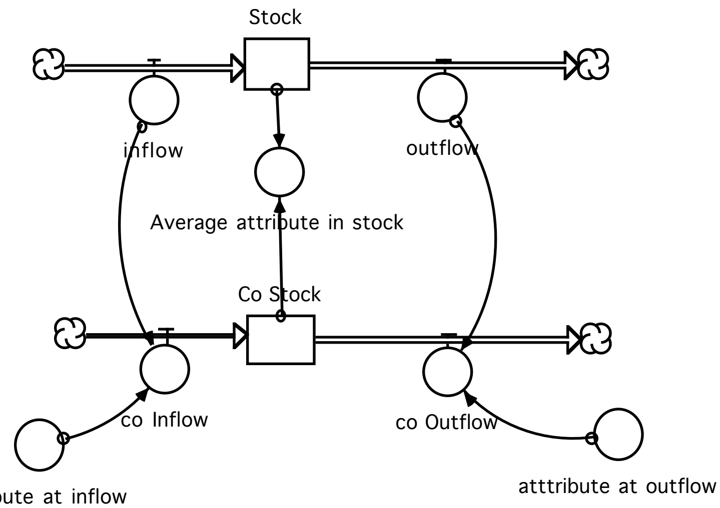
III. Student projects

   A. Chat with each about possible ideas
   B. Suggest references.
   C. Student roles in class discussions of projects.

IV. Building blocks of system dynamics models, "atoms" of structure, generic processes

   A. Rate equation patterns in ISDM (solicit examples)
      1. CONST * LEVEL.K
      2. LEVEL.K / LIFE
      3. (GOAL - LEVEL.K)/ADJTM
      4. AUX.K * LEVEL.K and LEVEL.K / LIFE.K
      5. NORM.K + EFFECT.K
      6. NORM.K * EFFECT.K
   B. Richmond's "generic processes" ("atoms" of structure) (diagram and describe)
      1. External resource production
      2. Linear growth, given constant resource and productivity
      3. Compounding process
      4. Exponential growth
         a) Doubling time = ln(2)/(fractional growth rate) = .693/(fractional growth constant
      5. Draining process
      6. Exponential decay
         a) Half-life = ln(2) * (time constant) = .693 * (time constant) = .693/(fractional decay constant)
      7. Stock adjustment process
      8. Exponential decay to a goal
         a) Half-life = ln(2) * (time constant) = ln(2) / (fractional net change constant)
      9. As information delay: SMOOTH or SMTH1
      10. Implicit goal-seeking process

11. Net flow, a combination of the compounding and draining processes
12. External resource depletion
13. Co-flow
    a) Elements
        (1) Primary flow
        (2) Coincident flow
        (3) Average value
    b) Diagram



        (1)

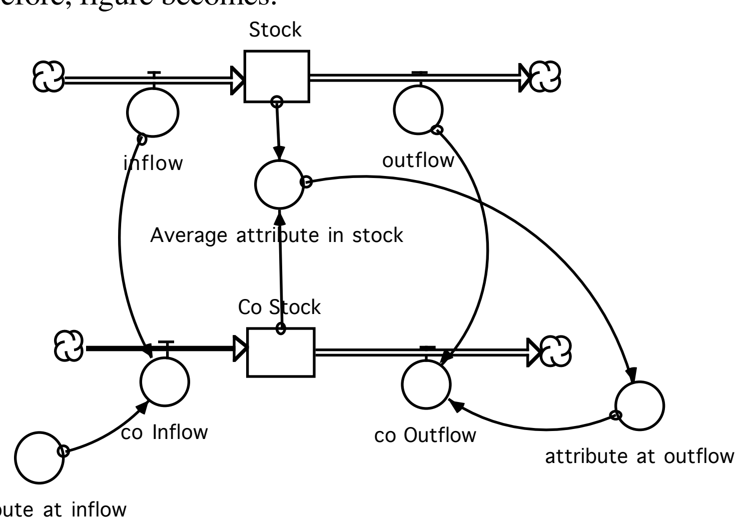
    c) Equilibrium conditions
        (1) In equilibrium, coInflow/Inflow = Co Stock/Stock = coOutflow/Outflow

        (2) = (attribute at outflow * outflow) / outflow

        (3) = attribute at outflow = attribute at inflow = average attribute

        (4) So, average attribute in stock = Co Stock/Stock. Approximately true in disequilibrium.

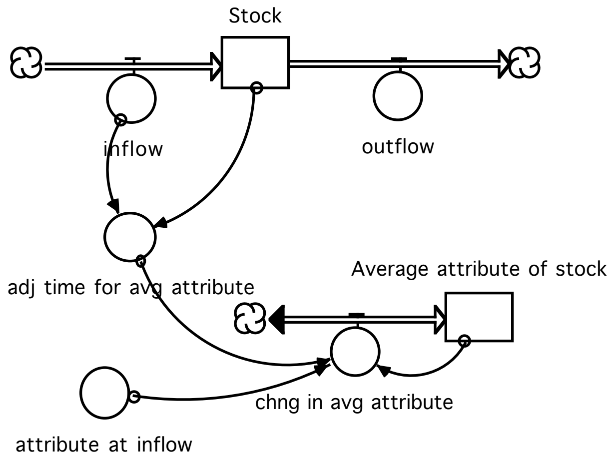
        (5) Therefore, figure becomes:



        (6)

d) Examples:
  (1) Average productivity of a work force
  (2) Energy efficiency of capital stock
  (3) Mortgage rates of housing stock
  (4) Intensity of need of kids in foster care
  (5) Interest rates of a bank's loan portfolio

e) Equivalent structure using SMOOTH or SMTH1 (Hines)

(1) 

(2) where adj time for avg attribute = Stock/inflow. [Note that this is *not* the outflow time constant, Stock/outflow, which is the average length of time an item dwells in the Stock level.]

(3) The average attribute here is a SMOOTH of the attribute at inflow. The SMOOTH amounts to a weighted average:

(4) Avg attribute.k = Avg attribute.j + dt * (attribute at inflow.j - Avg attribute.j) / TC.j

(5) = Avg attribute.j * (1 - dt/TC.j) + (attribute at inflow.j) * (dt/TC.j)

(6) where the weight depends on the time constant TC = Stock/inflow. A large stock/small inflow creates a large TC which causes the average attribute to adjust slowly; a small stock/large inflow creates a small TC which causes the average attribute to adjust rapidly.