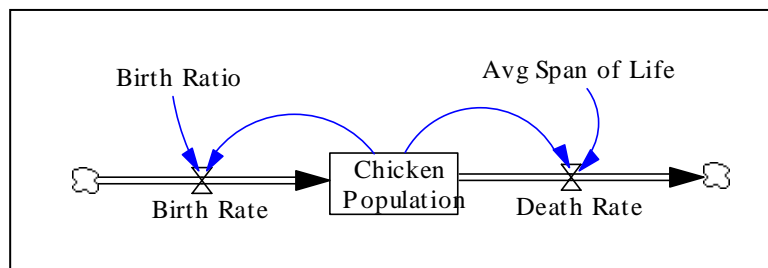--

Oct 17, 2006

Hard work vs. Smart work (Model Formation)

A. Installation

1. Go to www.vensim.com
2. Download Vensim PLE for academic purposes into your 'D:\\vensim' drive

B. Getting Started (Chicken's Life)

1. Choose New Model
2. Set Initial/Final Time, Time Step (should be smaller than the minimum time in the model variables; normally 0.125), Time Unit.
3. Draw the following causal loop diagram

4. Make equations for variables

Equation List

Avg Span of Life= 20
        Unit: Month

Birth Rate= Chicken Population*Birth Ratio
        Unit: Chicken/Month

Birth Ratio=0.1
        Unit: Dmnl/Month

Chicken Population= INTEG (Birth Rate-Death Rate,1000)
        Unit: Chicken

Death Rate=Chicken Population/Avg Span of Life
        Unit: Chicken/Month

FINAL TIME = 100
   ~   Month
   ~   The final time for the simulation.

INITIAL TIME = 0
   ~   Month
   ~   The initial time for the simulation.

TIME STEP = 0.125
   ~   Month
   ~   The time step for the simulation.

5. Unit Check: go to Model and Units Check
6. Model Check: go to Model and Check Model
7. Give a run name (xxx.**vdf**)
8. Simulate
9. Analyze
10. Apply different scenario and see results (Birth Ratio: 0.1 ->0.05, 0.75, 0.15; Life Span: 20 -> 15, 10, 25)
11. Save the model (xxx.**mdl**)


C. **Variation of Chicken's Life Model**

1. Further classify reasons for the decrease of the number of chicken into 1) Natural Death Rate and 2) Death by Road Crossing Rate (3% of the current chicken will pass away during the exodus)
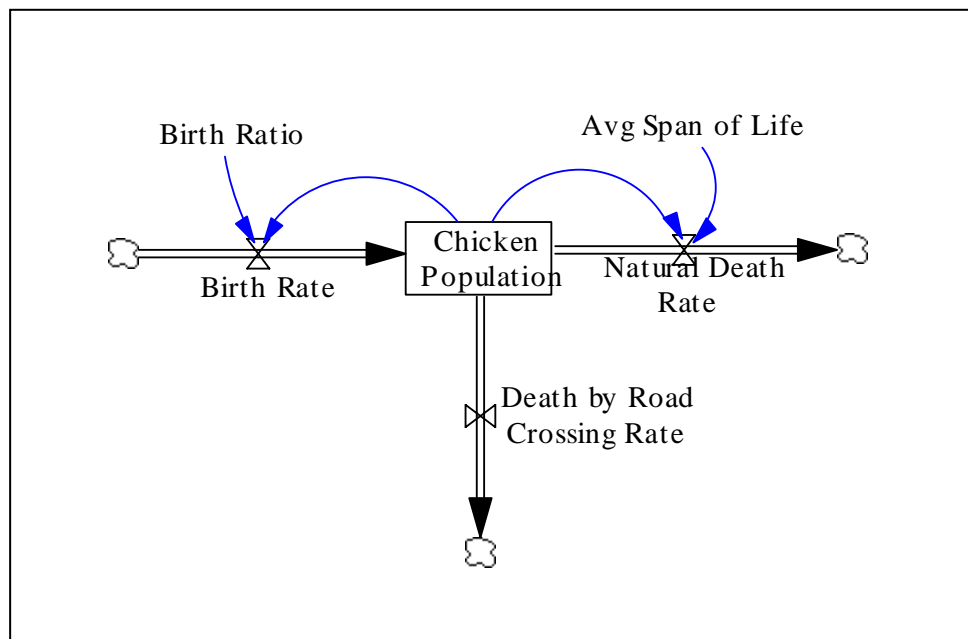
2. Simulate it
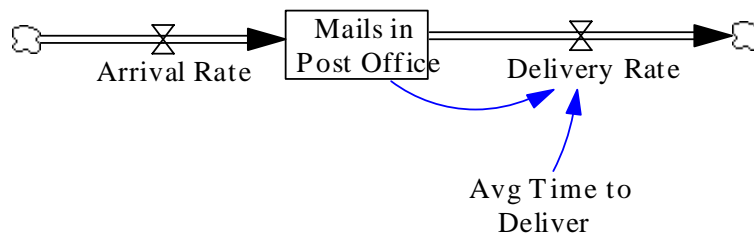3. Analyze changes in the number of chicken adapting the base case with different scenarios (3%->5%, 7%, 2%)

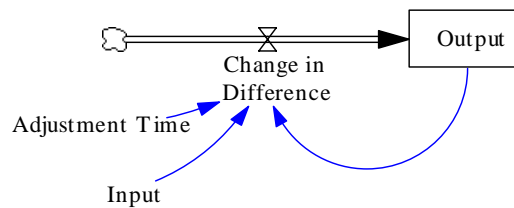**D. Material Delay and Information Delay**

   1. Material delay
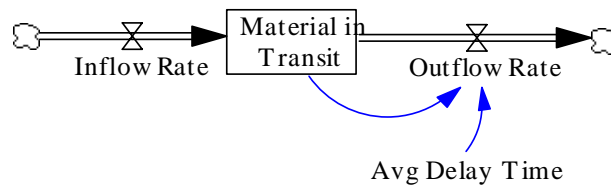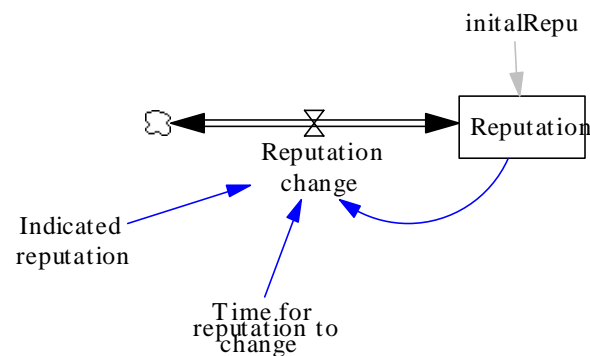

Outflow = Material in Transit/Avg Delay Time

<u>Example</u>

   2. Information Delay (adaptive expectations, smoothing)

Output = INTEGRAL (change in Difference, Output (0))

<u>Example1.</u>

<u>Example2.</u>

Loving each other

E. Inventory Management

1. Assume that
   1) the initial inventory was 300 widgets and
   2) target inventory level is three times of sales amount.

   If sales amount is increased by 50 widgets, what will happen to the inventory level? What is the inventory level in 100th month?

2. Get the inventory model: Vensim\PREMODEL\CHAP03\WFINV.MDL
3. Analyze the inventory level with different scenarios.
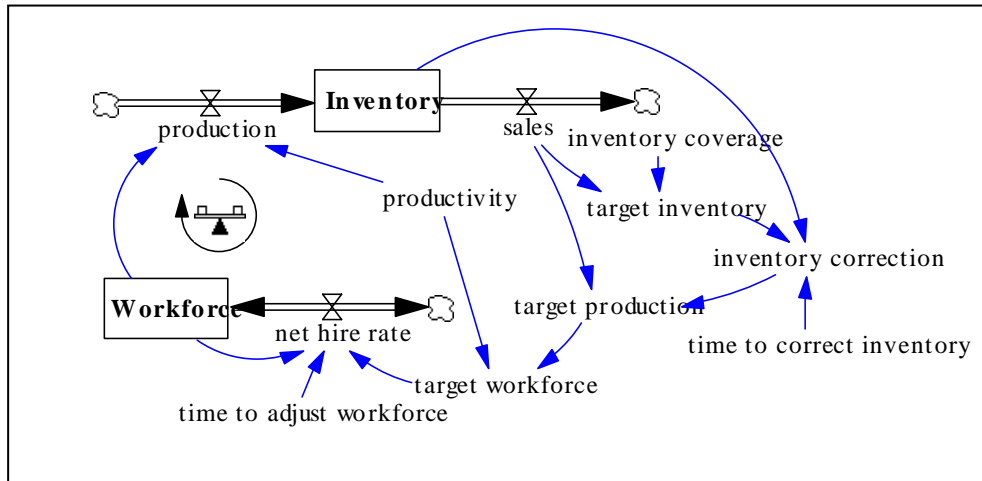

```
FINAL TIME  = 100
        ~        Month
        ~         The final time for the simulation.
        |

target inventory=
        sales * inventory coverage
        ~        Widget
        ~                |

target production = sales + inventory correction
        ~        Widget/Month
        ~                |

inventory correction = (target inventory - Inventory)/
            time to correct inventory
        ~        Widget/Month
        ~                |

inventory coverage = 3
        ~        Month
        ~                |

time to correct inventory=
        2
        ~        Month
        ~                |

INITIAL TIME  = 0
        ~        Month
        ~         The initial time for the simulation.
        |

Inventory = INTEG(production-sales,300)
```

~   Widget
~ |

net hire rate = (target workforce-Workforce)/time to adjust workforce
~   Person/Month
~ |

production = Workforce*productivity
~   Widget/Month
~ |

productivity = 1
~   Widget/Month/Person
~ |

sales = 100 + STEP(50,20)
~   Widget/Month
~ |

SAVEPER = 1
~   Month
~   The frequency with which output is stored.
|

target workforce = target production/productivity
~   Person
~ |

TIME STEP = 0.25
~   Month
~   The time step for the simulation.
|

time to adjust workforce=
   3
~   Month
~ |

Workforce = INTEG(net hire rate,   target workforce)
~   Person
~ |

F. Rework Cycle (Assignment)

Complete the equations for the rework cycle model. Assume that staff, productivity, quality, and rework discovery time are constants. A VENSIM diagram of the model, plus some hints, follows. Assume that there are 100 tasks to be done; set the normal values for productivity, quality, and rework discovery time at 1 task/month/person, 1.0, and 4 months, respectively.
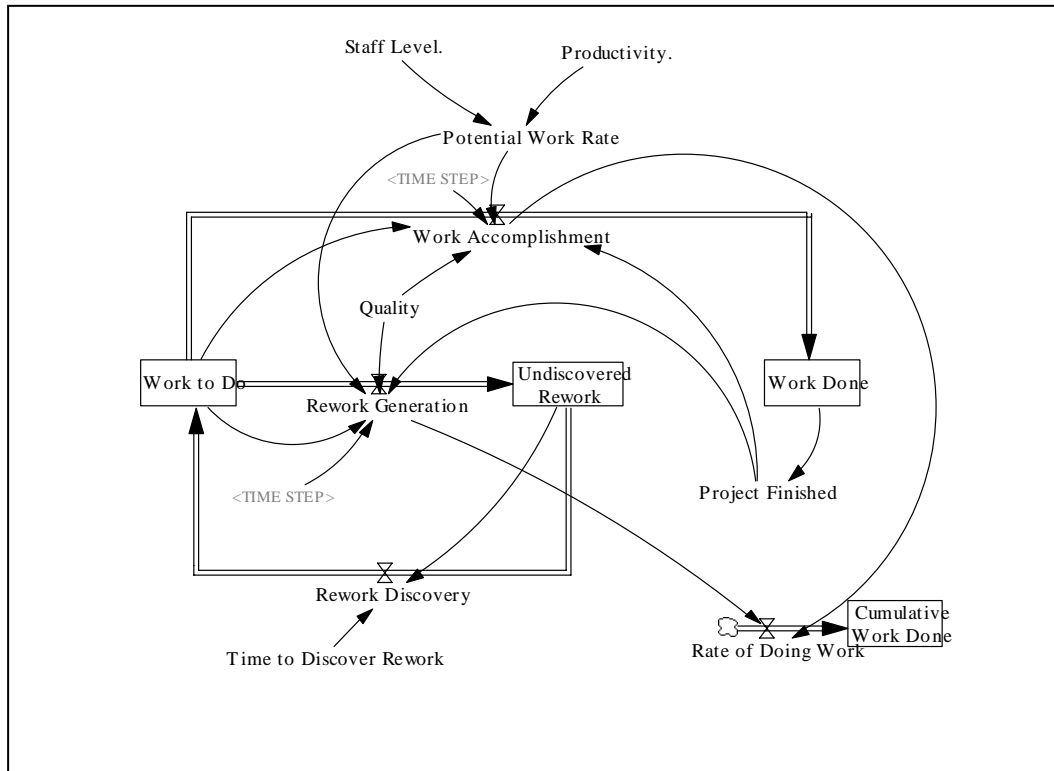
Model Analyses

1. With perfect quality, when does the project finish? What happens to work to do, work done, and undiscovered rework? *[Attach graph with one or two sentence explanation.]*

2. Now, set the normal value of quality to 0.75. When does the project finish? What happens to undiscovered rework? *[Attach graph with several sentence explanation.]*

3. Analyze the impact of productivity, work quality, and rework discovery time on project dynamics (specifically, completion date and total work done). Perform this analysis by simulating the model varying each parameter by plus-and-minus 33%. *[Spreadsheet charts summarizing results of simulations.]*

4.Summarize the lessons learned. *[Several sentences.]*

Hints (examples)

1. Rate

Work Accomplishment = Potential Work Rate* Quality * Project Finished

2. Auxiliaries

Potential Work Rate = Staff Level * Productivity

3. Constant
Quality = .75

4. Representing a delay

Rework Discovery = Undiscovered Rework / Time to Discover Rework
[This equation produces a delay between the time when rework is created and when it is discovered; in steady state, the delay time equals Time to Discover Rework]

5. Time Step

The value of "Time Step" should be less than one-half the smallest "first-order delay" in the model. Here, the smallest delay is the rework discovery delay.

6. Work Completion

Define the completion of work (Project Finished) when work done is say 99% of original work to do. Use Vensim's IF THEN ELSE function. Stop further work at this point.

7. Preventing from Going Negative

Vensim does not prevent levels from going negative. Therefore, you need to limit the rates leaving Work to Do (Rework Generation and Work Accomplishment) to equal the minimum indicated by potential rate work, and Work to Do divided by the TIME STEP. Use Vensim's MIN function. For example:
Work Accomplishment = MIN(Potential Work Rate*Quality, Quality*Work to Do/TIME STEP)*Project Finished

8. Unit Check

Please put in units for your variables and run the units check (under the model menu). This often helps you discover equation errors. Note that Vensim sometimes has trouble determining if units are balanced for equations with imbedded computations.