

Notes for Morgan State TIDES

Teaching modeling concepts

Begin with simple models

Use models that are already built to teach modeling concepts

Classes of models

Have = Had + Change

What phenomena can be modeled with this principle?

Open SimplePopulation.xls

Representation with equations that translate the principle

Level with respect to time

Time represented as a delta  $t$

Change in level a function of the level and a birth rate  $b$

The new rate  $R_n$  equals the old rate  $R_0$  plus change

Change is  $R_0$  times birth rate for that time period

Can represent these in Excel by named cells

See Column D

Copy down columns F G and H

Results graphed

What is the type of curve? What type of growth?

What happens if we change the birth rate?

Use the slider bar

Now can define a model parameter and its impact on the model results.

From a technical perspective, this is a good way to demonstrate the iterative nature of computations as each “iteration” in time is a separate cell with connections to the previous time period.

Slider bar – called scroll bar in Excel

Tied to a cell with the values specified – demonstrate

Adding limits to the model

Open the file SystemDynamics.xlsx

Here we represent the limit to population growth as a survival rate.

Think of some as the birth rate. Birth rate \* had the new bunnies

However, not all of the bunnies survive because of competition.

$$= \text{some} * \text{had} - \text{fraction} * \text{had} * (\text{had} - 1) / 2 * dt$$

The fraction that survives is a function of a survival fraction and the number of bunnies. This produces a limit to the growth of the population.

Try changing the fraction to .005. to .003 and observe what happens

Another way we could represent limits is by imposing an upper limit on the population. In biology, this can be thought of as the carrying capacity.

Let's put this substitute equation in cell E6

$$= (\text{had} * \text{constant} * (1 - \text{had} / \text{limit}) * dt)$$

Change the limit to 300

Now copy down cell E6 and observe what happens.

Point – there are multiple ways to mathematically reflect the limits to the system depending on how you conceptualize those limits.

A second modeling framework

I am the average of my neighbors

Kinds of models that use this principle?

Pollution, diffusion

Open Salt diffusion

Examine the formulas

Conditional formatting

Change the rules

F9 to iterate – what is this on the Mac?

Rabbits and wolves

Phet examples

See the list of resources

Vensim

Bunny comparison – same models with a different piece of software

Systems modeling software provides a pallet onto which you can create a model.

GUI allows excellent conceptualization of types of variables and their relationships to each other.

Several types

Level – box

Rate

Constants or auxiliary variables

Show simulation

SyntheSim and changing the sliders

Two representations of the system

More tomorrow

Social Network Analysis

Dataset shows the 2007 US Senate voting pattern

Click on the Edges tab

For each senator, there is a link to every other senator.

Dataset has been tabulated to see how often they voted the same

Questions: Are votes most often along party lines?  
Are there any senators that buck this trend?

What are the connections on votes among senators?

Primary linkages shown as edges that connect two people relative to the underlying data

Vertices represent the individuals

Once the connections are in place, they can be analyzed in several ways

Filtered to look for a common theme or focus on an interesting subset

Classification into groups to see patterns in the data

Calculation of metrics that measure the degree of connectivity in various ways

Different graphical representations that visualize the connections emphasizing different types of characteristics

First – extend the boundary on the graph to about half the page by dragging the boundary

For this dataset, click show graph in the left hand panel

See there are so many interconnections of the voting pattern from the raw data that no trends are visible.

Click on the NodeXL menu item at the top of the left

Choose Autofill columns

We are going to filter the data to look at a subset of the votes when the agreement between senators is strongest

Use the pulldown to choose Percent agreement for Edge Opacity and Edge Visibility

Click the button next to Edge Visibility and set the visibility to be greater than 0.65

We are filtering the links to those where senators agree more than 65% of the time

Set the opacity minimum to 0.65 instead of the smallest value

Click ok

On graph choose the Fruchterman-Reingold layout and click refresh graph

Click on layout again until you see a pattern such as mine

Here we see there are two major groups of like votes with a few senators in the middle of those connections

Let's label them to see who's who

Copy the senators names from Vertex 1 to the Label column on the vertex worksheet

Type the word Label in the Shape field for the Vertex and copy this down for all of the senators

Click refresh graph  
Layout again

What does this graph reveal?

We can also use the tool to create clusters of the relationship based on the available data

This package has a three possible clustering algorithm embedded.

There is a choice of clustering algorithms in some of the other tools

Click on NodeXL then groups then Group by Cluster

Use the default options

Then click refresh graph

The graph shows only two groups

So the “independent” senators are classified either as democrats or republicans based on their voting record cluster

Can change the color of the groupings

Right click on the color label of the grouping worksheet

Red for the republicans

Blue for Democrats

End of Day 1

Advanced SIR

Show all of the relationships output objects

Causal strips

Graph

Table

Build rabbit model

Insert custom graph

New view

Control panel

Choose graph

Name and title

Add three variables

Check all boxes

Label X axis

Agent Based Models

Disease

Simple Sick

Story

People in two states – healthy and sick

If a sick person comes into contact with a healthy person, there is some probability that they will become sick

Show the model

Show the sick probability and the plot capability

Forest Fire

Let's create another simple model

Frog and princess

What is the story?

When wandering through the forest, a princess comes upon a frog. If the princess kisses the frog, there is some chance that the frog will turn into a prince.

Start with a new project

Call it frogprince

Need to add the agents

Princess

Depictions in the Frog folder on the datasets

Click on edit depiction

Find the princess depiction

Prince

Find the prince depiction

Add a depiction  
Import the frog depiction

World or forest  
Clear the depiction  
Create a green outline box

Now we need to add behaviors  
Double click on the princess to bring up a blank behavior panel

Story is – princess as first actor  
Open the conditions palette

Choose See . princess from the palette and drag to the behavior  
Means if I am the princess  
Next condition – see a prince to the right  
% chance it is a prince – 25% (so the princess does not have to  
kiss too many frogs)

Now pull down the actions palette  
Scroll down to messages  
Choose the Make method  
This sends a signal to execute a method somewhere else in the  
program. Let's call the method princify  
We want to princify the prince on the right since that is what  
we saw

Now click on duplicate but edit it to seeing and changing a  
prince on the left

We could also do the other two directions but we will save time by skipping those options.

Final method – if we don't see a prince, we need to move around

See princess – action move random in forest

Now for the prince

Move random in the forest

New method – on princify

Change myself to the other depiction

Also can Show a message – Hello my princess or finally where have you been girl?

Then stop the simulation

Apply

Now need to create a new worksheet

Make it larger

Click on the forest

Then the dark rectangle – click in upper left and drag to lower right

Use the eraser to make a more interesting set of pathways

Now add a princess

Click on princess

Click on pencil and click in one forest box

Click on the frog

Click the pencil and in several places in the forest

Now we are ready to test the model

Save the worksheet when prompted and save the project

Now run the model

If time

Explore the ICHASS projects for a few minutes

Other resources

Organizations that link digital humanities researchers through conferences, online materials, project collaborations.

dH commons