Assignment 4 - Dynamics of spells of poverty

In a classic 1985 article in the Journal of Human Resources, Mary Jo Bane and David Ellwood of Harvard's Kennedy School of Government explored the distribution of lengths of time people spend in spells of poverty. Their work settled a confusion in in the literature on spells of poverty, which up to that time had produced widely varying estimates of the lengths of time people spend in poverty in their lives. As Bane and Ellwood state in their introduction,

> "The preliminary analyses we report in this article lead us to conclude that the seemingly inconsistent findings on permanent and transitory poverty from the sixties and seventies can indeed be reconciled. Our primary finding is that although many people have very short spells of poverty, the few with very long spells account for the bulk of all poverty and represent the majority at any given time."

The insight that Bane and Ellwood pulled from intensive data analyses and explorations of statistical distributions can be most easily seen as an insight about stocks and flows of people moving into and out of poverty. This exercise provides the opportunity to explore the stock-and-flow foundation of the insight that people *in* spells of poverty would report much longer lengths of such spells than people who have *emerged* from periods in poverty.

The Task

1. Download the Spells1 model from the syllabus on the class web site. The model splits the flow of people slipping into poverty into two streams, a "slow mover" stream and a "fast mover" stream. Look at the equations and values of constants in the model and answer the following:

   a. How long do "slow movers" stay in a spell of poverty? How long do "fast movers stay in a spell of poverty?
   [The constants in the model that determine these lengths of time are called "time constants." For example, the "time constant" for the stock of slow movers in poverty is called "SM time in poverty." For more information about delays and time constants (and more than you need at this point), skim *Business Dynamics,* chapter 11.]

   b. How many people total in the model flow into poverty each month?

   c. What is the initial fraction of those people who are "slow movers"? By implication, what is the initial fraction of "fast movers"?

2. Simulate the model, naming the base run something like "spells1 base."

   a. Describe what you see in this base run of Spells1. What do the graphs look like? (You don't need to show them.) Note the sizes of the populations: Which are smaller? Which are larger? Can you figure out why? [That's rather hard to do, and we'll talk about it in

class, so don't spend an excessive amount time thinking about it now.]

b. "People in poverty" would be the sum of the two stocks on the left. Use Vensim's spreadsheet tool to find the *numbers of slow and fast movers in poverty* and thus the *total number of people in poverty* in this base run. If one picked a person at random from the pool of people in poverty in this simulation (the two stocks on the left), what is the probability that person would be a slower mover?

c. From the numbers you found in (2b), compute the *average length of a spell of poverty for people in poverty* in this simulation. [Email me if you can't figure out how to do this.]

d. Make the computations in (2b) and (2c) for the two stocks on the right, *the slow and fast movers who are within a year of having emerged from spells of poverty*. What is the average length of a (past) spell of poverty for a person in this group?

e. Bane and Ellwood used data and statistical distributions to compare what are essentially your answers in (2c) and (2d). Do your numbers agree with Bane and Ellwood's conclusion?

3. Download the Spells2 model from the syllabus on the class web site.
Spells2 is the same as Spells1 with the addition of equations to compute the probabilities and averages you computed in (2). The two circled quantities are what we are interested in. The "Poverty estimate of a spell" is the estimate of the average length of a spell of poverty if we used data about people *in poverty* to determine the average spell. The "Post poverty estimate of a spell" is the estimate of the average length of a spell of poverty if we used data from people *no longer in poverty* (in this model within one year of a spell of poverty).

a. Simulate the based run of Spells2 (call it something appropriate, like "spells2 base").

The run should look like the base run of Spells1, with the addition of the computations of the quantities you found by hand in (2). Check whether the Spells2 values for the probabilities and averages match your computations, or not. (If they don't match yours, you shouldn't bother to go back to (2) to fix up your computations; just note to yourself why the computations in Spells2 make sense.)

b. The fraction of new people in poverty who are slow movers is a constant in the model. We can use the Set button to change that fraction and observe the results. Use the Set button to set the value of the Fraction of New Poor that are Slow Movers to 0.2.

Show graphs of the stocks, the probabilities, and the average estimates of spells in poverty (you should find these graphs in the list of Custom Graphs).

Describe what you see.

What do you conclude about the estimates of the lengths of spells of poverty a researcher

would find if the data used were from people *in* poverty or from people who have recently *emerged* from poverty?

c. So far we have tested the Bane and Ellwood conclusion just two scenarios, keeping all the various constants in the model fixed and changing just one, testing the fraction of new poor who are slower movers as 0.3 and 0.2. To gain confidence that we support the Bane and Ellwood results in a wide set of circumstances we would want to test a lot more scenarios.

So perform a series of simulations, testing values for the Fraction of New Poor that a Slow Movers ranging from 0.05 to 0.5. Show in a table the values for the fraction and the estimates of the average lengths of spells of poverty for people *in* poverty and for people *recently emerged* from poverty.

What do you observe in these tests?

4. There are four other constants in the model that one might think might influence these estimates of the lengths of spells of poverty:

- Total inflow to poverty
- SM time in poverty
- FM time in poverty
- "One year" (the time the model continues to track people after they have emerged from spells of poverty, assumed here to be 12 months, but could be more or less)

Your task in (4) is to design and carry out a series of experiments, testing various values of some of these constants, observing in each test whether or not the Bane and Ellwood conclusion is sustained or refuted.

Report your results in a table like the one you produced for (3c).

Some things to think about:

- Think like a scientist: Make one change at a time and observe the results. If you change more than one parameter for a test (and you'll probably want to), build up to that test by doing simulations testing changes in single parameters first.
- Think like a scientist: Plan a sequence of tests, not a random bunch of changes. Plan the sequence to try to facilitate conclusions. Plan the tests and what to observe and report.
- Think like a scientist: Test parameters you think have a chance to *overturn* what we and Bane and Ellwood have observed. (Confirming hypotheses is nowhere near as powerful as producing evidence that refutes a hypothesis.)
- Think like a graduate student with limited time: Don't try to be exhaustive. Plan a sequence of tests that have a chance to teach you something about the model and the estimation of lengths of spells in poverty. Carry out the tests, report the results, and stop.