STELLA® for History

*"The **STELLA** software is an innovative tool for the analysis of social/economic structures and the dynamic behaviors they generate."*

--Michael Radzicki
Worcester Polytechnic Institute

Barriers and Opportunities

History is much more than a set of independent events. Understanding the genesis of constitutional structures in England, the rise of the labor movement in the United States, the French revolution, or virtually any other topic requires a *dynamic* viewpoint. It's essential to look at the *interdependent relationships* that cause events to unfold over time.

Unfortunately, many of the tools that your colleagues in the physical sciences use to deal with dynamic phenomena are not readily at your disposal. For example, there is nothing analogous to a chemistry lab in which you or your students can rigorously test the hypotheses via controlled experimentation. And, the analytic frameworks for treating dynamics are considered too technically demanding, or too limiting, to be of practical value.

As a result, the study of history can become something of a static exercise for students. They often spend too much energy learning the *facts*, and never really appreciate the *why*. The lack of dynamic tools often makes it difficult to think rigorously about alternate interpretations of the historical record.

Enter the **STELLA**® software. **STELLA** enables virtually anyone to think rigorously about dynamic processes. With the **STELLA** software, it's easy for you (or your students) to diagram your assumptions about a historical process. As you flesh out the relationships governing the process, you'll be stating your assumptions more rigorously and precisely than is possible using words alone. Then, you can run the model to check the consistency of your assumptions. The **STELLA** software provides you with a powerful tool for testing theories, clarifying concepts, and communicating ideas. It allows you to put your energy to best use – *thinking* – in the office, or in the classroom.

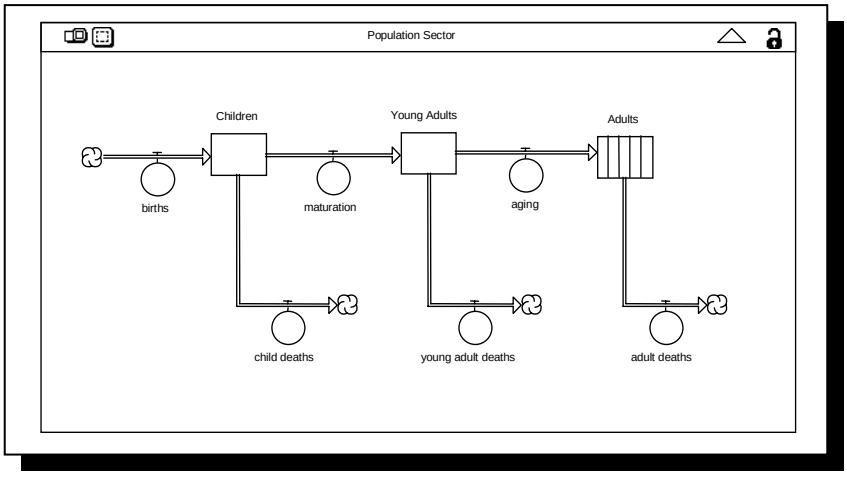
Case Study

The Setting: A University in the Eastern U.S.
The Topic: Historical Geography
The Challenge: Understanding the demise of the Aztecs

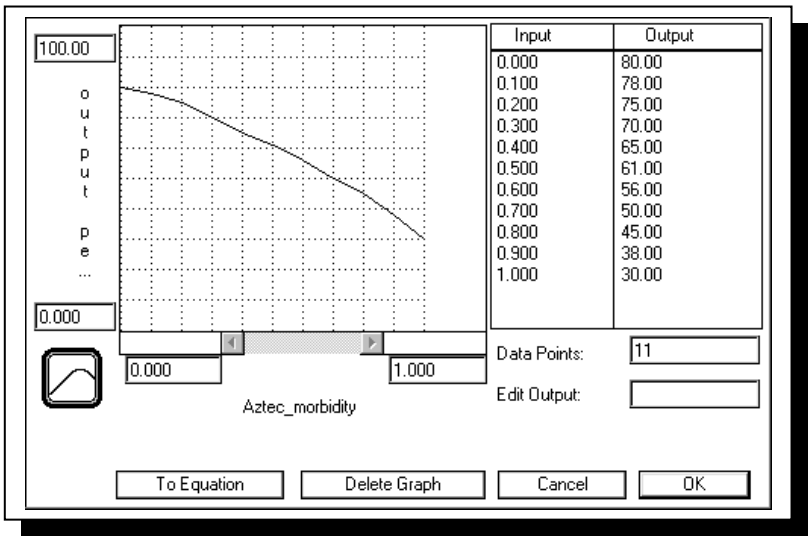
Background: A historical geographer was conducting an investigation into the demise of the Aztec population between 1500 and 1600. He quickly found out that, based on reasonably reliable data for 1560, scholars had clustered themselves into three competing schools of thought. One school concluded that the population decline was severe – that the Aztec population declined from 2.7 million to 160 thousand between 1500 and 1600. Another school of thought estimated a decline from 1.3 million to 340 thousand during the period. The estimates of a third group were in the middle.

The historian's research objective was to determine which of the three estimates was most likely to reflect what *actually* happened. To achieve this objective, the historian looked at what assumptions about epidemics, morbidity, and mortality would be necessary in order to be consistent with each of the three estimates. The **STELLA** software was the ideal tool for the investigation.

Step 1: Map. The historian began by segmenting the Aztec population into age classes. Each age class was represented with a stock. A birth flow and several death flows were added to the system. This core structure (shown below) was essential to account for the age distribution of the Aztec population over time. In addition, the historian used stocks and flows to represent a simple agricultural system, and to represent the spread of epidemics within the population.

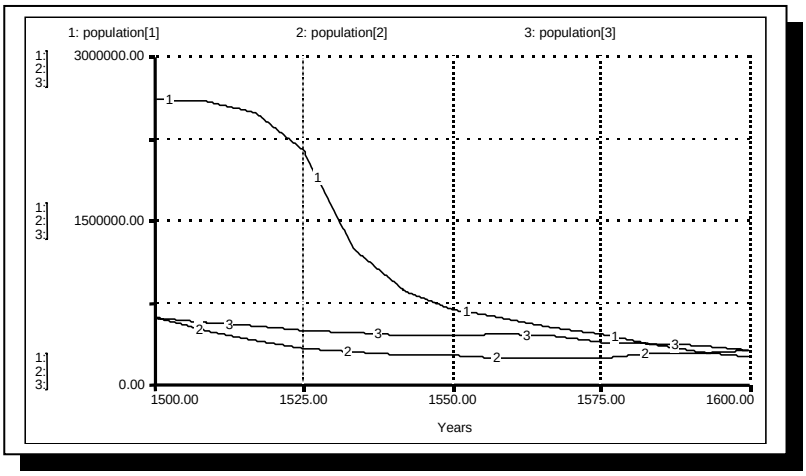


Step 2: Model. After the basic plumbing had been laid out, the next task was to incorporate assumptions about the interrelationships between population, agricultural production, and epidemics. The **STELLA** software's graphical function proved especially useful in capturing a number of "fuzzy" relationships, such as the one shown here between morbidity and agricultural output per capita. The slope of this relationship initially reflected an assumption consistent with the "moderate" estimates. It was subsequently altered to reflect the "severe" and "mild" schools of thought.



Step 3: Simulate. After all of the relationships had been defined, the researcher began an extensive set of simulation tests. In the process of conducting these tests, the historian discovered what assumptions – in the severity and duration of epidemics, and in the relationship between morbidity and agricultural output per capita – were required in order to generate simulation results consistent with the severe, medium, and low population estimates.

For results consistent with the severe estimate, it was necessary to assume that epidemics persisted throughout the period, and that they had the worst possible effects on mortality, morbidity, and agricultural output. For results consistent with the mild estimate, it was necessary to assume that epidemics were short in duration, and that they had minimal effects on morbidity, mortality, and agricultural output. Results consistent with the medium estimate could be generated with a range of plausible assumptions.



Step 4: Celebrate! The historian's tests supported a conclusion that the moderate estimate of population decline was most likely to have occurred. In order to generate either of the extreme scenarios, it was necessary to make a host of less-plausible assumptions about how epidemics affected the Aztecs.

In addition, model construction and simulation led the researcher to look at information that, while available, had been deemed relatively unimportant by the three schools of thought. The historian reports that even though the critical data had been right under everyone's nose all along, the process of modeling with the **STELLA** software enabled him to finally see its importance.