CSUMS Research Project Opportunities

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1. Gender Dynamics. The equations often used to model populations, the Lotka-Volterra equations, are inconsistent with the accepted model for interacting species. In particular, their derivation using the Laws of Mass Action results in contradictory conclusions in how the populations interact. One interpretation is that the prey equations apply only to the females, while the predator equation applies to both male and female prey. The objective of this project is to see if a more consistent model can be derived, one that accounts separately for the female and males in the population. In addition to correcting the Lotka-Volterra view-point, this model should be able to be used to study gender dependent predation questions. These arise, for example, with trophy hunting, with gender dependent defense or avoidance characteristics, etc. The papers covering this topic are listed under *Gender Dynamics* in the CSUMS library.

2. Steady States and Stability. Determining the possible steady states, and their stability properties, is an extremely challenging problem for large systems. In fact, finding a robust method for doing this remains an open problem in mathematics. One possible method that can be pursued is based on the known structure of the equations. For example, most of the very large systems obtained in biochemistry are obtained using Mass Action. In this case the equations have a known structure, and they are also associated with specific reaction mechanisms. This is very valuable information and it provides an opening into determining both the global stability properties of the steady states, and also provides a very interesting method for computing the steady states. The latter is based on homotopy methods. The papers covering this topic are listed under *Kinetics* and *Homotopy Methods* in the CSUMS library.