Math 140 Sheep Herding Modeling Project

This project should be done in groups of 2-4 students. The report and presentation will be done jointly —submit a single report for the project with all authors' names clearly listed.

Project deliverables:

1. 8-minute demonstration of your model and results in class (groups spread over Mon-Wed Dec 3-5).

2. **Final version of NetLogo code is due 9am Wed Dec 5** (save as lastnames.nlogo and email to tleise@amherst.edu)

3. **Report is due 9am Wed Dec 5** and should contain the following:

   a. Title and abstract with a brief overview of your work.

   b. Introductory section, including background on your problem of interest and any prior work done by others that you found.

   c. Modeling section following *ODD protocol*. Fully explain your model's rules, including how sheep and dog interact. Don't forget to include details like the size of your world, assumption of how large a patch is and how long a tick is. Also explain how you handled scheduling: did you ensure that each sheep decides how to move *before* any sheep move for each tick?

   d. Verification of your model: Describe at least 3 tests you ran to check that your code is working as intended.

   e. Validation of your model and results: Include analysis and graphs from simulations, as well as evidence that the dog in your model can successfully herd sheep to the desired location (e.g., a few screen shots). The main point here is to compare the outcomes of your model with the experimental data and then conclude whether your model can reproduce the actual sheep herding behavior. It's fine if it doesn't—the goal here is to produce a functioning model that you can analyze.

      i. You should produce graphs like Figure 1A in the original article (http://www.cell.com/current-biology/retrieve/pii/S0960982212005295) as well as nearest neighbor distributions at key time points (e.g., before and after reacting to dog).

      ii. Compare speeds of the sheep in the simulations to those in the data as a way to test whether the model sheep display a realistic range of speeds.

iii. How does varying the parameters affect the model outcomes? Are there key parameters that most strongly govern the results?

iv. You should also have at least one other measure to compare the herding dynamics between the simulation and the experiments.

f. Discussion and conclusions section: What can you conclude from your model about how sheep herd? What did you like best about your model? What next steps (modeling and/or experimental) should be taken to improve the model or test ideas about how individuals in a herd act?

g. Reference section listing all sources used, with any standard bibliographic format.