

Math 140 Sheep Dog Training Project

This project should be done in groups of 2-4 students (you may stay in your original sheep herding groups; you may also switch around if you wish). Submit a single report for your group with all authors' names clearly listed.

For this last project, please **choose 3 parameters associated with your dog's herding rules**. These should not be parameters governing sheep behavior. We want to train the dog to herd a fixed type of sheep, and the parameter choices should only affect how the dog acts, not how the sheep act. Update the *Mathematica* file to train the dog in your model. Copy some of the histograms showing outcomes (time taken to herd the sheep in the pen, for example) into your report, and also state the best parameter values found by your training regimen.

In addition, run a **sensitivity analysis**. That is, for each of the 3 parameters, run 100 simulations for parameter values at $\pm 5\%$ or $\pm 10\%$ of optimal, as well as for the optimal value itself (with the other 2 parameters fixed at their optimal values). Calculate the sensitivities S^+ and S^- for each of the 3 parameters as described in Chapter 23 and in lecture. We want to know whether we need to pinpoint precise optimal parameter values (in the case that the model is very sensitive) or rough estimates are good enough (in the case that the model produces similar outcomes when the parameter is changed a bit). You may use either *BehaviorSpace* or *Mathematica* for this analysis.

Project deliverables:

1. **Final version of NetLogo file and Mathematica file that generated your optimal parameters is due 4pm Wed Dec 19** (email to tleise@amherst.edu)
2. **Report is due 4pm Wed Dec 19** and should contain the following:
 - a. Brief description of your model. If you made any significant changes to the rules from the original model, please indicate what changes you made.
 - b. Description of the 3 parameters you chose to optimize.
 - c. Results: Include graphs of the histograms of outcomes and resulting best parameter values from the "training" heuristic. Also include graphs or tables showing your sensitivity analysis, as well as stating the calculated sensitivities S^+ and S^- for each of the 3 parameters.
 - d. Discussion of results: Did the parameter values that emerged from the "training" surprise you or did they seem similar to ones that you had already found to work well? Was your model sensitive to the particular parameter values, or did it work similarly for a wide range of values?