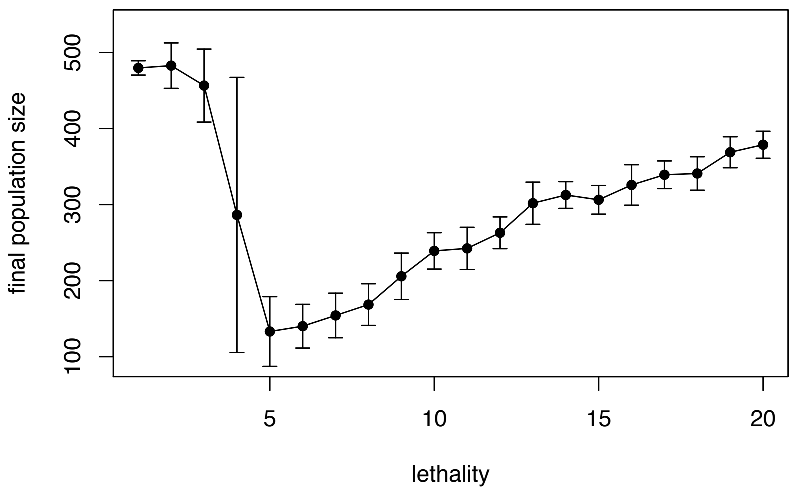
Assignment #5 Solutions

See the class website for some NetLogo code that implements the turtle disease model —changes to the original Tutorial #3 demo are highlighted in yellow. Using the BehaviorSpace tool together with the given R code, we obtained the following plot:



Note that the confidence intervals are simultaneous 95% intervals based on the Bonferroni inequality. One possible explanation for the shape of the curve is as follows. Recall that the disease starts with a single infected turtle. If the disease is highly lethal (small values of lethality = time until death), then an infected turtle will die before it has a chance to infect many other turtles, so that the epidemic will die out, and the final population size will relatively large. This is the Ebola scenario. As the disease becomes less lethal (lethality values approaching 5), there is more of a chance to infect other turtles, which has a large negative impact on population size. As lethality continues to decrease, the downward effects of the disease on the population size become increasingly offset by new healthy births, so that the population size gradually approaches the disease-free size. (The disease now looks more like a chronic disease.) An interesting aspect of the dynamics is the rapid "phase change" going from lethality values of 3 to 5. For lethality = 4, the behavior of the disease is very erratic, as can be seen from the very wide confidence interval; either it dies out or it explodes, depending upon the random movements of the turtle. Many other epidemic models (and real-world epidemics) also tend to have such a critical point, which is often characterized by the "reproduction number", or the average number of new infections spawned by a given infection. (Think about how you might estimate the reproduction number for the NetLogo model.) By varying *energy-from-grass*, you can investigate the effects of food shortages on disease epidemics (although you might then want to model the effect of nutrition on disease susceptibility).

Clearly there are many ways to make the disease model more realistic, starting with a more realistic infection model for adults and newborns. Even relatively simple models can sometimes lead to useful insights, such as the behavior in the above plot.