Unit 4 – Solving Complex Problems

\*\*Instructions:  Please change the text color of your responses to red text.  Please organize the endings to each page.

ACTIVITY 4.1.1 – Simulations in Science

GOALS:

* Use simulations to learn about complex systems that are too difficult to observe in the real world.
* Gain insight and knowledge using the iterative and interactive nature of models and simulations.
* Derive meaning knowing the inclusion or exclusion of certain elements is an important part of the model/simulation.

You will be using NetLogo for this assignment.  Please make sure that you have it installed on your laptop.    
  
Complete the following:

Step 9: Using a faster speed, run the simulation a few times at each of the following densities and note how often the fire reaches the right side of the world and the percent burned at each density.

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| Density | How Often Fire Reaches Right Side of World | | | | % Burned |
| Never | Sometimes | Often | Always |
| 57% | Yes |  |  |  | 10% |
| 58% | Yes |  |  |  | 25% |
| 59% |  |  | Yes |  | 60% |
| 60% |  |  |  | Yes | 70% |

Based on your data, what conclusions can you make about the relationship between tree density and the amount of the forest that would burn?

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| A higher tree density results in a larger proportion of the forest that is burned. |

Step 12: Run the simulation until you see a blank (green) world where both sheep and wolves have died out.  Using the plot of data, describe any correlations between the sheep population and the wolf population.

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| The sheep population and wolf population are inversely correlated, as when wolf populations increase sheep populations decrease, while when sheep populations increase, it is because wolf populations have decreased. However, when the sheep population increases, the wolf population increases soon after. |

Why do you suppose the wolf population eventually dies out, even with an abundance of sheep?

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| The wolf population always grows too large to support itself, growing faster than the number of sheep. |

Step 15: In the NetLogo control bar to the right of the ticks slider, uncheck view updates. The world will stop showing changes, but the simulation is still running. Allow the simulation to run for about 20,000 ticks and then stop the simulation by clicking the go button (the button is a toggle.)  What correlations can you make between the sheep population and the wolf population now?

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| The sheep population and wolf population still inversely fluctuate, in an almost-sinusoidal pattern. |

Make a hypothesis: Why do you think the system is no longer unstable?

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| The system is no longer unstable because the sheep’s dependence on grass stops them from growing uncontrollably, which also limits the population of the wolves, which stops the system from being so unstable. |

With a hypothesis, make a prediction: Predict what will happen when you increase the grass regrowth time.

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| Increasing the grass regrowth time will cause the maximum population of all species to decrease. |

Step 16: Experiment with grass-regrowth-time to support or contradict your hypothesis.  How does changing the grass regrowth time support or contradict your hypothesis and prediction?

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| Increasing the grass regrowth time decreases the population size of all species, which supports my hypothesis. However, it also causes the wolf population to go extinct, and makes the fluctuations in population size smaller for all species. |

Step 17:  Other variables can affect the stability of the simulation. While the simulation is running, experiment with both Sheep and Wolf settings sliders to see how those variables affect the simulation.  How do the Sheep settings and Wolf settings variables affect the stability of this system?

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| Increasing the initial sheep setting causes the wolf population to overshoot its carrying capacity and almost die out, but then return to equilibrium where all 3 populations fluctuate.  Increasing the initial wolf setting has the same effect, except the simulation starts on the overshoot, instead of before it. |

Step 25:  Insert your code below and run the simulation, confirming the simulation now has three turtles of varying color.

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| 3 different turtles are created, with different colors, moving in random directions.  to setup  clear-all  create-turtles 3 ; create one turtle  [  set color one-of base-colors  pen-down  ]  reset-ticks  end  to go  ask turtles [  rt random 360 ; set random heading  forward 1 ; advance one step  ]  tick  end  ; Public Domain:  ; To the extent possible under law, Uri Wilensky has waived all  ; copyright and related or neighboring rights to this model. |

Step 27:  Change your code so that the turtle turns less than 360 degrees and moves more or less than one step. Decimal values are acceptable.

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| The turtles now move in circular patterns.  to setup  clear-all  create-turtles 3 ; create one turtle  [  set color one-of base-colors  pen-down  ]  reset-ticks  end  to go  ask turtles [  rt random 30 ; set random heading  forward 5 ; advance one step  ]  tick  end  ; Public Domain:  ; To the extent possible under law, Uri Wilensky has waived all  ; copyright and related or neighboring rights to this model. |

Step 31:  Insert your code and run your simulation, experimenting with turn-amount. Be sure to test the largest and smallest values for turn-amount.

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Step 41: Insert your code and test your simulation to see your new shape in action.

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Step 50:  Insert your code and test the simulation to confirm that remaining raindrops evaporate when the rainfall is 0.

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Assuming that rain rate and evaporation rate reflect the correct real-world rates, how well does the evaporation algorithm fit the model?

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