Testing Report for Assignment 4
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2/21/19
CSC 207.02

10 organisms: 1 cooperator, 9 defectors
Prediction: The defectors will kill off the cooperator, likely around the 5th iteration because each update, eight out of nine of the defectors will get +2 energy, one from the cooperator, and the other from the update.

Analysis: The overall mean cooperation probability was 0.07. The defectors dominated by far, however in some trials there was one cooperator left. This is slightly surprising, and we believe that with a higher number of trials it would eventually be replaced.

100 organisms: 1 cooperator, 99 defectors
Prediction: The defectors will kill off the cooperator in all trials, probably around the 9th or 10th iteration. Most defectors will first reproduce at this time, thus likely replacing the one cooperator. Specifically, by iteration 9, the cooperator (if still alive) will have given a total of 72 extra energy to random defectors, and therefore many will already be at energy 10, and a few will likely have already reproduced or been replaced.

Analysis: The overall mean cooperation probability was 0.005. In half of the trials, the cooperator was killed off, but none had more than one. We were surprised that any survived at all, but we were correct that the defectors would continue to dominate.

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10 organisms: 9 cooperator, 1 defectors
Prediction: The cooperators will likely take over early on, probably by the end of the second round, because after the first iteration alone, 72 energies will be distributed amongst the population. Therefore, the advantage that the defector has over the cooperators will be mostly mitigated. Even if the defector reproduces first, it and its offspring will be reset to 0, and the cooperators will likely take over again.

Analysis: The overall mean cooperation probability was 0.58. Our results for this experiment were quite variable and surprising. Our prediction that the defector's advantage would be mitigated was clearly disproven, since they increased in all trials, and strongly dominated in two trials.

100 organisms: 99 cooperator, 1 defectors

Prediction: The cooperators will almost definitely win for similar reasons as with 10 organisms. However, since the population is much larger, energy will have a higher chance of being more evenly distributed, therefore the chances that the defector could rise above the odds are smaller. Also, the defector makes up a proportionately smaller amount of the population than with a population of 10.

Analysis: The overall mean cooperation probability was 0.524. This experiment was extremely variable, with cooperators dominating nearly completely in three cases (though never fully replacing the defectors). However, the overall mean is shows that our overall results were very close to a 50-50 split, and the rest of the trials were all across the board.

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10 organisms: 3 cooperator, 3 defectors, 4 partial cooperators
Prediction: Most of the defectors and many partial cooperators will reproduce around rounds 2-4. Cooperators will also reproduce first around round 3-4 if not replaced, and will stay behind. Therefore the cooperators will all be replaced over time. The partial cooperators will likely not do as well as the defectors, but with a population size of just 10 that is nearly evenly distributed, this seems that it could be relatively variable.

Analysis: The overall mean cooperation probability was 0.32. We found that the number of cooperators was one or zero, as predicted. However, the partial cooperators seemed to do slightly better than the defectors. This was variable, however, which disproves our prediction.

100 organisms: 33 cooperator, 33 defectors, 34 partial cooperators
Prediction: This simulation will behave similarly to its counterpart population of 10, however, because it is a larger sample size, results will be less variable.

Analysis: The overall mean cooperation probability was 0.3275. We found that the number of cooperators was consistently under ten, but never zero. As for the defectors and partial cooperators, neither went above 70% of total, and results favored them equally overall. These results did support our overall hypothesis, however we were incorrect that the results would be minimally variable.

Final Conclusion: We thought that in most cases, one population would get entirely replaced. However, we found that our results only supported this two cases, both when the defectors started as the vast majority. However, even in these cases, some cooperators nonetheless survived in some trials. We believe that this experiment demonstrates the sheer complexity and variability of biological systems, even when modeled in extremely simplified ways.

Table of Cooperation Means						
	1 cooperator, rest defectors		1 defector, rest cooperators		1/3 each type (one extra partial)	
Population size	10	100	10	100	10	100
Trial 1	0	0	0	0.34	0.2	0.34
Trial 2	0	0	0.1	0.98	0.4	0.27
Trial 3	0.1	0	0.7	0.13	0.3	0.35
Trial 4	0	0.01	0.6	0.98	0.3	0.445
Trial 5	0.1	0	0.8	0.11	0.15	0.35
Trial 6	0.1	0	0.8	0.98	0.15	0.405
Trial 7	0.1	0.01	0.6	0.51	0.4	0.35
Trial 8	0.1	0.01	0.8	0.72	0.45	0.215
Trial 9	0.1	0.01	0.8	0.17	0.35	0.34
Trial 10	0.1	0.01	0.6	0.32	0.5	0.21
Cooperation mean	0.07	0.005	0.58	0.524	0.32	0.3275