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Project 4: Functional Decomposition

1. For my own-choice quantity I decided to introduce genetically modified grain in the years 2019 and 2021. To do this I implemented a function called GMOGrain that ran on a fourth thread in an additional section. The function runs on a while loop just like the others and makes an additional change to the NowHeight variable after the Grain function updates it. If the current year is 2019 or 2021, the grain height for the month is multiplied by a random factor between 1.25 and 1.75 to simulate the increased growth potential of the modified grain. In the other years, the grain height is multiplied by 1 to simulate no effect. In order for this to work I had to add an additional barrier to each function after the Grain and GrainDeer update barrier to allow for the GMOGrain function to update the NowHeight variable before the Watcher function began printing and calculating.

2. Table of values from 72 month run

Year	Month	Temp (F)	Precipitation (inches)	Grain Height (inches)	Number of Deer
2017	0	0	0	0	1
	1	31	8.3	2.8	0
	2	42	11.5	10.1	1
	3	47	13.8	14.2	2
	4	64	11.3	13.2	3
	5	60	5.7	11.8	4
	6	78	6	9.8	5
	7	66	1.7	7.3	6
	8	62	0	4.4	7
	9	50	0	2	6
	10	40	1.2	2.7	5
	11	33	6.1	4.7	4

2018	0	27	6.6	3.9	5
	1	33	10.4	6.5	4
	2	35	13.8	9.9	5
	3	45	13.2	12.8	6
	4	71	10.1	9.8	7
	5	60	9.5	6.4	8
	6	63	5.9	2.5	7
	7	57	3	0	6
	8	60	2.2	0	5
	9	39	0.2	0.5	4
	10	35	3.6	2.8	3
	11	30	2.8	2.9	2
2019	0	40	7.1	12.7	3
	1	39	8.4	19.5	4
	2	39	11.7	30.7	5
	3	47	11.5	34.2	6
	4	70	9.5	26.3	7
	5	75	8.9	29.7	8
	6	69	3.9	19.4	9
	7	66	0	13.9	10
	8	61	0	4.5	11

	9	51	0	0	10
	10	43	3.6	0	9
	11	36	5.2	1.7	8
2020	0	38	9.4	4.4	7
	1	40	8.5	8.8	6
	2	46	13.6	10.9	7
	3	54	11.5	8.7	8
	4	62	11.6	4.7	9
	5	64	8.5	0	8
	6	68	2.9	0	7
	7	59	1	0	6
	8	50	0	0	5
	9	51	0	0	4
	10	41	0.9	1.4	3
	11	41	5	6.1	2
2021	0	33	7.6	14.8	3
	1	43	9	23.1	4
	2	36	12.7	32.6	5
	3	49	11	27.6	6
	4	70	9.1	28.3	7
	5	66	5.8	18.3	8

	6	70	4.1	16	9
	7	56	2.5	8.3	10
	8	64	1.8	1.3	9
	9	38	2.2	0.7	8
	10	26	0.4	0	7
	11	31	5	0	6
2022	0	40	7.9	4.6	5
	1	39	10.9	10	4
	2	42	13.5	14.8	5
	3	56	13.5	12.9	6
	4	60	9.1	10.1	7
	5	69	8.8	6.6	8
	6	63	4.5	2.6	7
	7	70	0	0	6
	8	55	0	0	5
	9	53	0	0	4
	10	40	0	1	3
	11	37	3.4	4.2	2

3. Chart showing patterns and relationships in variable values

Simulation Values Over 72 Months
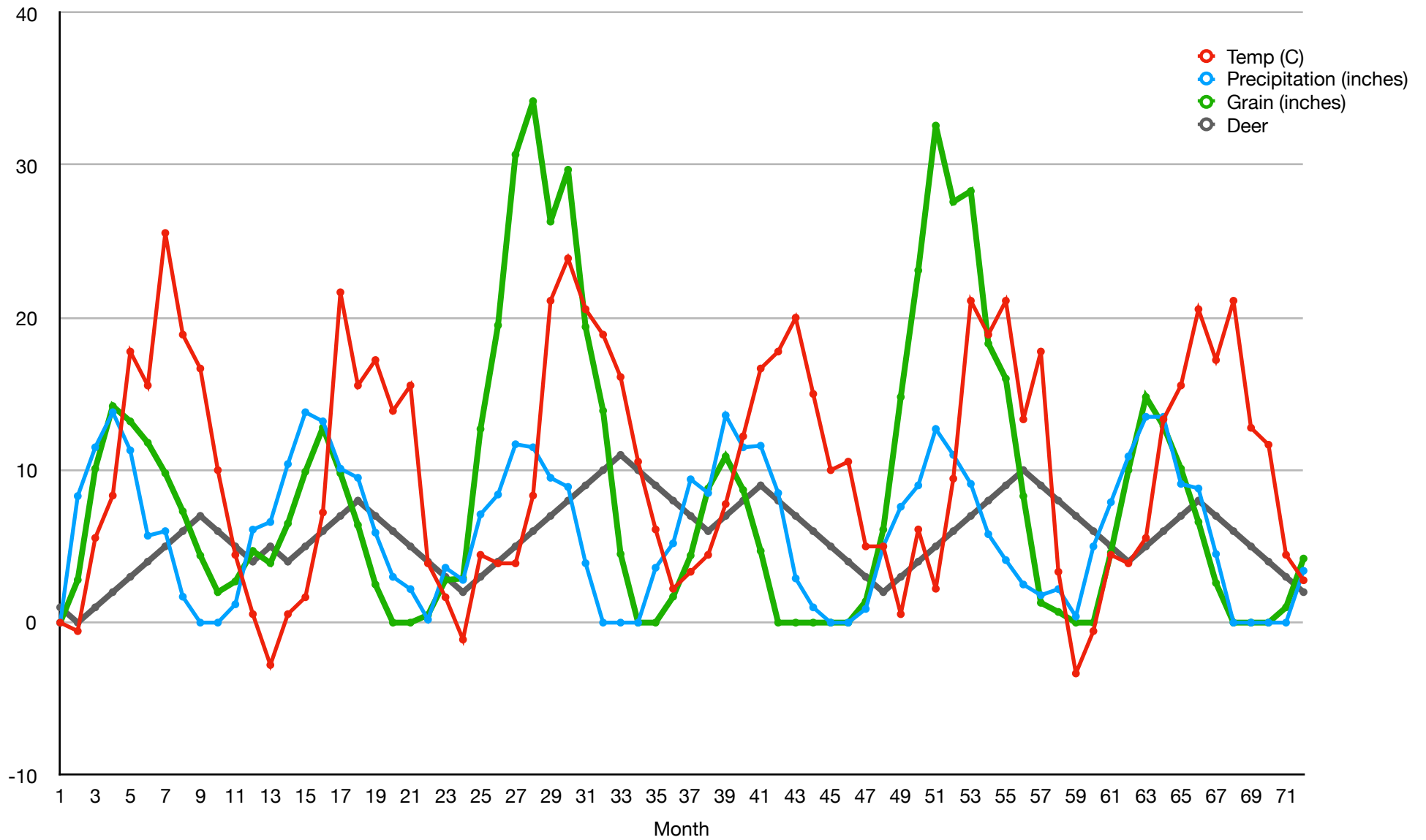
4. The simulation tends to follow a seasonal pattern where higher temperatures and levels of precipitation in the spring lead to grain growth and drops in precipitation and temperature in the fall and winter lead to, in almost all years, a decrease of grain height to zero. The grain height seems to correlate most strongly with precipitation level as the peaks and valleys of each in the graph are closely aligned, with spring leading to peaks for both, as happens in the northern hemisphere. The temperature spikes in the summer, so its peaks are shifted right a few months. The growth in the deer population tends to peak in late summer and fall as an abundance of grain over the summer leads to a growth in population. There is a pattern where as the number of deer increase, the height of the grain decreases so that when the deer are at their peak the grain is at its valley. This makes sense as each deer directly decreases the overall height of the grain. After the deer have eaten all of the grain, their numbers start to fall with a valley in the winter before slowly rising as grain begins to grow in the spring.

The factor I included is a simulation of using genetically enhanced grain in the years 2019 and 2021. The grain height in these years is multiplied by a factor between 1.25 and 1.75 each month, which leads to a sharp increase in grain height in these two years without any significant change in precipitation or temperature. The graph shows that the grain height is significantly higher in these years and that the precipitation levels are relatively the same. The peak population of deer in these two years is also higher than in other years as there is more grain to feed on. Since the number of deer decrease slowly relative to the height of the grain, the beginning deer population in the springs in 2020 and 2022 are higher than in other years as the peak population in the years of modified grain bolsters the community.