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Project #3 Functional Decomposition

- **My own-choice quantity and how it fits into the simulation.**

I added an agent “Hunter” to the simulation, which hunts some “graindeer” every month. The number of graindeer hunted by the hunter every month is affected by the amount of precipitation and the number of graindeer available to be hunted. If the amount of precipitation is no less than “AVG_PRECIP_PER_MONTH” in a given month, which indicates it rains a lot and the hunter has less chance to hunt graindeer, thus only 1/3 graindeer are hunted by the hunter in that month. Else, the amount of precipitation is less than “AVG_PRECIP_PER_MONTH” in a given month, which indicates it rains relatively little and the hunter has more chance to hunt graindeer, thus 1/2 graindeer are hunted by the hunter in that month. After adding this agent, the number of graindeer not only depends on the amount of grain available to eat, but also the number of graindeer hunted by the hunter. Each month, after decreasing or increasing the number of graindeer by one according to the compare with number of inches of height of the grain, number of graindeer hunted by hunter should also be subtracted from total number of graindeer.

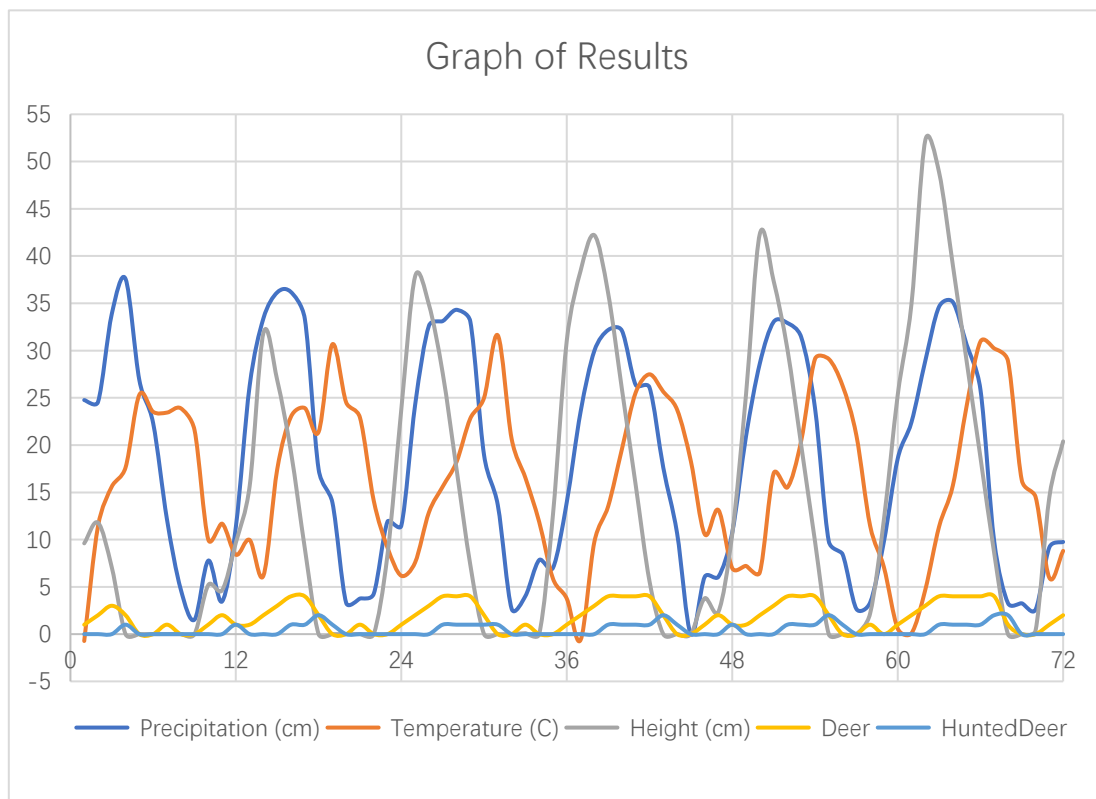
- **Table showing values for temperature, precipitation, number of graindeer, height of the grain, and my own-choice quantity as a function of month number.**

Table of Results					
Month	Precip (cm)	Temp (°C)	Height (cm)	NumDeer	HuntedDeer
1	24.767524	-0.72727	9.603983	1	0
2	24.562624	11.41669	11.790867	2	0
3	33.867993	15.606927	7.071884	3	0
4	37.578355	17.629712	0	2	1
5	26.872943	25.324885	0	0	0
6	22.323996	23.521368	0.000171	0	0
7	12.163411	23.438233	0.000317	1	0
8	4.746546	23.898977	0	0	0
9	1.534469	21.601872	0.000681	0	0
10	7.77638	9.999665	5.197728	1	0
11	3.46033	11.688124	4.63801	2	0
12	11.34457	8.403986	9.685075	1	1
13	26.279006	9.96222	15.659364	1	0
14	33.418246	6.191146	31.863559	2	0

15	36.156795	17.445159	26.863525	3	0
16	36.188944	23.013857	19.243794	4	1
17	33.364594	23.917092	9.08389	4	1
18	17.443015	21.39164	0	2	2
19	13.928409	30.664821	0	0	1
20	3.30211	24.514597	0.000023	0	0
21	3.764805	22.913212	0.000199	1	0
22	4.265797	14.115164	0	0	0
23	11.914287	9.143278	8.432871	0	0
24	11.476612	6.171752	23.800073	1	0
25	24.243765	7.580609	37.847508	2	0
26	32.618874	12.875548	34.875022	3	0
27	33.119548	15.608448	27.622478	4	1
28	34.315137	18.205494	17.506228	4	1
29	33.096291	22.810304	7.346602	4	1
30	18.939276	25.000593	0	2	1
31	13.636041	31.607742	0	0	1
32	2.685691	20.659417	0.002052	0	0
33	4.031839	16.535948	0.100782	1	0
34	7.844685	11.866883	0	0	0
35	7.013765	5.863961	12.681162	0	0
36	13.965808	3.754487	31.06214	1	0
37	23.514965	-0.617398	38.43388	2	0
38	29.97959	9.762802	42.204163	3	0
39	32.17774	13.518066	36.06214	4	1
40	32.102437	19.578209	25.914908	4	1
41	26.360329	25.565605	15.75492	4	1
42	26.092506	27.488467	5.594921	4	1
43	17.60441	25.643014	0	2	2
44	10.677321	23.755603	0	0	1
45	0	18.290083	0.016878	0	0
46	6.052022	10.582538	3.792047	1	0
47	6.072581	13.12265	2.368662	2	0
48	10.741013	6.973881	10.605351	1	1
49	20.926705	7.215436	25.346089	1	0
50	28.627824	6.532018	42.337837	2	0
51	33.030554	16.994722	37.384763	3	0
52	32.922969	15.517152	30.159029	4	1
53	31.433319	20.443641	20.004433	4	1
54	23.948097	29.109374	9.844433	4	1
55	9.832342	29.113833	0	2	2
56	8.45662	26.292407	0	0	1
57	2.672361	21.051564	0.001351	0	0

58	3.335371	11.466548	2.176573	1	0
59	9.773593	7.092599	12.111112	0	0
60	18.548921	0.598106	25.272665	1	0
61	22.423517	0.089315	34.928818	2	0
62	28.897849	4.678069	52.239747	3	0
63	34.639184	11.360181	48.872085	4	1
64	35.139687	15.721188	39.032613	4	1
65	30.620403	24.140375	28.872688	4	1
66	25.881303	30.950809	18.712688	4	1
67	9.798634	30.226237	8.552688	4	2
68	3.272464	28.895331	0	1	2
69	3.259311	16.287488	0	0	0
70	2.595538	14.517456	0.381302	0	0
71	9.182866	5.960344	14.497054	1	0
72	9.753336	8.809361	20.393988	2	0

- A graph showing temperature, precipitation, number of graindeer, height of the grain, and my own-choice quantity as a function of month number.



- **Commentary about the patterns in the graph and why they turned out that way.**

The curves of precipitation, temperature, number of graindeer, height of grain and number of hunted graindeer are synchronously change annually. Every year, they all rise firstly, peak in the middle, and then fall. The reason of this pattern is that they are interdependent.

- 1) The amount the grain grows is affected by the temperature and amount of precipitation. The temperature and precipitation follow cosine and sine wave patterns with some randomness added, whose curves change periodically, only affected by the particular month. So, the height of grain's curve also follows this pattern. But their peaks don't appear at the same month, because how good conditions are for grain growing depends on how close you are to an ideal temperature (°F) and precipitation (inches), not the highest precipitation and temperature.
- 2) The amount the grain grows and the number of graindeer affect each other. The Carrying Capacity of the graindeer is the number of inches of height of the grain. When the number of graindeer is less than the number of inches of height of the grain, the graindeer's curve rises. Otherwise, the graindeer's curve falls. The intersection point of grain's curve and graindeer's curve is the peak of the graindeer's curve every year. For grain's curve, at first it rises with graindeer's curve, but when there are too many graindeer to eat grain, it falls until the number of graindeer decreased to some point. And since grain's curve follows the pattern described in part (1), graindeer's curve also follows this pattern.
- 3) The number of graindeer hunted by the hunter every month is affected by the amount of precipitation and the number of graindeer available to be hunted. So, its curve follows the same pattern as graindeer's curve. And when precipitation is high, the number of graindeer hunted by the hunter is almost 0.

- **What evidence in the curves proves that your own quantity is actually affecting the simulation correctly?**

The agent I added is "Hunter", which directly affect the graindeer population, and indirectly affect the growth of the grain. The hunter decreases graindeer's population every month, so less graindeer are around to eat grain. And the number of graindeer hunted by the hunter every month is also affected by the amount of precipitation: When the precipitation is low, even more graindeer are hunted, which helps the grain grow under bad condition (too much rain). In this case, the "Hunter" I added actually facilitated the growth of grain, and the curves I got also proved it. In the graph, the peak of grain's curve is spiking higher every year, which proves that the "Hunter" is actually affecting the simulation correctly.