CS 575 Project 3

Jeremy Dao

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1. The quantity that I chose to add to the simulation was mice. Mice function very similarly to deer, except due to their smaller size the eat much less grain and should start and end up with a larger population than deer. Adding an additional animal to the simulation increases the amount of grain eaten and will lower the population of the deer since there is less grain to go around.

2. The following table displays the simulation values over time:

Month	Temperature (°F)	Precipitation (in)	Grain Height (in)	Num Deer	Num Mice
0	30.690914	9.750994	18.141462	3	8
1	52.550041	9.670324	17.822767	4	10
2	60.092468	13.333856	14.312278	5	12
3	63.733482	14.794628	9.746401	6	14
4	77.584793	10.579899	4.246409	7	16
5	74.338455	8.788975	0	6	18
6	74.188812	4.788744	0	5	16
7	75.018158	1.868719	0	4	14
8	70.883369	0.604122	0	3	12
9	49.999397	3.061567	0	2	10
10	53.038624	1.362334	0	1	8
11	47.127174	4.466367	4.116045	0	6
12	49.931995	10.346066	8.285487	1	8
13	43.144062	13.15679	16.924961	2	10
14	63.401287	14.234959	14.866938	3	12
15	73.424942	14.247616	11.867079	4	14
16	75.050766	13.135667	7.96713	5	16
17	70.504944	6.867329	3.168119	6	18
18	87.196671	5.483625	0	5	20
19	76.126274	1.300043	0	4	18
20	73.243782	1.482207	0	3	16
21	57.407295	1.679447	0	2	14
22	48.457901	4.690664	2.126704	1	12
23	43.109154	4.518352	8.793477	2	14
24	45.645096	9.544789	15.200791	3	16
25	55.175987	12.842076	13.107099	4	18
26	60.095207	13.039192	9.199989	5	20
27	64.76989	13.509896	4.222955	6	22
28	73.058548	13.030036	0	5	24
29	77.00106	7.456408	0	4	22
30	88.893921	5.36852	0	3	20
31	69.186951	1.057359	0	2	18
32	61.764706	1.587338	0	1	16
33	53.36039	3.088459	0	0	14

34	42.55513	2.761324	5.956778	0	12
35	38.758076	5.49835	15.005587	1	14
36	30.888683	9.25786	18.708601	2	16
37	49.573044	11.802988	20.954418	3	18
38	56.33252	12.668402	18.43026	4	20
39	67.240776	12.638755	14.236962	5	22
40	78.018089	10.378082	9.136969	6	24
41	81.479233	10.27264	3.136968	7	26
42	78.157417	6.93087	0	6	28
43	74.760086	4.20367	0	5	26
44	64.92215	0	0	4	24
45	51.048569	2.382686	0	3	22
46	55.62077	2.390779	0	2	20
47	44.552986	4.228746	4.390388	1	18
48	44.987785	8.23886	11.761642	2	20
49	43.757633	11.270797	19.414528	3	22
50	62.5905	13.004155	15.981155	4	24
51	59.930874	12.961799	11.788118	5	26
52	68.798553	12.375322	6.490955	6	28
53	84.396866	9.428385	0.290955	7	30
54	84.404892	3.871001	0	6	28
55	79.326332	3.329378	0	5	26
56	69.892815	1.05211	0	4	24
57	52.639786	1.313138	0	3	22
58	44.766678	3.847871	3.048314	2	20
59	33.076591	7.302725	7.357265	3	22
60	32.160767	8.828156	10.259445	4	24
61	40.420525	11.377106	17.613213	5	26
62	52.448326	13.637474	14.545409	6	28
63	60.298138	13.834522	8.513664	7	30
64	75.452675	12.055277	1.413704	8	32
65	87.711441	10.189489	0	7	30
66	86.407211	3.85773	0	6	28
67	84.011597	1.288372	0	5	26
68	61.317478	1.283193	0	4	24
69	58.13142	1.021865	0	3	22
70	42.728619	3.615301	3.909843	2	20
71	47.85685	3.839897	5.738681	3	22

3. The following graph displays the same data as the table above. Note that for sake of space and clarity, temperature has been converted to Celsius and precipitation and grain height have been converted to centimeters.

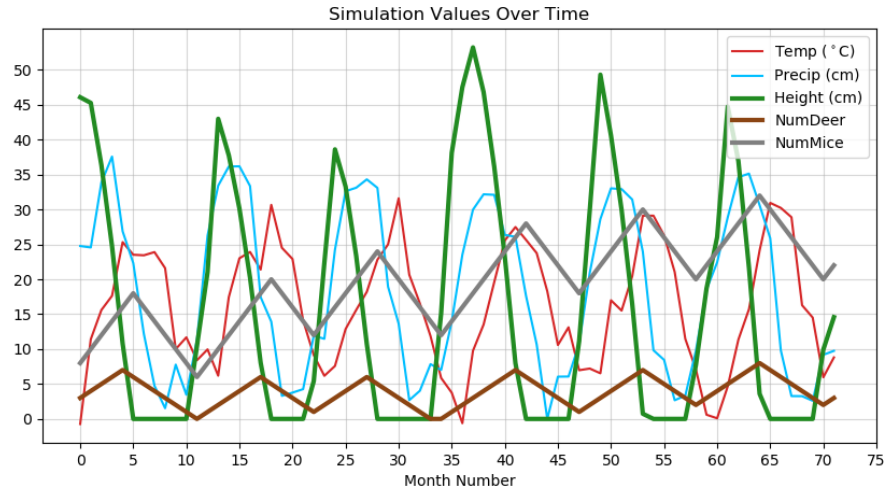

Figure 1: Progression of simulation values over time

4. To analyze the patterns in the simulation graph and their causes, we need to start at the base, meaning the temperature and precipitation values. These are scheduled to be cyclic according to the 12-month cycle with some random variation. We can see this in the graph, with the temperature and precipitation values (red and blue respectively) follow an overall up-and-down trend with a fixed frequency, with the occasional sharp deviations caused by the added randomness. This in turn causes the grain height to be cyclic and thus the population of deer and mice to be cyclic as well.
It is also interesting to look at the relatively timings of the up and downs of each curve. Note that grain height starts out large with a low population deer and mice, basically meaning grain is in excess. As a result deer and mice population go up until the animals eat all the grain and their population goes back down again. It is obvious that the population of the animals will follow the curve of grain height, since the amount of grain dictates whether population increases or decreases, but in the graph we can see the delay in the response. Note that every time the peak of the animal population happens after the peak of grain height and usually ends up when grain height is at its lowest. This makes sense since the effect of extra grain consumption from the additional animals will be seen on grain height almost immediately, but the effect of lowering grain directly opposes the current rise in animal population and thus it takes some time for the effect to be seen.