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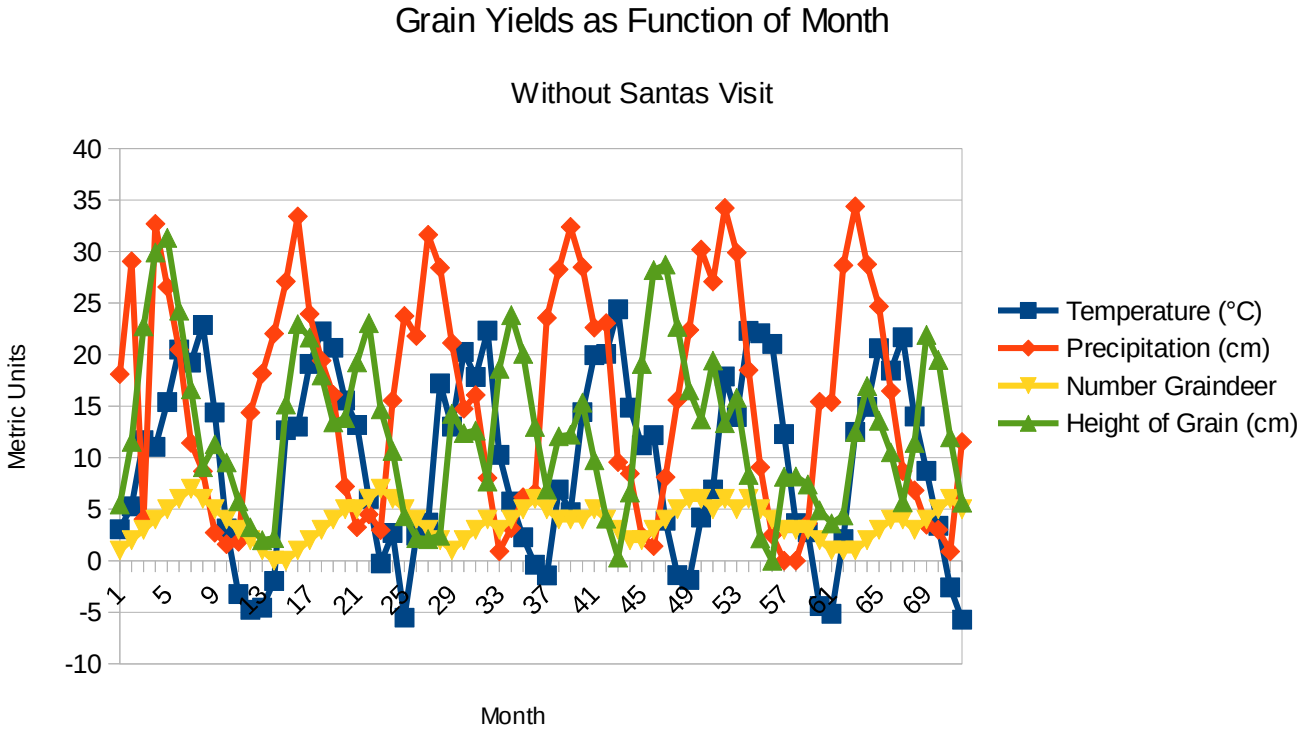
CS475
Spring 2016
Project 4
Functional Decomposition (“Grainville”)

Own-Choice Quantity

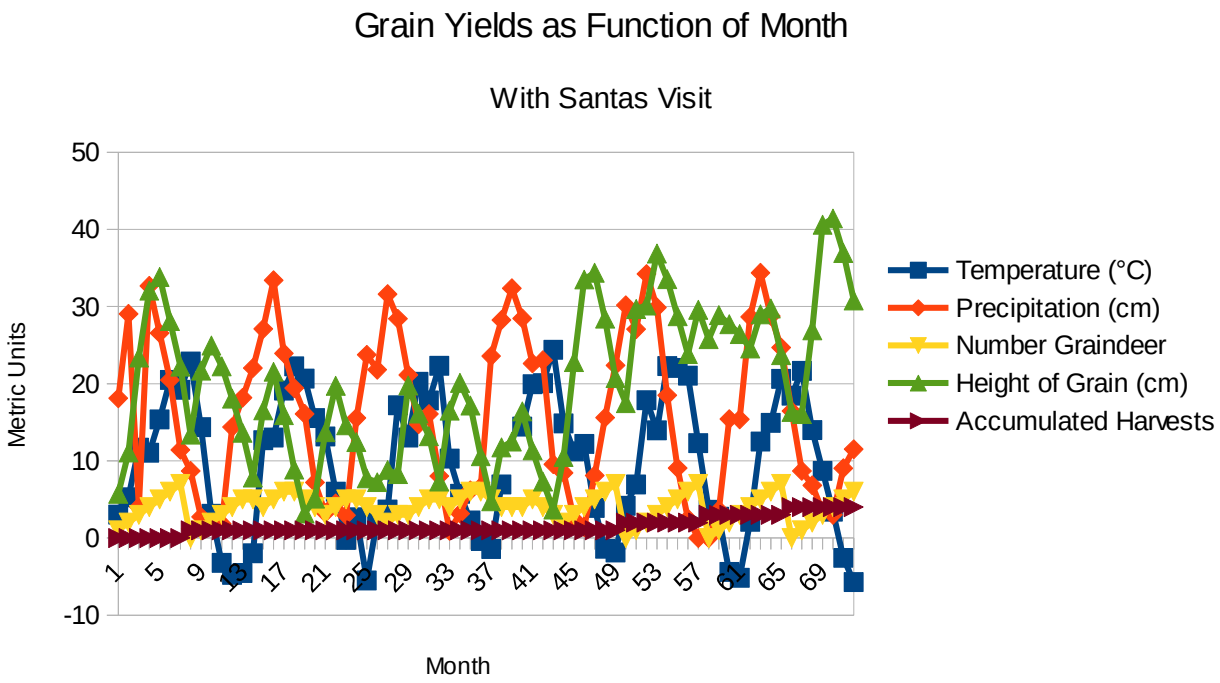
For this project, I chose as my own-choice values to be a monthly visit from Santa Clause. Each month he comes and fertilizes the grain, giving a growth multiplier of 1.05 times its current height. In addition to fertilizing the grain, when he makes his monthly visit, Santa checks on the number og Graindeer. If there are 8 or more, he harvests 8 of them for his team. This means the number of Graindeer never reaches 8, because as soon as it does Santa comes and takes them away, dropping the Graindeer count to 0.

Grain and Graindeer Quantities without Santa's Visit



Month	Temperature (°C)	Precipitation (cm)	Number Graindeer	Height of Grain (cm)
1	3.047354	18.11138364	1	5.459719
2	5.288804	29.048456	2	11.556136
3	11.698093	4.0278304	3	22.743697
4	11.044909	32.68592142	4	29.900779
5	15.387573	26.56464334	5	31.324541
6	20.481368	20.49373092	6	24.258259
7	19.230118	11.43175006	7	16.625628
8	22.881516	8.6922356	6	9.093568
9	14.383674	2.72702782	5	11.296694
10	3.142039	1.60609534	4	9.535686
11	-3.231178	1.85142124	3	5.778641
12	-4.76327	14.38603676	2	3.256042
13	-4.547185	18.17799768	1	2.007146
14	-1.970181	22.04180504	0	2.189365
15	12.667838	27.09820082	0	15.164651
16	13.01946	33.40609016	1	22.962169
17	19.108298	23.94398818	2	21.651217
18	22.260869	19.43116256	3	17.992853
19	20.66121	16.0989899	4	13.423454
20	15.551372	7.22068914	5	13.849755
21	13.172934	3.261614	5	19.239984
22	6.015663	4.49723002	6	23.049148
23	-0.264354	2.96466768	7	14.688808
24	2.686653	15.55291022	6	10.660195
25	-5.513006	23.74956642	5	4.317658
26	2.432094	21.81063456	4	2.209065
27	3.704387	31.61909348	3	2.111222
28	17.211685	28.42546258	2	2.449106
29	13.0142	21.13974182	1	14.252475
30	20.262532	14.74545692	2	12.382041
31	17.824512	16.07723988	3	12.63442
32	22.325719	8.02903906	4	7.690937
33	10.283165	0.92325444	3	18.631847
34	5.737644	3.1634176	4	23.819055
35	2.282541	6.16776516	5	20.065946
36	-0.381328	6.61468832	6	12.997223
37	-1.425424	23.57184516	5	6.912892
38	6.930033	28.261183	4	12.075475
39	4.727493	32.38422022	4	12.230249
40	14.431087	28.477845	4	15.347702
41	19.944089	22.62260398	5	9.75595
42	20.067007	23.0459661	4	4.099171
43	24.390301	9.57182236	3	0.312745
44	14.845278	8.46035646	2	6.616541
45	11.213101	2.41585496	2	19.091003
46	12.196102	1.41987524	3	28.207777
47	3.891082	8.10784256	4	28.732609
48	-1.404067	15.60313364	5	22.683109
49	-1.860991	22.38243174	6	16.529902
50	4.190131	30.19178366	6	13.723501
51	6.929686	27.0734917	5	19.424253
52	17.878571	34.22921272	6	13.359386
53	13.941854	29.8879006	5	15.81683
54	22.300072	18.49304912	6	8.345408
55	22.061361	9.07116042	5	2.167312
56	21.034542	2.50746514	4	0
57	12.28725	0	3	8.156422
58	3.65238	0	3	8.18897
59	2.770413	3.61533694	3	7.40939
60	-4.403542	15.42872962	2	4.893863
61	-5.141718	15.38532864	1	3.635935
62	2.092637	28.66273414	1	4.392793
63	12.510363	34.38035034	1	12.510363
64	14.925156	28.77390232	2	16.943176
65	20.631972	24.6819293	3	13.587459
66	18.445405	16.46418094	4	10.517907
67	21.67127	8.69882944	4	5.668248
68	13.994406	6.82232316	3	11.445418
69	8.714377	3.50094804	4	21.921559
70	3.392033	3.00921674	5	19.487219
71	-2.584186	0.90367485	6	11.980378
72	-5.704407	11.5146836	5	5.637111

Grain and Graindeer Quantities with Santas Visit



Month	Temperature (°C)	Precipitation (cm)	Number Graindeer	Height of Grain (cm)	Accumulated H
1	3.047354	18.11133284	1	5.732704	0
2	5.288804	29.048456	2	11.087076	0
3	11.698093	4.0278304	3	23.388369	0
4	11.044909	32.68592142	4	32.072723	0
5	15.387573	26.56464334	5	33.837809	0
6	20.481368	20.49373092	6	28.110384	0
7	19.230118	11.43175006	7	22.234856	0
8	22.881516	8.6922356	0	13.400936	1
9	14.383674	2.72702782	1	21.718265	1
10	3.142039	1.60609534	2	24.955618	1
11	-3.231175	1.85142124	3	22.258501	1
12	-4.76327	14.38603676	4	18.055694	1
13	-4.547185	18.17799768	5	13.646638	1
14	-1.970181	22.04180504	5	7.8528	1
15	12.667838	27.09820082	4	16.535488	1
16	13.01946	33.40609016	5	21.549155	1
17	19.108298	23.9439958	6	15.916112	1
18	22.260869	19.43116256	6	8.870134	1
19	20.66121	16.0989899	5	3.182272	1
20	15.551372	7.22068914	4	5.1225	1
21	13.172934	3.261614	3	13.705366	1
22	6.015663	4.49723002	4	19.723757	1
23	-0.24354	2.96466768	5	14.598588	1
24	2.686653	15.55291022	5	12.431974	1
25	-5.513006	23.74956642	4	7.727409	1
26	2.432094	21.81063456	3	7.233256	1
27	3.704387	31.61909348	2	8.825684	1
28	17.211685	28.42546258	3	8.288247	1
29	13.0142	21.13974182	3	19.762698	1
30	20.262532	14.74545692	4	16.119875	1
31	17.824512	16.07723988	5	13.190366	1
32	22.325719	8.02903906	5	7.325727	1
33	10.283165	0.92325444	4	16.51269	1
34	5.737644	3.1634176	5	20.118186	1
35	2.282541	6.16776516	6	17.18333	1
36	-0.381328	6.61468832	6	10.620335	1
37	-1.425424	23.57184516	5	4.762805	1
38	6.930033	28.261183	4	11.755156	1
39	4..727493	32.38422022	4	12.505425	1
40	14.431087	28.477845	4	16.404022	1
41	19.944089	22.62260398	5	11.352883	1
42	20.067007	23.0459661	4	7.314408	1
43	24.390301	9.57182236	3	3.704381	1
44	14.845278	8.46035646	2	10.508586	1
45	11.213101	2.41585496	3	22.798698	1
46	12.196102	1.41987524	4	33.511244	1
47	3.891082	8.10784256	5	34.404378	1
48	-1.404067	15.60313364	6	28.439119	1
49	-1.860991	22.38243174	7	20.733206	1
50	4.190131	30.19178366	0	17.489645	2
51	6.929686	27.0734917	1	29.683915	2
52	17.878571	34.22921272	2	30.13399	2
53	13.941854	29.8879006	3	36.88017	2
54	22.300072	18.49304912	4	33.55442	2
55	22.061361	9.07116042	5	28.745142	2
56	21.034542	2.50746514	6	23.83606	2
57	12.28725	0	7	29.591556	2
58	3.65238	0	0	25.771307	3
59	2.770413	3.61534456	1	28.908313	3
60	-4.403542	15.42872962	2	27.712424	3
61	-5.141718	15.38532864	3	26.44372	3
62	2.092637	28.66273414	4	24.560107	3
63	12.510363	34.38035034	5	28.979418	3
64	14.925156	28.77390232	6	29.746985	3
65	20.631972	24.6819293	7	23.710328	3
66	18.445405	16.46418094	0	16.338813	4
67	21.67127	8.69882944	1	16.06411	4
68	13.994406	6.82232316	2	26.933843	4
69	8.714377	3.50094804	3	40.613982	4
70	3.392033	3.00921674	4	41.422123	4
71	-2.584186	9.0367485	5	36.944542	4
72	-5.704407	11.5146836	6	30.797839	4

Commentary

In the first graph, where we don't have Santa making a monthly visit, grain height follows a roughly sine-wave curve, which is to be expected because that is what temperature and precipitation do as well. The height of the grain seems to most closely match temperature, though it does get pulled off mark a fair amount by precipitation. We also see in this curve that the amount of graindeer also follows a sine-wave curve, that matches well with the hight of the grain, but is lagging a little bit behind. This is also expected, since the amount of graindeer gets adjusted based on the previous months grain height, so when the height peaks, the graindeer count will peak the following month.

In the graph with Santa's visit, we also see a sine wave in the grain height. However, we can see, especially towards the end, that the peak and bottom of each wave is getting higher. This is due to the nature of Santa's fertilizer; it doesn't affect the growth rate, but rather helps the grain grow by a percentage of its current height. So with each wave on the graph, there will be an upward trend in the height due to the base of the wave being higher than it was before. This is also seen in the graindeer curve; as we approach the later months, we find that the height of deer peaks sooner and the number of harvests seems to accelerate. In the graph we can see that in the first 4 years we had one harvest. In the last 2 years we had 3, because the carrying capacity of the deer population never got very low.

We also see an influence from Santa's harvesting Graindeer; the bottom of the trough of the grain height curve isn't as shallow as before. The reason for this being that before, as the grain height decreased, so did the Graindeer population. Now, however, when the Graindeer population reaches a peak (or at least a peak of greater than 7) it immediately drops off to 0; this means that before, when the grain height peaked the deer would peak the next month, and consume grain contributing to the decrease in height. Now, however, when the height peaks, the deer also peak but get immediately harvested, so that they are no longer there to accelerate the decrease in height or contribute to the curves low point.