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CS475-400
Project #3

1. I chose to implement seasonal fires for my own-choice quantity. My quantity, represented as a percent for the chance of fires, is dependent upon temperature and precipitation. The higher the temperature and the lower the amount of precipitation, the greater the chance of fires that will burn the grain and kill off the deer. Every iteration calculates the chance of fire, and if the chance is above 0%, the grain height is burned by that value. So, if the chance of fires is 20%, grain height is reduced by 20%.

   Deer are also affected by the FireOdds quantity. If the FireOdds is above 0%, the deer will die twice as fast. This means if the height of the grain is less than the number of deer, the deer will decrease by 2 each iteration until the height of the grain becomes greater than the number of deer or the number of deer equals 0.

   I calculated FireOdds using the following code:

```
float tempFire = 1;
float tempHeat = NowTemp - 15.;
float tempRain = 28. - NowPrecip;
if((tempHeat + tempRain) > 0) {
        tempFire -= SQR((tempHeat + tempRain)) / 2000.;
```

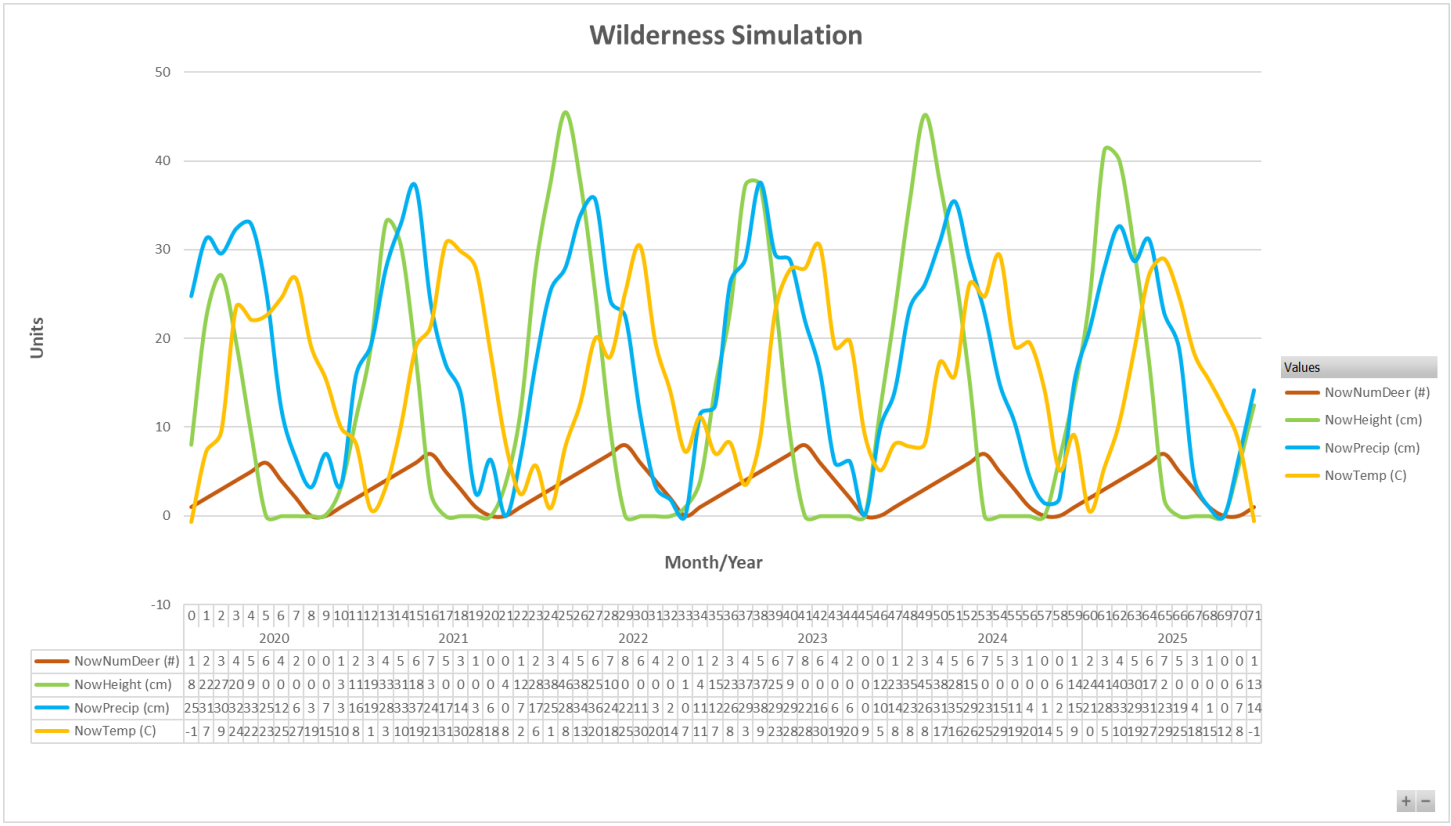
   The value of tempFire is the number to multiply NowHeight by to get the height after the fire. The actual odds of a fire can be found using (1 – tempFire).

2. Below are all the values generated by my program. There is also a table below each graph showing this information with the axis values swapped. (I added NowYear just to make finding the beginning/end of each year easier)

NowYear	NowMonth	NowNumDeer	NowHeight	NowPrecip	NowTemp	FireOdds
2020	0	1	8.064	24.768	-0.727	0
2020	1	2	22.408	31.267	7.22	0
2020	2	3	27.165	29.565	9.464	0
2020	3	4	19.545	32.362	23.518	0.9
2020	4	5	9.305	32.879	22.075	0.2
2020	5	6	0	25.367	22.548	5.2
2020	6	4	0	12.194	24.505	32
2020	7	2	0	6.433	26.718	55.4
2020	8	0	0	3.233	19.101	41.7
2020	9	0	0.17	7.031	15.332	22.7
2020	10	1	3.305	3.495	9.925	18.9
2020	11	2	10.983	15.827	8.129	1.4
2021	12	3	19.141	19.258	0.646	0
2021	13	4	33.116	27.886	3.236	0
2021	14	5	30.533	32.907	10.047	0
2021	15	6	17.853	37.096	18.957	0
2021	16	7	2.615	23.971	21.395	5.4
2021	17	5	0	17.061	30.707	35.5
2021	18	3	0	13.812	29.781	42
2021	19	1	0	2.553	27.952	73.7
2021	20	0	0	6.355	18.293	31.1

NowYear	NowMonth	NowNumDeer	NowHeight	NowPrecip	NowTemp	FireOdds
2021	21	0	3.691	0	8.175	22.4
2021	22	1	11.865	6.672	2.407	3.8
2021	23	2	27.816	17.138	5.666	0.1
2022	24	3	37.588	25.372	0.809	0
2022	25	4	45.544	27.995	7.839	0
2022	26	5	37.628	33.895	12.702	0
2022	27	6	24.936	35.601	20.01	0
2022	28	7	9.76	24.293	17.907	2.2
2022	29	8	0	22.465	25.208	12.4
2022	30	6	0	11.339	30.38	51.3
2022	31	4	0	3.369	19.604	42.7
2022	32	2	0	1.874	14.031	31.6
2022	33	0	1.027	0	7.195	20.4
2022	34	1	3.999	11.464	11.118	8
2022	35	2	14.51	12.462	6.982	2.8
2023	36	3	23.152	26.238	8.218	0
2023	37	4	37.243	28.88	3.438	0
2023	38	5	37.327	37.571	8.65	0
2023	39	6	24.628	29.493	22.979	2.1
2023	40	7	9.19	28.835	27.745	7.1
2023	41	8	0	21.99	27.887	17.9
2023	42	6	0	16.252	30.376	36.8
2023	43	4	0	5.999	19.029	33.9
2023	44	2	0	6.156	19.687	35.2
2023	45	0	0	0.143	9.063	24
2023	46	0	11.728	9.759	5.089	3.5
2023	47	1	23.102	14.111	8.088	2.4
2024	48	2	35.49	23.393	7.788	0
2024	49	3	45.236	26.074	8.097	0
2024	50	4	37.721	30.841	17.275	0
2024	51	5	27.874	35.451	15.742	0
2024	52	6	15.174	28.773	26.123	5.4
2024	53	7	0	22.844	24.708	11
2024	54	5	0	14.936	29.385	37.7
2024	55	3	0	10.56	19.142	23.3
2024	56	1	0	4.436	19.524	39.4
2024	57	0	0	1.461	14.185	33.1
2024	58	0	6.444	1.998	5.136	13
2024	59	1	14.122	15.148	9.042	2.4
2025	60	2	24.306	20.909	0.48	0
2025	61	3	41.216	27.915	5.391	0
2025	62	4	40.117	32.669	10.46	0
2025	63	5	29.989	28.713	18.688	0.4
2025	64	6	17.212	31.127	27.212	4.1
2025	65	7	1.891	22.85	28.964	18.3
2025	66	5	0	18.82	24.663	17.8
2025	67	3	0	4.284	18.307	36.5
2025	68	1	0	0.985	15.239	37.1
2025	69	0	0	0	12.098	31.5
2025	70	0	5.785	6.711	8.19	10.5
2025	71	1	12.505	14.177	-0.623	0

3. This first graph shows my simulation without including FireOdds variable information. The FireOdds was included in the calculation of everything, it's just not plotted on the graph. The graphs get a little difficult to read when there are a lot of lines going everywhere, so FireOdds is plotted on the next graph.

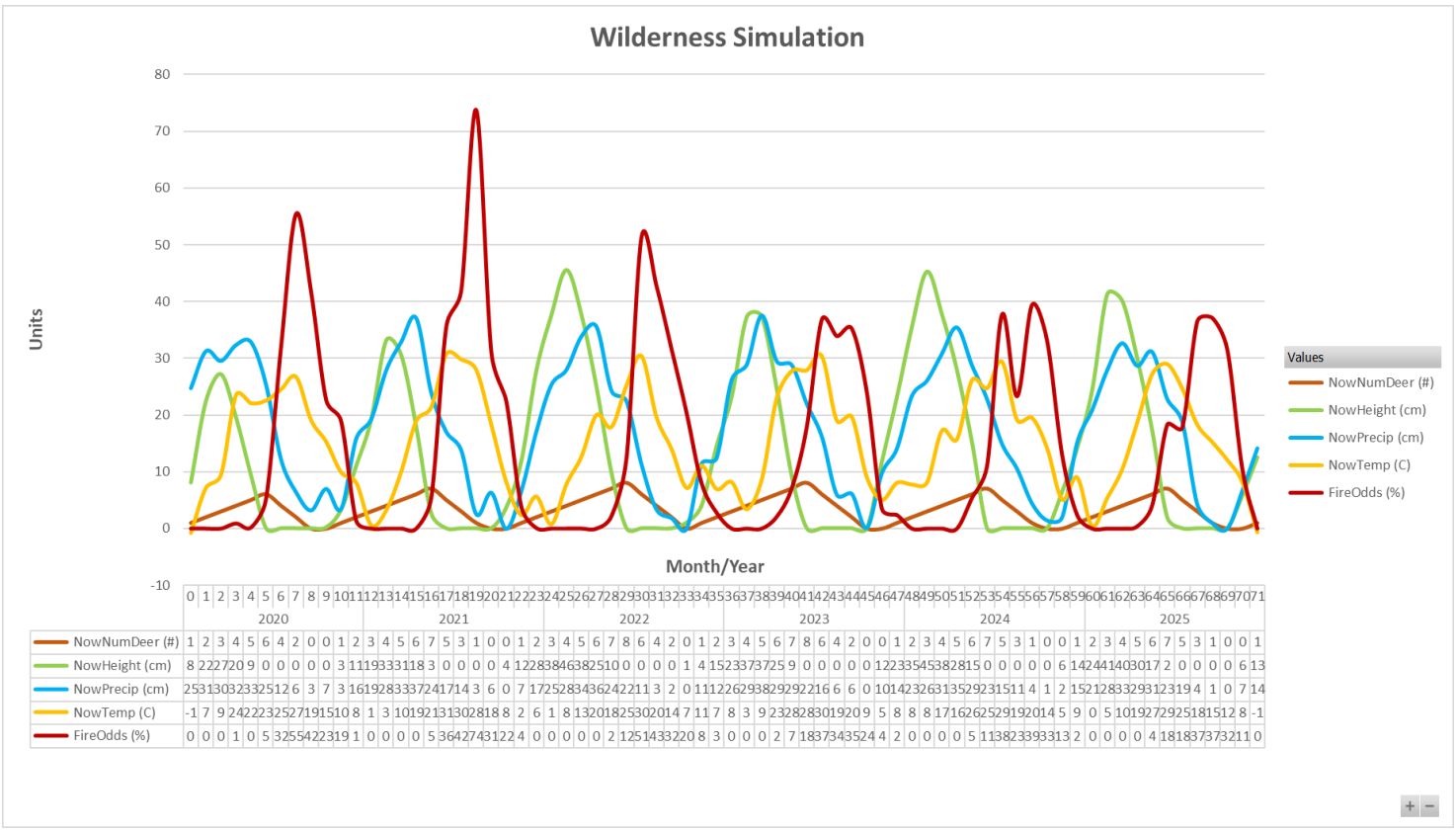


The cycles in my graphs look very similar to the cycles found in the project handout. I noticed that temperature usually peaks in the middle of the year and reaches its lowest values at the end/beginning. Precipitation is usually at its lowest in the late summer/fall and peaks in the spring, much like it does in real life. The timing difference for the cycles of NowTemp and NowPrecip can be attributed to the use of sin and cos for the calculation of these variables. Cos for NowTemp and Sin for NowPrecip.

NowHeight is tied to the temperature and precipitation, so the height of the grain follows a seasonal cycle as well. NowHeight is also dependent upon NowNumDeer, but that shouldn't attribute to the seasonal cycle. The higher the number of deer the more height is subtracted from the overall height.

NowNumDeer has the simple logic of increasing if NowHeight is greater than NowNumDeer and decreasing if the opposite is true. FireOdds changes this behavior somewhat, and we will talk about that in a moment. There is a well-defined cycle where the number of deer increases from late fall to early summer, and then shoots right back down to zero. This pattern in NowNumDeer's cycle arise as a result of the cycle in NowHeight.

Now let's discuss FireOdds, the variable I added to the simulation. Take a look at the following graph:



I can see three ways that proves my variable is affecting the simulation correctly.

1. If you compare the slope of the NowNumDeer line when FireOdds is elevated to the simulation without FireOdds included, you will see that the slope is -2 in my simulation vs -1 in the normal simulation. (when decreasing) This is because I have set the number of deer to decrease by two, rather than one, when FireOdds is elevated.
2. Grain seems to be incapable of growing when FireOdds is elevated. This is to be expected. Not only is it the end of the cycle for NowHeight in the normal simulation where the grain hits bottom, the FireOdds increases the severity of the drop and keeps the grain height at zero for several months each year.
3. FireOdds peaks when, both, the temperature peaks and the precipitation bottoms out. This is the behavior I was going for. When the heat is high and the grain is dry, there is a much greater chance that a fire will spark and burn the land.

I noticed that including my FireOdds variable causes a “reset” for the environment every year. Grain and deer are completely eliminated due to the fires. Grain grows and deer reproduce the next year, but the NowHeight and NowNumDeer always return to zero.