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| Project #4 Functional Decomposition ("Grainville")  Haoxiang Wang; Student ID: 932359049 |

1. Own-Choice Quantity

I chose to add tigers into the simulation. Tiger eats deer and deer eats grain, so number of tiger controls the growth of the grain indirectly. The way I set the number of tiger controlling the number of deer is a little unrealistic. I set one tiger eats 0.5 deer per month, which means two tigers will decrease the number of deer by 1, but one tiger won’t affect deer’s number.

Also, I set a threshold at the number of deer. If the number of deer is smaller than 5, the number of tigers will fight for the food, which causes the number of tiger decrease by 2. If the number of deer is larger than 5, and the remaining number of deer in this month (including calculation for the deer eaten by tiger in this month) is larger than 2, the number of tiger will be increased by 1, otherwise it will be decreased by 1.

1. Performance Results

The following table shows the result I got from the simulation. I set the original grain height to 20 inch, original number of deer to 7, and the original number of tiger to 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Date | Temperature(°C) | Precipitation | Grain(cm) | Deer | Tiger |
| 2016/1 | 3.047354 | 7.130446 | 60.86903 | 8 | 2 |
| 2016/2 | 5.288804 | 11.4364 | 62.51296 | 8 | 3 |
| 2016/3 | 11.69809 | 10.58576 | 53.08227 | 8 | 4 |
| 2016/4 | 11.04491 | 12.86847 | 43.84998 | 7 | 5 |
| 2016/5 | 15.38757 | 10.45852 | 35.00289 | 6 | 6 |
| 2016/6 | 20.48137 | 8.068398 | 27.38311 | 4 | 7 |
| 2016/7 | 19.23012 | 4.500689 | 22.30393 | 2 | 5 |
| 2016/8 | 22.88152 | 3.42214 | 19.76393 | 1 | 3 |
| 2016/9 | 14.38367 | 1.073633 | 18.56061 | 1 | 1 |
| 2016/10 | 3.142039 | 0.632321 | 28.29454 | 2 | 0 |
| 2016/11 | -3.23118 | 0.728906 | 31.25966 | 3 | 0 |
| 2016/12 | -4.76327 | 5.663794 | 32.49002 | 4 | 0 |
| 2017/1 | -4.54719 | 7.156692 | 33.18461 | 5 | 0 |
| 2017/2 | -1.97018 | 8.677876 | 40.01153 | 6 | 1 |
| 2017/3 | 12.66784 | 10.66858 | 32.76652 | 7 | 2 |
| 2017/4 | 13.01946 | 13.152 | 24.11589 | 7 | 3 |
| 2017/5 | 19.1083 | 9.426767 | 15.22694 | 7 | 4 |
| 2017/6 | 22.26087 | 7.650064 | 6.336958 | 4 | 5 |
| 2017/7 | 20.66121 | 6.338185 | 1.257124 | 1 | 3 |
| 2017/8 | 15.55137 | 2.842791 | 0.017303 | 0 | 1 |
| 2017/9 | 13.17293 | 1.2841 | 0.194765 | 1 | 0 |
| 2017/10 | 6.015663 | 1.770563 | 6.393612 | 0 | 0 |
| 2017/11 | -0.26435 | 1.167192 | 17.68362 | 1 | 0 |
| 2017/12 | 2.686653 | 6.123193 | 35.38011 | 2 | 0 |
| 2018/1 | -5.51301 | 9.350223 | 36.59564 | 3 | 0 |
| 2018/2 | 2.432094 | 8.586864 | 52.655 | 4 | 0 |
| 2018/3 | 3.704387 | 12.44846 | 62.14818 | 5 | 0 |
| 2018/4 | 17.21169 | 11.19113 | 55.80548 | 6 | 1 |
| 2018/5 | 13.0142 | 8.322733 | 48.49851 | 7 | 2 |
| 2018/6 | 20.26253 | 5.805298 | 39.60877 | 7 | 3 |
| 2018/7 | 17.82451 | 6.329622 | 30.72296 | 7 | 4 |
| 2018/8 | 22.32572 | 3.161039 | 21.83298 | 6 | 5 |
| 2018/9 | 10.28317 | 0.363486 | 15.23618 | 5 | 6 |
| 2018/10 | 5.737644 | 1.24544 | 16.41248 | 3 | 5 |
| 2018/11 | 2.282541 | 2.428254 | 27.31756 | 2 | 3 |
| 2018/12 | -0.38133 | 2.604208 | 38.03509 | 2 | 1 |
| 2019/1 | -1.42542 | 9.280254 | 50.15971 | 3 | 0 |
| 2019/2 | 6.930033 | 11.12645 | 53.86005 | 4 | 0 |
| 2019/3 | 4.727493 | 12.74969 | 60.75079 | 5 | 0 |
| 2019/4 | 14.43109 | 11.21175 | 54.49422 | 6 | 1 |
| 2019/5 | 19.94409 | 8.906537 | 46.87462 | 7 | 2 |
| 2019/6 | 20.06701 | 9.073215 | 37.98497 | 7 | 3 |
| 2019/7 | 24.3903 | 3.768434 | 29.09497 | 7 | 4 |
| 2019/8 | 14.84528 | 3.330849 | 20.26378 | 6 | 5 |
| 2019/9 | 11.2131 | 0.951124 | 13.28909 | 5 | 6 |
| 2019/10 | 12.1961 | 0.559006 | 7.260758 | 3 | 5 |
| 2019/11 | 3.891082 | 3.192064 | 17.18823 | 0 | 3 |
| 2019/12 | -1.40407 | 6.142966 | 31.65142 | 0 | 1 |
| 2020/1 | -1.86099 | 8.811981 | 45.13962 | 1 | 0 |
| 2020/2 | 4.190131 | 11.88653 | 58.08373 | 2 | 0 |
| 2020/3 | 6.929686 | 10.65886 | 63.26093 | 3 | 0 |
| 2020/4 | 17.87857 | 13.47607 | 59.45394 | 4 | 0 |
| 2020/5 | 13.94185 | 11.76689 | 54.50762 | 5 | 0 |
| 2020/6 | 22.30007 | 7.280728 | 48.15764 | 6 | 1 |
| 2020/7 | 22.06136 | 3.571323 | 40.53767 | 7 | 2 |
| 2020/8 | 21.03454 | 0.987191 | 31.64773 | 7 | 3 |
| 2020/9 | 12.28725 | 0 | 23.03493 | 7 | 4 |
| 2020/10 | 3.65238 | 0 | 23.5745 | 6 | 5 |
| 2020/11 | 2.770413 | 1.423364 | 28.62927 | 5 | 6 |
| 2020/12 | -4.40354 | 6.074303 | 28.21307 | 3 | 5 |
| 2021/1 | -5.14172 | 6.057216 | 28.76096 | 2 | 3 |
| 2021/2 | 2.092637 | 11.28454 | 44.35598 | 2 | 1 |
| 2021/3 | 12.51036 | 13.53557 | 42.14732 | 3 | 0 |
| 2021/4 | 14.92516 | 11.32831 | 38.39846 | 4 | 0 |
| 2021/5 | 20.63197 | 9.717295 | 33.31863 | 5 | 0 |
| 2021/6 | 18.44541 | 6.481961 | 26.9708 | 6 | 1 |
| 2021/7 | 21.67127 | 3.424736 | 19.35084 | 7 | 2 |
| 2021/8 | 13.99441 | 2.685954 | 10.57223 | 7 | 3 |
| 2021/9 | 8.714377 | 1.378326 | 4.303932 | 5 | 4 |
| 2021/10 | 3.392033 | 1.184731 | 9.550107 | 2 | 5 |
| 2021/11 | -2.58419 | 3.557775 | 16.29893 | 1 | 3 |
| 2021/12 | -5.70441 | 4.53334 | 18.12784 | 1 | 1 |

The graph created from the form listed above is shown below. The explanation is in the next section. In the graph, I change the grain height unit form inch to centimeter, and I change the temperature unit from °F to °C. Due to the paper size limitation, a bigger graph is put in the appendix after the main report.

1. Patterns & Explanation

As it shows in the graph, the temperature drops down every winter and the precipitation drops down every summer. The grain grows at every spring. After the grain grows, the number of deer grows. After the growing of number of number of deer, the number of tiger increases. These make senses since this is exactly how one species reacts with another.

Also, as the number of deer growing, the height of grain decreases since deer needs more food. As the number of tiger growing, the number of deer decreases since tiger needs more food. Then if there are not enough deer, the number of tiger decreases.

Taking one year for example:



At the beginning of 2018, there are not enough deer so the tiger doesn’t show up, and the grain grows. When the number of deer meets 5, the height of grain begins decreasing, and at the same time, tiger begins showing up. Once number of tiger is larger than 2, the number of deer meets a short term of balance but the number of tiger keep increasing. During this period of time, the height of grain keeps decreasing due to large number of deer. When there are a lot tigers, deer can no longer keep in balance, and the number begin to decease. At this time, the height of grain’s decreasing tendency slows down. After this, the number of tiger decreases since there are not enough food for them, and when the number of deer decreased to 3, the height of grain begins increasing again. All of these fits the pattern mentioned above and they kind of fit the nature rules.

1. Appendix

