



Oregon State University

CS 475 - Spring 2021

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Project #3

Functional Decomposition

by

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Quantity

My own choice of quantity was Magic Mushrooms. According to [this](#) and [this](#) link Reindeers love magic mushrooms. So, I introduced Magic Mushrooms to deers. This caused all of them to look for a mushroom before eating grain. If there are mushrooms, deers go eat the mushrooms first. If some of them cannot find mushrooms to eat, then they eat grain.

Mushrooms grow in certain conditions. If the humidity is high and temperature is reasonable, they grow very fast! On the other hand, If the temperature is very high and the humidity is very low, they dry out and the deers no longer want to consume them. Also, if the temperature is low, they cannot populate fast.

New carrying capacity is $height + NumMushrooms$. Mushrooms drastically increase the capacity in the first six months of the year but do not make any difference in the last six months since the temperature and humidity don't help much. Aaand remember, deers consume mushrooms first.

I put the graph and the table at the end of the document.

Commentary

Precipitation: It is cyclic and always between 0 and 38 centimeters. First 6 months have the highest precipitation. Because the sine wave gives positive values for the first 6 months and negative for the later months.

Temperature: This is also cyclic and between 0 and 32 degrees. Cosine wave is used for calculating the temperature and it is actually a quarter shifted version of sine wave. That means months 3-9 have the highest temperatures and others with the lowest.

Height: Height is proportional to precipitation and the temperature. From the first two variables we can conclude that the maximum height should be in the 6-9 months of each year. Graph also confirms this argument.

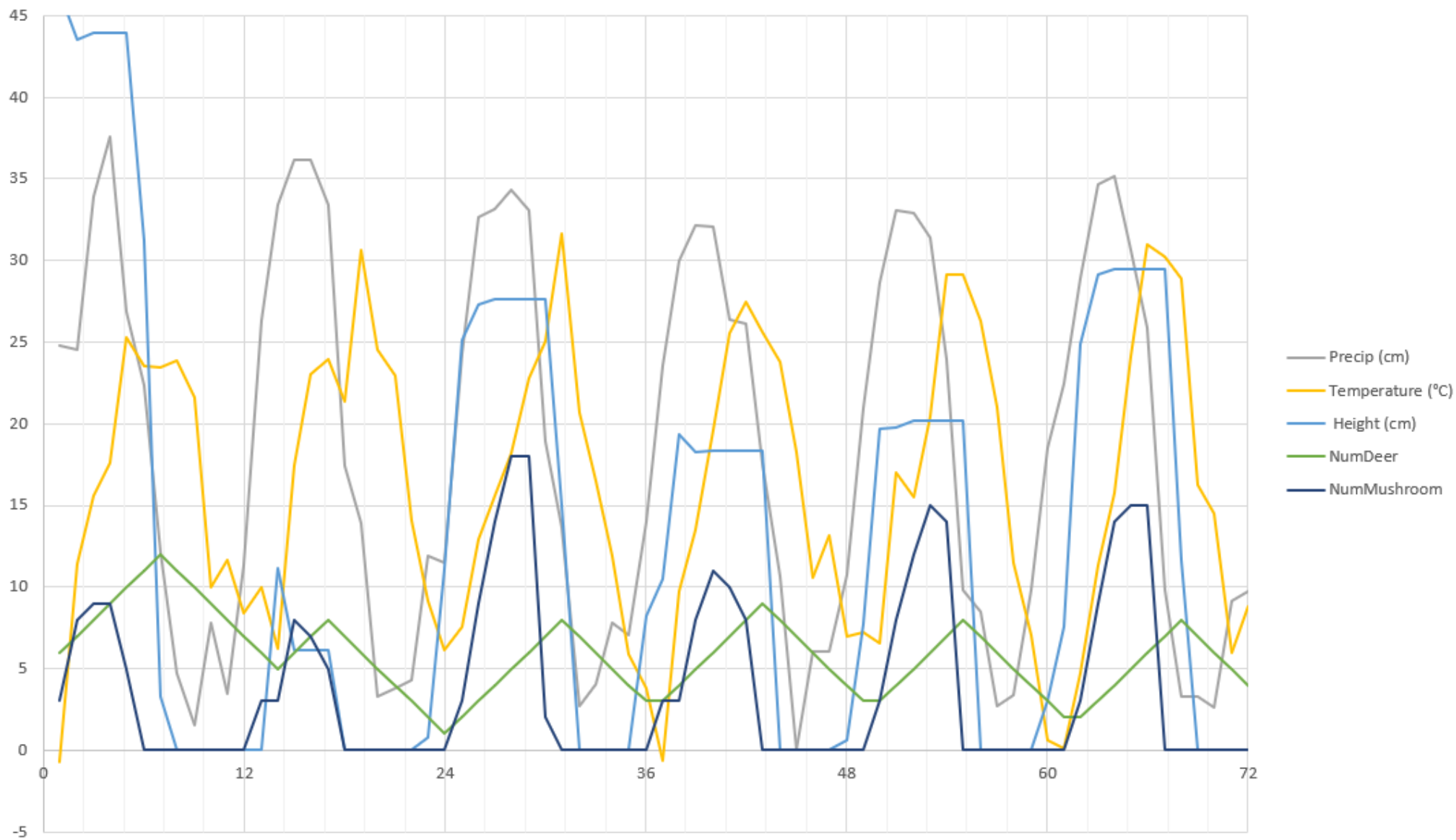
Initial Number = 18.5 inches / 47 cm

NumMushroom: Mushrooms grow in humid and warm environments. Any temperature or precipitation abnormalities decrease the growth rate. If the temperature is high and the humidity is low, some mushrooms dry out. Also, deers favor magic mushrooms to grain. If there are some mushrooms, deers first eat all the mushrooms then eat the grain. This extends the life of the grain, increases the carrying capacity and increases the deer population. Deers first consuming mushrooms mean that if the grain height is zero, we know for sure that there are no mushrooms. This can be observed on the graph. Dark blue lines (*mushroom*) become zero always before the light blue lines (*grain*).

Initial Number = 3

NumDeer: Deer population increases if the carrying capacity is bigger than the current population. Else, it decreases. In the graph, population increases in the first half of each year and decreases in the second half. Because, both grain and mushroom amount reaches zero in the sixth or seventh month of each year.

Initial Number = 5



Initial values; NumDeer = 5, Height = 18.5 (inches), NumMushrooms = 3

| Time | NowYear | NowMonth | Precip (cm) | Temperature (°C) | Height (cm) | NumDeer | NumMushroom |
|------|---------|----------|----------------|---------------------|----------------|---------|-------------|
| 1 | 2021 | 0 | 24.7675 | -0.7273 | 46.434 | 6 | 3 |
| 2 | 2021 | 1 | 24.5626 | 11.4167 | 43.5409 | 7 | 8 |
| 3 | 2021 | 2 | 33.868 | 15.6069 | 43.9019 | 8 | 9 |
| 4 | 2021 | 3 | 37.5784 | 17.6297 | 43.9669 | 9 | 9 |
| 5 | 2021 | 4 | 26.8729 | 25.3249 | 43.9669 | 10 | 5 |
| 6 | 2021 | 5 | 22.324 | 23.5214 | 31.2671 | 11 | 0 |
| 7 | 2021 | 6 | 12.1634 | 23.4382 | 3.3272 | 12 | 0 |
| 8 | 2021 | 7 | 4.7465 | 23.899 | 0 | 11 | 0 |
| 9 | 2021 | 8 | 1.5345 | 21.6019 | 0 | 10 | 0 |
| 10 | 2021 | 9 | 7.7764 | 9.9997 | 0 | 9 | 0 |
| 11 | 2021 | 10 | 3.4603 | 11.6881 | 0 | 8 | 0 |
| 12 | 2021 | 11 | 11.3446 | 8.404 | 0 | 7 | 0 |
| 13 | 2022 | 0 | 26.279 | 9.9622 | 0 | 6 | 3 |
| 14 | 2022 | 1 | 33.4182 | 6.1911 | 11.1242 | 5 | 3 |
| 15 | 2022 | 2 | 36.1568 | 17.4452 | 6.1242 | 6 | 8 |
| 16 | 2022 | 3 | 36.1889 | 23.0139 | 6.1244 | 7 | 7 |
| 17 | 2022 | 4 | 33.3646 | 23.9171 | 6.1245 | 8 | 5 |
| 18 | 2022 | 5 | 17.443 | 21.3916 | 0 | 7 | 0 |

| | | | | | | | |
|----|------|----|---------|---------|---------|---|----|
| 19 | 2022 | 6 | 13.9284 | 30.6648 | 0 | 6 | 0 |
| 20 | 2022 | 7 | 3.3021 | 24.5146 | 0 | 5 | 0 |
| 21 | 2022 | 8 | 3.7648 | 22.9132 | 0 | 4 | 0 |
| 22 | 2022 | 9 | 4.2658 | 14.1152 | 0 | 3 | 0 |
| 23 | 2022 | 10 | 11.9143 | 9.1433 | 0.8129 | 2 | 0 |
| 24 | 2022 | 11 | 11.4766 | 6.1718 | 11.1001 | 1 | 0 |
| 25 | 2023 | 0 | 24.2438 | 7.5806 | 25.1475 | 2 | 3 |
| 26 | 2023 | 1 | 32.6189 | 12.8755 | 27.255 | 3 | 9 |
| 27 | 2023 | 2 | 33.1195 | 15.6084 | 27.6225 | 4 | 14 |
| 28 | 2023 | 3 | 34.3151 | 18.2055 | 27.6662 | 5 | 18 |
| 29 | 2023 | 4 | 33.0963 | 22.8103 | 27.6666 | 6 | 18 |
| 30 | 2023 | 5 | 18.9393 | 25.0006 | 27.6666 | 7 | 2 |
| 31 | 2023 | 6 | 13.636 | 31.6077 | 14.9666 | 8 | 0 |
| 32 | 2023 | 7 | 2.6857 | 20.6594 | 0 | 7 | 0 |
| 33 | 2023 | 8 | 4.0318 | 16.5359 | 0 | 6 | 0 |
| 34 | 2023 | 9 | 7.8447 | 11.8669 | 0 | 5 | 0 |
| 35 | 2023 | 10 | 7.0138 | 5.864 | 0 | 4 | 0 |
| 36 | 2023 | 11 | 13.9658 | 3.7545 | 8.221 | 3 | 0 |
| 37 | 2024 | 0 | 23.515 | -0.6174 | 10.5127 | 3 | 3 |

| | | | | | | | |
|----|------|----|---------|---------|---------|---|----|
| 38 | 2024 | 1 | 29.9796 | 9.7628 | 19.363 | 4 | 3 |
| 39 | 2024 | 2 | 32.1777 | 13.5181 | 18.301 | 5 | 8 |
| 40 | 2024 | 3 | 32.1024 | 19.5782 | 18.3137 | 6 | 11 |
| 41 | 2024 | 4 | 26.3603 | 25.5656 | 18.3138 | 7 | 10 |
| 42 | 2024 | 5 | 26.0925 | 27.4885 | 18.3138 | 8 | 8 |
| 43 | 2024 | 6 | 17.6044 | 25.643 | 18.3138 | 9 | 0 |
| 44 | 2024 | 7 | 10.6773 | 23.7556 | 0 | 8 | 0 |
| 45 | 2024 | 8 | 0 | 18.2901 | 0 | 7 | 0 |
| 46 | 2024 | 9 | 6.052 | 10.5825 | 0 | 6 | 0 |
| 47 | 2024 | 10 | 6.0726 | 13.1227 | 0 | 5 | 0 |
| 48 | 2024 | 11 | 10.741 | 6.9739 | 0.6167 | 4 | 0 |
| 49 | 2025 | 0 | 20.9267 | 7.2154 | 7.7374 | 3 | 0 |
| 50 | 2025 | 1 | 28.6278 | 6.532 | 19.6492 | 3 | 3 |
| 51 | 2025 | 2 | 33.0306 | 16.9947 | 19.7761 | 4 | 8 |
| 52 | 2025 | 3 | 32.923 | 15.5172 | 20.1704 | 5 | 12 |
| 53 | 2025 | 4 | 31.4333 | 20.4436 | 20.1758 | 6 | 15 |
| 54 | 2025 | 5 | 23.9481 | 29.1094 | 20.1758 | 7 | 14 |
| 55 | 2025 | 6 | 9.8323 | 29.1138 | 20.1758 | 8 | 0 |
| 56 | 2025 | 7 | 8.4566 | 26.2924 | 0 | 7 | 0 |

| | | | | | | | |
|----|------|----|---------|---------|---------|---|----|
| 57 | 2025 | 8 | 2.6724 | 21.0516 | 0 | 6 | 0 |
| 58 | 2025 | 9 | 3.3354 | 11.4665 | 0 | 5 | 0 |
| 59 | 2025 | 10 | 9.7736 | 7.0926 | 0 | 4 | 0 |
| 60 | 2025 | 11 | 18.5489 | 0.5981 | 3.0016 | 3 | 0 |
| 61 | 2026 | 0 | 22.4235 | 0.0893 | 7.5777 | 2 | 0 |
| 62 | 2026 | 1 | 28.8978 | 4.6781 | 24.8886 | 2 | 3 |
| 63 | 2026 | 2 | 34.6392 | 11.3602 | 29.141 | 3 | 9 |
| 64 | 2026 | 3 | 35.1397 | 15.7212 | 29.4615 | 4 | 14 |
| 65 | 2026 | 4 | 30.6204 | 24.1404 | 29.4616 | 5 | 15 |
| 66 | 2026 | 5 | 25.8813 | 30.9508 | 29.4616 | 6 | 15 |
| 67 | 2026 | 6 | 9.7986 | 30.2262 | 29.4616 | 7 | 0 |
| 68 | 2026 | 7 | 3.2725 | 28.8953 | 11.6816 | 8 | 0 |
| 69 | 2026 | 8 | 3.2593 | 16.2875 | 0 | 7 | 0 |
| 70 | 2026 | 9 | 2.5955 | 14.5175 | 0 | 6 | 0 |
| 71 | 2026 | 10 | 9.1829 | 5.9603 | 0 | 5 | 0 |
| 72 | 2026 | 11 | 9.7533 | 8.8094 | 0 | 4 | 0 |