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**WIS4934**

**Assignment 5: Critical Population Densities and Predator Control**

Fit a type II functional response equation to the kill data by minimizing the sum of squared differences between the observed kill data and the predicted kills using the equation where *Nb* is the density of calves born per square kilometer, *a* is the rate of effective search and *h* is the handling time (these values must be positive).

-Balance Model predicting the caribou population growth rates as a function of density if the predator density producing the kills remains constant:

Nt\*Adult\_Survival\*(1-Harvest\_Rate)+(((0.3-0.015\* Nt)\* Nt)-(0.5\*(a\*(0.3-0.015\* Nt)\* Nt)/(1+a\*h\*(0.3-0.015\* Nt)\* Nt)))\*Juvenile\_Survival

*a=* rate of effective search

*h* = handling time

Figure 1.1- Graph displaying the apparent calf kill per km^2 along with the predicted survival along with a logarithmic trend line. After around 0.5 calves born/km^2 we can see that the apparent calf kill/km^2 rates are not increasing as rapidly. This suggests that when calves are first born, they are very susceptible/ vulnerable to predation, and as they grow larger in biomass, they are less likely to be as heavily predated.



Table 1.1- Solver used to find the best values for *a* and *h*.

Construct a simulation using Excel and keep the population bounded assuming the birth rate declines linearly with adult population size as to reach half its maximum (0.3) when adult density is 10/km2. Show how the critical age 1 and older population density (below which the population will collapse) varies with the harvest rate on 1 year and older caribou.

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| Figure 2.1- Graph displaying population of caribou assuming birth rates declining linearly. |  |
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| Figure 2.2- Graph displaying the critical population rates per harvest rate. The graph is taking the critical information from Figure 2.1. This graph is explaining that at higher harvest rates, the critical population size of the caribou must be higher for the population to not collapse. |  |

Also use your simulation to estimate how long the population will take to recover after a collapse (1.2 individuals per km2), with and without wolf control that temporarily cuts the predation loss in half.

Figure 3.1- Graph displaying that a caribou population with predator control will take less time to recover than a caribou population without predator control. We can see that the population will bounce back around year 37-43 with predator control, but without predator control the population will recover around year 50-60. From this graph, it would be important to implement a predator control program if the caribou population were to collapse.