DEPARTMENT OF MATHEMATICS

MATHS 260 Tutorial Week 7 Notes

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1. (a) Mice: the first term is a limited growth model. The maximum mouse population that is sustainable is 2000. The second term is the effect of ferrets eating mice. Ferrets: the first term is the ferret population decaying with no mice to eat. The second is the effect of having mice to eat.

   (b) Phase line is

   Sketch graphs that show $M \to 2$ at $t \to \infty$. In the long term the mouse population will approach 2000.

   (c) Ferret population will decay and approach zero.

   (d) Mice population will increase to 1630 as the ferret population increases slowly to 300, then the mice will decline to 1111 as the ferrets continue to increase to 740.

   (e)

$$\begin{aligned} \frac{dM}{dt} &= 2M\left(1-\frac{M}{2}\right) - 1.2MF \\ \frac{dF}{dt} &= -F + 0.9MF - 0.01 \end{aligned}$$

   Long term there will be approaching 1126 mice and 728 ferrets.

   (f) Replace the first term $-F$ by $\alpha F(1 - F/N)$ where α is a growth rate and N is the maximum population of ferrets from the other food source.

2. (a) Bounded growth for both populations, with competition between the two populations.

   (b) (0,0), (0,10), (5,0), (2,4)

   (c)

   (d) i. Approaches 10,000 of population y, no x.
   ii. Approaches 5,000 of population x, no y.
   iii. Approaches 10,000 of population y, no x.
   iv. Approaches 5,000 of population x, no y.

   Solutions approach (2,4) but then move away to (5,0) or (0,10).