DAY 12

Midterm Exam

During this exam, you can use your copy of the HP-25 Owner's Handbook *and the* HP-25 Applications Programs *book, and your notes and problem sets. However, I deliberately made an exam that uses all the ideas we have been developing, but applies them to an entirely new subject.*

The tables you need to make are already started on an attached sheet.

Half the exam is Problem 4, which is a programming problem. There are three program forms attached so that you have some extra chances to correct errors and re-copy your program.

Problem 1 *(3 pts)*

Assume there are R rabbits and W wolves. For Problem 1 let $W = 0$ (no wolves). If nothing eats the rabbits, they would just keep multiplying. Let's assume that the relevant time period for assessing multiplication is one month and that if you have R rabbits at the beginning of a month, then you have $(1 + r)R$ rabbits at the end of the month. In the real world, you must have an integer number of rabbits, but we won't let that interfere with our model-making.

Make a table that has $R = 30$ rabbits at the beginning, and a multiplication rate $r = 0.5$. So at Month 0 in your table, you will have 30 rabbits, and at Month 1, you will have 45 rabbits, and at Month 2, you will have 67.5 rabbits. Fill in your table using the multiplying rule all the way to Month 4.

Problem 2 *(2 pts)*

For Problem 2, assume there are no rabbits ($R = 0$). Assume there are 6 wolves initially $W = 6$. In our model, wolves starve if there are no rabbits to eat. We will call the starvation rate w. The formula is if you have W wolves at the beginning of the month, then you have $(1-w)W$ wolves at the end of the month. Let's have half the wolves starve each month if there are no rabbits, so $w = 0.5$. So at Month 0 in your wolves table, you will have 6 wolves, at Month 1, you will have 3 wolves, and at Month 2, you will have 1.5 wolves. Fill in your table all the way to Month 4.

Now things are going to get really interesting!! We are going to have both rabbits and wolves. Wolves eat rabbits and when they do, they can multiply instead of starving.

Problem 3 *(5 pts)*

Here is the new model. It is called the predatory-prey model. In this model, if there are W wolves and R rabbits at the beginning of the month, then at the end of the month there are:

$$(1 + r)R - eRW$$

rabbits, and at the end of the month, there are:

$$(1 - w)W + fRW$$

wolves. Let's start with $R = 30$ rabbits and $W = 6$ wolves. So $RW = 180$ initially. Let's have $e = 0.1$ and $f = 0.025$.

Use these formulas to make a table for just for Months 0 to 3. It will be helpful in the table to have RW as a column because you need that for both formulas. In Month 0, you will have $R = 30, W = 6$, and $RW = 180$. In Month 1, you will have $R = 27$ and $W = 7.5$.

Problem 4 *(10 pts)*

Write a program that does Problem 3.

Do it however you like, but if you don't have an outline in mind immediately, I suggest the following:

Have the user put R in REG0, W in REG1, r in REG2, w in REG3, e in REG4, and f in REG5.

Outline:

1. Calculate RW from the old R and W and update REG6.
2. Stop and display RW.
3. Calculate the new R and update REG0.
4. Stop and display R.
5. Calculate the new W and update REG1.
6. Stop and display W.
7. Go back to Step 1.

Use your program to quickly and efficiently fill in the table on the next page out to Month 6.

All done? Bored? Fill in a table for this problem that goes out to Month 18. The wolves and the rabbits will recover from their disastrously low population levels.