CDS-130/004 SPRING 2016: HOMEWORK 9 (version 1)
ASSIGNED 13 APRIL 2016, DUE 20 APRIL 2016 AT THE END OF CLASS

MATLAB PROGRAMMING EXERCISE

THESE ARE MATLAB PROGRAMMING EXERCISE: YOU MUST WRITE MATLAB CODE AND THEN EXECUTE YOUR CODE TO PRODUCE OUTPUT THAT SOLVES THIS PROBLEM. YOU MUST SHOW BOTH YOUR PROGRAM AND YOUR PROGRAM OUTPUT – IN HARDCOPY SCREENSHOT – TO RECEIVE FULL CREDIT FOR THIS EXERCISE. PLEASE NOTE THAT NO HANDWRITTEN MATLAB PROGRAMS, OR HAND-DRAWN DEPICTIONS OF OUTPUT, WILL BE ACCEPTED!

EXERCISE 1 (6 pts) "ECONOMIC LIFE IF A MACHINE"[1]

INTRODUCTION:

The economic, or service life of a capital asset such as a machine is broadly defined as the period of time over which that asset is useful to the owner. In this exercise, usefulness will be defined as positive value: If a machine maintains a positive value (called a salvage value) above some pre-defined threshold, then that machine is deemed economically useful. If the machine's value drops below the threshold, then that machine is no longer economically useful and should be sold so that the remaining value (the salvage value) can be recovered and perhaps reinvested elsewhere. Any other decision likely translates into a revenue losing proposition for the machine's owner. The service life of a capital asset therefore ends when that asset is sold for salvage.

When you think about it, a highly simplified model of this situation works just like a bank account: There is an initial "deposit" into the account, which models the initial, purchase value of the machine. This value degrades over time. That is, the value in the account "dies" at a given rate due to ***depreciation***. Depreciation occurs because the machine slowly wears out over time. Occasionally, the machine might be refurbished, which could be modeled as a "deposit" into the account (think: "immigration of value" into the machine). Or, a newer version of the same machine might be introduced to the market, and the appearance of that new version might immediately devalue the existing machine. New version introduction could therefore be modeled as a "special situation" that causes an instant reassignment of the existing machine's value.

In the interest of simplifying this modeling exercise as much as possible, we'll ignore the effects of inflation on the values of the assets involved.

PROBLEM STATEMENT:

"EZ Office, Inc." is a leading producer of office supplies. EZ tasks its marketing research division with studying product X and in particular, with discovering ways to produce and sell product X. As it turns out, product X can be manufactured by a variety of means, but one of the most efficient is to manufacture it using the "SuperModel 100" machine.

EZ's accounting division reads the performance specs on the SuperModel 100 machine, and determines that its value will depreciate by 15% per year due to normal manufacturing wear and tear, and that this depreciation should be applied at the end of every year, beginning with the first year. On the other hand, EZ's engineering division reads the same specs and determines that the

[1] The motivation for this homework problem is based, in part, on the Harvard Business School accounting case study entitled, "Super Project" (Vancil & Wyman, 1967).

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SuperModel 100 can undergo a one-time-only refurbishment, at the end of the 7th year of the machine's service, and that this refurbishment will instantly add $200,000 to the machine's value at that time, thus extending its service life. EZ's engineering division also determines that *refurbishment will take place after depreciation*, at the end of the 7th year.

EZ purchases a SuperModel 100 on 31 December of the current year for $350,000, and places it into service producing product X. All goes well according to the project plan until year 13 (lucky year 13!) At the end of year 13, "Mega Industries", the manufacturers of the SuperModel 100 machine, introduce a new version called the *SuperModel 2000 Turbo*. Not only can the SuperModel 2000 Turbo produce product X faster and with less manufacturing errors than the SuperModel 100, but it can also be reconfigured to additionally produce products A, B and C. The introduction of the SuperModel 2000 Turbo immediately devalues the SuperModel 100 to 25% of its existing value at the time of the newer machine's introduction, but, the SuperModel 100's *depreciation rate also immediately resets to 8% for its remaining service life*. The devaluation and depreciation reset both occur at the end of the 13th year, following the SuperModel 100's depreciation according to its original rate.

Needless to say, EZ is forced to re-evaluate its project plan. They make the following decision: ***EZ will sell the SuperModel 100 machine for salvage at the end of the year just before the SuperModel 100's total value falls below $10,000 (that is, the machine's value is >= $10,000 in year `t`, but then becomes < $10,000 in year `t+1`). In what year, `t`, does this salvage sale occur?***

NOTES:

The above problem looks for the year `t` when salvage sale occurs, and NOT the salvage value.
Note that the sale will occur AT THE END OF THAT YEAR, AFTER DEPRECIATION OCCURS.

DO NOT "FLOOR" DOLLARS IN THIS EXERCISE!

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EXERCISE 2 (8 pts) "PARALLEL BANK ACCOUNTS"

INTRODUCTION:

Banking customers frequently move money back and forth from savings to checking. Sometimes, they will also move money from savings into a CD, and then after the CD matures, reconsolidate the CD back into savings. They do this, of course, to achieve a higher savings interest rate. In this exercise we will consider the situation where a banking customer moves money from savings into a CD, and then reconsolidates her accounts after closing out the CD account at a later date.

PROBLEM STATEMENT:

A banking customer has \$5,000 in checking and \$17,500 in savings at the beginning of year 1. The checking account pays no interest, but the savings account pays 1.25% interest. At the end of year 5, the customer decides to open a CD by withdrawing \$10,000 from savings and depositing the funds into a CD account. The CD account pays 2.75% interest for the first three years following initial deposit, and then at the end of the third year following initial deposit, the interest rate changes to 3.45%. The banking customer keeps the CD open for eight total years and at the end of the eighth year following initial deposit, closes the CD (that is, withdraws all funding from it), and deposits that money back into her savings account. Assuming that no other deposits or withdrawals occur in any of the accounts other than those mentioned above, what is the combined balance of the customer's checking and savings accounts at the end of year 18?

NOTE: DO NOT "FLOOR" DOLLARS IN THIS EXERCISE!

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EXERCISE 3 (8 pts.): "The Great Circular Migration"

There are approximately 1.2 million wildebeest roaming the Serengeti Plain in northern Tanzania this year when their Great Circular Migration begins; let's assume that it begins on 1 January 2015. Throughout the Migration, which lasts until 31 December 2015, the wildebeest herd reproduces at its natural rate of 3.1% per month, but 1.75% also die of starvation each month. Furthermore, 20,000 wildebeest fall prey to hungry lions on the last days of each of the following months: March, April, May and June. On 31 August, these wildebeest are joined permanently by a neighboring herd of 600,000 wildebeest from Kenya. Unfortunately, the newcomers bring with them a fatal rinderpest infection that afflicts the entire combined herd and as a result, the combined herd is reduced by 30% on 31 October, and then reduced yet again by 45% on 31 December. The October infection also results in a bout of dysentery for the remaining herd, beginning on 31 October. As a result, they starve more quickly due to dehydration—thus effectively increasing their starvation rate from 1.75% per month to 8.75% per month for the remainder of the year.

Assuming that your numerical model begins on 1 January 2015, what is the predicted size of the combined wildebeest herd one year later, on 1 January 2016, when they complete their Great Circular Migration? Create a plot showing the variation of the herd's population size over the course of the year, from the beginning of month 1 to the beginning of month 13.

NOTE: WHOLE wildebeest, NOT FRACTIONAL wildebeest!