"Practice: Modeling Problems with Spreadsheets"

Instructions: Solve the problems by modeling the situations with spreadsheets; it might help to isolate the input parameters, choose a rate of change, and show how the situation looks over time.

Problem 1

Moon Island Prison currently holds 450 inmates, with 70 under maximum security and the rest in general population. Every month, about 1% of the general population misbehaves and must be moved to maximum security; about 2.5% of the maximum security population is moved into general population; and about 3% of the general population is released for parole. If the prison's maximum security population grows at the rate of 5.5% every month, and the prison can hold a maximum of 500 inmates, how long will it be before the prison is over capacity, if ever?

Note that it is never the case that a fraction of a person will move from one population to the other. If it looks like a fraction of a person needs to move to satisfy the conditions of the problem, round the number of people to the nearest whole person. So instead of 2.35 people we get 2, and instead of 2.69 people we get 3.

Hint: Show what the populations are at the end of each month (e.g. at the end of month zero, at the end of month one, at the end of month two, etc.).

Problem 2

Create a spreadsheet to calculate the progression of a retirement fund. Assume that each year, $5,000 is contributed to the fund, and 8% interest is earned on the balance at the beginning of the year (this means that each contribution does not count toward the interest earned until the next year). How much money will be in the retirement fund after 30 years? What if $10,000 is contributed each year, and the interest rate is instead 5%?

Hint: Each year's ending balance is equal to the previous year's balance + interest earned (on that previous balance) + the new contribution.