**Understanding and rethinking advice about mortgages**

**Goals of this activity:**

To use spreadsheets to understand and rethink common advice about mortgages.\*

To appreciate the stepwise design of a lesson that uses spreadsheets. (As you undertake the activity makes notes on where you would adjust or add to it.)

\* A mortgage is a loan taken out to pay for a house that is paid back with interest over a pre-established number of years (the "term" of the loan) through equal, usually monthly, payments. Each month's payment is enough to cover interest on the outstanding balance of the loan—the principal outstanding—and also pay off some of the principal.

**Preparatory homework.** Practice spreadsheet commands and operations using the simple spreadsheet, http://www.faculty.umb.edu/peter\_taylor/mortgage.xlsx.

**Puzzle 1. Equalizing monthly payments**

Using a spreadsheet, not an algebraic formula, establish what the equal monthly payment needs to be.

Step 1. Prior to opening the spreadsheet.

Fill in the "formulas in words" in the table below. See the examples given.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| no. of months | principal | % int. rate | monthly payment |  |
| ? | ? | ? | ? |  |  |
|  |  |  |  |  |  |
| month | balance of loan | interest paid | loan paid off | balance of loan |
|  | start of month | during month | during month | end of month |  |
| month=  previous month + 1 | balance at the start of month 1 = the initial principal; balance at the start of any other month = balance at the end of the previous month |  |  |  | <- formulas  in words |

In step 2 you will convert these formulas in words into spreadsheet formulas and copy them down for months 2, 3, 4, etc. Then, if the no. of months, initial principal, and % interest rate are specified, you can guess the monthly payment and use the spreadsheet to see if the balance of the loan at the end of the payoff period (="no. of months") is zero. If not, you can guess again, until you get it right.

Step 2. Prepare the spreadsheet and use it.

Copy the table above into your spreadsheet (or open the spreadsheet "mortgage1.xls").

Start off with no. of months = 360, the $ initial principal = 100000, the % interest rate = 6, and the $ monthly payment = 1000. (If your initial principal is, say, 400000, then simply multiply any results you get by 4.)

Set A8 to be 1. Input formulas into cells B8, C8, D8, E8, A9, B9 that correspond to the formulas in words. Remember to add $ if you want the column or row to be locked when you copy these formulas into other rows, e.g., C$2 and D$2.

If the answers look sensible, copy C8-E8 into C9-E9. If not, revise your formulas; ask for help from neighbor or the teacher if needed. When you are ready, copy A9-E9 into rows 10-367.

Again, check that answers make sense.

Now play around with the value of monthly payment until you get E367 = 0.00

Tidy up the format of the spreadsheet so column widths and number of decimal places are appropriate.

**Puzzle 2. Comparing 15- and 30-year mortgages.**

People are often advised by bankers, realtors or friends to take a 15-year mortgage instead of a 30-year mortgage because the amount of interest they will pay over the course of the loan is much less.

Adapt your spreadsheet to show that this last statement is correct. (Assume the interest rate stays the same, but don't assume monthly payments will stay the same.) Don't wipe out the columns you have for the 30-year mortgage, but create additional columns.

What problems, if any, do you see with this advice?

If you took the advice, what would you do with the money you didn't have to pay for your mortgage in months 181-360?

Suppose someone invested it and was guaranteed an annual dividend of D%. Adapt your spreadsheet to show how much money they would have at the end of month 360.

Suppose they didn't take the advice, but invested at the same D% annual dividend what they weren't having to pay to make up the higher monthly payments for the 15-year mortgage. (If you didn't get higher monthly payments, go back and check your formulas.) Who do you think will have more money at the end of month 360 -- the 15-year mortgagee or the 30-year mortgagee? Explain your thinking or intuition.

Adapt your spreadsheet to show how much money the 30-year mortgagee would have at the end of month 360. Was your thinking/intuition correct? If not, explain what you hadn't seen before. Does it matter who pays more $$ in interest over the term of the mortgage?

Adapt your spreadsheet to explore the consequences of the two people having a) only enough money to pay the monthly payment for the 30-year mortgage; b) enough money to pay the monthly payment for the 15-year mortgage; and c) some left over above that to invest. Draw conclusions.

Adapt it further to allow for different interest rates on 15- and 30-year mortgages. Explore the consequences and draw conclusions.

Compose nuanced advice that the banker, realtor, or friend should give about mortgages. What would you do or say to those who persist in giving the simple advice and explanation?

**Puzzle 3. Arranging to have money when you most need it. (Advanced spreadsheet work -- ask for help if you want to solve it, but get stuck.)**

Puzzles 1 and 2 assume that a $ in month 360 is worth the same to you as a $ in month 1. What features of the real world make that assumption not true?

Suppose you were offered a mortgage with a 30-year term that allowed *unequal* monthly payments and the balance of the loan possibly to increase if need be, say, to 95% of the value of the house. Taking into account inflation, the rise in your income, the appreciation of the value of your house, and any other features you noted above, adapt your spreadsheet to make monthly payments that reflect the changing value to you of a $ at different times. (A starting point might be to aim for payments of equal real $ value to you. If inflation is 3%, $1.03 after one year is worth the same as $1 now.)

Suggest reasons why this kind of mortgage is not offered.