

Name _____ which class? M 12 & T/Th 11-12:15 OR M 4 & T/Th 3:30-4:45

Home decisions

Dr. Sarah's MAT 1010: Introduction to Mathematics

goals for this lab:

- Explore applications of algebra in everyday life.
- Investigate real-world data and interpret key features.
- Utilize technology to adapt and use mathematical formulas that include cell referencing to answer real-world questions and interpret results.
- Communicate quantitative information using a variety of representations, including numerical, algebraic, and tables, in written documents.

Buying a home at some point? In real-life many people take out a loan for their home. As much as possible in this class we are investigating real-world situations, and this assignment is no exception. This all actually happened—to me!

1. Write down the loan payment formula with numbers filled in for an 84212 loan for 30 years compounded at 6.75% monthly. Check that your calculator shows a monthly payment of \$546.20.

2. Download the Excel file **condocarlabsols.xlsx**.

Notice the info up top in Excel is similar to homework. Click on the boxes with a number in it, so you can see Excel's formula for that in the formula bar. For example, in B3 =PMT(D1,360,-B2) is Excel's formula for calculating our loan payment formula for 30 years (360 months) using the periodic rate in D1 and the loan in B2.

In the table below, write down the formulas in D1 (the monthly rate at the very top right of the document) and D3 (the total interest paid) and compare them to your by-hand knowledge.

| A | B | C | D |
|-------------|------------------|--------------------------|--|
| condo cost | 105265 | monthly rate | = |
| loan amount | =0.8*B1 | 1st years total interest | =C6+C7+C8+C9+C10+C11 +C12+C13+C14+C15+C16+C17 |
| payment | =PMT(D1,360,-B2) | total interest 30 years | = |

3. Scroll to the last months payment of the 30 year loan (month 360 in the A column) to see the amortization ("killing the dept"). Verify the final balance in E365 (i.e. the loan balance for month 360) is 0—be sure you are looking at the final row with numbers.

Circle one: yes it is 0 I don't see a zero balance

4. Recall that the monthly interest (\$) is calculated by taking the outstanding balance and multiplying by the monthly rate. So why does the interest (\$) paid each month, in column C, decrease as time increases (Hint: the monthly rate stays the same, but what happens to the outstanding balance, and how does this impact the interest?)

5. As you get used to the Excel amortization table, compare the filled in numbers of ONLY THE FIRST ROW with your Excel document—verify they are the same (the instructions for the others are below this table). For the year 2 (24 months) and year 5 balances, be careful to look in the A column for the proper month (NOT the gray markers left of it, which are numbered differently than the month - for example, grey 24 is only month 19) and then look at the corresponding E value for the loan balance; I have highlighted these in yellow to help you find them.

| instructions | | year 5 balance CHECK FIRST: | year 2 balance in E of month 24 | monthly payment in column B | total interest in D3 |
|---------------------|---------------------------------------|--------------------------------|------------------------------------|--------------------------------|-------------------------|
| question 5. | original info | \$79,054.61 | \$82,354.53 | \$546.20 | \$112,419.07 |
| question 6. | option 1 smaller loan | \$77,177.10 | | | |
| question 7. | option 2 lower rate | \$78,601.16 | | | |
| questions 8.–11. | option 2 + \$20 lower rate + extra | \$77,196.75 | | | see #11. first: |

Before we finalized the bank payments, we found out that a deceased relative was leaving us some money, which would arrive before we closed the loan. The vice president gave us two options.

6. Option 1: Take out a smaller loan
 We could reduce the loan amount by \$2000
 So change B2 to read
 $=.8*B1-2000$
 in the FORMULA BAR for B2 and then hit enter—it is much easier to change it in the formula bar. Notice that this will change the rest of the amortization table. Verify that you have the same year 5 balance as in the chart and then fill in the row labeled as question 6 in the above table in question 5. Careful that you use the A column that is highlighted for the month number. I’ve included the correct year 5 balance to ensure you have the correct numbers!
7. Option 2: Buy down the rate
 We could leave the original loan amount the same, and pay to reduce the rate from 6.75% down to 6.25%. In real-life, lenders refer to this as “buying down the rate,” “discount points” or “mortgage points.”
 So first change D1 to read
 $=.0625/12$
 by doing this in the FORMULA BAR after clicking on D1. Hit return.
 Click on B2 and change it back to
 $=.8*B1$
 in the FORMULA BAR. Verify that you have the same year 5 balance as the question 7 row in the above table and then fill in the rest of that row.
8. Paying extra each month on option 2
 If we choose option 2, then we have a lower monthly payment. Perhaps we can afford to pay more per month? The vice president mentioned this to me. Let’s investigate this to see what happens if we pay a bit extra on option 2 each month. Namely, leave the lower rate in D1 and B3 changes via adding +20 at the end to
 $=PMT(D1,360,-B2) + 20$
 Hit return and verify that you have the same year 5 balance as the questions 8.–11. row in the above table but Do NOT fill anything in on paper yet.

9. Scroll down the Excel file until you see when we have paid off the loan, which will be indicated as a negative balance via the color and parentheses: (red balance). It will be less than month 360 since we are paying more than is required, so the balance is smaller each month and we accumulate less interest on that balance and at the same time pay off the loan faster. You'll want the first row where red appears as only in the E column, with the other columns still showing (in black) the final payment. What month, in the A column, is our final payment?

10. Notice that the formula in D3 will no longer be correct since we are not paying for 360 months. In fact, a zero balance does not coincide with a specific month so we need to apply a little more creative thinking.

Look at the just the row of the Excel chart corresponding to the month you found in question 9 and fill it in below:

| A | B | C | D | E |
|---------|----------------------|--------------------------|---------------------------|--------------|
| month # | End of Month Payment | Interest Paid that Month | Principal Paid that Month | Loan Balance |
| | | | | () |

We pay our monthly payment for the exact number of months that it takes for the chart to turn to negative (red) when we have finished paying off the loan BUT we receive money back (the amount in red/parentheses) since we have overpaid on this last month. So the total paid will be

$$\# \text{ month} \times \text{End of Month Payment} - \text{overbalance}$$

Exactly how much total do we end up paying over the life of the loan when we pay this extra \$20 each month? Show work.

11. How much total interest do we pay over the life of the loan now? The interest will be the total you paid (your last answer) – loan amount because money goes in as payment on the loan or payment on the interest, so compute

$$\#10. - 84212$$

12. Now fill in the last row of the table in question 5, using both your response in #11. and the information from Excel.

Next answer the following questions, comparing Option 1 to the original Option 2

13. Which option has a lower monthly payment? Circle one: Option 1 Option 2

14. Which option pays less total interest (\$) over the life of the loan? Circle one: Option 1 Option 2

15. Which option has a lower loan balance at the end of year 2? Circle one: Option 1 Option 2

16. Which option has a lower loan balance at the end of year 5? Circle one: Option 1 Option 2

17. Decision: Think about which you would have selected and why. Circle one: Option 1 Option 2