


## Recursively Defined Sequences, Credit Cards, and You


It's the first day of college and you get...a credit card offer! The offer says "0% APR for the first six months" but the fine print (taken from an actual credit card website for college students, and no, I won't tell you which one) is given below:


\*After the promotional period ends, your standard purchase APR will be applied to any unpaid balance transfer and promotional purchase balances, and your standard cash advance APR will be applied to any unpaid cash advance balances. As of September 18, 2008 the standard variable purchase APR is 12.99%, and the standard variable cash advance APR is 19.99%. However, if you are in default under any Card Agreement that you have with us, we may automatically increase the rate on all balances (including any promotional balances) to a variable default rate of 28.99%. The minimum finance charge: \$0.50. Foreign purchase transaction fee is 3% of purchase amount after its conversion into U.S. dollars. The transaction fee for cash advances is 3.0% of the amount of each cash advance, \$5 minimum. The transaction fee for balance transfers is 3.0% of the amount of each balance transfer, \$5 minimum. However, we will waive the balance transfer transaction fee on balances you transfer in response to this offer. The minimum monthly payment is \$5.00 or 3.0% of the outstanding balance, whichever is higher. Subject to credit approval. Additional terms and conditions apply. [Yes, I made the fine print larger so you could read it.]

Six months into the year, you decide you really need a new laptop, and so you shell out \$1000 on your credit card.

Let's see if you read the fine print...

 What is the minimum payment on your \$1000 laptop?

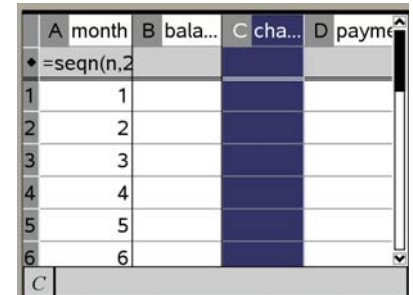
 Suppose you miss two payments and are now "in default". What is your new interest rate?

 What is the minimum finance charge?

OK, now let's plug this into a spreadsheet.


Make a new document and get a Lists & Spreadsheets page. Title column A "month" and fill it with the integers 1, 2, ... 240. (It couldn't possibly take 240 months to pay off this computer, could it?) Title column B "balance", column C "charges" and title column D "payments". Don't put any numbers in those columns yet.

In B1, put 1000, in C1, put the expression  $=b1 * .1229 / 12$  [the = is important!] and in D1 put  $=max\{5, 0.03 * b1\}$ . (Why did we assume that there was interest? Because the card is already six months old!)

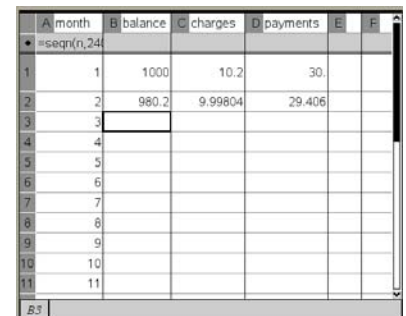


A month	B bala...	C cha...	D payme...
1			
2			
3			
4			
5			
6			

Check that your answers seem reasonable. (What does the "max" function do?)

 What assumption have we made about your monthly payment?


Now in B2 put the expression  $=round(b1 + c1 - d1, 2)$ . (What assumption are we making now?) Copy the formulas from c1 and d1 to c2 and d2 ( $\text{ctrl}-C$  and  $\text{ctrl}-V$  copy and paste, respectively). Your spreadsheet should now look like the one at right.



A month	B balance	C charges	D payments
1	1000	10.2	30
2	980.2	9.99804	29.406
3			
4			
5			
6			
7			
8			
9			
10			
11			

OK, are you ready? We're going to fill in the rest of the spreadsheet using these assumptions: that you pay the minimum payment each month, that your rate never increases above 12.24%, etc.

Select cells B2, C2, and D2, press  $\text{ctrl}-\text{Data-Fill Down}$ , and select the range of cells B3-D100 before pressing  $\text{ctrl}-\text{enter}$ .

 Is the balance paid off after 100 months?

✎ Open a new calculator page and type `sum(payments)`. How much has your \$1000 computer cost you so far?

✎ Keep filling down until the computer is paid off. How many months does it take, and how much total did it cost you?

This wasn't so bad, but let's take another common scenario: after two months of making your payments on time, you lose a bill in a pile of math problem sets, and they bump you up to the "default rate" of \_\_\_\_\_. [Go back and read the fine print.]

To alter the scenario, go to cell d3 and change the value to 0; then go to cell c4 and change the interest rate to the new, higher one, and fill all the way down.

✎ How many months does it take to pay off the \$1000 computer now?

✎ How much did the \$1000 computer cost you this time?

Finally, title column E "totalpaid". Use it to compute partial sums of the payment series as follows: In cell e1, put the formula `=d1`, but in cell e2 put the formula `=e1+d2`. Then fill down alongside the other cells. Produce a graph that shows both the remaining balance and the total paid each month.

✎ What does the graph suggest about the situation?

**Reflect:** On a separate sheet, write a paragraph or two addressing the following issues. There are lots of right answers (and very few, if any, wrong ones) to these questions—the important thing is to show me you've actually thought about the situation.

- Is it "worth it" to buy the computer using a credit card?
- This simulation doesn't model all aspects of using a credit card. Show this to someone in your family who has a credit card, and ask them whether it seems realistic. Or track down an actual paper copy of a credit card offer and describe at least one feature of the credit card agreement that is not incorporated in this model. (Not just different interest rates, but different types of rules, charges, etc.)
- Suppose you decided to pay \$50 per month like clockwork (after your unfortunate default), regardless of the balance. How does that affect the time it takes to pay off the loan and the total amount paid?
- In what situations does it make sense to use a credit card to buy something? How do you think this activity will affect your use of credit cards?