

MAA Session on Quantitative Literacy and Decision Making

Friday January 6, 9:00-10:15

Room 202

Using MS Excel to Improve Understand of Financial Mathematics

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Financial Mathematics in General Education

- Important topic
- Student interest
- Compelling examples
- Some topics too easy
 - Sales tax and discounts
 - Basic budgeting
- Some topics too hard
 - Annuity formulas
 - Options pricing
- Some topics belong in Business
 - Income tax returns
 - Retirement planning

Annuities

- Home mortgage payments
- Student loan payments
- Credit card debt reduction
- Simple retirement models

Annuities

$$PV = \frac{p[1 - (1 + i)^{-n}]}{i}$$

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- PV = present value
- p = payment
- i = interest rate/period
- n = number of periods
- Formula is challenging to derive
- Offers limited appreciation for the mathematical model

Annuities

Underlying model is very simple:

- a) Start with initial loan (or deposit) amount
- b) Add interest for 1 period (usually 1 month)
- c) Subtract payment
- d) Repeat b) and c) until the loan is repaid
- e) Repeat a) – d) with different payments until desired loan term is achieved

Annuities

Steps d) and e) are not practical to do by hand. Use spreadsheets such as Microsoft Excel to handle the arithmetic.

- d) Repeat b) and c) until the loan is repaid
- e) Repeat a) – d) with different payments until desired loan term is achieved

Build the model in Excel

	A	B	C	D	E	F
1	Loan Amount	200000				
2	Nominal Interest Rate	0.045				
3	Monthly Interest Rate	0.00375				
4	Monthly Payment	1000				
5						
6	Period	Starting Balance	Interest	Payment	End Balance	
7	1	200000	750	1000	199750	
8	2	199750				
9						

Build the model in Excel

	A	B	C	D	E
1	Loan Amount	200000			
2	Nominal Interest Rate	0.045			
3	Monthly Interest Rate	=B2/12			
4	Monthly Payment	1000			
5					
6	Period	Starting Balance	Interest	Payment	End Balance
7	1	=\$B\$1	=B7*\$B\$3	=\$B\$4	=B7+C7-D7
8	=A7+1	=E7			
9					

Build the model in Excel

							F
1	Loan Amount						
2	Nominal Annual Interest Rate						
3	Monthly Interest Rate		0.00375				
4	Monthly Payment		1000				
5							
6	Period		Starting Balance	Interest	Payment	End Balance	
370	364		7256.85462	27.213	1000	6284.06783	
371	365		6284.067825	23.565	1000	5307.63308	
372	366		5307.63308	19.904	1000	4327.5367	
373	367		4327.536704	16.228	1000	3343.76497	
374	368		3343.764966	12.539	1000	2356.30408	
375	369		2356.304085	8.8361	1000	1365.14023	
376	370		1365.140225	5.1193	1000	370.259501	
377	371		370.2595011	1.3885	1000	-628.35203	
378	372		-628.3520258	-2.3563	1000	-1630.7083	
379	373		-1630.708346	-6.1152	1000	-2636.8235	
380	374		-2636.823502	-9.8881	1000	-3646.7116	
381	375		-3646.71159	-13.675	1000	-4660.3868	
382	376		-4660.386759	-17.476	1000	-5677.8628	

Build the model in Excel

1	Loan A						F
2	Nominal						
3	Monthly Interest Rate		0.00375				
4	Monthly Payment		1013.37				
5							
6	Period		Starting Balance	Interest	Payment	End Balance	
360		354	6988.830449	26.208	1013.37	6001.66856	
361		355	6001.668563	22.506	1013.37	5010.80482	
362		356	5010.80482	18.791	1013.37	4016.22534	
363		357	4016.225338	15.061	1013.37	3017.91618	
364		358	3017.916183	11.317	1013.37	2015.86337	
365		359	2015.863369	7.5595	1013.37	1010.05286	
366		360	1010.052857	3.7877	1013.37	0.47055497	
367		361	0.470554966	0.0018	1013.37	-1012.8977	
368		362	-1012.89768	-3.7984	1013.37	-2030.066	
369		363	-2030.066047	-7.6127	1013.37	-3051.0488	
370		364	-3051.048794	-11.441	1013.37	-4075.8602	
371		365	-4075.860227	-15.284	1013.37	-5104.5147	

With the Excel model, you can ask:

- How much do you owe at month 120?
- Total interest in months 21 through 32?
- If payments are raised to \$1100/month,
 - when do you finish paying the loan?
 - how much less interest is paid?
- If you pay an extra \$5000 in month 24,
 - when do you finish paying the loan?
 - how much less interest is paid?
- Given PV , p and n , solve for i .

Excel Benefits

- All the steps are shown in the table
- Variety of questions can be reasonably asked
- Variety of levels of understanding possible without the student becoming totally lost

Excel Challenges

- Students with math anxiety often also have computer programming anxiety
- Quantity of information can be overwhelming
- Students have difficulty taking useful notes and following demonstrations of Excel

General education goals

- Basic understanding of the mathematical model driving annuity payments
- Reduce anxiety and increase empowerment in financial (and other quantitative) matters
- Increased skills with Microsoft Excel
- Improved problem solving ability

Thank you for your attention

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