

General Principle : Decompose Complex Problems

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Peter R. Douglass
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Example:

- You given the initial balance of a loan, a monthly interest rate for that loan, and a standard monthly payment amount.
- On the last month, only the remaining balance is paid
- You are asked to calculate the balance owed at the end of each month.

A Monolithic Solution

Book1 - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Acrobat

Clipboard Font Alignment Number Styles Cells Editing

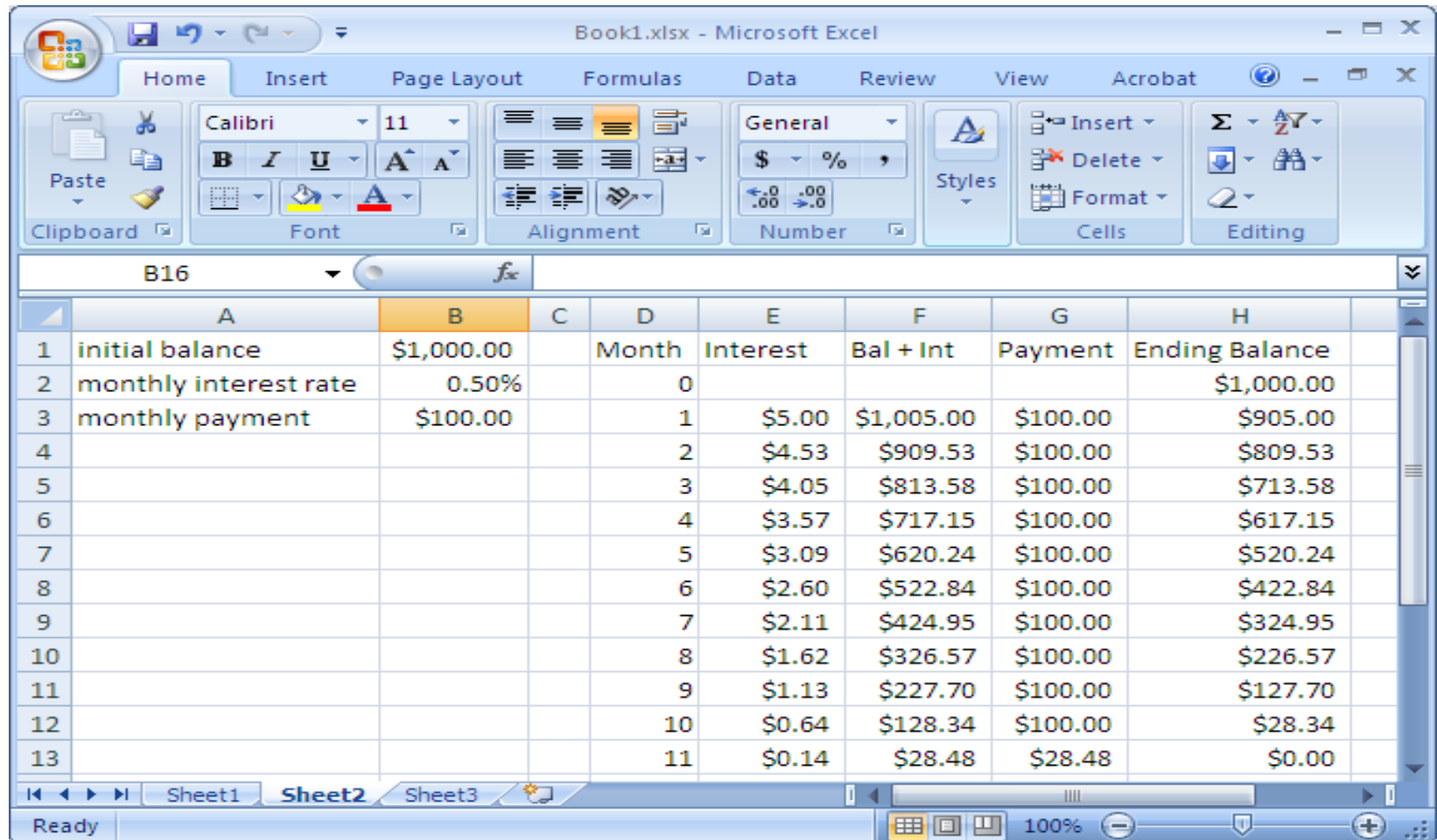
E3 $=\text{MAX}(\text{ROUND}(E2+E2*\$B\$2-\$B\$3,2),0)$

	A	B	C	D	E	F	G	H
1	initial balance	\$1,000.00		Month	Ending Balance			
2	monthly interest rate	0.50%		0	\$1,000.00			
3	monthly payment	\$100.00		1	\$905.00			
4				2	\$809.53			
5				3	\$713.58			
6				4	\$617.15			
7				5	\$520.24			
8				6	\$422.84			
9				7	\$324.95			
10				8	\$226.57			
11				9	\$127.70			
12				10	\$28.34			
13				11	\$0.00			

Sheet1 Sheet2 Sheet3

Ready 100%

Breaking the Problem into Smaller Parts



The screenshot shows a Microsoft Excel spreadsheet titled "Book1.xlsx". The ribbon is set to "Home", and the active cell is B16. The spreadsheet contains a table with columns A through H and rows 1 through 13. The table represents a loan amortization schedule with an initial balance of \$1,000.00, a monthly interest rate of 0.50%, and a monthly payment of \$100.00. The columns are: A (initial balance), B (monthly interest rate), C (monthly payment), D (Month), E (Interest), F (Bal + Int), G (Payment), and H (Ending Balance).

	A	B	C	D	E	F	G	H
1	initial balance	\$1,000.00		Month	Interest	Bal + Int	Payment	Ending Balance
2	monthly interest rate	0.50%		0				\$1,000.00
3	monthly payment	\$100.00		1	\$5.00	\$1,005.00	\$100.00	\$905.00
4				2	\$4.53	\$909.53	\$100.00	\$809.53
5				3	\$4.05	\$813.58	\$100.00	\$713.58
6				4	\$3.57	\$717.15	\$100.00	\$617.15
7				5	\$3.09	\$620.24	\$100.00	\$520.24
8				6	\$2.60	\$522.84	\$100.00	\$422.84
9				7	\$2.11	\$424.95	\$100.00	\$324.95
10				8	\$1.62	\$326.57	\$100.00	\$226.57
11				9	\$1.13	\$227.70	\$100.00	\$127.70
12				10	\$0.64	\$128.34	\$100.00	\$28.34
13				11	\$0.14	\$28.48	\$28.48	\$0.00

Showing Formulas

The screenshot shows Microsoft Excel with the following data and formulas:

	A	B	C	D	E	F	G	H
1	initial balance	1000		Month	Interest	Bal + Int	Payment	Ending Balance
2	monthly interest rate	0.005		0				=B1
3	monthly payment	100		=D2+1	=ROUND(H2*\$B\$2,2)	=H2+E3	=MIN(F3,\$B\$3)	=F3-G3
4				=D3+1	=ROUND(H3*\$B\$2,2)	=H3+E4	=MIN(F4,\$B\$3)	=F4-G4
5				=D4+1	=ROUND(H4*\$B\$2,2)	=H4+E5	=MIN(F5,\$B\$3)	=F5-G5
6				=D5+1	=ROUND(H5*\$B\$2,2)	=H5+E6	=MIN(F6,\$B\$3)	=F6-G6
7				=D6+1	=ROUND(H6*\$B\$2,2)	=H6+E7	=MIN(F7,\$B\$3)	=F7-G7
8				=D7+1	=ROUND(H7*\$B\$2,2)	=H7+E8	=MIN(F8,\$B\$3)	=F8-G8
9				=D8+1	=ROUND(H8*\$B\$2,2)	=H8+E9	=MIN(F9,\$B\$3)	=F9-G9
10				=D9+1	=ROUND(H9*\$B\$2,2)	=H9+E10	=MIN(F10,\$B\$3)	=F10-G10
11				=D10+1	=ROUND(H10*\$B\$2,2)	=H10+E11	=MIN(F11,\$B\$3)	=F11-G11
12				=D11+1	=ROUND(H11*\$B\$2,2)	=H11+E12	=MIN(F12,\$B\$3)	=F12-G12
13				=D12+1	=ROUND(H12*\$B\$2,2)	=H12+E13	=MIN(F13,\$B\$3)	=F13-G13

Comparison

- The Monolithic solution calculates the monthly balance with one complex formula
- The Solution with intermediate results, performs the same calculation by breaking up the complex formula into three simpler formula.

Dividing the solution into a number of smaller parts has many advantages.

1. It is easier to catch mistakes.

- there are more results that can be checked

2. It is easier to verify correctness

- verification can be done step by step

3. It is easier to reuse the parts

- For example, if we were asked to find the total amount paid for the loan, it would be easier to make the necessary changes to the solution broken into parts than to the monolithic solution.