CS-150L
Computing for Business Students
Future Value of a Retirement Annuity

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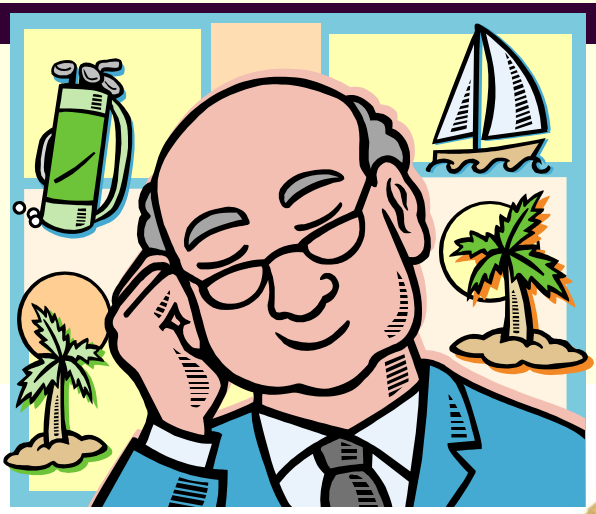

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Lab 8

- Calculating Future Value of a Retirement Annuity
- Calculating Retirement Income
- Using the Social Security Administration's benefit calculator.
- Excel **FV(rate, nper, pmt)**, Future Value function.
- Using an annuity accrual table to vary the payment amount.

Retirement Annuity

Accrual Phase: payments are made into the annuity account. During this phase, the value of the annuity increases by:

- Contributions: Deposits may be made weekly, monthly, quarterly, or yearly. An *ordinary annuity* is an annuity whose payments are made at the *end* of each period.
- Interest or Return on Current Investment.

Pension Phase: This begins upon retirement.

- Each period, payments are made *out* of the annuity.
- Interest on the annuity balance continues to add to the value of the annuity.

Excel FV(rate, nper, -pmt)

- Excel built-in function for calculating the future value of an annuity.

$$FV_{annuity} = pmt \times \left(\frac{(1+rate)^{nper} - 1}{rate} \right)$$

  - *rate* is the periodic interest rate (APR divided by the number of periods per year),
  - *nper* is the total number of periods of the annuity,
  - *pmt* is the amount contributed to the annuity each period. In order to use this equation, the payment must be the same every period.

FV(rate, nper, -pmt) example

	A	B	C	D
1		Named Constant		
2	Periodic Rate	rate	12.000%	
3	Number of Periods	nper	30	
4	Periodic Contribution	pmt	$150.00	
5				
6	Future Value	FV	=FV(rate,nper,-pmt)	
7			$36,199.90	

- All of the values are given in periods.
- Thus, it does not need to be stated whether the period is days, weeks, months, years, or Mars years.
- Judging by the values, make a guess at the period.

FV – The Magic of Compound Interest

	A	B	C	D	E
1			Named Reference	Value	Equation
2	Given	APR		12.000%	
3		Number of Years		40	
4		Number of Periods per Year		12	
5		Monthly Contribution	pmt	$150.00	
6		Periodic Rate	rate	1.000%	D2/D4
7		Number of Periods	nper	480	D3*D4
8	Future Value			=FV(rate, nper, -pmt)	
9				$1,764,715.88	

- 1.7 million is a not bad "nest egg".
- Are these numbers realistic?

What if? (Active Excel Worksheet)

APR		4.000%
Number of Years		40
Periodic Rate	rate	0.333%
Number of Periods	nper	480
Monthly Contribution	pmt	$150.00
Future Value	FV	$177,294.20

What if Monthly Contribution is changed? ($150 → $300)

What if APR is changed?

(12.0% → 6.0% or→ 10.0% or→ 18.0%)

Future Value & Compounding Periods

A	B	C	D	E
		Name	Value	
Given	APR	APR	12.000%	
	Number of Years	years	40	
	Annual Contribution	pmt	$1,800	Equation
FV (compounded annually)			$1,380,765	FV(APR, years, -pmt)
FV (compounded monthly)			$1,764,716	FV(APR/12, years*12, -pmt/12)
FV (compounded daily)			$1,851,882	FV(APR/365, years*365, -pmt/365)

$$FV_{annuity} = pmt \times \left(\frac{(1+rate)^{nper} - 1}{rate} \right)$$

Quiz: Future Value

An annuity is created in which $50.00 is invested every month for 25 years. The annuity offers a guaranteed 2.25% APR.

An Excel worksheet is set up with named references, APR, YEARS, and PMT.

What is the Future Value?

	A	B
1	APR	2.250%
2	YEARS	25
3	PMT	$50.00

a) =FV(APR, YEARS, -PMT)

b) =FV(APR/12, YEARS, -PMT)

c) = FV(APR/12, YEARS/12, -PMT)

d) = FV(APR/12, YEARS*12, -PMT)

e) = FV(APR/12, YEARS, -PMT/12)

Quiz: Future Value

An annuity is created in which $50.00 is invested every month for 25 years. The APR of the annuity is 2.25%.

One person uses the equation:

=FV(APR/12,YEARS*12,-PMT)

Another person uses the equation:

=FV(APR,YEARS,-PMT*12)

	A	B
1	APR	2.250%
2	YEARS	25
3	PMT	$50.00

Which equation is correct?

a) They are both correct.

b) The 1st. The 2nd gives an answer that is too large.

c) The 1st. The 2nd gives an answer that is too small.

d) The 2nd. The 1st gives an answer that is too large.

e) The 2nd. The 2st gives an answer that is too small.

Research

- Choose a person: Name & Retirement Date
- Choose a Career.
- Choose a Geographic Location.
- Starting Salary in 2009.
- Senior Salary: (salary at retirement in 2009 dollars).
- Contribution Rate (percentage of salary)
- Accrual Rate of Return
- Pension Rate of Return
- Years of Life After Retirement.

FV Worksheet: Researched Values

	B	C
5	Annual Salary	$10,000.00
6	Pre-tax Employee Contribution	8.00%
7	After-tax Employee Contribution	0.00%
8	Employer Contribution	5.00%
9	Total Dollar Amount of Annual Contributions	$1,300.00
10	Annual Investment Return Rate	20.00%
11	Years Contributing	48

Employer Contribution: =MIN(C6,5%)

Total Annual Contributions: ?

=C5*C6 + C5*C7 + C5*C8

Quiz: Total Annual Contributions

	A	B
1	Annual Salary	$15,000.00
2	Pre-tax Employee Contribution	4.00%
3	After-tax Employee Contribution	0.00%
4	Employer Contribution	4.00%
5	Total Dollar Amount of Annual Contributions	$1,200.00
6	Annual Investment Return Rate	20.00%
7	Years Contributing	48

Which equation gives the Total Annual Contributions in B5?

a) =B2*B1 + B3*B1 + B4*B1

b) =B2*B6 + B3*B6 + B4*B6

c) =B6 * (B1+B2+B3+B3)

d) =B6 * (B2+B3+B3)

e) =B2*B7 + B6*B7

FV Worksheet: Scenarios

12	Scenarios:	End of Year Contribution	End of Quarter Contribution	End of Month Contribution
13	Contributions Per Year	1	4	12
14	Periodic Interest Rate	20.00%	5.00%	1.67%
15	Amount Contributed each Period	$1,300.00	$325.00	$108.33
16	Periods Contributing	48	192	576
17	Total Contributions	$62,400.00	$62,400.00	$62,400.00
18	Future Value FV function	$41,071,866.65	$76,071,445.88	$88,663,784.49
19	Future Value Equation	$41,071,866.65	$76,071,445.88	$88,663,784.49

- Why is the Future Value so much larger in the third column than in the first column?
- FV function: =FV(*rate*, *nper*, *-pmt*)
- FV Equation: $FV = pmt \times \left(\frac{(1+rate)^{nper} - 1}{rate} \right)$

Pension Phase

21	The Size of my "nest egg"	$88,663,784
22	Yearly Interest Rate	6.99%
23	Years of Retirement	25
24	Monthly Pension	$626,092
25	Monthly Social Security Benefit	$1,460
26		
27	**Monthly Retirement Income:**	$627,552

- Use PMT(*rate*, *nper*, *pv*) function to determine the amount you will withdraw from your pension each month. At the end of *nper*, the value will be zero.
- Note: *rate* is not APR and *nper* is not years.

Error in Lab Manual: Lab 8

- On Page 81,
- 8.2.3: f) *Total Dollar Amount of Annual Contribution*

  Should be
- 8.2.3: f) **Total Dollar Amount of All Contributions this Period**

Accrual table (Active Excel Worksheet)

ease:	1.48%			
Pre-tax Employee Contribution	Employer Contribution	Total Dollar Amount of All Contributions this Period	Monthly Investment Return	Value
				$ -
8.00%	5.00%	$ 108	1.67%	$ 108
8.00%	5.00%	$ 110	1.67%	$ 220
8.00%	5.00%	$ 112	1.67%	$ 335
8.00%	5.00%	$ 113	1.67%	$ 454
8.00%	5.00%	$ 115	1.67%	$ 577
8.00%	5.00%	$ 117	1.67%	$ 703

Total Dollar Amount of Contribution

B5*C5 + B5*D5 + B5*E5

	A	B	C	D	E	F
3	Year	Annual Salary	Pre-tax Employee Contribution	Employer Contribution	After-tax Employee Contribution	Total Dollar Amount of Annual Contribution
4	0					
5	1	$ 10,000	10.00%	5.00%	0.00%	$ 1,500
6	2	$ 10,500	10.00%	5.00%	0.00%	$ 1,575
7	3	$ 11,025	10.00%	5.00%	0.00%	$ 1,654
8	4	$ 11,576	10.00%	5.00%	0.00%	$ 1,736

The contribution information from columns B, C, D, and E is totaled in column F. Thus, when the *value* column is calculated, columns B, C, D and E and not needed.

Quiz: Value at End of Each Year

	A	B	C	D	E	F	G
1		Annuity Account with Increasing Annual Contributions					
3	Year	Annual Salary	Pre-tax Employee Contribution	Employer Contribution	Total Dollar Amount of Annual Contribution	Annual Investment Return	Value
4	0						$ -
5	1	$ 10,000	10.00%	5.00%	$ 1,500	20.00%	$ 1,500
6	2	$ 10,500	10.00%	5.00%	$ 1,575	20.00%	$ 3,375

What equation should be entered in G5 and filled down?

a) =E5 + F5*B5

b) =G4*F5 + E5*F5

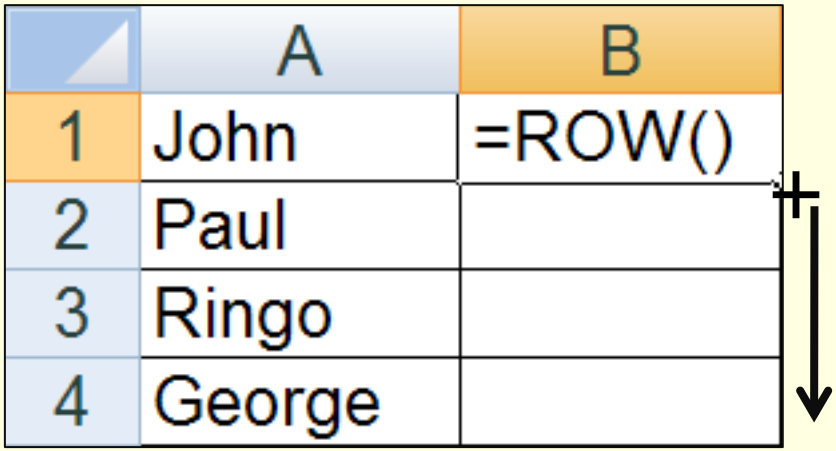
c) =G4 + F5*B4

d) =G4 + G4*F5

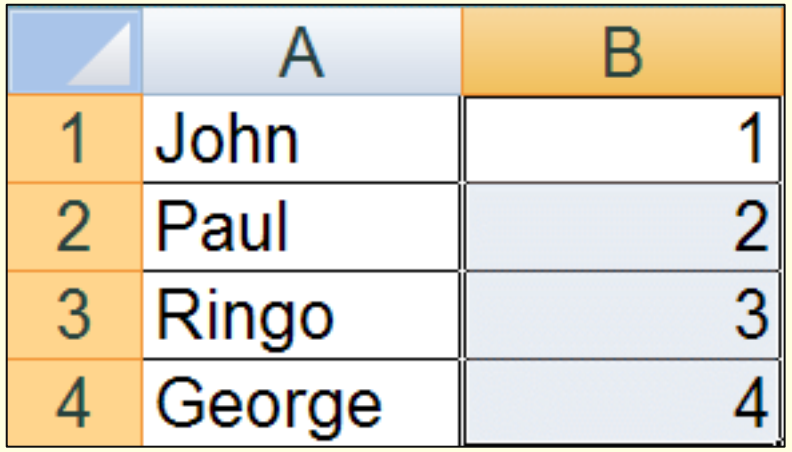
e) =G4 + G4*F5 + E5

ROW(), ROW(reference) Function

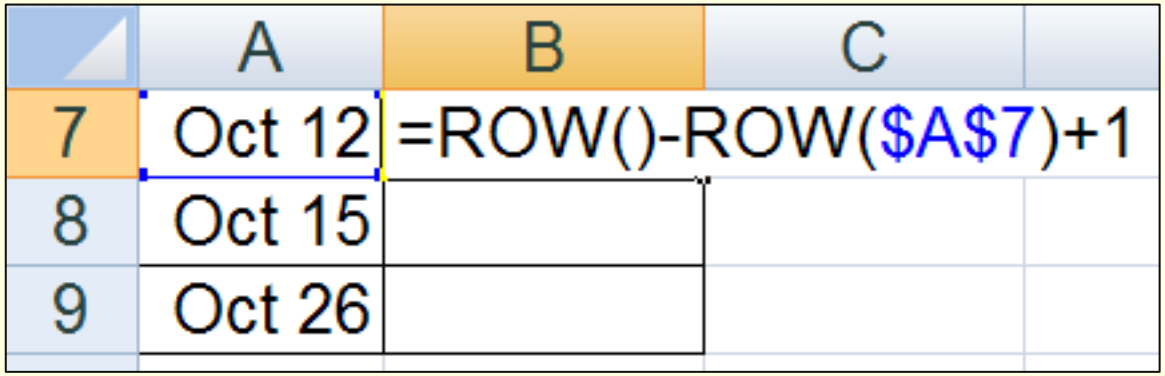
The ROW() function returns the row number of its location.



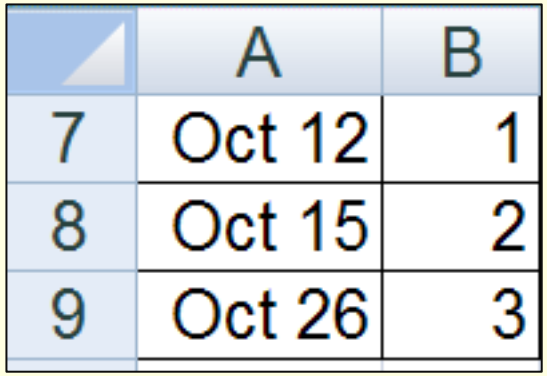
	A	B
1	John	=ROW()
2	Paul	
3	Ringo	
4	George	



	A	B
1	John	1
2	Paul	2
3	Ringo	3
4	George	4



	A	B	C
7	Oct 12	=ROW()-ROW(A7)+1	
8	Oct 15		
9	Oct 26		

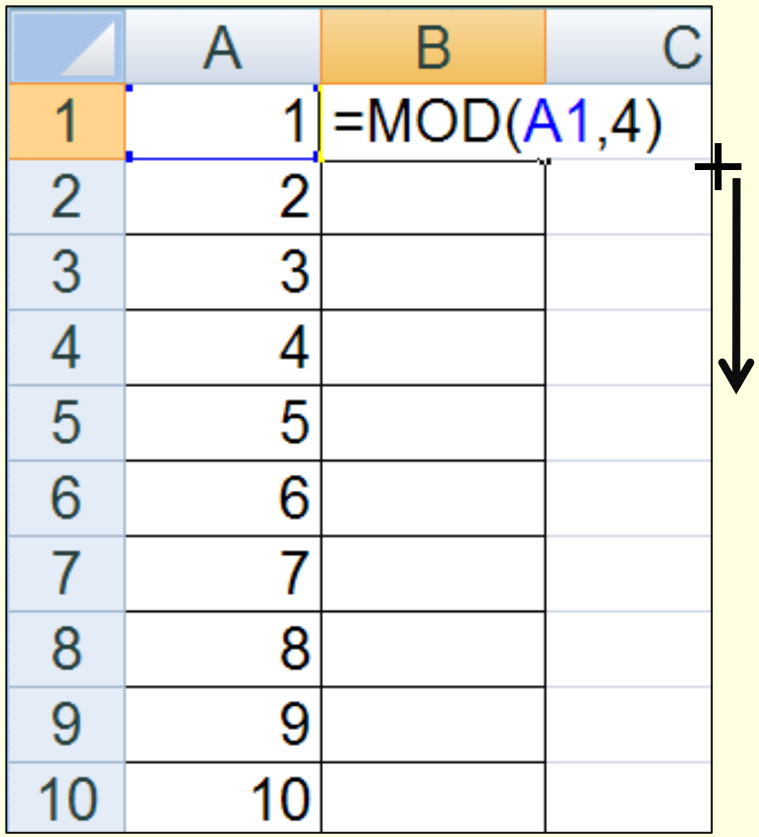


	A	B
7	Oct 12	1
8	Oct 15	2
9	Oct 26	3

MOD(number, divisor) Function

In computing, the ***modulo*** operation finds the remainder of division of one number by another.

The second number is called the ***divisor***.



	A	B
1	1	1
2	2	2
3	3	3
4	4	0
5	5	1
6	6	2
7	7	3
8	8	0
9	9	1
10	10	2

Using MOD() and ROW() Together

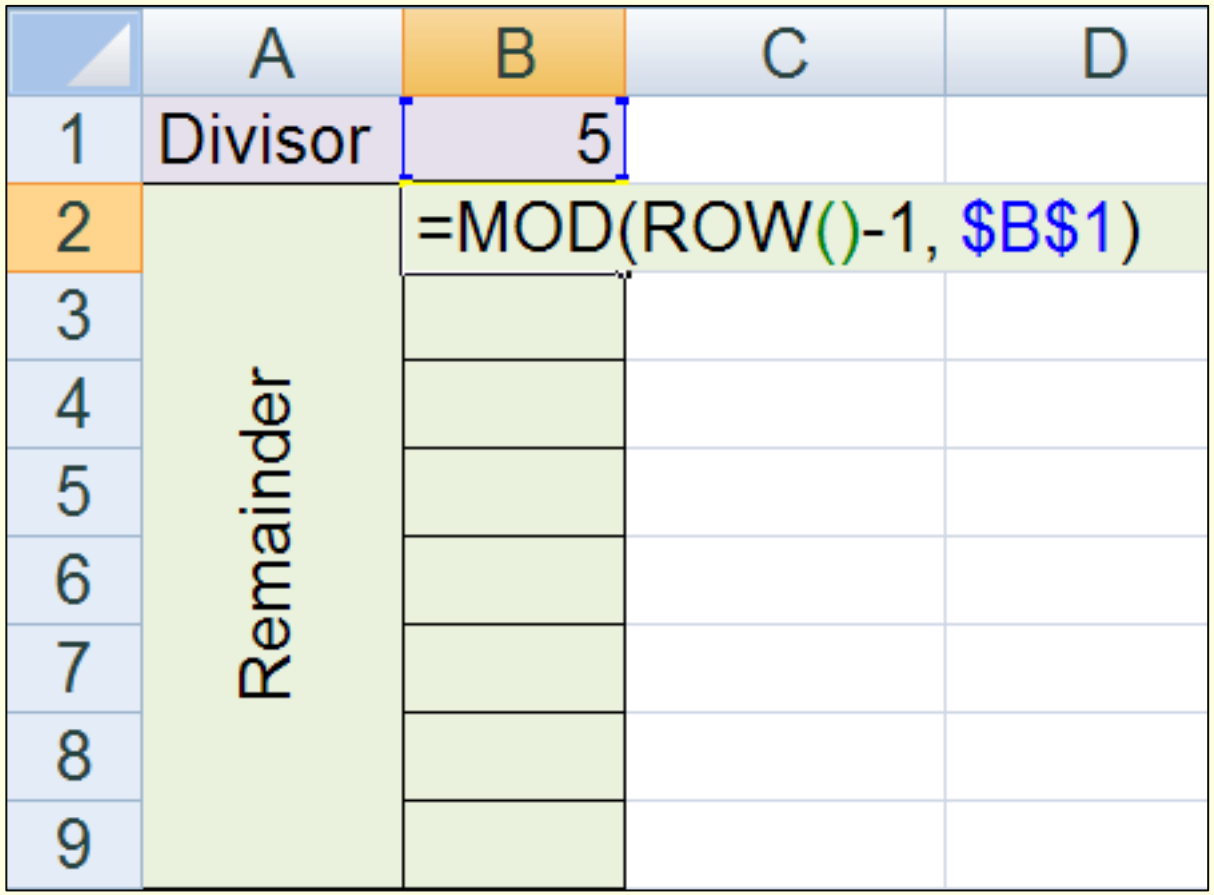
What is the result of filling down the equation in B2?

	A	B	C	D
1	Divisor	3		
2	Remainder	=MOD(ROW()-1, B1)		
3				
4				
5				
6				
7				
8				
9				

	A	B
1	Divisor	3
2	Remainder	1
3		2
4		0
5		1
6		2
7		0
8		1
9		2

Quiz: ROW() and MOD()

If the equation shown in cell B2 is filled down through B9, then what value will be displayed in cell B6?



a) 0
b) 1
c) 2
d) 3
e) 4

“Logical” Equation

	A
1	=MOD(ROW(), 2)=1
2	
3	
4	
5	
6	

two ‘=‘ symbols

A ***logical equation*** is an equation that returns either the value TRUE or FALSE.

	A	B
1	TRUE	
2	FALSE	
3	TRUE	
4	FALSE	
5	TRUE	
6	FALSE	

Quiz: Logical Equation

If the equation in C2 is filled down through C7, then what will be displayed in **C5**, **C6** and **C7**?

	A	B	C
1	Roll 1	Roll 2	Win
2	1	6	=A2+B2=7
3	2	5	
4	3	4	
5	4	4	?
6	6	1	?
7	6	2	?

a) FALSE, FALSE, FALSE

b) FALSE, TRUE, FALSE

c) FALSE, TRUE, TRUE

d) TRUE, FALSE, FALSE

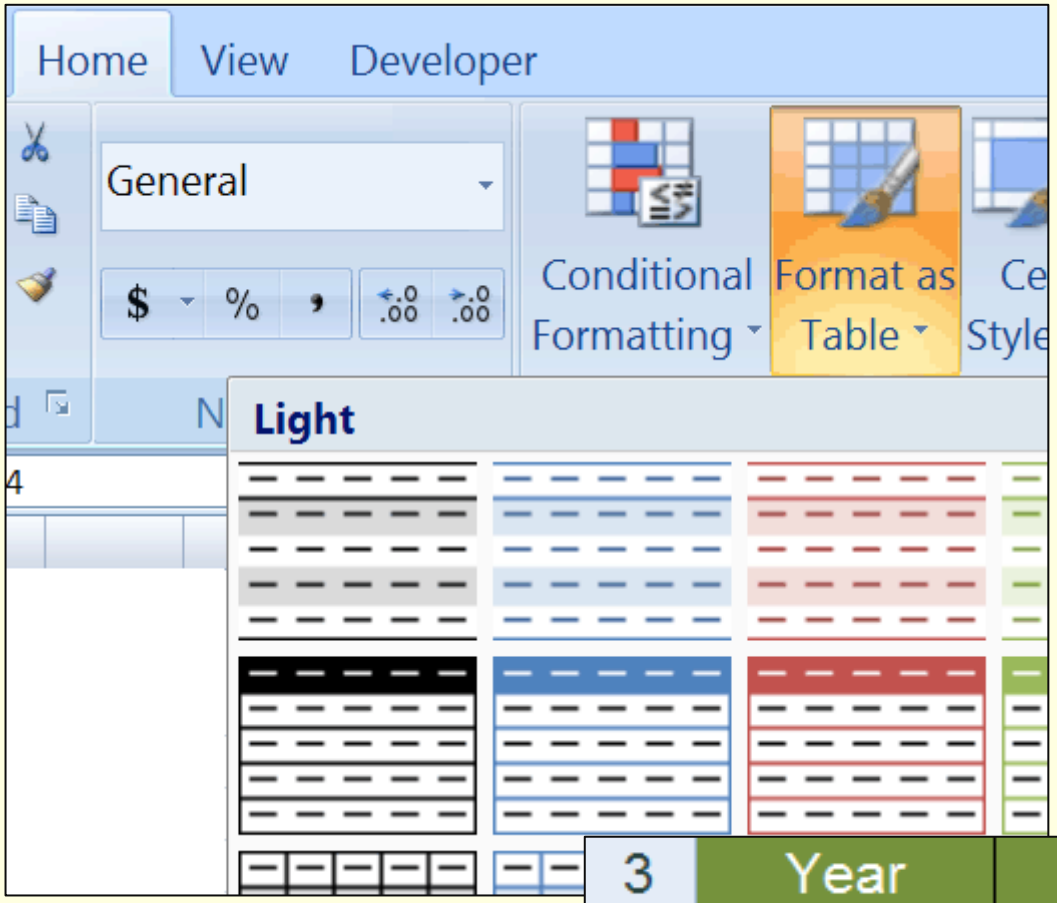
e) TRUE, TRUE, TRUE

Fill Background on Every Odd Row

	A	B	C	D	G	H
3	Year	Annual Salary	Pre-tax Employee Contribution	Employer Contribution	Annual Investment Return	Value
4	0					$ -
5	1	$ 10,000	10.00%	5.00%	20.00%	$ 1,500
6	2	$ 10,250	10.00%	5.00%	20.00%	$ 3,338
7	3	$ 10,506	10.00%	5.00%	20.00%	$ 5,581
8	4	$ 10,769	10.00%	5.00%	20.00%	$ 8,312
9	5	$ 11,038	10.00%	5.00%	20.00%	$ 11,631
10	6	$ 11,314	8.00%	5.00%	20.00%	$ 15,428
11	7	$ 11,597	8.00%	5.00%	20.00%	$ 20,021
12	8	$ 11,887	8.00%	5.00%	20.00%	$ 25,570
13	9	$ 12,184	8.00%	5.00%	20.00%	$ 32,268
14	10	$ 12,489	8.00%	5.00%	20.00%	$ 40,345

Fill Background on Every Odd Row

Method 1: Format as Table



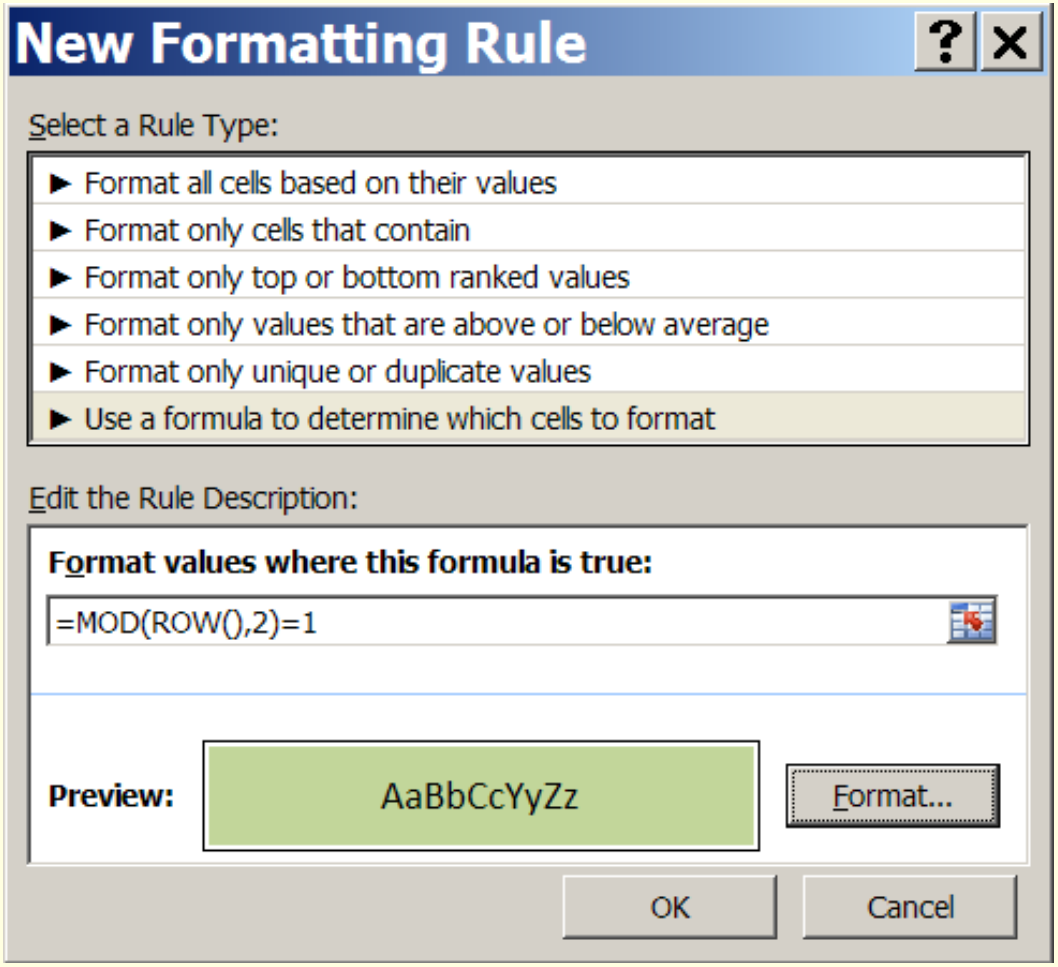
3	Year	Salary	Contribution	C
4	Column1	Column2	Column3	C
5	0			

Works, but often changes the width of one or more columns.

Also, adds a row or adds column dropdown menus to each column.

Fill Background on Every Odd Row

Method 2: Conditional Formatting



1. Select cells.
2. Select "*Conditional Formatting*" → "*New Rule...*"
3. Select "*Use a formula to determine which cells to format*"
4. Enter =MOD(ROW(),2)=1
5. Click "*Format*", and specify the format you want.
6. Click "OK".

Quiz

- which does NOT give the correct balance?
  last period's balance + interest + new deposit
- cumulitive Interest + cumulitive deposits
- last period's balance + last period's balance*periodic rate of return + new deposit