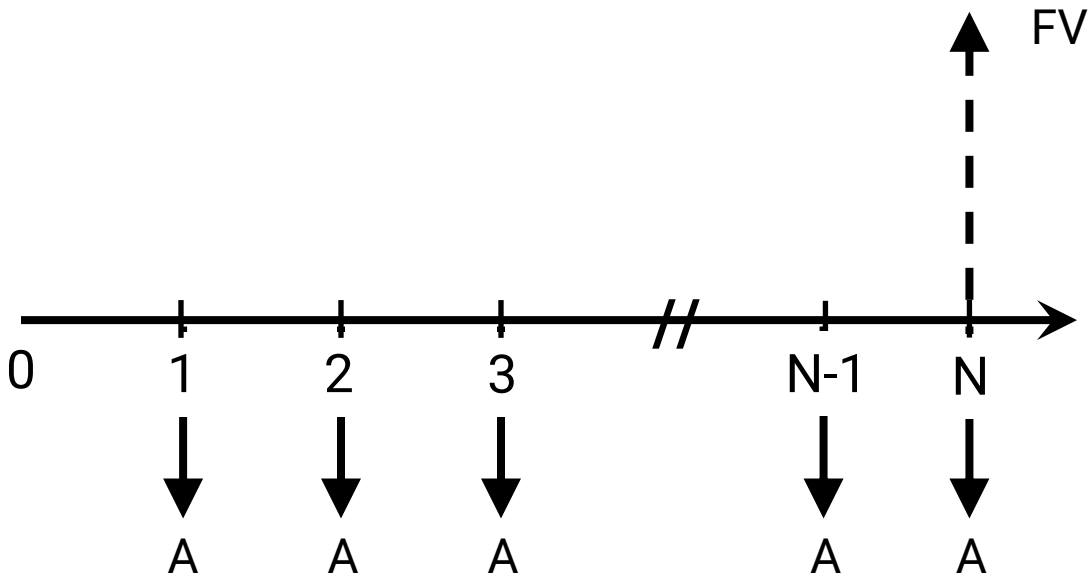
Spreadsheets to the Rescue!

What Happens When There is More than 1 Payment?

Example. You contribute an amount, A, to your retirement plan every month.



A uniform series of payments are called “Annuities”, with a value “A”.

Usually, annuities are paid at the ***end of the period (“Ordinary Annuity”)***.

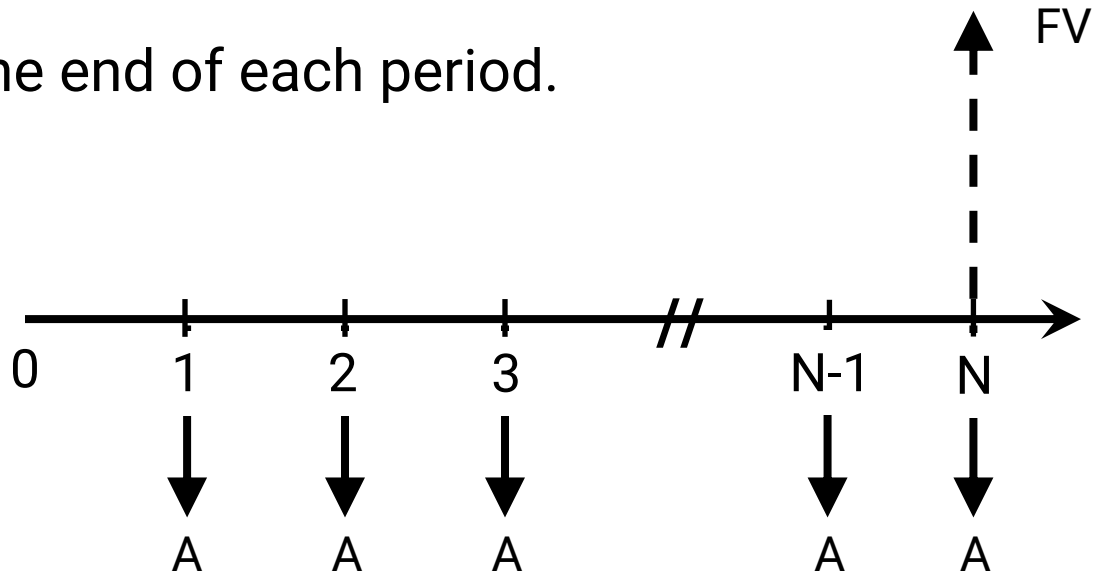
In some cases, annuities come at the beginning of the period (“Annuities Due”).

Calculating Future Value Given A, i, and N

The payments are the same every period.

There is no payment at time = 0.

All payments come at the end of each period.



Note: there is no initial payment at time = 0!

$$FV = A\left[\frac{(1+i)^N - 1}{i}\right]$$

FV Function in Excel…

FV: determines the future value of an investment based on the interest rate, number of periods, multiple, uniform payments, and the present value of the investment.

Format: FV(rate, nper, pmt, pv, type).

rate: The interest rate per period.

nper: The number of payment periods.

pmt: The dollar value of the series payment at each period; cash outflows are represented by negative values, cash inflows by positive values.

pv: The present value or also the initial investment.

type: This describes the type of series payments: If the payment comes at the end of period (Ordinary Annuities), this value is the default, 0. If the payment comes at the beginning of the period (Annuities Due), the number is 1.

FV Function in Excel…

FV: determines the future value of an investment based on the interest rate, number of periods, multiple, uniform payments, and the present value of the investment.

Format: FV(rate, nper, pmt, pv, type). *(this determines our "FV")*

rate: The interest rate per period. *(this is our "i")*

nper: The number of payment periods. *(this is our "N")*

pmt: The dollar value of the series payment at each period; cash outflows are represented by negative values, cash inflows by positive values. *(this is our "A")*

pv: The present value or also the initial investment. *(this is our "PV")*

type: This describes the type of series payments: If the payment comes at the end of period (Ordinary Annuities), this value is the default, 0. If the payment comes at the beginning of the period (Annuities Due), the number is 1. *(we'll assume the default "0" for now)*

Future Value, Given A, using Excel

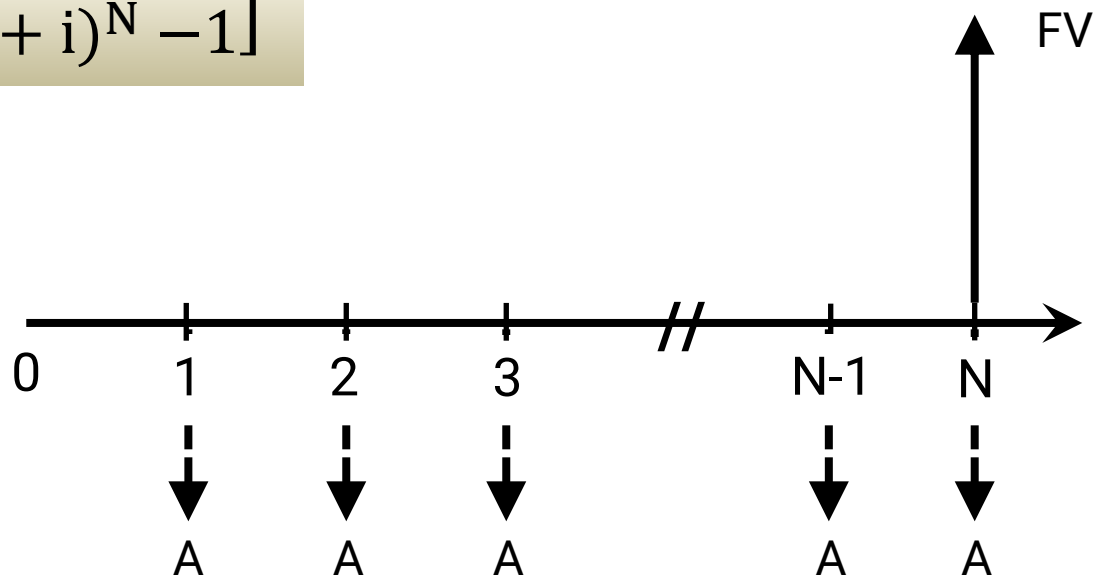
Example. What is FV given A = $2,000/yr, i = 2%, n = 30 years.

	A	B	C	D	E
1	**TVM with Excel**				
2	**Future Value Calculations**				
3					
4	PV =	$0	*this is our initial investment at time = 0*		
5	PMT =	-$2,000	*this is our A, at the end of each period*		
6	RATE =	2.00%	*this is our i*		
7	NPER =	30	*this is our N*		
8					
9	FV =	$81,136	*FV(rate, nper, pmt, pv, type)*		
10			*=FV(B6,B7,B5,B4)*		
11			*=FV(0.02, 30, -2000, 0, 0)*		

What is the Annuity, given FV, i, and N

If you know the Future Value of your investment, what is the required annuity payment, A, to get there?

$$A = FV\left[\frac{i}{(1+i)^N - 1}\right]$$



PMT Function in Excel…

PMT: calculates the value of the annuity based on the interest rate, number of periods, and the present and future values of the investment.

Format: PMT(rate, nper, pv, fv, type).

rate: The interest rate per period.

nper: The number of payment periods.

pv: The present value or also the initial investment.

fv: The future value of the investment.

type: This describes the type of series payments: If the payment comes at the end of period (Ordinary Annuities), this value is the default, 0. If the payment comes at the beginning of the period (Annuities Due), the number is 1.

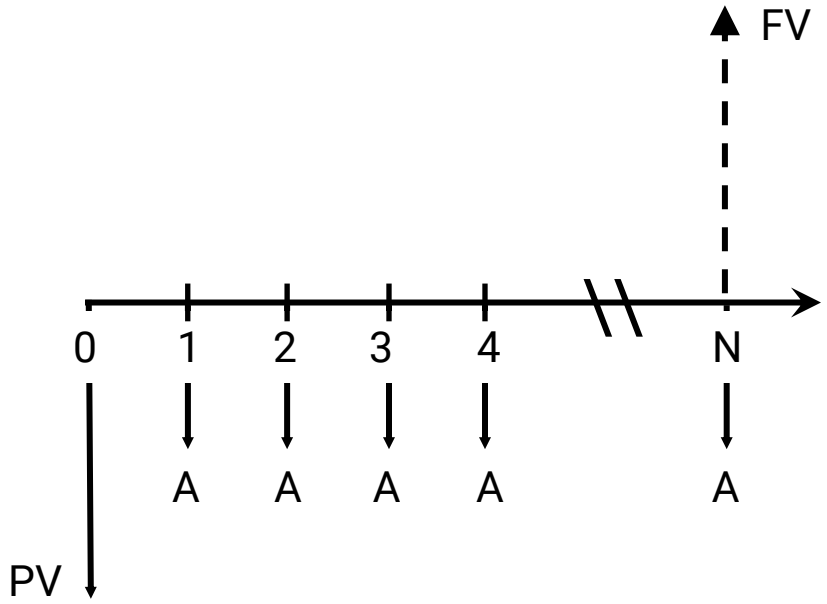
Finding A, Given FV using Excel

Example. What is A given FV = $1,000,000, i = 8%, N = 30 years.

	A	B	C	D	E	F
1	**TVM with Excel**					
2	**Annuity (Payment) Calculations**					
3						
4	PV =	$0	*this is our initial investment at time = 0*			
5	FV =	$1,000,000	*this is the value of our investment at time = N*			
6	RATE =	8.00%	*this is our i*			
7	NPER =	30	*this is our N*			
8						
9	PMT =	-$8,827.43	*PMT(rate, nper, pv, fv, type)*			
10			*=PMT(B6,B7,B4,B5)*			
11			*=PMT(0.08, 30, 0, 1000000, 0)*			

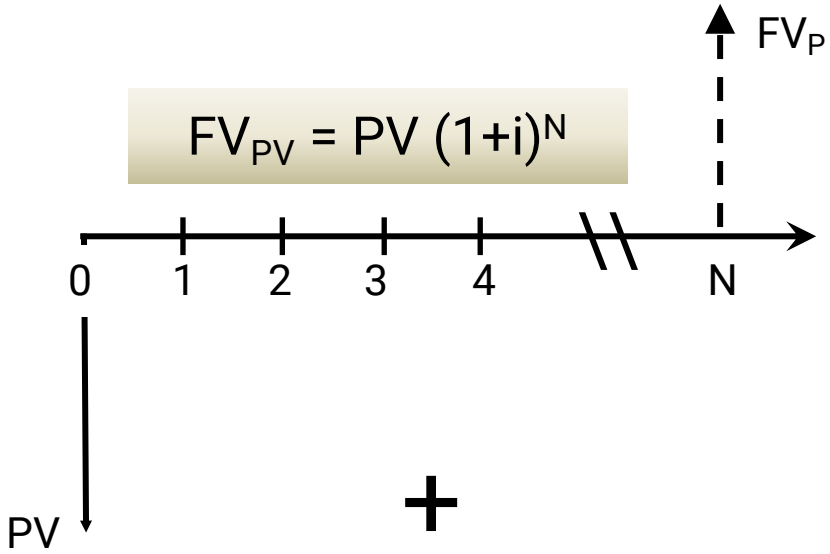
When you have a combination of cash flows…

How would you solve for this scenario?



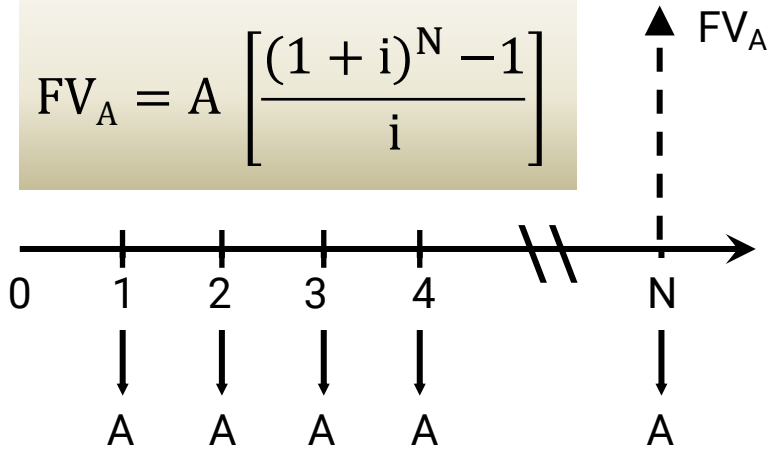
$$FV = FV_{PV} + FV_A$$

$$FV_{PV} = PV\,(1+i)^N$$



+

$$FV_A = A\left[\frac{(1+i)^N - 1}{i}\right]$$



Dealing with several types of cash flows…

Example: At the beginning of year you invested $10,000 into your retirement fund that earns 10% per year. You add an additional $5000 to the fund at the end of this year and every year after that for 10 years. What is your investment worth at the end of 10 years?

$FV_{PV} = PV\,(1+i)^N$

$$FV_{PV} = \$10{,}000\,(1+0.10)^{10}$$

$$FV_{PV} = \$25{,}937$$

$$FV_A = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$FV_A = \$5{,}000\left[\frac{(1+0.10)^{10} - 1}{0.10}\right]$$

$$FV_A = \$79{,}687$$

$$FV = FV_{PV} + FV_A = \$105{,}625$$

Or let Excel do the heavy lifting for you…

Example: At the beginning of year you invested $10,000 into your retirement fund that earns 10% per year. You add an additional $5000 to the fund at the end of this year and every year after that for 10 years. What is your investment worth at the end of 10 years?

How would you solve this with excel?

	A	B	C	D	E
1	**TVM with Excel**				
2	**Future Value Calculations**				
3					
4	PV =	-$10,000	*this is our initial investment at time = 0*		
5	PMT =	-$5,000	*this is our A, at the end of each period*		
6	RATE =	10.00%	*this is our i*		
7	NPER =	10	*this is our N*		
8					
9	FV =	$105,625	*FV(rate, nper, pmt, pv, type)*		
10			*=FV(B6,B7,B5,B4)*		
11			*=FV(0.10, 10, -5000, -10000)*		

Note we've included both a "pv" and a "pmt"!

Summary So Far…

Single Payment Cash Flows:

- Compound Amount: $FV = PV\,(1+i)^N$
- Present Value: $PV = FV/(1+i)^N$

Uniform Series Cash Flows:

- Compound Amount: $FV = A\left[\frac{(1+i)^N - 1}{i}\right]$
- Sinking Fund: $A = FV\left[\frac{i}{(1+i)^N - 1}\right]$

- Using Excel, you can quickly calculate:
  - FV: using the FV function
  - PV: using the PV function
  - i: using the RATE function
  - N: using the NPER function
  - A: using the PMT function

Next Time…

Applying TVM to your Personal Finances!

Credits & References

Slide 1: Accounting or Financial Management Software Program on Laptop Screen in Office Desk, by Menara Grafis, Adobe Stock (432160164.jpeg).

Slide 13: Digital format file icon. flat draw creative modification icon with initial name. vector illustration. Green icon. By Calibro44, Adobe Stock (473865302.jpeg).

Slide 14: Financial planning word with coin in glass jar and graph up by suthisak, Adobe Stock (186340259.jpeg).