Modeling Compound Growth in Excel Part 2

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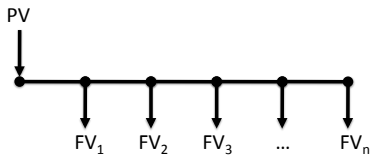
Compounding



Compound Growth
Basic Formula

$$FV = PV(1 + rate)^{nper}$$

Future Value in Excel

FV(rate, nper, pmt, PV, type)

Compounding
Present Value

$$PV = FV\left[\frac{1}{(1 + rate)^{nper}}\right]$$

Present Value in Excel

PV(rate, nper, pmt, FV, type)

Solving for nper

$$FV = PV(1 + rate)^{nper}$$

Solving for nper

$$\frac{FV}{PV} = (1 + rate)^{nper}$$

Digression

$$\frac{FV}{PV} = (1 + rate)^{nper}$$

- If FV > PV then FV/PV > 1, growth
- If FV < PV then FV/PV < 1, loss

Digression

$$\frac{FV}{PV} = (1 + rate)^{nper}$$

If FV = PV then FV/PV = 1 and either nper = 0 or rate = 0.

Returning to solving for nper remember

$$\log_a b$$

$$n = \log_m m^n$$

Solving for nper

Now take the $\log_{(1 + rate)}$ of both sides.

Solving for nper

$$\text{nper} = \log_{(1+\text{rate})} \frac{FV}{PV}$$

nper is a built-in function in Excel

nper(rate, pmt, pv, fv, type)

Example

Problem : Warren Buffet's net worth in 2008 was $62 billion. If you started with $1,000 and earned 30% per year, in what year would you have as much as Mr. Buffet had in 2008?

Answer:

Solution

$$2009 + \log_{1.3} \frac{62 \times 10^9}{10^3}$$

Solution

= 2009 + NPER(30%, 0, -1000, 62*10^9)
= 2077

Example

Problem : An ichthyologist estimates that there are 2 million Walleyes in Lake Oskegon in 2009. If they multiply at 5% per year, when was the first fish introduced?

Answer:

Example

Problem : An ichthyologist estimates that there are 2 million Walleyes in Lake Oskegon in 2009. If they multiply at 5% per year, when was the first fish introduced?

Answer: = 2009 - $\log_{1.05} 2 \times 10^6$
= 2009 – nper(5%, 0, -1, 2 * 10^6)
= 1711

Solving for rate

$$FV = PV(1 + rate)^{nper}$$

Solving for rate

$$\frac{FV}{PV} = (1 + rate)^{nper}$$

Solving for rate

$$a^{m^n} = a^{mn}$$

Solving for rate

$$\frac{FV}{PV} = (1 + rate)^{nper}$$

Solving for rate

$$rate = \left(\frac{FV}{PV}\right)^{\frac{1}{nper}} - 1$$

Solving for nper

rate(nper, pmt, pv, fv, type, guess)

Why is there a guess?

$$\text{rate} = \left(\frac{FV}{PV}\right)^{\frac{1}{nper}} - 1$$

- Need to compute $nper_{th}$ root of FV / PV;

Computing the rate Iteratively

1. Answer := guess + 1
2. Try := $Answer^{nper}$
3. If Abs(FV/PV – Try) is acceptable, stop.
4. If Try < (FV/PV) Answer := Answer + increment
5. If Try > (FV/PV) Answer := Answer – increment
6. Goto step 2.

Computing the rate

- If you don't provide a guess, Excel uses 10%
- If Excel doesn't come up with an acceptable answer in 20 iterations, it signals a #NUM error

Example

Problem : You have $10,000 to invest. You're going to need $20,000 in 10 years. What interest rate do you need?

Answer:

Example

Problem : You have $10,000 to invest. You're going to need $20,000 in 10 years. What interest rate do you need?

Answer: $2^{1/10} - 1$

= rate(10, 0, -10000, 20000)

= 7.18%

Example

Problem : Andrew's tomato plants are 3 cm high. He expects them to grow by 1% per week for the 2 months that they remain inside. At what rate will they have to grow when they are outdoors if he wants them to be 20 cm in 6 months?

Answer:

Example

Problem : Andrew's tomato plants are 3 cm high. He expects them to grow by 1% per week for the 2 months that they remain inside. At what rate will they have to grow when they are outdoors if he wants them to be 20 cm in 6 months?

Answer: $= (20 / 3(1 + .01)^{8})^{(1/16)} - 1$

= rate(16, 0, fv(1%, 8,, 3), 20)

= 12%