Time Value of Money

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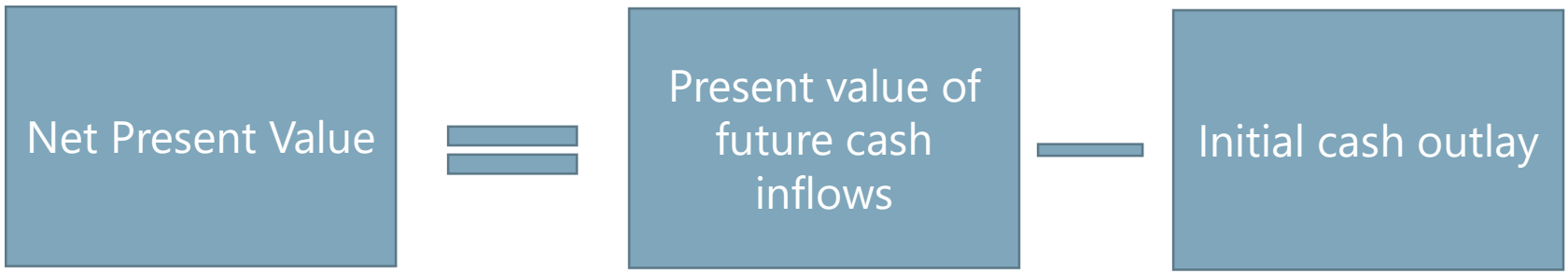
Financial Management

University Elective

Fundamental Principle of Finance



Cash flows occur at different points of time

Comparison and aggregation of such cash flows

Compounding and discounting

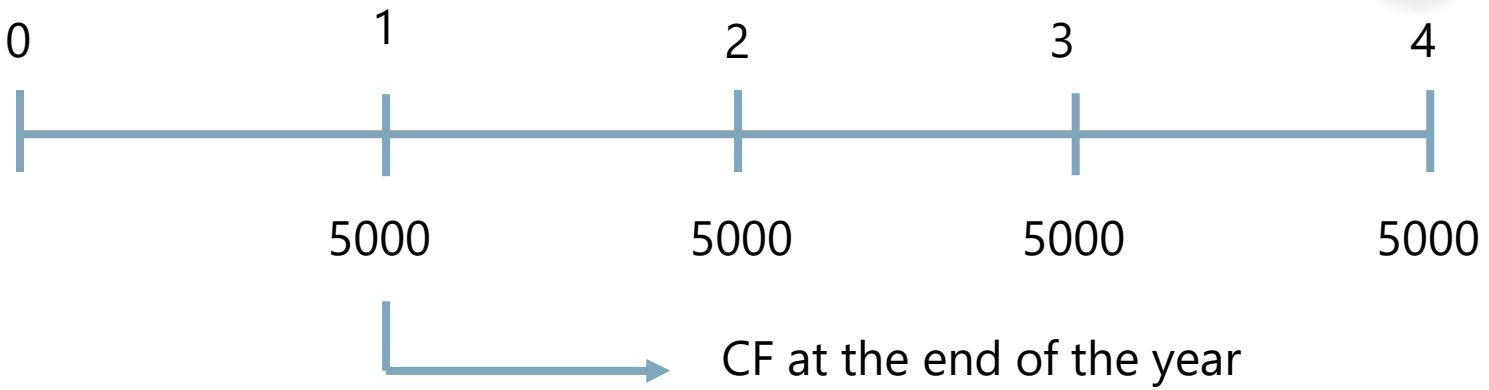
Time Value of Money

- A rupee today is more valuable than a rupee a year hence
- Why?
- Preference for current consumption over future consumption
- Money invested today will grow at a certain rate
- Inflation – purchasing power

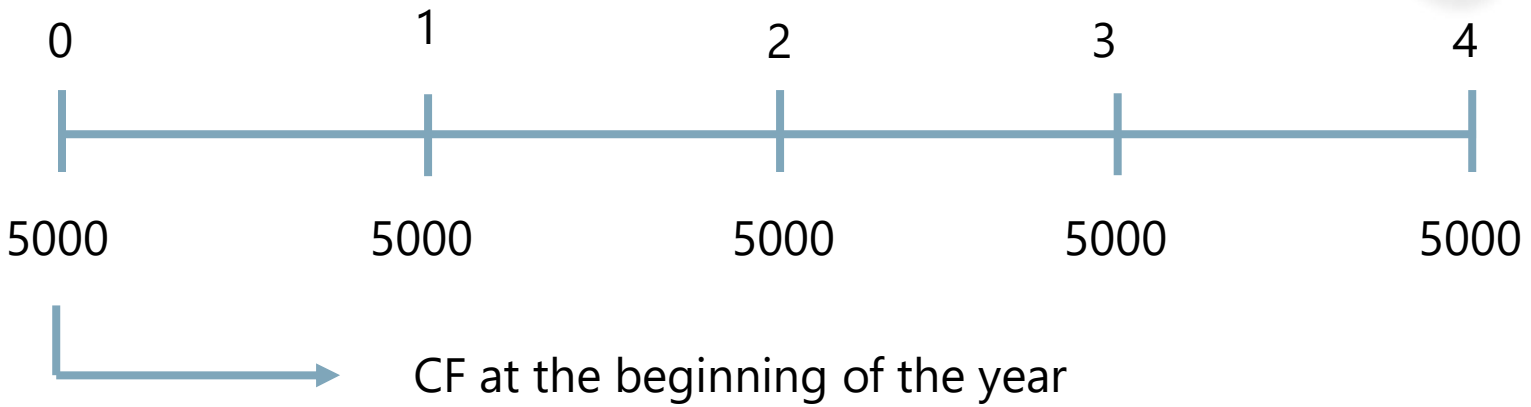
Topics to be covered

- Future value of single amount
- Future value of annuity
- Present value of single amount
- Present value of annuity
- Effective rates

Timeline



Timeline



- CF at the end of year 1 = CF at the beginning of year 2

Notation

- PV – Present Value
- FVn – Future value n years hence
- Ct – Cash flow (CF) occurring at the end of year t
- A – stream of constant periodic CF over a given time
- r – interest rate or discount rate
- g – expected growth rate in CF
- n – number of periods over which CF occurs

Future Value of Single Amount

- You invest Rs 2000 in a scheme for 3 years. The rate of interest is 10%. The interest is reinvested every year.

	Year 1	Year 2	Year 3
Beginning	2000	2200	2420
Interest	200	220	242
Ending	2200	2420	2662

Future Value of Single Amount

- Process of investing money + reinvesting interest earned on it = Compounding
- 2000(1.1)
- 2000(1.1) (1.1)
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- $FVn = PV (1 + r)^n$
- $(1 + r)^n$ – future value interest factor / future value factor

Compound Interest and Simple Interest

- Compound interest – reinvestment of interest
- Simple interest – no reinvestment

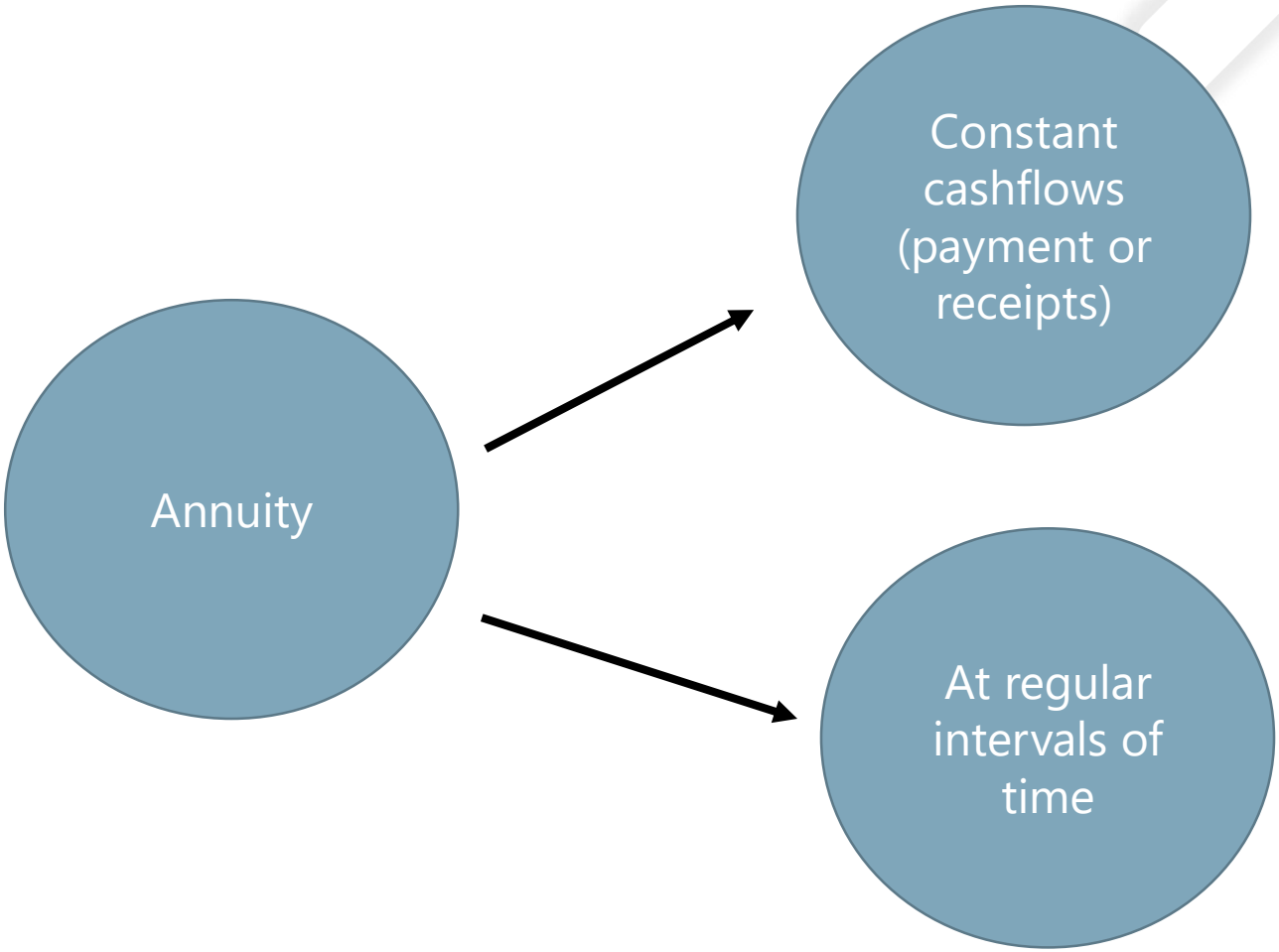
How to calculate FVIF?

- Multiply (1+r) n times
- Use ^ symbol in calculator
- Use table

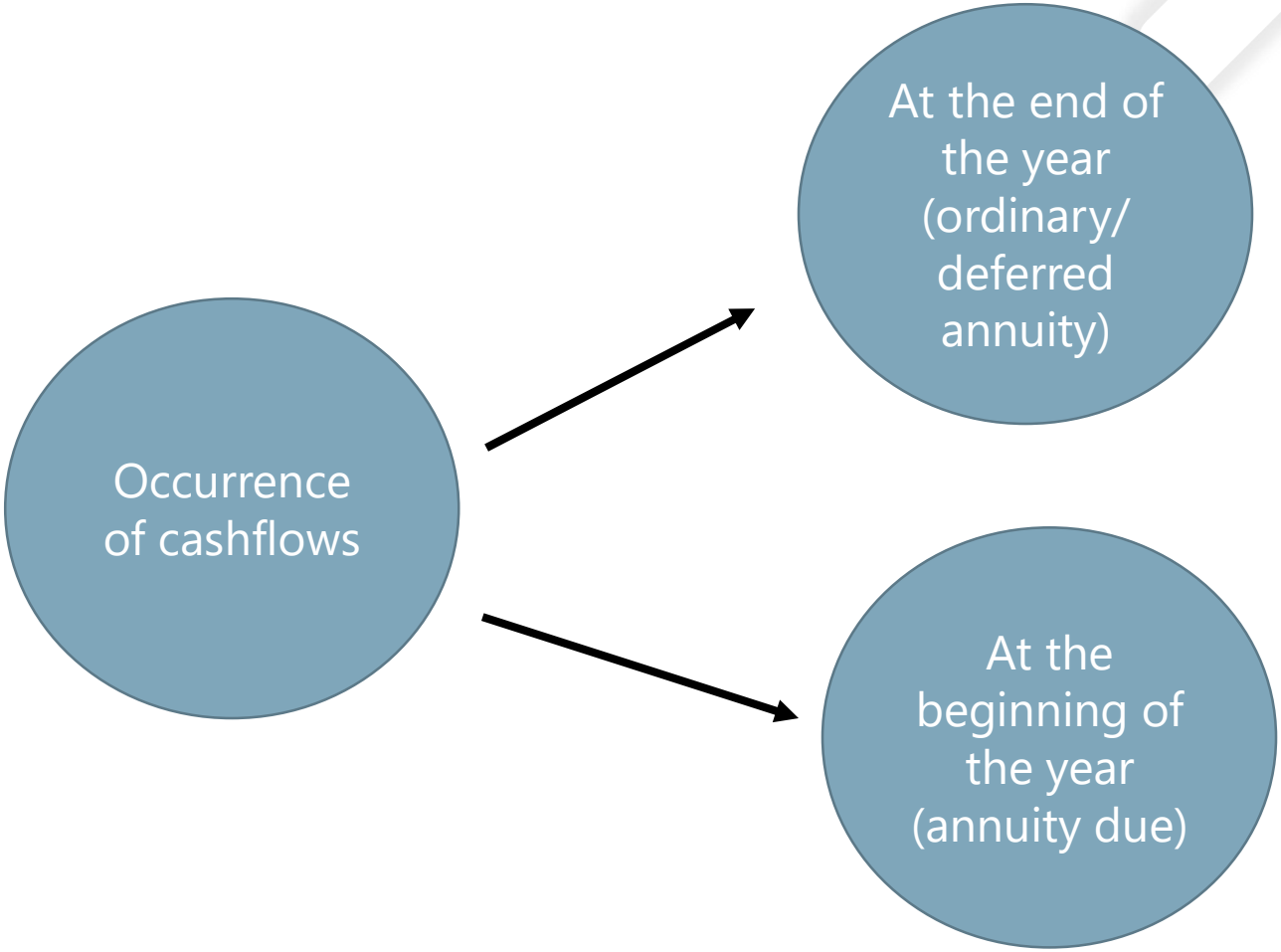
Future Value of Uneven Cashflows

- $FVn = PV\ (1 + r)^{n-1} + PV\ (1 + r)^{n-2} + \ldots + PV\ (1 + r)^{n-n}$

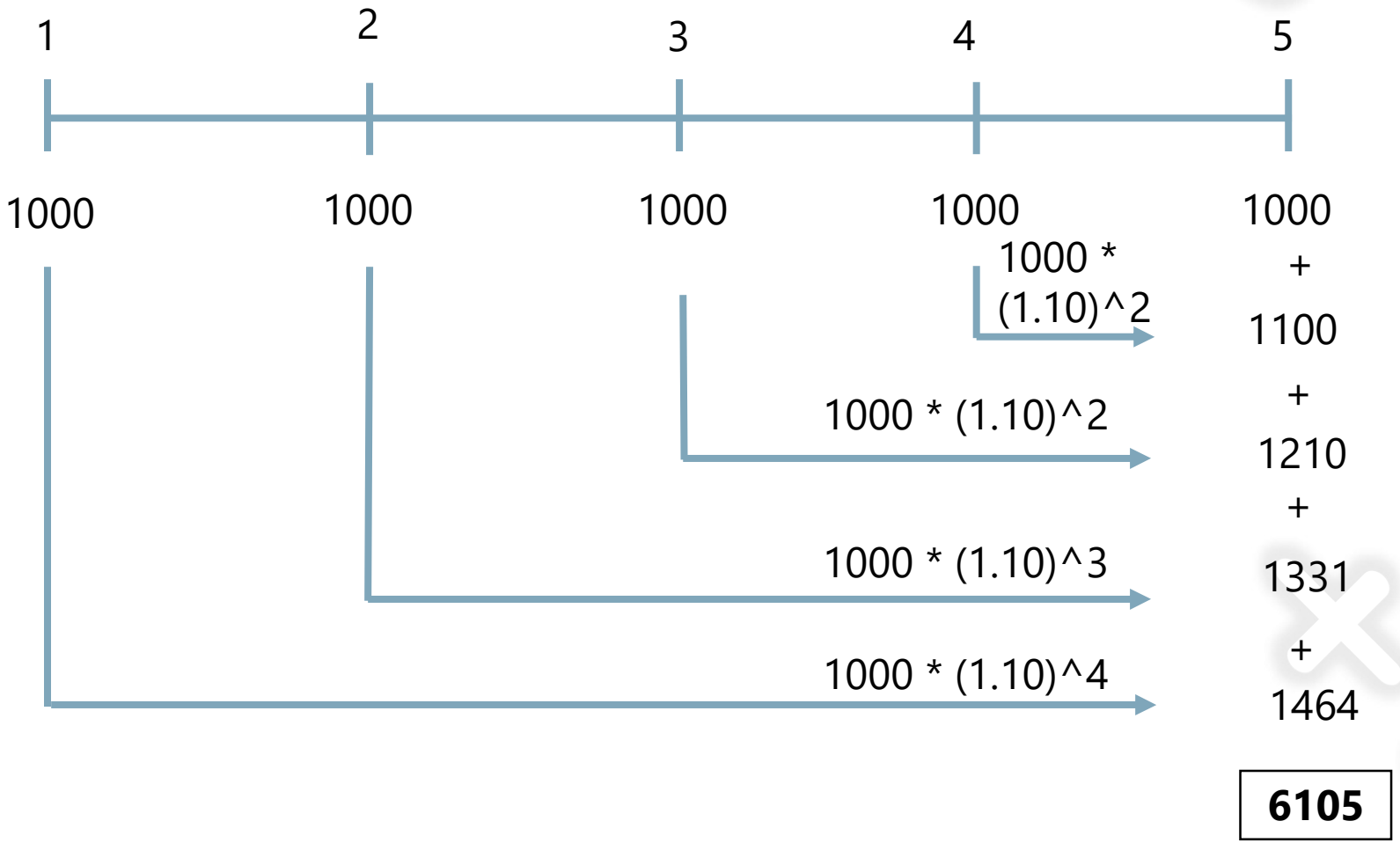
Future Value of Annuity



Future Value of Annuity



Timeline for an Annuity (Future Value)



Formula for Future Value of Annuity

$$FVA_n = A\left[\frac{(1+r)^n - 1}{r}\right]$$

Present Value of a Single Amount

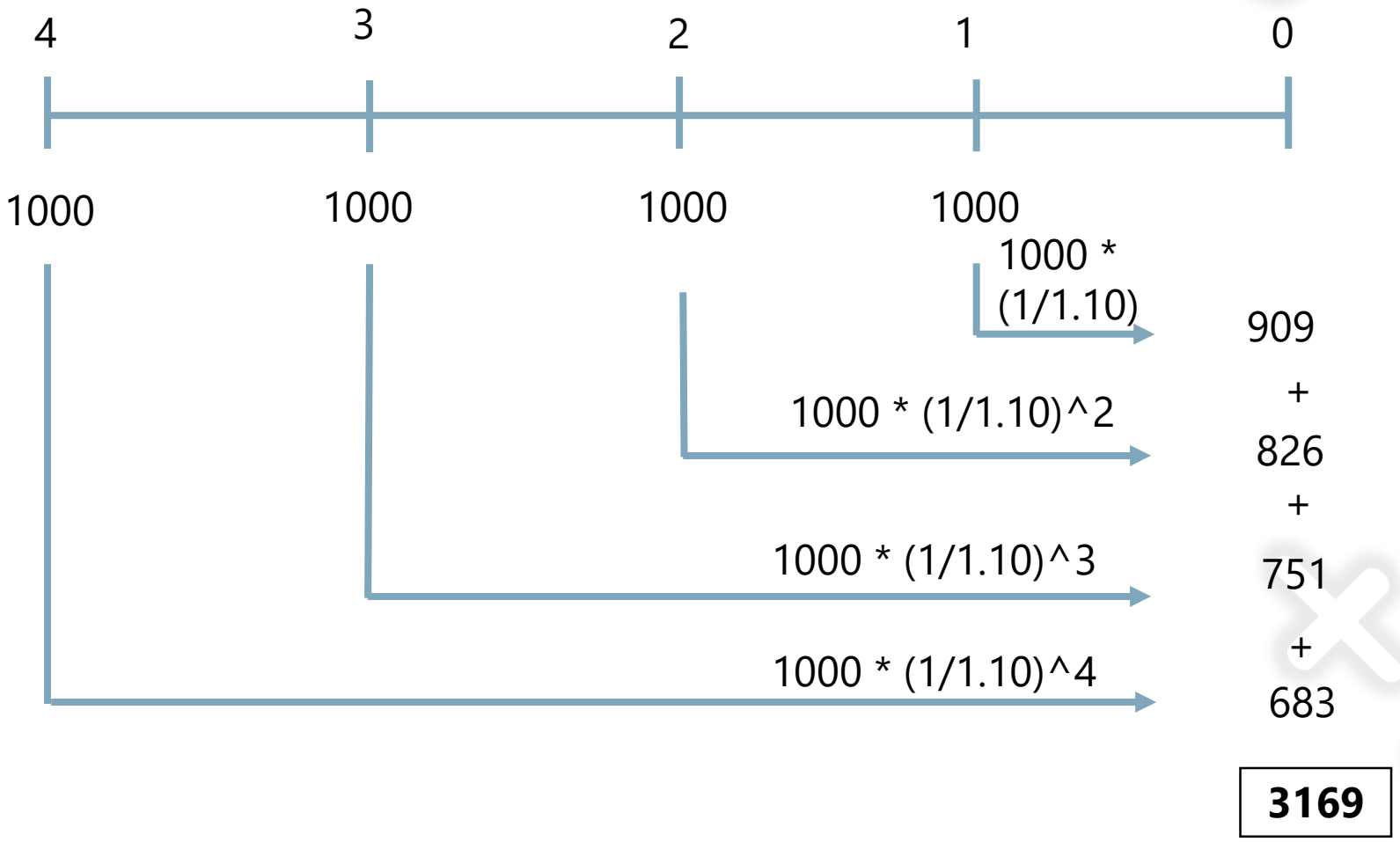
- Discounting to present time
- Discounting – inverse of compounding
- $FVn = PV (1 + r)^n$
- Dividing both sides by $(1 + r)^n$
- $PV = FVn [1/(1 + r)^n]$
- $[1/(1 + r)^n]$ – present value interest factor

Present Value of Uneven Cashflows

- $PVn = C_1/(1+r)^1 + C_2/(1+r)^2 + \ldots + C_n/(1+r)^n$

Timeline for an Annuity (Present Value)

- Receive Rs 1000 annually for 4 years (at the end; r = 10%)



Intra-Year Compounding and Discounting

- $FV_n = PV\ (1 + r/m)^{m*n}$
- m = frequency of compounding

Effective Interest Rates

+ Effective interest rate =

$(1 + \text{stated annual interest rate}/m)^m - 1$

+ Continuous compounding

Effective interest rate = $e^r - 1$

+ Rs 1000 invested for a year at 12% interest

+ Annual compounding – 1120

+ Semi-annual compounding – 1123.6

+ [1000*0.12*0.5 =60] [1060*0.12*0.5=63.6] [1000+60+63.6=1123.6]

Compounding Frequency

Compounding Frequency	m
Annual	1
Semi-annual	2
Quarterly	4
Monthly	12
Weekly	52
Daily	365
Continuous	formula