EduTap

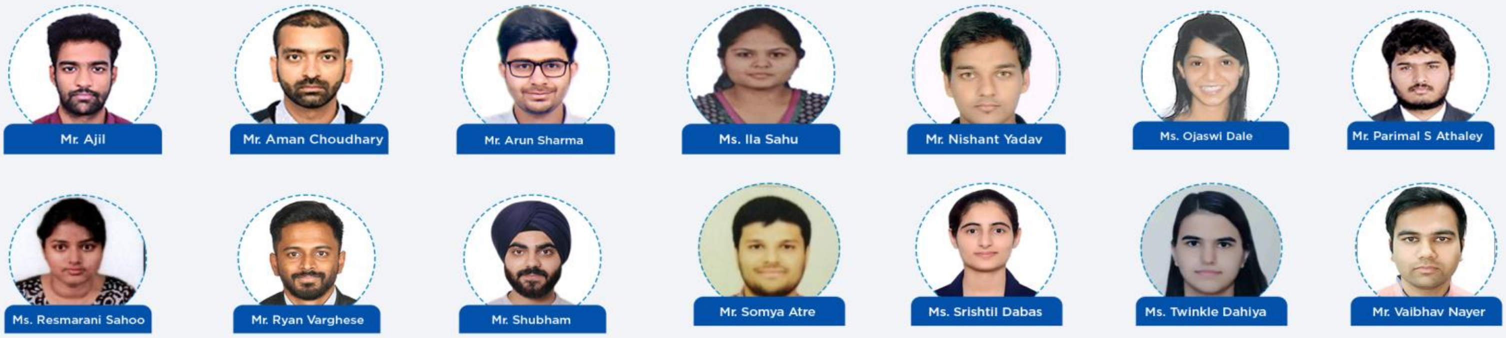
SUMMARY SHEET

Time Value of Money

EduTap

EduTap Hall of Fame

RBI Grade B 2020 - 21
198 Selections Out of 257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Ms. Resmarani Sahoo, Mr. Ryan Varghese, Mr. Shubham, Mr. Somya Atre, Ms. Srishtil Dabas, Ms. Twinkle Dahiya, Mr. Vaibhav Nayer

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63 Selections Out of 80


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NABARD Grade A 2020
65 Selections Out of 69


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Important Points

1. This Summary Sheet shall only be used for Quick Revision after you have read the Complete Notes
2. For Building Concepts, along with examples/concept checks you should rely only on Complete Notes
3. It would be useful to go through this Summary sheet just before the exam or before any Mock Test
4. Questions in the exam are concept based and reading only summary sheets shall not be sufficient to answer all the questions

1 Summary Points

- Time value of money is central to the concept of finance. It recognizes that the value of money is different at different points of time. A rupee today is more valuable than a year.

- Money has time value because - Risk and Uncertainty, Inflation, Consumption, Investment opportunities

- **Simple Interest** = $P0 * (I) * (n)$

  P0 – Initial Amount Invested
  I – Interest Rate
  n – Number of years

  Future Value = Initial Principle/amount + Simple Interest

- **Compound Interest**

  Annual Compounding: Here interest after first year would become part of principal and you would get interest in 2nd year on the interest generated in first year

The total amount (Principal + Interest) at the end would be = $P(1+r)^n$

Compound Interest would be Total Amount - Principal

So, Compound Interest = $P(1+r)^n - P$

Where P is Principal

r is annual rate of Interest

n is number of years

Now compounding can be semi-annual or quarterly or even monthly basis. Semiannual compounding would mean interest would be charged on interest accumulated every 6 months. In the same way, monthly compounding would mean that interest would be charged on interest accumulated every month

The total amount (Principal + Interest) at the end would be = $P\,(1 + r/m)^{m*n}$

Where P is Principal

r is annual rate of Interest per annum

n is number of years

m = Number of times compounding is done during a year

Compound Interest would be Total Amount - Principal

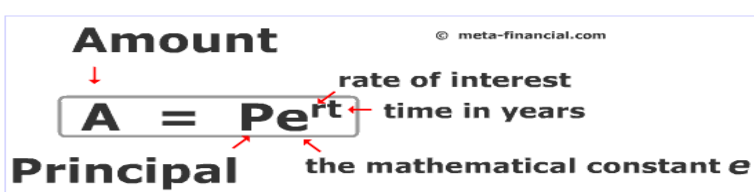
So, Compound Interest = $P\,(1 + r/m)^{m*n} - P$

m = 2 (if the compounding is Half – Yearly)

= 4 (if the compounding is Quarterly)

= 12 (If the compounding is Monthly)

Continuous Compounding: Continuous compounding is the mathematical limit that compound interest can reach. It is an extreme case of compounding since most interest is compounded on a monthly, quarterly or semiannual basis. Hypothetically, with continuous compounding, interest is calculated and added to the account's balance every infinitesimally small instant. While this is not possible in practice, the concept of continuously compounded interest is important in finance.



- **Future Value**

1) Future Value of Money (Single cash flow) $= P(1+r)^n$

This formula would be same as for compounding

2) Future Value Annuity

$$FV_{Ordinary\ Annuity} = C * \left[\frac{(1+i)^n - 1}{i}\right]$$

C = Cash flow per period
i = interest rate
n = number of payments

3) Future Value Annuity Due

$$FV\ of\ Annuity\ Due = (1+r) \times P\left[\frac{(1+r)^n - 1}{r}\right]$$

$P = Periodic\ Payment$
$r = rate\ per\ period$
$n = number\ of\ periods$

- **Present Value**

1) Present Value of single cashflow

$$PV = \frac{FV}{(1+i)^n} \quad \text{or} \quad PV = FV * (1+i)^{-n}$$

If the compounding is – Monthly, Quarterly, half-yearly etc.

P = Future Value / (1 + r/m) ^{m*n}
Where
P is Present Value
FV is Future Value
r is the interest rate per annum
n is the number of years
m is compounding frequency

2) Present Value Annuity

$$PV_{\text{Ordinary Annuity}} = C * \left[\frac{1-(1+i)^{-n}}{i}\right]$$

C = Cash flow per period
i = interest rate
n = number of payments
PV is present value. We can also call it P

3) Present Value Annuity Due

$$PV_{\text{Annuity Due}} = C * \left[\frac{1-(1+i)^{-n}}{i}\right] * (1+i)$$

C = Cash flow per period
i = interest rate
n = number of payments
PV is present value. We can also call it P

4) Present Value Growing Annuities

Let's take an example that the money you would get each year for next n years will keep on growing each year. The annuities which we discussed were having same amount each year but in growing annuities the money will increase by same percentage each year

Suppose you will get C at the end of First year. After that assuming growth rate as g, you will get C (1+g) in the second year, C (1+g) * (1+g) in the third year and like this C * $(1+g)^{n-1}$ in the nth year

So, when you find the present value assuming discount rate as r, you will do like this
Present Value = $C/(1+r) + C^* (1+g) / (1+r)^2 + C^* (1+g)^2 / (1+r)^3 + \ldots\ldots\ldots\ldots C^* (1+g)^{n-1} / (1+r)^n$

By solving this using Geometric progression, we get
Present Value = $C/(r-g) * ([1 - (1+g)^n / (1+r)^n])$

In case discount rate = growth rate (r=g) then
Present Value = $n^* c / (1+r)$

5) Present Value Growing Annuities where first cash flow also includes the growth rate. That is first cash flow is C * (1+g) and not C

Present Value = C (1+g) /(r-g) * ([1 - $(1+g)^n$ / $(1+r)^n$])

If r =g then

Present Value = n* C

6) Present Value Perpetuities

Perpetuity is annuity which goes for infinite period
Present Value of Perpetuity = C/r
Where C is amount received at the end of each year and r is the interest rate

Example: Assume you get rent of 60 each month for next infinite years. Assuming interest rate is 9% find the present value

Solution:

Since this is a perpetuity, we can find present value using

Present Value of Perpetuity = 60/1.09 = 667

7) Present Value Growing Perpetuities

A growing perpetuity is the cash flow expected to grow at constant rate forever for infinite years

Present Value = C / (r -g)
Where C is amount received at the end of each year
r is the interest rate
g is the growth rate

The formula for Present value of Growing Perpetuity only works if the discount rate is more than growth rate. In case discount rate is less than growth rate the r-g will become negative and we will get negative value which is not a valid value

Example:

1000 cash flow is expected to grow at 5% per year for infinite period and the required return used for the discount rate is 10%. Find the present value

Solution:

This is a growing perpetuity.

C = 1000

R =10%

G = 5%

Present Value = C / (r -g)

= 1000 / (.1-.05)

= 20,000

- **The rule of 72** (rule of 70 and the rule of 69.3) is a shortcut to estimate the number of years required to double your money at a given annual rate of return

  No. of Years (To double the money) = 72 / Annual Interest Rate

- **The rule of 114** is a shortcut to estimate the number of years required to triple your money at a given annual rate of return

  No. of Years (To triple the money) = 114 / Annual Interest Rate

- **The rule of 144** is a shortcut to estimate the number of years required to Quadruple your money at a given annual rate of return

  No. of Years (To quadruple the money) = 144 / Annual Interest Rate

- **Effective Interest rate (EIR)**

  The formula for calculation of effective interest is as below:

  $EIR = (1+r/m)^{m} - 1$

  where EIR = Effective Rate of Interest

  r = Nominal Rate of Interest (Yearly Interest Rate)

  m = Frequency of compounding per year

- **Present Value Factors**

Present Value of 1 Factors (PV of 1 factors)

n	1%	2%	4%	8%	12%
2	0.980	0.961	0.925	0.857	0.797
5	0.951	0.906	0.822	0.681	0.567
10	0.905	0.820	0.676	0.463	0.322
12	0.887	0.788	0.625	0.397	0.257
15	0.861	0.743	0.555	0.315	0.183
16	0.853	0.728	0.534	0.292	0.163
24	0.788	0.622	0.390	0.158	0.066

PV Factors gives you the present value of 1 Unit (dollar or rupee) for a combination of years (n) and Interest rates (r). These are also called present Value Interest Factors

Example

You are valuing a project that is expected to run for 5 years and is expected to get one-time cash flow of $500m after five years. You estimate a discount rate of 12%. What is the present value of this cash flow?

Solution Using PV Method:

P = 500 * PV Factor

See combination of n = 5 and interest rate = 12% in the above table, you will find PV factor as 0.567. PV factor for 1 Rupee for 5 years at 12% rate of interest is .567. So, for 500 would 500*.567

P = 500 * .567

P = 283.5

- **Future Value Factors**

  FV Factors gives you the future value of 1 Unit (dollar or rupee) for a combination of years (n) and Interest rates (r). These are also called Future Value Interest Factors

  Suppose at the time of your birth, 25 years ago, your father deposited 1,200 in an account at an annual interest rate of 15 percent. How much money would exist in that account today assuming annual compounding? Assume Future Value factor for 25 years at 15 % interest is 32.91

  Solution:

  Future Value of Money = Principal* Future Value Factor

= 1,200* 32.91
= 39,502.74

- **Present Value Annuity Factors**

PVA Factors gives you the present value of 1 Unit (dollar or rupee) of Annuity for a combination of years (n) and Interest rates (r)

What is the present value if the project which pays cash flows of 1000 per year for each of the next **5** years assuming interest rate to be **5**%? Assume PVAF for 5 years at 5% rate of interest to be 4.329

Solution:

PV = 1000 * PVAF for 5 years at 5% rate of Interest

PV = 1000* 4.329

PV = 4329

- **Future Value Annuity Factors**

FVA Factors gives you the future value of 1 Unit (dollar or rupee) of Annuity for a combination of years (n) and Interest rates (r)

<u>**Example**</u>: Suppose you invest 1000 **at the end of** each year for next **5**years with interest rate to be **5**%. What would be total value of money at the end of 5 years? Assume FVAF for 5 years at 5% rate of interest to be 5.5256

Solution:

PV = 1000 * FVAF for 5 years at 5% rate of Interest
PV = 1000* 5.5256

PV = 5525.6