

- **Time Value for Money** Individual investors generally prefer possession of a given amount of cash now, rather than the same amount at some future time. This *time preference for money* may arise because of (a) uncertainty of cash flows, (b) subjective preference for consumption, and (c) availability of investment opportunities. The last reason is the most sensible justification for the *time value of money*.
- **Risk Premium** *Interest rate* demanded, over and above the *risk-free rate* as compensation for time, to account for the uncertainty of cash flows.
- **Interest Rate or Time Preference Rate** Rate which gives money its value, and facilitates the comparison of cash flows occurring at different time periods.
- **Required Interest Rate** A risk-premium rate is added to the risk-free time preference rate to derive *required interest rate* from risky investments.
- **Compounding** Compounding means calculating future values of cash flows at a given interest rate at the end of a given period of time.
- **Future Value (F) of a Lump Sum** Today (P) for n periods at i rate of interest is given by the following formula:

$$F_n = P(1 + i)^n = P(\text{CVF}_{n, i})$$

The compound value factor, $\text{CVF}_{n, i}$ can be found out from Table A given at the end of the book.

- **Future Value of an Annuity** (that is, the same amount of cash each year) for n periods at i rate of interest is given by the following equation

$$F_n = P \left[\frac{(1 + i)^n - 1}{i} \right] = P(\text{CVAF}_{n, i})$$

The compound value of an annuity factor ($\text{CVAF}_{n, i}$) can be found out from Table B given in Annexure at the end of the book.

- **Sinking Fund** An annuity to be deposited for n periods at i rate of interest to accumulate to a given sum. The following equation can be used:

$$A = F \left[\frac{1}{\text{CVFA}_{n, i}} \right] = F(\text{SFF}_{n, i})$$

Sinking Fund factor ($\text{SFF}_{n, i}$) is a reciprocal of $\text{CVAF}_{n, i}$.

- **Discounting** Discounting means calculating the present value of cash flows at a given interest rate at the beginning of a given period of time.
- **Present Value (P) of a Lump Sum (F)** occurring at the end of n period at i rate of interest is given by the following equation:

$$P = \frac{F_n}{(1+i)^n} = F_n(\text{PVF}_{n,i})$$

The present value factor ($\text{PVF}_{n,i}$) can be obtained from Table C given in Annexure at the end of the book.

- **Present Value of an Annuity (A)** occurring for n periods at r rate of interest can be found out as follows:

$$\begin{aligned}
 P &= A \left[\frac{1 - \frac{1}{(1+i)^n}}{i} \right] = \frac{(1+i)^n - 1}{i(1+i)^n} \\
 &= A \left[\frac{1}{i} - \frac{1}{i(1+i)^n} \right] = A(\text{PVAF}_{n,i})
 \end{aligned}$$

Table D at the end of this book can be used to find out the present value of annuity factor ($PVAF_{n,i}$).

- **Capital Recovery** determining annual cash flows to be earned to recover a given investment. The following equation can be used:

$$A = P \left[\frac{1}{PVF A_{n,i}} \right] = P(CRF_{n,i})$$

Notice that the *capital recovery factor* ($CRF_{n,i}$) is a reciprocal of the present value annuity factor, $PVAF_{n,i}$.

- **Wealth or Net Present Value** It is defined as the difference between the present value of cash inflows (benefits) and the present value of cash outflows (costs). Wealth maximisation principle uses interest rate to find out the present value of benefits and costs, and as such, it considers their timing and risk. The following formula can be used to calculate NPV or wealth of any pattern of cash flows:

$$NPV = W = \frac{NCF_1}{(1+k)^1} + \frac{NCF_2}{(1+k)^2} + \dots + \frac{NCF_n}{(1+k)^n} - C_0 = \sum_{t=1}^n \frac{NCF_t}{(1+k)^t} - C_0$$

- **Multi-period Compounding** When interest compounds for more than once in a given period of time, it is called *multi-period compounding*. If r is the *nominal interest rate* for a period, the *effective interest rate* (EIR) will be more than the nominal rate r in multi-period compounding since interest on interest within a year will also be earned, EIR is given as follows:

$$\text{EIR} = \left[1 + \frac{i}{m} \right]^{n \times m} - 1$$

where m is the number of compounding in a year and n is number of years. Table 2.7 gives the summary of the compounding and discounting formulae.

- **Internal Rate of Return (IRR)** IRR is the rate, which equates the present value of cash flows to the initial investment. Thus in operational terms, in the present value equation, all variables are known except r ; r can be found out by trial and error method:

$$NPV = W = \frac{\text{NCF}_1}{(1+r)^1} + \frac{\text{NCF}_2}{(1+r)^2} + \dots + \frac{\text{NCF}_n}{(1+r)^n} - C_0 = \sum_{t=1}^n \frac{\text{NCF}_t}{(1+r)^t} - C_0 = 0.$$

