UNIT 2 TIME VALUE OF MONEY

Structure

2.0 OBJECTIVES

After studying this unit, you should be able to:

- explain future value and present value concepts;
- explain compound interest and discount;
- compute future value of a single amount and an annuity; and
- compute present value of a single amount and an annuity.

2.1 INTRODUCTION

You must have heard that a rupee today is worth more than a rupee tomorrow. Did you imagine, why is it so? Let me tell you by an example. Anil's grandfather decided to gift him rupee one lakh (1,00,000) at the end of five years; and gave him a choice of having Rs. 75,000 today. Had you been in Anil's place what choice would you have made? Would you have accepted Rs. 1,00,000 after five years or Rs. 75,000 today? What do you say? Apparently, Rs. 75,000 today is much more attractive than Rs. 1,00,000 after five years because present is certain than future. You could invest Rs. 75,000 in the inarket and earn return on this amount. Rs. 1,00,000 at the end of five years would have less purchasing power due to inflation, We hope you have got the message that a rupee today is worth more than a rupee tomorrow. But the matters money are not so simple. The time value of money concepts will unravel the mystery of such choices which all of us do face in our daily life. We may say a good understanding of time value of money constitute 90% of finance sense. Investment decisions involve cash flow occurring at different points of time. Therefore, recognition of time value of money is very important. In this unit, you will learn about compound interest and discount concepts and how future value of a single amount and an annuity and present value of a single amount and an annuity is calculated.

Let us start with future value of a single amount for a single period and more than one period.

2.2 FUTURE VALUE OF A SINGLE CASH FLOW

First of all let us explain the meaning of future value. By future value (FV) we mean the amount of money an investment will grow to over some period of time at some given interest rate. In other words, future value is the cash value of an investment at sometime in future.

Future Value of a Single Amount for Single Period

If you deposit Rs. 1000 in a fixed account of your bank at 10% interest per year, how much you will get after one year'? You will get Rs. 1100. This is equal to your principal amount Rs. 1000 and Rs. 100 interest which you have earned on it in a year. Hence, Rs. 1100 is the future value of Rs. 1000 deposited (invested) for one year at 10 per cent. It means that Rs. 1000 today is worth Rs. 1100 in one year given that 10 per cent is the interest rate.

Thus, if you invest for one period at an interest rate of i, your investment will grow to (1+i) per rupee invested. In tlic above example, i is 10 per cent.

Future Value of a Single Amount for more than One Period

Taking the previous example, if you invest the same amount for two years what will you have after two years, assuming tlic interest rate remain the same ? *You* will earn Rs. 1100+10 + Rs. 100 interest during the second year so you will have total of Rs. 1210 (1100+110). This is the future value of Rs. 1000 for two years at 10 per cent.

You can notice here that this Rs. 1210 has four parts. First part is Rs. 1000 which is the principal amount, second part is Its. 100 as interest earned in first year and third part is another Rs. 100 earned as interest in second year. The fourth and last is Rs. 10 which is the interest earnecl in second year on interest paid in first year Rs. 100 x10 = Rs. 10. So tlie total interest earned is Its. 210. Hence, the future value is Rs. 1210 (1000+100+1oo+10).

The process of putting your money and any accumulated interest on an investment for more than a period, thereby reinvesting the interest is called **compounding.** Compounding tlie interest means earning interest on interest. We can call tlie result compound interest. The interest earned each period only on tlie original principal is called **simple interest.**

Future value of a single cash flow can be calculated by tlie following formula :

$FV_n = PV (1 + i)^n$

FV_n = future value for n years

PV = cash flow

i = rate of interest per year

n = total number of years

Future value of a single cash flow for n years

Year	Amount in the beginning of the period	Interest	Amount at the end of the period
1	PV	PV X i	$PV_1=PV(1+i)$
2	$PV(1+i)$	$PV(1+i)i$	$PV_2=PV(1+i)^2$
3	$PV(1+i)^2$	$PV(1+i)^2i$	$PV_3=PV(1+i)^3$
n-1	$PV(1+i)^{n-2}$	$PV(1+i)^{n-2}i$	$PV_{n-1}=PV(1+i)^{n-1}$
n	$PV(1+i)^{n-1}$	$PV(1+i)^{n-1}i$	$PV_n=PV(1+i)^n$

The above equation in the table is a basic equation in compounding analysis. The $(1+i)^n$ factor is called the compounding factor or Future Value Interest Factor (FVIF). As the calculations become very difficult with increasing number of years, the published tables. called Future value tables are available showing value of $(1+i)^n$ with different combinations of i and n. You would see such tables attached at the end of this block of this course and can use these tables to find out future value factor. If you have to find future value factor at 10% for five years, find the column that corresponds to 10 percent and then look down the rows until you come to five years. That is how we found the future value factor 1.611 for the example given below.

What will be your Rs. 1000 worth after five years at 10% ?

$FV_n = PV(1+i)^n$

$= 1000 \times 1.611$

$=$ Rs 1611

The total interest earned on Rs. 1000 in five years is Rs. 611.

In five years the total simple interest earned is Rs. 500, i.e., Rs.100 per year at 10% and Rs. 111 (Rs. 611–500) is from compounding. Table given below shows the simple interest, compound interest and total amount earned each year and at the end of five years.

Table 2.1

Year	Amount in the beginning	Simple interest	Compound interest	Total interest earned	Amount at the end of year
1	Rs. 1000	100	0	100	1100
2	Rs. 1100	100	10	110	1210
3	Rs. 1210	100	21	121	1331
4	Rs. 1331	100	33.1	133.1	1464.1
5	Rs. 1464.1	100	46.4	146.4	1610.5
		500	**110.5**	**610.5**	**1611**

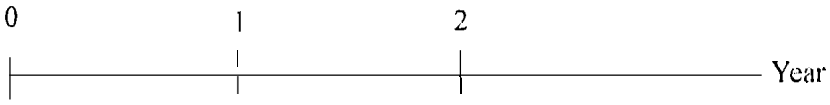
We have discussed the future value of a lumpsum (single) amount for number of years. Now let us calculate **future value of multiple cash flows.**

Let us start with same example. Suppose you deposit Rs. 1000 today in a bank at 10%. In one year you again deposit Rs. 1000. How much now you have in two years? At the end of the first year you will have Rs. 2100. i.e., (Rs. 1100 + second deposit Rs. 1000).

Since you have left this deposit for another year at 10%, Therefore at the end of second year you will have Rs. 2100 x 1.10 = Rs. 2310.00

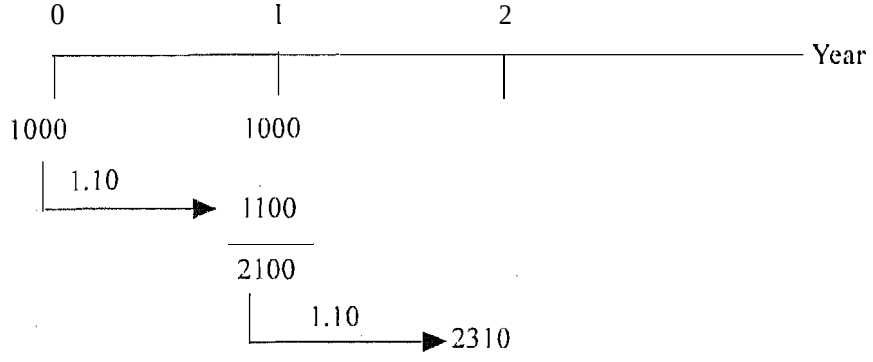
Let us illustrate it with help of a graph, also called time line

1)



Cash flows 1000 1000

2) Future value



This is one way of finding out future value of two deposits of Rs. 1000. There is another method. The first Rs. 1000 is deposited for two years at 10%, therefore, its future value is Rs. 1000 x 1.10^2 = 1000 x 1.2100 = Rs. 1210

The second Rs. 1000 is deposited for one year at 10%, so its future value is Rs. 1000 × 1.10 = Rs. 1100

The total value is = 1210 + 1100 = Rs. 2310

So there are two ways to calculate future value for multiple cash flows.

1) Compound the accumulated balance forward one year at a time.

2) Calculate tlie future value of each cash flow first and then add them.

Both methods will give you the same answer. You can use anyone of them.

Effect of Compounding

You may remember tlie example of Anil in the very beginning. Suppose his great grand father had invested Rs. 100 for 60 years ago at 10% interest rate. How much it would have grown till today? Let us find out the future value Factor.

FVIF = $(1 + .1)^{60} = 1.1^{60} = 304.48$

FV = 100 × 304.48 = Rs. 30,448.00

In this case simple interest is Rs. 600 where as the balance Rs. 29,848 (30,448 – 600) is from compounding. Therefore, the effect of compounding is great over long periods as compared to short periods

2.3 FUTURE VALUE OF AN ANNUITY

An annuity is a series of payments (or receipts) of fixed amount e.g., payment of premium in case of life policy and home loans etc. Annuity may be of two types : (n) regular or ordinary annuity, and (b) annuity due. In case of regular annuity the payment or receipt occurs at the end of each period. If the payment or receipt occurs at the beginning of each period it is called annuity due.

Future Value of Regular (ordinary) Annuity

The compound value of an annuity is the total amount one would have at the end of the annuity period if the amount is invested at a certain rate of interest and is held to the end of the annuity period. A promise to pay Rs. 1000 a year for 5 years is a 5 year annuity.

Illustration 1 : if you deposit Rs. 5000 at tlie end of every year in a bank for 5 years and the bank is paying 10% interest, the future value of this annuity will be Rs. 30,525.5.

$Rs.5000(1.10)^4+Rs.5,000(1.10)^3+Rs.5000(1.10)^2+Rs.5000(1.10)+Rs.5,000$

Or

$Rs.5000\ (1.4641)+Rs.5,000(1.3310)+Rs.5000(1.2100)+Rs.5,000(1.10)+Rs.5,000$

$= Rs.\ 30,525.5$

The above procedure can be expressed as given below :

Future Value of An Annuity

$$FVA = A \quad \frac{(1+i)^n - 1}{}$$

A = Periodic cash flow

i = Interest rate

n = Number of years

Taking the figures from illustration 1

$$FVA = 5000 \left[\frac{(1+.10)^5 - 1}{.10} \right]$$

$$FVA = 5000 \left[\frac{(1.6105 - 1)}{.10} \right]$$

$$FVA = 5000 \times \frac{0.6105}{0.10}$$

$$FVA = 5000 \times 6.105$$

$$FVA = Rs.\ 30,525$$

In the formula $\frac{1+i)^n - 1}{i}$ is called future value interest factor of an annuity. You can find out the FVIFA from the table, see the table for 10% for 5 years it is 6.105.

You can directly multiply 5000 by 6.105 and will get Rs. 30525 as future value of annuity.

Illustration 2: A person plans to contribute Rs. 2,000 every year to a retirement account which is paying 8% interest. If the person retires in 30 years, what is the future value of this amount?

$FVA = A\ [(1+i)^n - 1/i]$

$FVIFA = (1 + .08)^{30} - 1/.08$

$= 10.063 - 1/.08$

$= 113.28$

You can also directly find out future value interest factor for an annuity (FVIFA) at 8% for 30 years from tlie future value annuity table, it is 113.28

Future value of annuity is = 2,000 x 113.28 = Rs. 2,26560

Finding the interest rate (i)

Illustration 3 : Suppose you receive a lumpsum of Rs. 94,000 at the end of 8 years after paying annuity Rs. 8,000 for 8 years. What is the implicit rate (i) in this ?

First of all find $FVIFA_{in}$

$$96{,}000 = 8{,}000\ FVIFAi_8$$

$$FVIFAi_8 = \frac{96{,}000}{8{,}000} = 12$$

Look at tlie future value annuity table and see the row corresponding to 8 years until we find value close to 12, it is 12.300 and is below the column of 12%. Hence interest rate is below 12 per cent.

Finding the Annual Annuity

Now, take an example where the total **annuity future value** (received or paid), **rate of interest** and tlie **period is known.** You are required to find tlie amount of **annual annuity.** How much you should deposit in a bank annually so that you get Rs. 1,50,000 at the end of 10 years at 10% rate of interest?

$$\text{Annual Annuity} = 1{,}50{,}000 \times \frac{1}{FVIFA_{10,10}}$$

$$= \text{Rs. } 1{,}50{,}000 \times \frac{1}{15.937}$$

$$= \text{Rs. } 9{,}412.05$$

So you should deposit Rs. 9,412.05 in a bank every year for 10 years in order to get Rs. 1,50,000 at the end of 10 years.

Note: The $FVIFA_{in}$ is called sinking fund factor, when used as a denominator.

Illustration 4: How much a person should save annually to accumulate Rs. 1,00,000 for his daughter's marriage by tlie end of 10 years, at the interest rate of 8%.

$$\text{Annual Annuity} = 1{,}00{,}000 \times \frac{1}{FVIFA_{in}}$$

$$\text{Annual Annuity} = 1{,}00{,}000 \times \frac{1}{1_{4.487}}$$

$$= 1{,}00{,}000 \times .073$$

$$= \text{Rs. } 6{,}903$$

A person should save Rs. 6,903 annually for 10 years to get Rs. 1,00,000.

Future Value of Annuity Due

An annuity for which the cash flows occur at the beginning of each period is called, annuity due. Lease and installment are tlie example of annuity due.

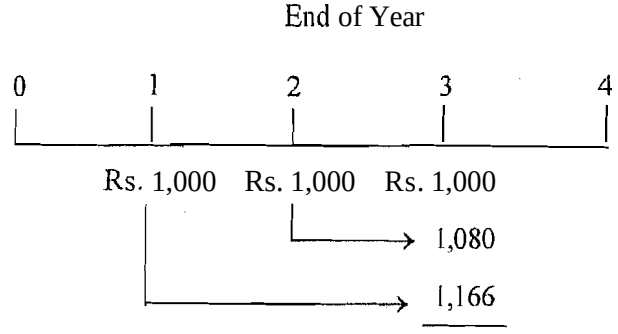
To compute annuity due. tlie methods used in calculating ordinary annuity with some changes will be applied.

Let us start with the calculation for tlie future value of a Rs. 1,000 ordinary annuity for 3 years at 8 percent and compare it with that of the future value of a Rs. 1,000 annuity due for 3 years at 8 per cent. Note that the casli flows for the ordinary annuity occur at the end of periods 1, 2, and 3, while those for the annuity due occur at the beginning of periods 2, 3 and 4. Therefore, the difference between tlie future value of an ordinary annuity and annuity due is the point at which the future value (FV) is calculated. For an ordinary annuity. FV is calculated as of the last cash flow. while for an annuity due, FV is calculated as of one period after tlie last cash flow.

Tie future value of the 3 year annuity due is simply equal to the Future value of a 3 year ordinary annuity compounded for one more period. The future value of an annuity due is determined as

$FVAD_n$ = ordinary annuity future value x (1+i)

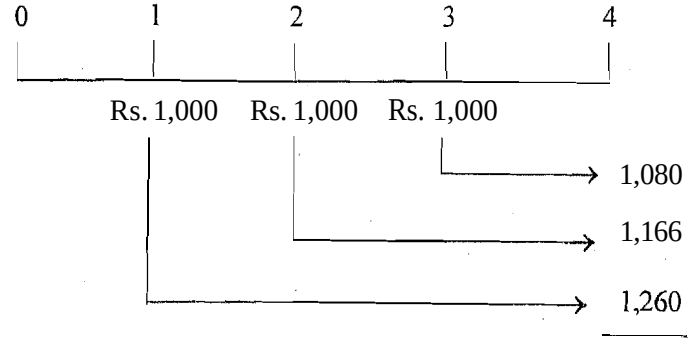
Ordinary annuity



(Rs. 1,000) ($FVIF_{8\%, 3}$) = (Rs. 1,000) (3.246) = Rs. 3,246

Future value of an ordinary annuity at 8% for 3 years, is Rs. 3246

Annuity due



(Rs. 1,000) ($FVIFA_{8\%\ 3}$) (Rs. 1.08) = (Rs. 3,246) (1.08) = Rs. 3,506

Future value of an annuity due of 8% for **3** years (FVAD,). = Rs. 3,506

Check Your Progress A

1) What do you mean by future value?

.....

.....

.....

.....

.....

2) What is compounding?

.....

.....

.....

.....

.....

3) What is the difference between regular annuity and annuity due?

.....

.....

.....

.....

.....

4) You have deposited Rs. 10,000 in a fixed deposit in a bank at 6% rate of interest. How much will you get after 5 years?

.....

.....

.....

.....

.....

5) How much Rakesh will get after 12 years if lie deposits Rs.2,500 today in a fixed disposit at 1O%?

.....

.....

.....

.....

.....

2.4 PRESENT VALUE OF A SINGLE CASH FLOW

You have seen that tlie future value of Re. 1 for one year at 10% is Rs. 1.10. Now, we put a question in a different way. How much you have to invest today at 10% to get Re. I in one year? You know tlie future value here is Re. 1, but what is tlie present value of Re. 1? You need Re. 1 at the end of the year, the present value will be:

You know that $PV\ (1 + i)^n = FV_n$

$$PV = \frac{1}{(1+.1)^1} = \frac{1}{(1.1)}$$

$$= \text{Re } .909$$

Present value of Re 1 is Re. 909. Let us see the discount factor here

$$PV = \frac{FV_n}{(1+i)^n}$$

$$= FV, \frac{}{(1+i)^n}$$

In this equation $\frac{1}{(1+i)^n}$ is the present value interest factor or discount factor

Suppose you want to earn Rs. 1500 in three years at 7% rate of interest. How much should you invest today to get Rs. 1,500 in three years?

$$PV = 1500 \frac{1}{(1.07)^3}$$

$$= 1500 \times .8163 = \text{Rs. } 1224$$

Present value is just the opposite of future value. In future value we do compounding of money. In present value concept we discount back to the present. Tlie process of reducing future income payments to their present value is called **discounting.** The value today of the sum received in the future is called its present value. If you want to know PV of Rs. 500 in one year at 8%, then:

$PV \times 1.08 = \text{Rs. } 500$

$$PV = 500' \times \frac{1}{1.08} = \text{Rs. } 462.5$$

You need not do much calculations. Present Value Tables help you in finding out present value of cash flow. These tables are given at the end of this block. Just multiply the present value interest factor by the amount. So, Rs.500 x 0.925 = Rs. 462.5. (See P.V. factor at 8% for one year in present value table, it is 0.925).

2.5 PRESENT VALUE OF SERIES OF CASH FLOWS

Tlie series of cash flows may be

a) Even series of cash flows i.e., annuity

b) Uneven series of cash flows

As you know in tlie equation the $1/(1+i)^n$ is called discount factor or present value factor and tlie rate used is called discount rate. Tlie technique of calculating the present value of a future cash flow is called 'Discounted Cash Flow (DCF)' valuation.

2.5.1 Present Value of an Annuity

You want to have Rs. 800 at tlie end of each of three years. If the discount rate is 10%. What tlie present value of Rs.2,400?

There are two methods to find out present value.

Under first method the present value of an annuity is tlie sum of the present values of all the inflows of this annuity. It can be expressed as follows:

$$\text{Rs. } 800 \left(\frac{1}{1.10}\right)^1 + 800 \left(\frac{1}{1.10}\right)^2 + 800 \left(\frac{1}{1.10}\right)^3$$

= Rs. 800 x 0.9091 + Rs. 800 x 0.8264 + Rs. 800 x 0.7513

= Rs. 727.28 + 661.12 + 601.04 = Rs. 1989.44

Tlie above can be arrived by tlie formula

$$\text{or PVA} = \frac{A}{(1+i)} + \frac{A}{(1+i)^2} + \frac{A}{(1+i)^3} + \cdots\cdots + \frac{A}{(1+;)i)^{-1}} + \frac{A}{(1+i)^n}$$

$$\text{PVA} = A\,\frac{(1+i)^n - 1}{i(1+i)^n}$$

$\left\{\frac{(1+i)^n-1}{i(1+i)^n}\right\}$ is present value interest factor for annuity ($PVIFA_{in}$)

A = annuity amount

I = discount rate

n = number of years

PVA = present value of annuity

Alternate Method

Instead of calculating present value for each year we can multiply annuity amount by annuity present value interest factor. See annuity P.V. interest factor table, it is 2.48685 at 10% for 3 years. So Rs. 800 x 2.48685 = Rs. 1989.44 is the present value of an annuity.

Note: If present value annuity table is not available the PVIFA can be calculated as follows:-

$$\text{Present value interest factor} = \frac{1}{(1.1)^3} - \frac{1}{1.331}$$

$$= .75131$$

$$\text{Present value interest factor for annuity} = \frac{1 - \text{P.V. factor}}{I}$$

$$= \frac{(1 - .75131)}{.10}$$

$$= \frac{.248685}{.10} = 2.48685$$

2.5.2 Present Value of Uneven Cash Flaws

You may often get uneven cash flow streams. The example is dividend on equity shares.

Illustration 5: Aman makes an investment in a mutual fund which promises following cash flows for five years. The discount rate is 10%. Find the present value.

Year	Cash flow (Rs.)
1	1,000
2	2,000
3	2,000
4	3,000
5	3,000

First, see present value table to find present value factor.

Year	**Cash** flows **(Rs.)**	**P.V. factor**	P.V. **of each cash flow (Rs.)**
1	1,000	0.9091	909.1
2	2,000	0.8264	1,652.8
3	2,000	0.7513	1,502.6
4	3,000	0.6830	2,049.0
5	3,000	0.6209	1,862.7
		Total P.V.	Rs. 7,976.2

Perpetuities: When the cash flow is for an indefinite period, it is called a perpetuity or CONSOLS. It is a special type of annuity. Its present value can be found by dividing cash flow by discount rate (Cash flow/ Discount rate). For example, if you get an offer of a perpetual cash flow of Rs 1000 every year and return required is 16%. The value of the perpetuity will be:

$$\frac{1000}{0.16} = \text{Rs. } 6250$$

It means if Rs, 6250 is invested at 16% rate of interest, it would provide a yearly income of Rs. 1,000 every year.

Present value of an annuity due

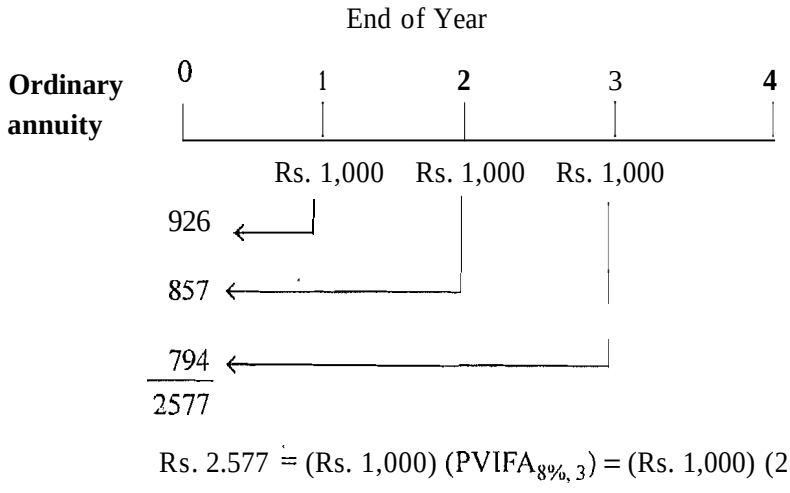
Let us see how the present value of an annuity due can be calculated. We will calculate both the present value of a Rs. 1,000 ordinary annuity at 8 per cent for 3 years (PVA_3), as well as the present value of Rs. 1,000 annity due at 8 per cent for 3 years (PVAD).

The present value of a 3 year annuity due is equal to the present value of a 2 year ordinary annuity plus one non-discounted periodic receipt or payment. In other words first calculate the present value of annuity for 2 year and add back the amount of annuity to that amount. It can be calculated as given below:

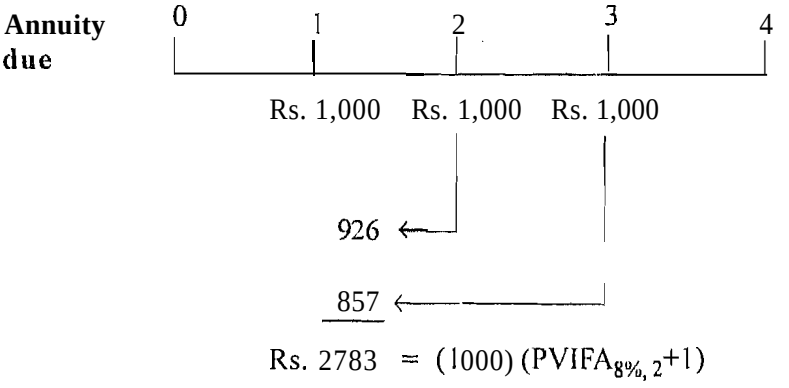
$PVADn = A\ (PVIFAi_{n-1} + 1)$

You could see the present value of an annuity due as the present value of an ordinary annuity that had been brought back one period too far. That is, you want the present value one period later than the ordinary annuity value and then compound it one period forward. The formula for camputing PVADn is:

$PVAD_{,,}$ = Ordinary annuity present value $\times (1+i)$



Rs. 2.577 = (Rs. 1,000) $(PVIFA_{8\%, 3})$ = (Rs. 1,000) (2.577)



Rs. 2783 = (1000) $(PVIFA_{8\%, 2}+1)$

(1.08) (Rs. 1,000) $(PVIFA_{8\%, 3})$ = Rs. (2783) = (Rs. 1,000) $(PVIFA_{8\%, 2+1})$

(1.08) (Rs. 1,000) (2.577) = Rs. 2,783 = (Rs. 1.000) (2.783)

You notice here that above formula is used for calculating future and prsent value of annuity due.

So two steps are involved here.

i) Calculate the future/present value of annuity and .

ii) Multiply your figure by (1+i)

Finding Discount Rate, Annual Payments

Discount Rate

For a single period you can find tlie rate by using PV equation. Suppose you invest Rs. 1,200 and after one year you get Rs. 1,320. Using PV equation you get:

$$PV = FV_n / (1+i)^n$$

$$\text{Rs. } 1200 = \frac{1320}{(1+ i)}$$

$$1 + i = \frac{1320}{1200} = 1.10$$

$$i = 10\%$$

Suppose you want Rs. 1,200 to double in 8 years. At what rate should you invest?

$$(1 + i)^8 = \frac{\text{Rs. } 2,400}{\text{Rs. } 1,200} = 2$$

To find the rate use future value table. The future value factor after 8 years is equal to 2. If you look the line corresponding to 8 periods in the Table, the future value factor 1.99256 (round of 2) corresponds to 9% . Therefore tlie interest rate is 9%.

Note:-A rule called 'Rule 72' can be used where the amount is to be doubled. The rule is divide 72 by interest rate. If interest rate is 9% tlie doubling period will be $\frac{72}{9} = 8$ years.

This rule can be used in the 5% to 20% range. For example for interest rate of 6% the doubling period is about $72 \div 6 = 12$ years. Another rule of thumb to calculate accurate doubling period is called Rule of 69. Formula is $0.35 + 69/\text{interest rate}$. Take interest rate 9% and 12% from the example the doubling period will be $0.35 + 6919 = 8.01$ years and $0.35 + 69112 + = 6.1$ years respeclively.

In case of an annuity, the rate can be known with the help of "Present value of an annuity" Table. Suppose a mutual fund offers pay you to Rs. 30,000 for 8 years, if you pay now Rs. 1,50,000. It means PV = 1,50,000, cash flow Rs. 30,000 and period is 8 years. In the table find tlie Factor 5 (1,50,000/30,000) in line of 8 years. It is about 12%.

In case of uneven series, tlie table can't be used. The rate is found by 'Trial and Error' method. Consider the following example :

Year	**Cash flows**	PV
1.	Rs. 10,000	Rs. 50,000
2.	Rs. 20,000	
3.	Rs. 40,000	

Steps

1) Assume two different rates
2) Find the present values at these two assumed rates
3) Compare these present values with PV as given and make approximation.
   a) Let us assume 20% and 15%.
   b) The PV at 20% = Rs. 45,330 and at 15% = Rs. 50,140. Since PV given is Rs. 50,000 so approximately rate is 15%.

The **annual** payment

Suppose you need a loan of Rs. 50,000 at the interest rate of 15%, and you want to repay your loan in six annual installment. What will be the annual payment?

$$\text{Present value of Annuity} = \text{Annual Annuity} \times \frac{1 - (\text{present value factor})}{1}$$

$$50{,}000 = \text{Annual Annuity} \times \frac{1 - \left(\frac{1}{(1.15)^6}\right)}{.15}$$

$$50{,}000 = \text{Annual Annuity} \times \frac{1 - .432}{.15}$$

$$50{,}000 = A \times 3.786$$

$$\text{Annual Annuity} = 50{,}000 / 3.786$$

Annual Annuity = Rs. 13206

You will have to pay Rs. 13,206 each for 6 years.

Check Your Progress B

1) Tick the correct Statement.

   a) Discount factor is rate of discount to calculate future value.

   b) Coinpounding is the process of calculating interest on principal.

   c) Dividend on preference shares is a perpetuity.

   d) Annuity is the same amount received every year.

   e) Rule of "72" can be applied every where.

2) What is the present value of a perpetuity?

.....

.....

.....

.....

2.6 LET US SUM UP

The concept of time value of money refers to the fact that money say Re. 1 received today is different in its worth from Re. 1 received at any time in future. In other words money received in future is less valueable than the money received today. The time value of money helps in converting the different rupee amounts arising at different points of time into equivalent values of a particular point of time. These equivalent values can be expressed as future values or as present values, By compounding technique the present value can be converted into a future value and by discounting method future value can be converted to present value. For this we make use of rate of interest or discount factor. Both can be calculated for a single amount and an annuity.

2.7 KEYWORDS

Annuity : It is a series of equal future cash flows periodically.

Annuity due : An annuity for which the cash flows occur at the beginning of the period.

Compounding : The process of reinvesting principal and interest to earn interest for another period

Compound Interest : Interest earned on both the principal and the interest reinvested from prior periods.

Discount Factor or Rate : The rate of interest or cut off rate used to find the present value of future amount.

Future Value : The amount an investment is worth after a period.

Perpetuity : The cash flows of an annuity is for an indefinite period. It is also called CONSOLS.

Present Value : The current value of future cash flows discounted at the discount rate.

Simple Interest : The interest earned on original principal amount.

2.8 ANSWERS TO CHECK YOUR PROGRESS

A 4) Rs.13382; 5) Rs.7,846

B 1) (a) False (b) False (c) True (d) True (e) False

2.9 TERMINAL QUESTIONS / EXERCISES

1) Explain "Time Value of Money". What is the role of interest rate in it ?

2) A person deposits Rs. 1000 today, Rs. 2000 in two years and Rs. 5000 in five years. He withdraws Rs. 1500 in three year and Rs. 1000 in seven years. How must he will have after 8 years if interest relate is 7%? What is the present value of these cash flows'?

3) If a deposit of Rs. 3000 is made today and the interest rcccived is 10% yearly, how much the deposit will grow after 7 years and 11 years'?

4) You want to accumulate Ks. 20,000 by the end of 10 years. The discount rate is 12%. How much should you have annually?

5) Find the presentvalue of following cash follows, assuming 5% intcrcst rate.

Year	**cash flows**
1	Rs. 1000
2	Rs. 2000
3	Rs. 3000
4	Rs 4000
5	Rs. 5000