Time Value of Money - Prasanna Chandra : By Asst.Prof. Margi Choksi

6.1 Calculate the value 5 years hence of a deposit of Rs.1,000 made today if the interest rate is (a) 8 percent, (b) 10 percent, (c) 12 percent, and (d) 15 percent.

Value five years hence of a deposit of Rs.1,000 at various interest rates is as follows:

r = 8% FV_5 = Rs.1469

r = 10% FV_5 = Rs.1611

r = 12% FV_5 = Rs.1762

r = 15% FV_5 = Rs.2011

6.2 If you deposit Rs.5,000 today at 12 percent rate of interest in how many years (roughly) will this amount grow to Rs.1,60,000 ? Work this problem using the rule o/72-do not use tables.

30 years : 72/ i= 72/12 = 6 Years So, every 6 years amount will be doubled.

Year	Amount
6	10,000
12	20,000
18	40,000
24	80,000
30	1,60,000

6.3 A finance company offers to give Rs.8,000 after 12 years in return for Rs.1,000 deposited today. Using the rule of 72 and 69, figure out the approximate interest offered.

In 12 years Rs.1000 grows to Rs.8000 or 8 times. This is 2^3 times the initial deposit. 1000*2^3 = 8000. Hence
doubling takes place in 12 years / 3 times = approx at every 4 years.
4TH 1000--------2000
8TH 2000-----4000
12TH 4000-----8000

According to the Rule of 69, the doubling period is:

4 years = 0.35 + 69 / Interest rate

Equating this to 4 and solving for interest rate, we get

Interest rate = 18.9%.
Using the Rule of 72,
Doubling period =72/I

4 years= 72/i
I = 18 %

6.4 You can save Rs.2,000 a year for 5 years, and Rs.3,000 a year for 10 years thereafter. What will these savings cumulate to at the end of 15 years, if the rate of interest is 10 percent?

Saving Rs.2000 a year for 5 years and Rs.3000 a year for 10 years thereafter is equivalent to saving Rs.2000 a year for 15 years and Rs.1000 a year for the years 6 through 15.

Hence the savings will cumulate to:

2000 x FVIFA (10%, 15 years) + 1000 x FVIFA (10%, 10 years)

= 2000 x 31.772 + 1000 x 15.937 = Rs.79481.

6.5 Mr. Vinay plans to send his son for higher studies abroad after 10 years. He expects the cost of these studies to be Rs.1000,000. How much should he save annually to have a sum of Rs.1000,000 at the end of 10 years, if the interest rate is 12 percent ?

Let A be the annual savings.

A x FVIFA (12%, 10 years) = 1,000,000
A x 17.549 = 1,000,000

So, A = 1,000,000 / 17.549 = Rs.56,983.

6.6 A finance company advertises that it will pay a lump sum of Rs.10,000 at the end of 6 years to investors who deposit annually Rs.1,000. What interest rate is implicit in this offer?

1,000 x FVIFA (r, 6 years) = 10,000

FVIFA (r, 6 years) = 10,000 / 1000 = 10

From the tables we find that
FVIFA (20%, 6 years) = 9.930
FVIFA (24%, 6 years) = 10.980

Using linear interpolation in the interval, we get:

$$r = \frac{20\% + (10.000 - 9.930)}{(10.980 - 9.930)} \times 4\% = 20.3\%$$

6.7 Someone promises to give you Rs.5,000 after 10 years in exchange for Rs.1,000 today. What interest rate is implicit in this offer?

1,000 x FVIF (r, 10 years) = 5,000
FVIF (r,10 years) = 5,000 / 1000 = 5

From the tables we find that

FVIF (16%, 10 years) = 4.411
FVIF (18%, 10 years) = 5.234

Using linear interpolation in the interval, we get:

$$r = 16\% + \frac{(5.000 - 4.411) \times 2\%}{(5.234 - 4.411)} = 17.4\%$$

6.8 Find the present value of Rs.10,000 receivable after 8 years if the rate of discount is (i) 10 percent, (ii) 12 percent, and (iii) 15 percent.

The present value of Rs.10,000 receivable after 8 years for various discount rates (r) are:

$r = 10\%$	PV	$= 10,000 \times \text{PVIF}(r = 10\%, 8 \text{ years})$
		$= 10,000 \times 0.467 = \text{Rs.4,670}$
$r = 12\%$	PV	$= 10,000 \times \text{PVIF}(r = 12\%, 8 \text{ years})$
		$= 10,000 \times 0.404 = \text{Rs.4,040}$
$r = 15\%$	PV	$= 10,000 \times \text{PVIF}(r = 15\%, 8 \text{ years})$
		$= 10,000 \times 0.327 = \text{Rs.3,270}$

6.9 What is the present value of a 5-year annuity of Rs.2,000 at 10 percent ?

Assuming that it is an ordinary annuity, the present value is:

2,000 x PVIFA (10%, 5years)
= 2,000 x 3.791 = Rs.7,582

6.10 At the time of his retirement, Mr.Jingo is given a choice between two alternatives: (a) an annual pension of Rs.10,000 as long as he lives, and (b) a lump sum amount of Rs.50,000. If Mr.Jingo expects to live for 15 years and the interest rate is 15 percent, which option appears more attractive?

The present value of an annual pension of Rs.10,000 for 15 years when $r = 15\%$ is:

10,000 x PVIFA (15%, 15 years)
= 10,000 x 5.847 = Rs.58,470

The alternative is to receive a lumpsum of Rs.50,000.

Obviously, Mr. Jingo will be better off with the annual pension amount of Rs.10,000.

6.11 Mr.X deposits Rs.1,00,000 in a bank which pays 10 percent interest. How much can he withdraw annually for a period of 30 years. Assume that at the end of 30 years the amount deposited will whittle down to zero.

Applied formula will be of Present value of Annuity :

The amount that can be withdrawn annually is:

$$A = \frac{100,000}{\text{PVIFA (10\%, 30 years)}} = \frac{100,000}{9.427} = \text{Rs.10,608}$$

6.13 What is the present value of an income stream which provides Rs.2,000 a year for the first five

years and Rs.3,000 a year forever thereafter, if the discount rate is 10 percent ?
Hint; The present value for a perpetual annuity is derived by dividing the constant annual flow by the discount factor.

The present value of the income stream is:

2,000 x PVIFA (10%, 5 years) + 3000/0.10 x PVIF (10%, 5 years)
= 2,000 x 3.791 + 3000/0.10 x 0.621
= Rs.26,212

6.15 Suppose someone offers you the following financial contract. If you deposit Rs.20,000 with him he promises to pay Rs.4,000 annually for 10 years. What interest rate would you earn on this deposit?

Rs.20,000 =- Rs.4,000 x PVIFA (r, 10 years)
PVIFA (r,10 years) = Rs.20,000 / Rs.4,000 = 5.00

From the tables we find that:
        PVIFA (15%, 10 years)   =   5.019
        PVIFA (18%, 10 years)   =   4.494

Using linear interpolation we get:

$$r = 15\% + \left[\frac{5.019 - 5.00}{5.019 - 4.494} \right] \times 3\%$$

= 15.1%

6.16 What is the present value of the following cash flow streams?

End of year	Stream A	Stream B	Stream C
1	100	1,000	500
2	200	900	500
3	300	800	500
4	400	700	500
5	500	600	500
6	600	500	500
7	700	400	500
8	800	300	500
9	900	200	500
10	1,000	100	500

The discount rate is 12 percent.

PV (Stream A) = Rs.100 x PVIF (12%, 1 year) + Rs.200 x PVIF (12%, 2 years) + Rs.300 x PVIF(12%, 3 years) + Rs.400 x PVIF (12%, 4 years) + Rs.500 x PVIF (12%, 5 years) + Rs.600 x PVIF (12%, 6 years) + Rs.700 x PVIF (12%, 7 years) + Rs.800 x PVIF (12%, 8 years) + Rs.900 x PVIF (12%, 9 years) + Rs.1,000 x PVIF (12%, 10 years)

= Rs.100 x 0.893 + Rs.200 x 0.797 + Rs.300 x 0.712
+ Rs.400 x 0.636 + Rs.500 x 0.567 + Rs.600 x 0.507
+ Rs.700 x 0.452 + Rs.800 x 0.404 + Rs.900 x 0.361

+ Rs.1,000 x 0.322

= Rs.2590.9

Similarly,
PV (Stream B) = Rs.3,625.2
PV (Stream C) = Rs.2,851.1

6.17 Suppose you deposit Rs.10,000 with an investment company which pays 16 percent interest with quarterly compounding. How much will this deposit grow to in 5 years?

$$FV_5 = Rs.10,000 [1 + (0.16 / 4)]^{5 \times 4}$$
$$= Rs.10,000 (1.04)^{20}$$
$$= Rs.10,000 \times 2.191$$
$$= Rs.21,910$$

6.18 How much would a deposit of Rs.5,000 at the end of 5 years be, if the interest rate is 12 percent and if the compounding is done quarterly ?

$$FV_5 = Rs.5,000 [1+(0.12/4)]^{5 \times 4}$$
$$= Rs.5,000 (1.03)^{20}$$
$$= Rs.5,000 \times 1.806$$
$$= Rs.9,030$$

6.30 Phoenix Company borrows Rs.500,000 at an interest rate of 14 percent. The loan is to be repaid in 4 equal annual instalments payable at the end of each of the next 4 years. Prepare the loan amortisation schedule.

24. Equated annual installment = 500000 / PVIFA(14%,4)
   = 500000 / 2.914
   = Rs.171,585

Loan Amortisation Schedule

Year	Beginning amount	Annual installment	Interest	Principal repaid	Remaining balance
1	500000	171585	70000	101585	398415
2	398415	171585	55778	115807	282608
3	282608	171585	39565	132020	150588
4	150588	171585	21082	150503	85*

(*) rounding off error

IM PANDEY

Determine the present value of the cash inflows of `3,000 at the end of each year for next 4 years and Rs. 7,000 and Rs. 1,000 respectively, at the end of years 5 and 6. The appropriate discount rate is 14 per cent.

Discount rate		14%						
Year			0	1	2	3	4	5	6

A. Cash flows		3,000.00	3,000.00	3,000.00	3,000.00	7,000.00	1,000.00
B. PVF at 14%		1	0.7695	0.6750	0.5921	0.5194	0.4556
C. Present value [A x B]	12832.30	2,632	2308.40	2024.91	1776.24	3635.58	455.59

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GTU Paper Sums :
MAY/JUNE 2012
1. If you deposit Rs. 3000 today at 8 % rate of interest in how many years (roughly) will this amount grow to Rs. 1,92,000 ? Work this problem using the rule of 72-do not use tables. (ANSWER : 54 Years)
2. You plan to go abroad for higher studies after working for the next five years and understand that an amount of Rs.2,000,000 will be needed for this purpose at that time. You have decided to accumulate this amount by investing a fixed amount at the end of each year in a safe scheme offering a rate of interest at 10 percent. What amount should you invest every year to achieve the target amount? (ANSWER : 327595 Rs.)
3. A finance company advertises that it will pay a lump sum of Rs.100,000 at the end of 5 years to investors who deposit annually Rs.12,000. What interest rate is implicit in this offer? (ANSWER : 25.26 %)

JANUARY,2013
4. What is the present value of an income stream which provides Rs,. 1000 at the end of year one, Rs. 2500 at the end of year two and Rs. 5000 during each of the years 3 through 10, if the discount rate is 12 %.

WINTER 2013
5. Mr. Gotalawala is planning for her daughter's marriage after 10 years. He estimated the total expenses for the marriage Rs. 20,00,000. How much he should invest annually at the end of year in DSP Blackrock mutual funds which give annual return of 15%? (ANSWER : Rs. 98,504)

6. Mr. Daruwala borrows from Bank for 5 years worth Rs. 10,00,000 to buy a new car named Honda city. If Mr. Daruwala wants to pay an equal annual installment at the end of every year, and if the rate of interest is 10%, Calculate the amount of installment every year. Also prepare Loan amortization schedule. (ANSWER : A = 263797)

7. Miss Akshara is planning to borrow a loan worth INR 1000000 for five years. She approached SBI and SBI offered her 15% rate of interest. Calculate the annual installment and prepare loan amortization schedule. (ANSWER : A = 298312 Rs.)

WINTER 2015
8. A house owner has rented out his house for 3 years at a rent of Rs. 40,000/- with an agreement that rent will increase by 5% every year. If the owners required rate of return is 8%, what is the present value of expected (annuity) rent ?