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VIRTUAL COACHING CLASSES
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FOUNDATION LEVEL
PAPER 3: BUSINESS MATHEMATICS, LOGICAL REASONING & STATISTICS

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WHY IS INTEREST PAID? – Pg 4.2 of study material

- **Time value of money:** Time value of money means that the **value of a unity of money** is different in different time periods. The sum of money received in future is less valuable than it is today. In other words the present worth of money received after some time will be less than a money received today
- **Opportunity Cost:** The lender has a choice between using his money in different investments. If he chooses one he forgoes the return from all others. In other words lending incurs an opportunity cost due to the possible alternative uses of the lent money.
- **Inflation:** Most economies generally exhibit inflation. Inflation is a fall in the purchasing power of money. Due to inflation a given amount of money buys fewer goods in the future than it will now. The borrower needs to compensate the lender for this.
- **Liquidity Preference:** People prefer to have their resources available in a form that can immediately be converted into cash rather than a form that takes time or money to realize.

Terms

- **Interest**

- Interest is the price paid by a borrower for the use of a lender's money. Simple interest is the interest computed on the principal for the entire period of borrowing. It is calculated on the outstanding principal
  - **Principal**
- Principal is initial value of lending (or borrowing).
  - **Rate of Interest**
- The rate at which the interest is charged for a defined length of time for use of principal , usually annual basis
- Per annum means for a year.
  - **Accumulated amount (or Balance)**
- Accumulated amount is the final value of an investment. It is the sum total of principal and interest earned. Suppose you deposit ` 50,000 in your bank for one year with a interest rate of 5% p.a. you would earn interest of ` 2,500 after one year.
- So **Accumulated amount (or Balance) = Rs 52,500**

Interest

- **Interest:** Interest is the price paid by a borrower for the use of a lender's money. If you borrow (or lend) some money from (or to) a person for a particular period you would pay (or receive) more money than your initial borrowing (or lending).
- **Simple interest:** is the interest computed on the principal for the entire period of borrowing.
- $I = Pit$

  $A = P + I$

  $I = A - P$

  Here, A = Accumulated amount (final value of an investment)

  P = Principal (initial value of an investment)

  i = Annual interest rate in decimal.

  I = Amount of Interest

  t = Time in years

Simple interest

- A = P + I
- = P + Pit
- = P(1 + it) I = A – P
- Here,
- A = Accumulated amount (final value of an investment) P = Principal (initial value of an investment)
- i = Annual interest rate in decimal.
- I = Amount of Interest t = Time in years

Ex 1 – pg 4.5 of Study material

- How much interest will be earned on ` 2000 at 6% simple interest for 2 years?
- **Solution:** Required interest amount is given by I = P × i × t
- $= 2{,}000 \times \frac{6}{100} \times 2$
- = ` Rs 240

Example 2: pg 4.4

- Sania deposited ` 50,000 in a bank for two years with the interest rate of 5.5% p.a. How much interest would she earn?
- Let us work out

- = Rs ` 5,500

Example 3: Pg 4.5

- Sachin deposited ` 1,00,000 in his bank for 2 years at simple interest rate of 6%. How much interest would he earn?
- How much would be the final value of deposit?
- Ans = Rs 12,000,
- Final Value = Rs1,12,000

Example 4: pg 4.5

- Find the rate of interest if the amount owed after 6 months is ` 1050, borrowed amount being ` 1000.

- i= 10 %

Example 5: pg 4.5

- Rahul invested ` 70,000 in a bank at the rate of 6.5% p.a. simple interest rate. He received ` 85,925 after the end of term.
- Find out the period for which sum was invested by Rahul.
- **Solution:** We know A = P (1+it)
- t =3.5
- time = 3.5years

Example 6: pg 4.6

- A sum of ` 46,875 was lent out at simple interest and at the end of 1 year 8 months the total amount was ` 50,000. Find the rate of interest percent per annum.
- **Solution:** We know A = P (1 + it)
  - i =0.04
  - rate =4%

Example 7: pg 4.8

- In what time will ` 85,000 amount to ` 1,57,675 at 4.5 % p.a. ?
- **Solution:** We know
- A = P (1 +it)
- T= 19
- 19 years ` 85,000 will amount to ` 1,57,675 at 4.5% p.a.simple interest rate.

Compound interest

- **Compound interest** as the interest that accrues when earnings for each specified period of time added to the principal thus increasing the principal base on which subsequent interest is computed.
- Formula for compound interest:
  $A_n = P (1 + i)^n$
  where, i = Annual rate of interest
  n = Number of conversion periods per year
  Interest = $A_n - P = P (1 + i)^n - P$
  n is total conversions i.e. t x no. of conversions per year
- MF – SIP
- PPF

- Future value of a single cash flow can be computed by above formula. Replace A by future value (F) and P by single cash flow (C.F.) therefore
- $F = C.F. (1 + i)^n$
- **Annuity can be defined as a sequence of periodic payments (or receipts) regularly over a specified period of time.**

Example 8 : Compound Interest

- Saina deposited ` 1,00,000 in a nationalized bank for three years. If the rate of interest is 7% p.a., calculate the interest that bank has to pay to Saina after three years if interest is compounded annually.
- Also calculate the amount at the end of third year.

Solution

- Compound interest at the end of third year
- = ` (7,000 + 7,490 + 8,014.30)
- = ` 22,504.30
- Amount at the end of third year
- = Principal (initial deposit) + compound interest
- = ` (1,00,000 + 22,504.30)
- = `Rs 1,22,504.30

Typical conversion periods – pg 4.11

Conversion period	Description	Number of conversion period in a year
1 day	Compounded daily	365
1 month	Compounded monthly	12
3 months	Compounded quarterly	4
6 months	Compounded semi annually	2
12 months	Compounded annually	1

Formula for Compound Interest

- $A1 = P + P\,i = P\,(1 + i)$;
- at the end of second payment period $A_2 = A_1 + A_1\,i = A1\,(1 + i)$
- $= P\,(1 + i)\,(1 + i)$
- $= P\,(1 + i)^2$;
- at the end of third payment period $A_3 = A_2 + A2i$
- $= A_2\ (1 + i)$
- $= P(1 + i)^2\,(1 + i)$
- $= P(1 + i)^3$
- $A_n = A_{n-1} + A_{n-1}\,i$
- $= A_{n-1}\ (1 + i)$
- $= P\,(1 + i)^{n-1}\,(1 + i)$
- $= P(1 + i)^n$

Interest

- Thus the accrued amount An on a principal P after n conversion periods at i (in decimal) rate of interest per conversion period is given by
- Interest = $A_n - P = P (1 + i)^n - P$
- $= P \{(1+i)^n-1\}$
- n = total conversions i.e. t x no. of conversions per year

Pg 4.12

- **Note :** Computation of A shall be quite simple with a calculator.
- However compound interest table and tables for at various rates per annum with (a) annual compounding ; (b) monthly compounding and (c) daily compounding are available.

Example 9 : (example 12 of pg 4.12)

- 2,000 is invested at annual rate of interest of 10%.
- What is the amount after two years if compounding is done (a) Annually (b) Semi-annually (c) Quarterly (d) monthly.

Solution

- **Solution:** (a) Compounding is done annually
- Here principal P = ` 2,000; since the interest is compounded yearly the number of conversion periods n in 2 years are 2. Also the rate of interest per conversion period (1 year) i is 0.10
- $A_n = P(1 + i)^n$
- $A_2 = ` 2,000 (1 + 0.1)2$
- $= ` 2,000 \times (1.1)2$
- $= ` 2,000 \times 1.21$
- $= ` 2,420$

Solution (b): compounding semi annually

- *For semiannual compounding n = 2×2 =4*

- 0.1
- i = 2 =0.05
- A4 = 2,000(1+0.05)4
- = 2,000 ×1.2155
- = ` 2,431

Solution (c): compounding quarterly

For quarterly compounding n = 4×2 =8

- $\frac{0.1}{4}$ =0.025
- $A_8 = 2{,}000\ (1+0.025)^8$
- = 2,000 × 1.2184
- = ` 2,436.80

Solution (d): compounding quarterly

For monthly compounding

- n = 12 × 2 = 24, i = 0.1/12 = 0.00833
- A24 = 2,000 (1 +0.00833)^{24}
- = 2,000 × 1.22029
- = ` Rs 2,440.58

Example 11 : **Example 16 of** Pg 4.14

- What annual rate of interest compounded annually doubles an investment in 7 years? Given that $2^{1/7} = 1.104090$
- **Solution:** If the principal be P then $A_n = 2P$. Since An = $P(1+ i)^n$
- $2P = P (1 + i)^7$
- $2^{1/7} = (1 + i)$
- $1.104090 = 1 + i$
- $i = 0.10409$
- Required rate of interest = 10.41%per annum

Example 12 : **Example 20 of pg 4.15**

- Rs 16,000 invested at 10% p.a. compounded semi-annually amounts to `Rs 18,522. Find the time period of investment.
- **Solution:** Here P = `16,000
- A_n = `18,522
- i = 10 × 1/2 % = 5%= 0.05

- n = ?
- We have A n = $P(1 + i)^n$
- 18,522 $=16,000(1+0.05)^n$
- **18,522 /** 16,000 $=(1.05)^n$

$(1.157625) = (1.05)^n$

$(1.05)^3 = (1.05)^n$

$n = 3$

- Therefore time period of investment is three half years i.e. 1 ½ years

Pg 4.17 : **EFFECTIVE RATE OFINTEREST**

- If interest is compounded more than once a year the effective interest rate for a year **exceeds the per annum** interest rate.
- Suppose you invest ` 10,000 for a year at the rate of 6% per annum compounded semi annually.
- Effective interest rate for a year **will be more than 6%** per annum since interest is being compounded more than once in a year.
- Thus if we compound the interest **more than once a year** effective interest rate for the year **will be more** than actual interest rate per annum.
- But if interest is compounded annually effective interest rate for the year **will be equal** to actual interest rate per annum

- Interest for first six months = ` 10,000 × 6/100 × 6/12
- = ` 300
- Principal for calculation of interest for next six months
- = Principal for first period one + Interest for first period
- = ` (10,000 + 300)
- = ` 10,300
- Interest for next six months = ` 10,300 × 6/100 × 6/12 = ` 309
- Total interest earned during the current year
- = Interest for first six months + Interest for next six months
- = ` (300 + 309) = ` 609
- Interest of ` 609 can also be computed directly from the formula of compound interest.

- We can compute effective rate of interest by following formula
- I = PEt
- Where I = Amount of interest
- E = Effective rate of interest in decimal
- t = Time period
- P = Principal amount Putting the values we have
- $609 = 10,000 \times E \times 1$

  $E = \frac{609}{10,000}$
- = 0.0609 or
- = 6.09%

Effective Rate of Interest

- The effective interest rate can be computed directly by following formula:
- $E = (1 + i)^n - 1$
- So effective interest rate can be defined as the **equivalent annual rate of interest** compounded annually if interest is compounded more than once a year.
- Where E is the effective interest rate
- i = actual interest rate in decimal
- n = number of conversion period

Example 13 : **Example 23 of pg 4.19**

- Find the amount of compound interest and effective rate of interest if an amount of ` 20,000 is deposited in a bank for one year at the rate of 8% per annum compounded semi annually.

- **Solution:**
- **Compound interest =**
- = ` 20,000 × 0.0816
- = ` 1,632
- Effective rate of interest can also be computed by following formula $E = (1 + i)^n - 1$
- $= (1 + 0.04)^2 - 1$
- =0.0816 or 8.16%

Ex 4B

- 1. ` If P = ` 1,000, R = 5% p.a, n = 4; What is Amount and C.I. is
- (a) ` 1,215.50,`215.50
- (b) ` 1,125, `125
- `( c) 2,115,`115
- (d) none of these
- **Option a is correct**

Ex 4 B No 10

- The C.I on ` 16000 for 1 ½ years at 10% p.a payable half -yearlyis
- (a)`2,222 (b)`2,522 (c)`2,500 (d) none of these

- Ans = 2522 , b

Ex 4b No 8

- The useful life of a machine is estimated to be 10 years and cost `10,000.
- Rate of depreciation is10%p.a
- .The scrap value at the end of its life is
- (a)`3,486.78 (b)`4,383 (c)`3,400 (d) none of these

- Hint = 1-depr rate
- Ans = 0.34867 * 10,000
- = Rs 3486.78
- So option a is correct

Ex 4B – Qu 14

- Qu 14. The C.I on ` 4,000 for 6 months at 12% p.a payable quarterly is
- (a)`243.60 (b)`240 (c)`243 (d) none of these
- Here i= 12/4= 3 %
- n= 2

- Ans a, 243.6

THANK YOU