



Subject: Financial Mathematics

Chapter: Unit 1

Category: Practice Questions

Chapter 1

1. CT1 September 2013 Q4

Describe the characteristics of the cashflows that are paid and received in respect of:

- (i) An index-linked security.
- (ii) an equity.

2. CT1 September 2015 Q8

State the characteristics of an equity.

3. CT1 September 2016 Q3

Describe the characteristics of a repayment loan (or repayment mortgage).

4. CT1 September 2018 Q9

Describe the cashflows which are paid and received in respect of an index-linked security.

5. CM1A September 2020 Q1

Describe the cashflows for an investor who purchases an index-linked bond.

6. CM1A September 2022 Q2

A non-tax-paying investor wishes to invest a lump sum for a period of 5 years. The investor is considering depositing the lump sum with a bank. Interest will be credited to the initial lump sum at a variable market rate. Interest will only be added when the cash is withdrawn. The investor has set up a generalised cashflow model for this investment.

Describe the cashflows with reference to the certainty and uncertainty of size and timing of payments from the investor's point of view.

Chapter 2

Non IFOA PQs

1. What is the difference between the compound interests on Rs.5000 for 1 ½ year at 4% per annum compounded yearly and half-yearly?

[Ans - 2.04]

When the interest is compounded yearly,

$$A = P[1 + (R/100)]^n$$

$$= \text{Rs. } 5000 [1 + (4/100)] [1 + (1/2 \times 4/100)]$$

$$= \text{Rs. } 5000 [1 + (1/25)] [1 + (1/50)]$$

$$= \text{Rs. } 5000 [(25 + 1)/25] [(50 + 1)/50]$$

$$= \text{Rs. } 5000 \times (26/25) \times (51/50)$$

$$= \text{Rs. } 5304$$

$$CI = A - P = \text{Rs. } 5304 - \text{Rs. } 5000 = \text{Rs. } 304$$

When the interest is compounded half-yearly,

$$n = 1 \frac{1}{2} \text{ years} = 3 \text{ half-years}$$

$$A = P[1 + (R/200)]^{2n}$$

$$\text{Here, } 2n = 3$$

$$A = \text{Rs. } 5000 [1 + (4/200)]^3$$

$$= \text{Rs. } 5000 [1 + (1/50)]^3$$

$$= \text{Rs. } 5000 [(50 + 1)/50]^3$$

$$= \text{Rs. } 5000 \times (51/50) \times (51/50) \times (51/50)$$

$$= \text{Rs. } 5306.04$$

$$CI = A - P = \text{Rs. } 5306.04 - \text{Rs. } 5000 = \text{Rs. } 306.04$$

$$\text{Difference between compound interest} = \text{Rs. } 306.04 - \text{Rs. } 304 = \text{Rs. } 2.04$$

2. If your investment earns 5.5% compounded monthly, what is the effective rate of interest?

[Ans - 5.6408%]

3. At what rate of compound interest per annum, a sum of Rs. 1200 becomes Rs. 1348.32 in 2 years?

[Ans - 6%]

4. Find the compound interest on Rs. 8000 at 15% per annum for 2 years 4 months, compounded annually.

[Ans - 3109]

5. If a lender charges 12% interest, compounded quarterly, what effective annual interest rate is the lender charging?

[Ans - 12.55%]

[Soln: $i = [1 + (0.12 / 4)]^4 - 1 = (1.03)^4 - 1 = 1.1255 - 1 = 0.1255 = 12.55\%$]

6. If a lender charges 12% interest, compounded monthly, what is the effective interest rate per quarter?

[Ans - 3.03%]

$i = [1 + (0.03 / 3)]^3 - 1 = (1.01)^3 - 1 = 0.0303 = 3.03\%$

7.

(a) An effective yearly rate is quoted at 12% per year where the compounding period is monthly. What is the effective monthly rate?

(b) Find the nominal interest rate per year and effective interest rate per compounding period for an effective annual interest rate of 12.36% where compounding is semi-annual.

[Ans – (a) 0.949%, (b) 12%]

8. For an interest rate of 18% per year, compounded continuously, calculate the effective monthly, quarterly and annual interest rates.

[Ans – 1.511%, 4.6%, 19.72%]

9. What is the nominal rate payable monthly if the effective rate is 10%?

[Ans – 9.57%]

10. What is the effective rate if the nominal rate payable weekly is 22.27%?

[Ans – 20.00%]

11. Mary would like to invest a certain amount of money into a bank account. The bank offers her two options:

A- interest rate of 8.2% per annum, compounded quarterly

B- interest rate of 8.4% per annum, compounded semi-annually.

Which one of the two options is better?

[Ans – Option B]

12. Convert an effective annual interest rate of 10% to:

a) A nominal rate compounded monthly

b) A nominal rate compounded quarterly

[Ans – a: 9.57%, b: 9.645%]

13. A bank offers a nominal interest rate of 6% per annum, compounded monthly. Another investment offers a 6.1% effective annual rate. Which investment provides a better return?

[**Ans** – The first investment (6% nominal compounded monthly) is better because it yields an effective annual rate of 6.1678%]

14. At what annual compound interest rate, will a sum of Rs. 1500 amount to Rs. 1683 in 2 years?

[**Ans** – 6%]

15. You invest £8,000 at an interest rate of 4% per year.

How long (in days) will it take for your money to grow to £10,000 if:

- (a) The interest is calculated using simple interest?
- (b) The interest is calculated using compound interest (effective rate)?
- (c) The interest is calculated using a force of interest?

Assume the year has 365 days.

[**Ans** – a: 6.25 years, b: 5.691 years, c: 5.5785 years]

16. Convert 8.2% effective interest rate to a nominal interest rate compounded every two months.

[**Ans** – 7.93%]

IFOA PQs**1. CT1 September 2011 Q1**

A 91-day treasury bill is issued by the government at a simple rate of discount of 8% per annum.

Calculate the annual effective rate of return obtained by an investor who purchases the bill at issue.

[Ans: 8.416%]

2. CT1 September 2012 Q1

An investor is considering two investments. One is a 91-day deposit which pays a rate of interest of 4% per annum effective. The second is a treasury bill.

Calculate the annual simple rate of discount from the treasury bill if both investments are to provide the same effective rate of return.

[Ans: 0.03903]

3. CT1 September 2013 Q1

The nominal rate of discount per annum convertible quarterly is 8%.

- (i) Calculate the equivalent force of interest.
- (ii) Calculate the equivalent effective rate of interest per annum.
- (iii) Calculate the equivalent nominal rate of discount per annum convertible monthly.

[Ans: (i) 0.080811, (ii) 0.084166, (iii) 0.080539]

4. CT1 September 2013 Q1

The rate of interest is 4.5% per annum effective.

(i) Calculate:

- (a) The annual effective rate of discount.
- (b) The nominal rate of discount per annum convertible monthly.
- (c) The nominal rate of interest per annum convertible quarterly.
- (d) The effective rate of interest over a five-year period.

(ii) Explain why your answer to part (i)(b) is higher than your answer to part (i)(a).

[Ans – (i) a - 4.3062%, b - 4.3936%, c - 4.4260%, d - 24.618%]

5. CT1 September 2014 Q3

A 91-day treasury bill is bought for £98.83 and is redeemed at £100.

- (i) Calculate the annual effective rate of interest from the bill.
- (ii) Calculate the annual equivalent simple rate of interest.

[Ans: (i) 0.04834, (ii) 0.04748]

6. CT1 April 2015 Q2

Calculate the time in days for £3,000 to accumulate to £3,800 at:

- (a) A simple rate of interest of 4% per annum.
- (b) A compound rate of interest of 4% per annum effective.

[Ans –(a) – 2,433.33 days, (b) – 2,199.91 days]

7. CT1 September 2015 Q2

The nominal rate of discount per annum convertible monthly is 5.5%.

(i) Calculate, giving all your answers as a percentage to three decimal places:

(a) The equivalent force of interest.

(b) The equivalent effective rate of interest per annum.

(c) The equivalent nominal rate of interest per annum convertible monthly.

(ii) Explain why the nominal rate of interest per annum convertible monthly calculated in part (i)(c) is less than the equivalent annual effective rate of interest calculated in part(i)(b)

(iii) Calculate, as a percentage to three decimal places, the effective annual rate of discount offered by an investment that pays £159 in eight years' time in return for £100 invested now.

(iv) Calculate, as a percentage to three decimal places, the effective annual rate of interest from an investment that pays 12% interest at the end of each two-year period.

[Ans – (i) a - 5.513%, b - 5.667%, c - 5.525%, (iii) - 5.632%, (iv) - 5.830%]

8. CT1 September 2016 Q1

The nominal rate of interest per annum convertible quarterly is 5%. Calculate, giving all the answers as a percentage to three decimal places:

(i) The equivalent annual force of interest.

(ii) The equivalent effective rate of interest per annum.

(iii) The equivalent nominal rate of discount per annum convertible monthly.

[Ans – (i) - 4.969%, (ii) - 5.095%, (iii) - 4.959%]

9. CT1 April 2017 Q1

Calculate the nominal rate of discount per annum convertible monthly which is equivalent to:

- (i) An effective rate of interest of 1% per quarter.
- (ii) A force of interest of 5% per annum.
- (iii) A nominal rate of discount of 4% per annum convertible every three months.

[Ans – (i) - 3.9735%, (ii) - 4.9896%, (iii) - 4.0134%]

10. CT1 September 2017 Q1

- (i) Calculate the time in days for £6,000 to accumulate to £7,600 at:
 - (a) A simple rate of interest of 3% per annum.
 - (b) A compound rate of interest of 3% per annum effective.
 - (c) A force of interest of 3% per annum.

Note: You should assume there are 365 days in a year.

- (ii) Calculate the effective rate of interest per half year which is equivalent to a force of interest of 3% per annum.

[Ans – (i) a – 3244.4 days, b – 2919 days, c – 2876.1 days, (ii) – 1.51131%]

11. CT1 September 2018 Q2

The effective rate of discount per annum is 5%. Calculate:

- (i) The equivalent force of interest:
- (ii) The equivalent rate of interest per annum convertible monthly;
- (iii) The equivalent rate of discount per annum convertible monthly.

[Ans – (i) – 0.051293, (ii) – 0.051403, (iii) – 0.051184]

12. CM1A April 2019 Q5

Calculate, as a percentage to four decimal places, the nominal rate of interest per annum convertible half-yearly which is equivalent to:

- (i) an effective rate of discount of 0.5% per month.
- (ii) a nominal rate of discount of 6% per annum convertible every two years.
- (iii) a nominal rate of interest of 6% per annum convertible quarterly.

[Ans – (i) – 0.061064, (ii) – 0.064949, (iii) – 0.060450]

13. CM1A April 2022 Q2

An investor is considering making an investment and is deciding between two possible alternatives:

- A 6-month investment which can be purchased at a simple rate of discount of 4.15% p.a.
- A bank deposit, for 6 months, offering an effective rate of interest of 4.35% p.a.

Determine which of these two alternatives offers the higher rate of return.

[Ans – Since 4.35% > 4.283% the Bank Deposit offers a better return.]

14. CM1A September 2022 Q2

A non-tax-paying investor wishes to invest a lump sum for a period of 5 years. The investor is considering depositing the lump sum with a bank. Interest will be credited to the initial lump sum at a variable market rate. Interest will only be added when the cash is withdrawn. The investor has set up a generalised cashflow model for this investment. Describe the cashflows with reference to the certainty and uncertainty of size and timing of payments from the investor's point of view.

15. CM1A April 2023 Q2

A general insurance company has set up a generalised cashflow model for the claims payments it will pay arising from its portfolio of car insurance policies. Describe the cashflows with reference to the certainty and uncertainty of size and timings of payments from the insurance company's point of view.



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