Practice Questions with Answers: Time Value of Money

Question 1

Which of the following statements is not true for time lines?

A. Time lines represent a graphical representation of the cash flows associated with a time value of money problem.
B. Cash flows which occur later are put to the left on the time line.
C. Cash outflows are given a negative sign, while cash inflows are given a positive sign.

Answer: B

Both statements A and C are correct. Statement B is incorrect. Cash flows which occur later are put to the right on the time line.

Question 2

Which of the following statements is not true for interpretation of interest rates?

A. Interest rates are also called opportunity costs because they measure the value investors forgo when choosing a particular course of action.
B. Interest rates are used when discounting or compounding cash flows and express the time value of money.
C. Interest rates can be interpreted as required rates of return set by central banks.

Answer: C

Interest rates can be interpreted as discount rates, opportunity costs, and required rates of return. Both A and B correct. However, only the first part of answer C is correct, the second is wrong. Required rates of return are usually determined by investors. They aren't set unilaterally by governmental agencies.

Question 3

Which of the following statements is most likely to be true about the nominal risk-free interest rate?

A. Nominal risk-free rate is expressed as the sum of the real-risk free rate and the inflation premium.
B. The interest rate on a corporate bond is considered to be an example of a nominal risk-free rate.
C. Nominal risk-free rate is the rate for a completely risk-free security in a zero-inflation environment.

Answer: A

The sum of the real risk-free interest rate and the inflation premium is called the nominal risk-free interest rate, which makes A correct. The interest rate on a corporate bond would most likely require a combination of premiums for default, liquidity, and maturity. US Treasury bills are good examples of securities which offer nominal risk-free rates as they are essentially risk-free and backed by the government. The real risk-free rate is a theoretical concept which assumes that there is no inflation or default risk (the chance of not paying back the borrowed funds).

Question 4

Bank A has a stated annual interest rate equal to 12%. If this rate is equivalent to an effective annual rate of 12.683%, what is the compounding frequency?

A. Daily
B. Monthly
C. Yearly

Answer: B

Let's start with answer C. If the compounding frequency is yearly, the effective annual rate would be equal to the stated annual interest rate, which is 12%. Obviously, we can eliminate answer C straight away. Now, we are left with two possible options for compounding frequency, for which we have to calculate the effective annual rate using its formula. We have:

$$Effective\ Annual\ Rate = (1 + \frac{Stated\ annual\ interest\ rate}{m})^m - 1$$

$$Effective\ Annual\ Rate_{Monthly\ Compounding} = 12.683\% = (1 + \frac{12\%}{12})^{12} - 1$$

$$Effective\ Annual\ Rate_{Daily\ Compounding} = 12.747\% = (1 + \frac{12\%}{365})^{365} - 1$$

We see that the monthly compounding frequency produces an effective annual rate of 12.683%, which corresponds to answer B.

Question 5

John deposits $100,000 in a bank for 3 years. The stated annual interest rate is 4%, while the compounding frequency is quarterly. Calculate the future value of the deposit at the end of year 3.

A. $112,480
B. $112,682
C. $114,212

Answer: B

We use the formula for calculating the future value of a cash flow. The periodic interest rate is equal to 4% divided by 4 because the compounding is quarterly. This equals 1%. The number of compounding periods mN is equal to 4 multiplied by 3 years for a total of 12 periods. The present value is equal to the amount invested in the bank, which is $100,000. The future value we obtain for the investment is equal to $112,682, which corresponds to answer B.

$$FV_N = PV\left(1 + \frac{r_s}{m}\right)^{mN}$$

$$\$112{,}682 = \$100{,}000\left(1+\frac{0.04}{4}\right)^{12}$$

Alternatively, we could use a financial calculator to get the same result. The following sequence is entered into Texas Instruments BA 2 plus.

N	I/Y	PV	PMT	CPT → FV
12	1	100,000	0	**112,682.50**

Question 6

Company X Inc. has an unfunded pension liability of $100 million that must be paid in 10 years. A group of financial analysts wants to discount this liability back to the present. If the relevant discount rate is 8%, what is the present value of this liability?

A. $46,319,348
B. $56,319,348
C. $76,319,348

Answer: A

We have a single future liability that must be paid 10 years from now. The compounding frequency is not given, so we assume it is equal to 1. Using the simplified formula for calculating the present value we have:

$$PV = \frac{FV_N}{(1+r)^N}$$

$$PV = \frac{\$100{,}000{,}000}{(1+0.08)^{10}} = \$46{,}319{,}348$$

So, the future value is equal to $46,319,348 which is answer A.

Alternatively, using Texas Instruments BA 2 plus we enter the following sequence of commands in the calculator.

N	I/Y	CPT →PV	PMT	FV
10	8	**46,319,349**	0	-100,000,000

Question 7

Jessica wants to have $200,000 three years from now for her trip around the world. How much money does she need to deposit in her bank account so that in three years she accumulates the required amount? Assume that the stated annual interest rate is 5%, and the compounding frequency is monthly.

A. $122,000
B. $156,000
C. $172,195

Answer: C

In this case, we need to use the extended formula for calculating the present value of a single amount of money because the compounding frequency is higher than 1. The number of compounding periods is equal to 12 multiplied by 3 for a total of 36. The periodic interest rate is calculated as the stated annual interest rate of 5% is divided by 12 compounding periods in a year or 0.417%.

$$PV = \frac{FV_N}{\left(1 + \frac{r_s}{m}\right)^{mN}}$$

$$\$172{,}195 = \frac{\$200{,}000}{(1 + 0.00417)^{36}}$$

Alternatively, using Texas Instruments BA 2 plus we enter the following sequence of commands in the calculator.

N	I/Y	CPT →PV	PMT	FV
36	0.417	**172,195**	0	-200,000

Question 8

What is the future value (FV) of a $5,000 deposit invested for two years using continuous compounding, if the stated annual interest rate is equal to 5%?

A. $5,155.27
B. $5,215.36
C. $5,525.86

Answer: C

We need to use the future value formula for continuous compounding. Substituting in it gives us $5,525.86

$$FV_N = PVe^{r_s N}$$

$$FV_N = \$5{,}000e^{0.05x2} = \$5{,}525.86$$

Question 9

A security pays $500 annually for a total of 10 years. Payments occur at the end of each year, and the annual interest rate is equal to 4%. The present value (PV) of the investment is closest to:

- **A. $4,055.45**
- B. $4,155.45
- C. $4,255.45

Answer: A

Payments occur at the end of the period. Therefore, the security is an ordinary annuity. There are multiple ways to solve this problem. The most calculation-intensive approach is to find the present value of each cash flow and then sum them. As an alternative, we can implement the shortcut formula for calculating the present value of an ordinary annuity. The annuity payment, A, is equal to $500. The interest rate, r, is equal to 4% and N is the number of years. We substitute into the formula to obtain $4,055.45.

$$PV = A\left[\frac{1-\frac{1}{(1+r)^N}}{r}\right]$$

$$PV = \$500\left[\frac{1-\frac{1}{(1+0.04)^{10}}}{0.04}\right] = \$4{,}055.45$$

Alternatively, using Texas Instruments BA 2 plus we enter the following sequence of commands in the calculator to reach the same result.

N	I/Y	CPT →PV	PMT	FV
10	4	**-4,055.45**	500	0

Question 10

A 10-year annuity pays $700 at the end of each year starting from year 6 onwards. The annual interest rate is 10% during all the years. The present value (PV) of the investment is closest to:

- A. $2,570.71
- **B. $2,670.71**
- C. $2,770.71

Answer: B

This problem requires a 2-step process of calculation. First, we need to find the present value (PV) of the investment as of year 5. Since cash flows occur at the year-end of each period, we know the security is an ordinary annuity. We use the shortcut formula for finding the present value of an ordinary annuity and substitute in the parameters given. The present value as of year 5 is equal to $4,301.20.

$$PV = A\left[\frac{1-\frac{1}{(1+r)^N}}{r}\right]$$

$$PV_{Year\ 5} = \$700\left[\frac{1-\frac{1}{(1+0.10)^{10}}}{0.10}\right] = \$4{,}301.20$$

Step 2 requires discounting the previously obtained value for 5 additional periods to calculate the present value as of t=0. For this purpose, we use the PV formula for a single cash flow to find that it is equal to $2,670.71.

$$PV = \frac{FV_N}{(1+r)^N}$$

$$PV = \frac{\$4{,}301.20}{(1+0.10)^5} = \$2{,}670.71$$

Alternatively, we can use a financial calculator. For Step 1, we enter the following values:

N	I/Y	CPT →PV	PMT	FV
10	10	**-4,301.20**	700	0

Then, the previously found PV becomes the future value for Step 2, and we discount it for 5 additional periods:

N	I/Y	CPT →PV	PMT	FV
5	10	**2,670.71**	0	-4,301.20

Question 11

Melissa invests in a security that pays $500 at the beginning of each of the next 5 years, starting from today. If the annual interest rate is equal to 5%, the future value (FV) of the security is closest to:

A. $2,800.96
B. $2,850.96
C. $2,900.96

Answer: C

First of all, let's determine the type of annuity we are dealing with. Since payments occur at the beginning of each period, the security is an annuity due. There are several ways to calculate the future value. The first one is to find the future value of each separate cash flow and then sum them up. The second approach is to use the short-cut formula for the future value of an ordinary annuity, and then multiply the result by 1 plus the interest rate. We have the following:

$$FVA_{Due} = FVA_{Ordinary} \times (1+r)$$

$$FVA_{Due} = A\left[\frac{(1+r)^N - 1}{r}\right](1+r)$$

$$FV_N = \$500\left[\frac{(1+0.05)^5 - 1}{0.05}\right](1+0.05) = \$2{,}900.96$$

At the end, the future value of the annuity due is equal to $2,900.96.

Alternatively, we use a Texas Instruments BA 2 plus:

First, we switch to BGN mode by entering the following sequence: [2ND][BGN][2ND][SET][2ND][QUIT]				
N	I/Y	PV	PMT	CPT → FV
5	5	0.00	500	**-2,900.96**

Question 12

John buys a perpetual preferred stock that pays $75 on a yearly basis, starting one year from now. If the annual rate of return is equal to 8%, the present value (PV) of the stock is closest to:

A. $937.50
B. $983.50
C. $1003.50

Answer: A

We use the present value formula for perpetuity and substitute in the known parameters:

$$PV_{perpetuity} = \frac{PMT}{r}$$

$$PV_{perpetuity} = \frac{\$75}{0.08} = \$937.50$$

In the end, we obtain $937.50 for the value of the stock.

Question 13

Assuming that the annual interest rate is equal to 5%, calculate the present value (PV) of the following uneven cash flows:

Time (Years)	Cash flow($)
1	\$2,500
2	\$3,000
3	\$1,700

A. \$4,759
B. \$5,286
C. \$6,571

Answer: C

We apply the formula for calculating the present value of uneven cash flows:

$$Present\ Value = \frac{Cash\ Flow_1}{(1+r)} + \frac{Cash\ Flow_2}{(1+r)^2} + \cdots \frac{Cash\ Flow_N}{(1+r)^N}$$

$$\$6{,}571 = \frac{\$2{,}500}{(1+0.05)^1} + \frac{\$3{,}000}{(1+0.05)^2} + \frac{\$1{,}700}{(1+0.05)^3}$$

At the end, we find the present value of \$6,571

Question 14

Veronika wants to save enough to buy a new car in 4 years by making equal end-of-year deposit payments. The value of the car is expected to be \$40,000. The relevant interest rate for the deposit account is equal to 3%. The amount of equal yearly payments, which will allow her to achieve her dream is closest to:

A. \$9,561.08
B. \$9,661.08
C. \$9,861.08

Answer: A

We know that Veronika has to make 4 equal payments at the end of each of the next 4 years. This cash flows structure is an ordinary annuity. We could use the future value formula for ordinary annuities and solve for A:

$$FV_N = A\left[\frac{(1+r)^N - 1}{r}\right]$$

Substituting in the known parameters results in payment of \$9,561.08:

$$\$40{,}000_4 = A\left[\frac{(1+0.03)^4-1}{0.03}\right]$$

$$A = \frac{\$40{,}000}{4.184} = \$9{,}561.08$$

Alternatively, using a financial calculator we have:

N	I/Y	PV	CPT →PMT	FV
4	3	0	**9,561**	-40,000

Question 15

At 12% rate of return, how long does it take to quadruple your initial investment of $100,000?

A. 11.23
B. 12.23
C. 14.23

Answer: B

The solution is easier than it seems. We want to know how many years it would take for the initial investment of $100,000 to become four times more or $400,000. We use the formula for calculating the future value of a single cash flow and substitute in the parameters we know:

$$FV_N = PV(1+r)^N$$

$$\$400{,}000_N = \$100{,}000(1+0.12)^N$$

$$(1+0.12)^N = 4$$

Taking the natural logarithm of both sides and solving for N results in:

$$N = \ln(4)/\ln(1.12) = 12.23$$

At the end we obtain that it would take approximately 12 years and 3 months for the investment to quadruple.

Alternatively, using Texas Instruments BA 2 plus we have:

CPT →N	I/Y	PV	PMT	FV
12.23	12	100,000	0	-400,000