Question 1
L2FI-TBB206-1412
LOS: LOS-9500
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium

A pathwise valuation model has five paths giving the present values of the cash flows of a four-year 5% annual coupon bond as displayed in the following exhibit:

Path	Present Value
1	100.4343
2	101.9043
3	102.1156
4	102.5566
5	103.7456

Which of the following is closest to the fair value of the bond according to this model?

- ○ 102.1156.
- ● 102.1513.
- ○ 103.7456.

Rationale

This Answer is Correct

The fair value of a bond using a pathwise interest model is the average of the present values of the cash flows along each path. In this case the average of the present values is (100.4343 + 101.9043 + 102.1156 + 102.5566 + 103.7456) / 5 = 102.1513.

Question 2
L2FI-TB0008-1412
LOS: LOS-9440
Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation
Difficulty: medium

A fixed-income investor is investigating several different markets for arbitrage opportunities. They identify that both one-year and two-year spot rates are 3%, then collect the following data on two-year annual coupon paying bonds in the market:

Bond	Coupon	Price
Dadda Corp.	2%	99.0965
Ayya Corp.	3%	100
Doitcha Inc.	4%	101.9135

Do arbitrage opportunities exist in this market?

- No.
- Yes, in one bond only.
- Yes, in two bonds.

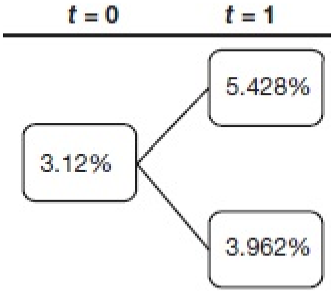
Rationale

This Answer is Correct

With a flat spot curve of 3%, the price of the bonds should be the present value of the cash flows discounted at 3%. For Dadda Corp. this is $2 / 1.03 + 102 / 1.03^2 = 98.0865$, which is different to the market price hence an arbitrage opportunity exists. Ayya Corp. is clearly correctly priced since it is trading at par and has a coupon equal to 3%, thus will yield 3% as required. Doitcha Inc. is also fairly valued since $4 / 1.03 + 104 / 1.03^2 = 101.9135$.

Question 3
L2R44TB-AC013-1512
LOS: LOS-9470
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium

An analyst has calibrated a binomial interest rate tree and determined the following tree:



Based on this binomial interest rate tree, the analyst will determine the value of a two-year, 4.0% annual-pay coupon bond with a par of 100 to be *closest to*:

- 100.21
- 100.04
- 98.65

Rationale

100.21

The backward induction process requires working from the bond's maturity back to today. At maturity the bond pays par of 100 plus its last coupon of 4, or a total of 104. At the two nodes for *t* = 1 the values of the bond are as follows:

$$\mathrm{V}_{\text{At any node}} = 0.50 \times \left[\frac{\mathrm{VH+C}}{(1+i)} + \frac{\mathrm{VL+C}}{(1+i)}\right]$$

$$\mathrm{V}_{1,\mathrm{H}}\,(\text{Corresponding to a1} - \text{year forward rate of5.428\%}) = 0.50 \times \left[\frac{100+4}{(1+0.05428)} + \frac{100+4}{(1+0.0542}\right.$$

$$\mathrm{V}_{1,\mathrm{L}}\,(\text{Corresponding to a1} - \text{year forward rate of3.962\%}) = 0.50 \times \left[\frac{100+4}{(1+0.03962)} + \frac{100+4}{(1+0.0.039}\right.$$

Next, the value today (*t* = 0) is found as follows:

$$\mathrm{V}_{\text{At any node}} = 0.50 \times \left[\frac{\mathrm{VH+C}}{(1+i)} + \frac{\mathrm{VL+C}}{(1+i)}\right]$$

$$\mathrm{V}_{0}\,(\text{Corresponding to a1} - \text{year forward rate of3.12\%}) = 0.50 \times \left[\frac{98.6455+4}{(1+0.0312)} + \frac{100.0366+4}{(1+0.0312)}\right]$$

Rationale

100.04

The backward induction process requires working from the bond's maturity back to today. At maturity the bond pays par of 100 plus its last coupon of 4, or a total of 104. At the two nodes for $t = 1$ the values of the bond are as follows:

$$V_{\text{At any node}} = 0.50 \times \left[\frac{\text{VH+C}}{(1+i)} + \frac{\text{VL+C}}{(1+i)}\right]$$

$$V_{1,H}\,(\text{Corresponding to a1} - \text{year forward rate of5.428\%}) = 0.50 \times \left[\frac{100+4}{(1+0.05428)} + \frac{100+4}{(1+0.0542}\right.$$

$$V_{1,L}\,(\text{Corresponding to a1} - \text{year forward rate of3.962\%}) = 0.50 \times \left[\frac{100+4}{(1+0.03962)} + \frac{100+4}{(1+0.0.039}\right.$$

Next, the value today ($t = 0$) is found as follows:

$$V_{\text{At any node}} = 0.50 \times \left[\frac{\text{VH+C}}{(1+i)} + \frac{\text{VL+C}}{(1+i)}\right]$$

$$V_0\,(\text{Corresponding to a1} - \text{year forward rate of3.12\%}) = 0.50 \times \left[\frac{98.6455+4}{(1+0.0312)} + \frac{100.0366+4}{(1+0.0312)}\right]$$

Rationale

98.65

The backward induction process requires working from the bond's maturity back to today. At maturity the bond pays par of 100 plus its last coupon of 4, or a total of 104. At the two nodes for $t = 1$ the values of the bond are as follows:

$$V_{\text{At any node}} = 0.50 \times \left[\frac{\text{VH+C}}{(1+i)} + \frac{\text{VL+C}}{(1+i)}\right]$$

$$V_{1,H}\,(\text{Corresponding to a1} - \text{year forward rate of5.428\%}) = 0.50 \times \left[\frac{100+4}{(1+0.05428)} + \frac{100+4}{(1+0.0542}\right.$$

$$V_{1,L}\,(\text{Corresponding to a1} - \text{year forward rate of3.962\%}) = 0.50 \times \left[\frac{100+4}{(1+0.03962)} + \frac{100+4}{(1+0.0.039}\right.$$

Next, the value today ($t = 0$) is found as follows:

$$V_{\text{At any node}} = 0.50 \times \left[\frac{\text{VH+C}}{(1+i)} + \frac{\text{VL+C}}{(1+i)}\right]$$

$$V_0\,(\text{Corresponding to a1} - \text{year forward rate of3.12\%}) = 0.50 \times \left[\frac{98.6455+4}{(1+0.0312)} + \frac{100.0366+4}{(1+0.0312)}\right]$$

Question 4
L2FI-TBX105-1502
LOS: LOS-9510
Lesson Reference: Lesson 3: Monte Carlo Method
Difficulty: easy

A risk analyst collects the following data for a putable bond:

Yield curve shift (basis points)	10
Average shift in yield of bond (basis point)	8
Current price of the bond	103.90
Price of bond when yields shift down	104.03
Price of bond when yields shift up	103.80

The effective convexity of the bond is *closest* to:

- 0.03.
- 1.11.
- 288.74. (selected)

Rationale

This Answer is Correct

$$\begin{aligned}\text{Effective}\quad \text{convexity} &= (104.03 + 103.80 - (2 \times 103.90))/((0.001)^2 \times 103.90) \\ &= 0.03/0.0001039 \\ &= 288.74\end{aligned}$$

Question 5
L2R44TB-AC011-1512
LOS: LOS-9460
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium
An analyst uses a binomial interest rate model to estimate the term structure, assuming a random walk with a lognormal distribution. Assumptions the analyst implicitly makes include:

- (selected) greater volatility as interest rates increase.
- the possibility that interest rates are negative.
- a deterministic drift term as part of interest rate paths.

Rationale

greater volatility as interest rates increase.

By using a lognormal distribution, the analyst is implicitly assuming (1) the interest rate volatility increases as the interest rate rises and (2) that interest rates can never be negative.

Rationale

the possibility that interest rates are negative.

By using a lognormal distribution, the analyst is implicitly assuming (1) the interest rate volatility increases as the interest rate rises and (2) that interest rates can never be negative.

Rationale

a deterministic drift term as part of interest rate paths.

By using a lognormal distribution, the analyst is implicitly assuming (1) the interest rate volatility increases as the interest rate rises and (2) that interest rates can never be negative.

Question 6
L2FI-TB0010-1412
LOS: LOS-9460
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium

An analyst collates the following term structure of forward rates:

$f(0,1)$ 2%
$f(1,1)$ 3%
$f(2,1)$ 4%
$f(3,1)$ 4%
$f(4,1)$ 3%

If the analyst uses a binomial model for interest rates with a lognormal random walk and assumed volatility of 10%, the interest rate expected in the third period after one movement up and one movement down along the interest rate tree is closest to:

- 2%.
- 3%.
- 4%. (selected)

Rationale

This Answer is Correct

The middle rate at time 2 will be close to the implied one-year forward rate at time 2, that is, $f(2,1)$, which is 4%.

Question 7
L2AI-PQ4301-1501
LOS: LOS-9470
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: hard

Assuming an interest rate volatility of 10%, a three-period binomial interest rate tree is constructed. At every node, there is a 50% chance of moving to the higher interest rate node and a 50% chance of moving to the lower interest rate node.

				7.0053%
		5.4289%		
3.50%				5.7354%
		4.44448%		
				4.6958%
t = 0		**t = 1**		**t = 2**

Using the binomial tree, the arbitrage-free value of a three-year 6% coupon bond is *closest* to:

- $102.42
- $101.85
- $103.58

Rationale

This Answer is Correct

$V_{2,HH}$ = $99.0605, C = $6

$V_{2,HL}$ = $100.2502, C = $6

$V_{2,LL}$ = $101.2457, C = $6

$V_{1,H}$ = $100.2148, C = $6

$V_{1,L}$ = $102.2051, C = $6

V_0 = $103.5845

Question 8
L2FI-TB0011-1412
LOS: LOS-9470
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium

An analyst uses the following three-year binomial tree for interest rates to value fixed-income investments:

Time 0	Time 1	Time 2
		5%
	4%	
2%		4.50%
	3%	
		4%

Using this tree, which of the following values is closest to the value today of a two-year 5% annual pay coupon bond?

- 99.46.
- 104.36.
- 104.46.

Rationale

This Answer is Correct

The two-year 5% coupon bond will have a certain payment of 105 in two years' time. Interest rates in the second year could be 3% or 4% according to the tree with equal probability. Hence, the value of the final cash flow at time 1 will be:

(0.5 105 / 1.03)+(0.5 105 / 1.04) = 101.45.

Adding the coupon that is paid at time 1 and discounting back to the present gives a value of (101.45 + 5) / 1.02 = 104.36.

Question 9
L2R44TB-ITEMSET-AC001-1512
LOS: LOS-9460
LOS: LOS-9470
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: N/A

Use the following information to answer the next 3 questions:

Andre Dixon, CFA, uses a binomial interest rate tree model for fixed-income valuation purposes. Dixon is currently considering a two-year, 2.4% annual-pay coupon bond issued by a large commercial banking firm located in the U.S. The bond, with a par value of $100, has significant liquidity and extremely low credit risk. Dixon believes several of his institutional clients would be interested in this bond, especially since they prefer low duration bonds.

Dixon assumes a lognormal random walk and designs the following tree:

t = 0	t = 1
	6.86%
6.10%	
	6.21%

Dixon makes the following comment to one of the institutional clients after a meeting: "Using the lognormal assumption means that I am implicitly assuming that the term structure of interest rates will always remain positive and that there is higher interest rate volatility when the rate is at 6.86% than when the rate is at 6.21%."

i.
Dixon is *most likely* assuming that interest rate volatility is *closest to*:

- (●) 5%
- ( ) 10%
- ( ) 15%

Rationale

This Answer is Correct

To answer this question requires knowledge that lognormal volatility is approximately two standard deviations at time period one: Higher time period one (t = 1) rate = $0.0621e^{2 \times 0.05}$ = 0.0686. If he were using 10% or 15% as the interest rate volatility, the resulting higher t = 1 rate would be 7.585% or 8.383%, respectively.

Rationale

This Answer is Correct

To answer this question requires knowledge that lognormal volatility is approximately two standard deviations at time period one: Higher time period one (t = 1) rate = $0.0621e^{2 \times 0.05}$ = 0.0686. If he were using 10% or 15% as the interest rate volatility, the resulting higher t = 1 rate would be 7.585% or 8.383%, respectively.

Rationale

This Answer is Correct

To answer this question requires knowledge that lognormal volatility is approximately two standard deviations at time period one: Higher time period one (t = 1) rate = $0.0621e^{2 \times 0.05}$ = 0.0686. If he were using 10% or 15% as the interest rate volatility, the resulting higher t = 1 rate would be 7.585% or 8.383%, respectively.

ii.

Assuming the binomial interest rate tree is used, the value of the bond issued by the commercial bank is *closest to*:

- ○ \$87.30
- ○ \$88.47
- ◉ \$92.86

Rationale

This Answer is Incorrect

The bond matures in two years and pays \$102.40 (par value plus interest) and it pays \$2.40 at the beginning of year 1 (1 year from today). Using the backward induction process (work from maturity back to today), the bond's value is calculated as follows:

$$\begin{aligned}
\text{Value}_{1,\text{H}} &= \frac{\$100.00+2.40}{(1.0686)^1} = \$95.8263 \\
\text{Value}_{1,\text{L}} &= \frac{\$100.00+2.40}{(1.0621)^1} = \$96.4128 \\
\text{Value}_0 &= 0.5\left(\frac{\$95.8263+2.40}{(1.061)^1} + \frac{\$96.4128+2.40}{(1.061)^1}\right) = \$92.8554 \approx \$92.86
\end{aligned}$$

Rationale

This Answer is Incorrect

The bond matures in two years and pays \$102.40 (par value plus interest) and it pays \$2.40 at the beginning of year 1 (1 year from today). Using the backward induction process (work from maturity back to today), the bond's value is calculated as follows:

$$
\begin{aligned}
\text{Value}_{1,\text{H}} &= \frac{\$100.00+2.40}{(1.0686)^1} = \$95.8263 \\
\text{Value}_{1,\text{L}} &= \frac{\$100.00+2.40}{(1.0621)^1} = \$96.4128 \\
\text{Value}_0 &= 0.5\left(\frac{\$95.8263+2.40}{(1.061)^1} + \frac{\$96.4128+2.40}{(1.061)^1}\right) = \$92.8554 \approx \$92.86
\end{aligned}
$$

Rationale

This Answer is Incorrect

The bond matures in two years and pays $102.40 (par value plus interest) and it pays $2.40 at the beginning of year 1 (1 year from today). Using the backward induction process (work from maturity back to today), the bond's value is calculated as follows:

$$
\begin{aligned}
\text{Value}_{1,\text{H}} &= \frac{\$100.00+2.40}{(1.0686)^1} = \$95.8263 \\
\text{Value}_{1,\text{L}} &= \frac{\$100.00+2.40}{(1.0621)^1} = \$96.4128 \\
\text{Value}_0 &= 0.5\left(\frac{\$95.8263+2.40}{(1.061)^1} + \frac{\$96.4128+2.40}{(1.061)^1}\right) = \$92.8554 \approx \$92.86
\end{aligned}
$$

iii.

With respect to the two components in his comment, Dixon is *most likely* correct by stating that he is implicitly assuming:

- (selected) no negative interest rates and higher interest rate volatility as interest rates rise.
- no negative interest rates, but is incorrect on interest rate volatility because it is constant at his assumed rate.
- higher interest rate volatility as interest rates increase, but the lognormal process does allow for negative interest rates.

Rationale

This Answer is Incorrect

The lognormal assumption means that interest rates on every path will be positive. In addition, when interest rates are higher, the lognormal assumption builds in higher volatility.

Rationale

This Answer is Incorrect

The lognormal assumption means that interest rates on every path will be positive. In addition, when interest rates are higher, the lognormal assumption builds in higher volatility.

Rationale

This Answer is Incorrect

The lognormal assumption means that interest rates on every path will be positive. In addition, when interest rates are higher, the lognormal assumption builds in higher volatility.

Question 10
L2FI-TBB205-1412
LOS: LOS-9490
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium

One-year spot rates are 1% and two-year spot rates are 2% assuming annual coupon payments. An analyst has derived the following interest rate tree:

Time 0	Time 1
	R
1.00%	
	2.46%

By considering the price of a two-year 5% annual coupon bond, determine which of the following interest rates would produce an arbitrage free tree:

- ○ 3.00%.
- ○ 3.23%.
- ◉ 3.57%.

Rationale

This Answer is Correct

Using the spot rates, the price of a two-year, 5% coupon bond will be:

$$\text{Price} = \$5/1.01 + \$105/1.02 * 2 = \$105.8732.$$

In order for the tree to be arbitrage free, it must give the same value when using backward induction.

If interest rates are low (2.46%) in the second period, the value of the bond at that node will be (0.5 * (105) + 0.5 * (105)) / 1.0246 = 102.479

If the value of the bond when interest rates go up at time 1 Vu, then for the tree to be arbitrage free:

$$105.8732 = (0.5 \times (\text{Vu} + 5) + 0.5 \times (102.479 + 5))/1.01$$

Hence Vu must be 101.3849

If the value in this high node at time 1 is 101.38 then it must be the case that:

$$101.3849 = ((0.5 \times 105) + (0.5 \times 105))/(1 + \text{R}).$$

Hence, *R* is 3.57%.

This problem is likely more easily solved through trial and error rather than the detailed calculations above.

Question 11
L2R44TB-AC014-1512
LOS: LOS-9500
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium
A properly calibrated pathwise valuation model will produce an identical bond value as the value found using a binomial interest rate tree model:

- (selected) at all times.
- only if the bond does not include an embedded option.
- only if the interest rate paths outlined by each method are identical.

Rationale

✓ **at all times.**

The pathwise valuation method specifies a list of potential paths and then averages the present values to determine price. If properly calibrated, the pathwise model will generate a value that is identical to the value found using the binomial interest rate tree. The interest rate paths do not have to be identical and the two models will have the same value for a bond with an embedded option.

Rationale

✗ **only if the bond does not include an embedded option.**

The pathwise valuation method specifies a list of potential paths and then averages the present values to determine price. If properly calibrated, the pathwise model will generate a value that is identical to the value found using the binomial interest rate tree. The interest rate paths do not have to be identical and the two models will have the same value for a bond with an embedded option.

Rationale

✗ **only if the interest rate paths outlined by each method are identical.**

The pathwise valuation method specifies a list of potential paths and then averages the present values to determine price. If properly calibrated, the pathwise model will generate a value that is identical to the value found using the binomial interest rate tree. The interest rate paths do not have to be identical and the two models will have the same value for a bond with an embedded option.

Question 12
L2FI-TB0009-1412
LOS: LOS-9450
Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation
Difficulty: medium

A fixed-income investor has collated the following information regarding the par yield curve:

Bond	Par Yield
Annual pay one-year	1%
Annual pay two-year	3%

If the prices are known to be arbitrage-free, which of the following is *most likely* to describe the fair value of a two-year zero-coupon bond?

- (selected) Slightly less than 94.26.
- Exactly 94.26.
- Slightly more than 94.26.

Rationale

This Answer is Correct

The par yield of the one-year annual pay instrument is the same as the one-year spot rate since there is only one cash flow of the bond at maturity. Hence, the one-year spot rate is 1%. Valuing the 3% two-year bond using spot rates will mean discounting the first coupon by only 1%, which must mean we discount the second payment by slightly more than 3% to get a price of par. This means that the two-year spot rate must be slightly greater than 3%. This means that the fair value of a zero-coupon two-year bond much be slightly less than $100 / (1.03)^2 = 94.26$.

Question 13
L2R44TB-AC009-1512
LOS: LOS-9450
Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation
Difficulty: medium
Spot rates are determined to be 3.0%, 4.5%, and 6.0% for the next three years. A three-year, 7% annual-pay option-free bond value with a par value of 100 is *closest to*:

- ○ 102.67
- ◉ 103.05
- ○ 106.87

Rationale
102.67
To find the value, each of the bond's cash flows is discounted by the spot rate that applies to that cash flow and then these individual present values are summed:

$$\text{Value} = \frac{7}{(1.030)^1} + \frac{7}{(1.045)^2} + \frac{107}{(1.060)^3} = 103.05$$

Rationale
103.05
To find the value, each of the bond's cash flows is discounted by the spot rate that applies to that cash flow and then these individual present values are summed:

$$\text{Value} = \frac{7}{(1.030)^1} + \frac{7}{(1.045)^2} + \frac{107}{(1.060)^3} = 103.05$$

Rationale
106.87
To find the value, each of the bond's cash flows is discounted by the spot rate that applies to that cash flow and then these individual present values are summed:

$$\text{Value} = \frac{7}{(1.030)^1} + \frac{7}{(1.045)^2} + \frac{107}{(1.060)^3} = 103.05$$

Question 14
L2FI-TBX104-1502
LOS: LOS-9510
Lesson Reference: Lesson 3: Monte Carlo Method
Difficulty: easy
Mortgage-backed securities are likely to be valued most accurately using:

- Binomial models.
- Discounted cash flows.
- Monte Carlo methods.

Rationale

This Answer is Correct

Mortgage-backed securities have cash flows that depend not only on the level of interest rates but the path that interest rates have taken to be at the current level. This is because the prepayment speed of the underlying mortgage pool depends on the path interest rates have taken in the past. Binomial models are not appropriate for path-dependent cash flows because the model has no memory of which path interest rates took to reach any given node. Discounted cash flow techniques do not allow for interest rate volatility and only consider one path of interest rates; hence, they are not appropriate for the valuation of securities with embedded prepayment options like mortgage-backed securities.

Question 15
L2AI-PQ4303-1501
LOS: LOS-9470
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: hard

Consider the following two-year coupon bonds:

Bond	Coupon	Market Price
A	2.5%	97.182
B	3.5%	99.057
C	4.5%	100.00

Given that the one-year spot rate is 4% and that the two-year spot rate is 4.5%, which of the bonds is *most* likely underpriced?

- ○ Bond A.
- ○ Bond B.
- ◉ Bond C.

Rationale

This Answer is Correct

$2.5/1.04 + 102.5/1.045^2 = 96.266$ (overpriced)

$3.5/1.04 + 103.5/1.045^2 = 98.143$ (overpriced)

$4.5/1.04 + 104.5/1.045^2 = 100.021$ (underpriced)

Question 16
L2FI-TB0012-1412
LOS: LOS-9480
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: medium

Greg Royston-Smythe, CFA, is an analyst who is considering using a binomial model to value fixed income investments. His research department currently uses two different interest rate trees for valuation purposes and are confused as to which model is giving the more accurate results. Smythe tests the models on an option free three year 8% annual coupon bond and obtains the following results:

Interest rate tree 1 valuation: 100

Interest rate tree 2 valuation: 97.5

Smythe collates the following par curve data:

Maturity (yrs)	Yield (%)
1	6
2	7
3	8
4	9
5	10

Based on the information above, which of the interest rate trees is arbitrage free?

- ○ Neither of them.
- ● Interest rate tree 1 only.
- ○ Interest rate tree 2 only.

Rationale

This Answer is Correct

If the interest rate tree is arbitrage-free, then it will price option-free bonds correctly. The par curve tells us that a three-year 8% annual coupon bond is trading at par. It is interest rate tree 1 that correctly represents this price; interest rate tree 2 does not.

Question 17
L2R44TB-AC010-1512
LOS: LOS-9450
Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation
Difficulty: medium
A two-year annual-pay option-free bond with a 6% coupon is priced at 98.921 on the ABC Bond Exchange. An analyst, using the price of the bond on a different exchange (the EDU Exchange), has calculated that the one- and two-year spot rates implied by the bond's price on the EDU Exchange are 6.2% and 6.8%, respectively. Ignoring transaction costs, is there an arbitrage opportunity?

- No.
- Yes, because the bond is selling at a lower price on the EDU Exchange than its price on the ABC Bond Exchange.
- Yes, because the bond is selling at a higher price on the EDU Exchange than its price on the ABC Bond Exchange.

Rationale

No.

First, the price on the EDU Exchange needs to be determined:

$$\text{Price}_{\text{EDU Exchange}} = \frac{6}{(1.062)^1} + \frac{106}{(1.068)^2} = 98.5813$$

The bond's price is lower on the EDU Exchange and an arbitrage profit can be earned by selling the bond on the ABC Bond Exchange and simultaneously buying the same bond on the EDU Exchange.

Rationale

Yes, because the bond is selling at a lower price on the EDU Exchange than its price on the ABC Bond Exchange.

First, the price on the EDU Exchange needs to be determined:

$$\text{Price}_{\text{EDU Exchange}} = \frac{6}{(1.062)^1} + \frac{106}{(1.068)^2} = 98.5813$$

The bond's price is lower on the EDU Exchange and an arbitrage profit can be earned by selling the bond on the ABC Bond Exchange and simultaneously buying the same bond on the EDU Exchange.

Rationale

Yes, because the bond is selling at a higher price on the EDU Exchange than its price on the ABC Bond Exchange.

First, the price on the EDU Exchange needs to be determined:

$$\text{Price}_{\text{EDU Exchange}} = \frac{6}{(1.062)^1} + \frac{106}{(1.068)^2} = 98.5813$$

The bond's price is lower on the EDU Exchange and an arbitrage profit can be earned by selling the bond on the ABC Bond Exchange and simultaneously buying the same bond on the EDU Exchange.

Question 18

L2R44TB-AC007-1512

LOS: LOS-9440

Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation

Difficulty: medium

A trader is valuing fixed-income securities in the sovereign debt market. Which of the following pricing techniques would *least likely* be consistent with arbitrage-free valuation?

- ○ Valuing the bond as a portfolio of zero-coupon bonds.
- ○ Using bootstrapped spot curves to determine present values.
- ◉ Discounting coupons and principal assuming a flat yield curve.

Rationale

✗ **Valuing the bond as a portfolio of zero-coupon bonds.**

When the yield curve is flat, bond prices can be computed using one risk-free rate that applies to all future cash flows. This is the simplest of all pricing model assumptions and will very likely not result in a price that is equal to the observed market price. Bootstrapping and using zero-coupon bonds are part of the process to produce arbitrage-free pricing.

Rationale

✗ **Using bootstrapped spot curves to determine present values.**

When the yield curve is flat, bond prices can be computed using one risk-free rate that applies to all future cash flows. This is the simplest of all pricing model assumptions and will very likely not result in a price that is equal to the observed market price. Bootstrapping and using zero-coupon bonds are part of the process to produce arbitrage-free pricing.

Rationale

✓ **Discounting coupons and principal assuming a flat yield curve.**

When the yield curve is flat, bond prices can be computed using one risk-free rate that applies to all future cash flows. This is the simplest of all pricing model assumptions and will very likely not result in a price that is equal to the observed market price. Bootstrapping and using zero-coupon bonds are part of the process to produce arbitrage-free pricing.

Question 19
L2R44TB-AC012-1512
LOS: LOS-9450
Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation
Difficulty: medium
An analyst uses a binomial interest rate tree to estimate the term structure assuming lognormal distribution of rates. The analyst computes historical volatility as 12% and implied volatility estimated from a swaption as 14%. The use of the implied volatility will *most likely* result in:

- (selected) a wider interest rate path.
- present values that are not arbitrage-free.
- interest rate paths that include negative interest rates.

Rationale
a wider interest rate path.
The use of a higher volatility measure will result in interest rate paths that are wider. The lognormal assumption precludes negative rates and the resulting term structure will produce arbitrage-free bond values.

Rationale
present values that are not arbitrage-free.
The use of a higher volatility measure will result in interest rate paths that are wider. The lognormal assumption precludes negative rates and the resulting term structure will produce arbitrage-free bond values.

Rationale
interest rate paths that include negative interest rates.
The use of a higher volatility measure will result in interest rate paths that are wider. The lognormal assumption precludes negative rates and the resulting term structure will produce arbitrage-free bond values.

Question 20
L2R44TB-ITEMSET-AC004-1512
LOS: LOS-9480
LOS: LOS-9500
LOS: LOS-9510
Lesson Reference: Lesson 2: Interest Rate Trees and Arbitrage-Free Valuation
Difficulty: N/A

Use the following information to answer the next 3 questions:

Bert Cole, CFA, uses Monte Carlo simulation, in addition to other fixed-income valuation tools, to identify undervalued securities. Cole observes the current spot rate to be 3% and the spot curve is upward sloping.

Cole is evaluating the following risk-free, three-year bonds:

Issuer	Coupon	Option
Bond A	4.0%	None
Bond B	3.8%	Putable
Bond C	3.5%	Callable

Using spot rates, Cole has calculated a value of $101.385 for Bond A. His supervisor asks him to determine the value of this bond using the binomial interest rate tree.

He opts to value Bond B using a binomial interest rate tree and has calculated a value of $102.45. He decides to check this using a pathwise valuation.

Finally, Monte Carlo simulation has produced the following output for Bond C:

Path	*t* = 0 Present Value	*t* = 1 rates	*t* = 2 rates
1	100.701	2.61	4.19
2	98.026	3.45	6.34
3	95.432	4.86	7.93
4	95.760	5.49	6.86
5	100.249	4.74	2.49
6	99.304	5.02	3.25

i.
Given the upward sloping spot yield curve, the value that Cole will calculate for Bond A by using the binomial interest rate tree will *most likely* be:

- (selected) approximately equal to the value determined using spot rates.
- more than the value determined using spot rates.
- less than the value determined using spot rates.

Rationale

This Answer is Correct

An option-free bond that is valued using spot rates should have the same value when using a binomial interest rate tree. If the value is not the same, then the binomial interest rate tree is *most likely* not properly calibrated.

Rationale

This Answer is Correct

An option-free bond that is valued using spot rates should have the same value when using a binomial interest rate tree. If the value is not the same, then the binomial interest rate tree is *most likely* not properly calibrated.

Rationale

This Answer is Correct

An option-free bond that is valued using spot rates should have the same value when using a binomial interest rate tree. If the value is not the same, then the binomial interest rate tree is *most likely* not properly calibrated.

ii.

The pathwise valuation that Cole plans to complete on Bond B will *most likely* result in a value that is:

- ○ less than $102.45.
- ○ greater than $102.45.
- ● approximately equal to $102.45.

Rationale

This Answer is Incorrect

A pathwise valuation method should produce the same bond value as the value determined by the binomial interest rate tree model.

Rationale

This Answer is Incorrect

A pathwise valuation method should produce the same bond value as the value determined by the binomial interest rate tree model.

Rationale

This Answer is Incorrect

A pathwise valuation method should produce the same bond value as the value determined by the binomial interest rate tree model.

iii.

Using the Monte Carlo simulation model, the value of Bond C is *closest to*:

- $98.07
- $98.25
- $98.67

Rationale

This Answer is Incorrect

The value of the bond using the Monte Carlo simulation results is the average of the time zero ($t = 0$) present values. This average is $98.246.

Rationale

This Answer is Incorrect

The value of the bond using the Monte Carlo simulation results is the average of the time zero ($t = 0$) present values. This average is $98.246.

Rationale

This Answer is Incorrect

The value of the bond using the Monte Carlo simulation results is the average of the time zero ($t = 0$) present values. This average is $98.246.

Question 21
L2R44TB-AC008-1512
LOS: LOS-9440
Lesson Reference: Lesson 1: The Meaning of Arbitrage-Free Valuation
Difficulty: medium
A bond issued by the German government is callable in three years and matures in five years. Its arbitrage-free value can best be described as the arbitrage-free value of the:

- straight bond plus the arbitrage-free value of the call option.
- straight bond minus the arbitrage-free value of the call option.
- call option minus the arbitrage-free value of the straight bond.

Rationale
straight bond plus the arbitrage-free value of the call option.
Each component of the bond must have an arbitrage-free value. The call is a negative feature to bondholders, as the issuer has the right to call the bonds. So, a callable bond's value is the difference between the arbitrage-free value of the bond without the call feature (i.e., a straight bond) and the arbitrage-free value of the option.

Rationale
straight bond minus the arbitrage-free value of the call option.
Each component of the bond must have an arbitrage-free value. The call is a negative feature to bondholders, as the issuer has the right to call the bonds. So, a callable bond's value is the difference between the arbitrage-free value of the bond without the call feature (i.e., a straight bond) and the arbitrage-free value of the option.

Rationale
call option minus the arbitrage-free value of the straight bond.
Each component of the bond must have an arbitrage-free value. The call is a negative feature to bondholders, as the issuer has the right to call the bonds. So, a callable bond's value is the difference between the arbitrage-free value of the bond without the call feature (i.e., a straight bond) and the arbitrage-free value of the option.

Question 22
L2FI-TBB207-1412
LOS: LOS-9510
Lesson Reference: Lesson 3: Monte Carlo Method
Difficulty: medium
Which of the following models is likely to be most appropriate for valuing a mortgage-backed security?

- ○ Binomial model.
- ○ Pathwise model.
- ◉ Monte Carlo model.

Rationale

This Answer is Correct

Monte Carlo methods are often used when cash flows are path dependent as in the case of mortgage-backed securities, which have variable prepayment speeds in the underlying collateral according to the path that interest rates take.