26 THE ARBITRAGE-FREE VALUATION FRAMEWORK

1. A 3-year, 3% annual pay, $100 par bond is valued using pathwise valuation. The interest rate paths are provided below:

Path	Year 1	Year 2	Year 3
1	2%	2.8050%	4.0787%
2	2%	2.8050%	3.0216%
3	2%	2.0780%	3.0216%
4	2%	2.0780%	2.2384%

The value of the bond in path 4 is closest to:

(A) $100.02
(B) $101.88
(C) $102.58

2. Currently the term structure of interest rate is downward sloping. Which of the following models most accurately describe the current term structure?

(A) Cox-Ingersoll-Ross model.
(B) Ho-Lee model.
(C) Vasicek model.

3. A 3-year, 3% annual pay, $100 par bond is valued using pathwise valuation. The interest rate paths are provided below:

Path	Year 1	Year 2	Year 3
1	2%	2.8050%	4.0787%
2	2%	2.8050%	3.0216%
3	2%	2.0780%	3.0216%
4	2%	2.0780%	2.2384%

The value of the bond in path 2 is closest to:

(A) $100.88
(B) $101.15
(C) $102.72

4. Using the following interest rate tree of semiannual interest rates what is the value of an option free semiannual bond that has one year remaining to maturity and has a 6% coupon rate?

6.53%

6.30%

5.67%

(A) 97.53.
(B) 99.81.
(C) 98.52.

5. A bond with a 10% annual coupon will mature in two years at par value. The current one-year spot rate is 8.5%. For the second year, the yield volatility model forecasts that the one-year rate will be either 8% or 9%. Using a binomial interest rate tree, what is the current price?

(A) 102.659.
(B) 103.572.
(C) 101.837.

6. Government par curve is provided below:

Maturity (years)	Par rate
1	5.0%
2	6.0%
3	6.5%
4	7.0%

The value of a 4-year, 5% annual pay, $100 par government bond is closest to:

(A) $98.49
(B) $93.15
(C) $101.12

7. Which of the following choices is least-likely a property of a binomial interest rate tree?

(A) Adjacent forward rates in a nodal period are one standard deviation apart.
(B) Non-negative interest rates.
(C) Higher volatility at higher rates.

8. Relative to the binomial model, Monte Carlo method is most likely:

(A) more suitable when valuing securities whose cash flows are interest rate path dependent.
(B) less flexible in forcing interest rates to mean revert.
(C) more flexible as it does not need a volatility estimate.

9. Suppose that we calculate the value of an option-free, fixed-rate coupon bond, discounting the cash flows using two methods:

I. the zero-coupon yield curve.

II. an arbitrage-free binomial lattice.

Compared to the first methodology, the second method is expected to produce:

(A) a lower value if the bond carries a coupon higher than the corresponding benchmark bond.

(B) a higher value in the presence of volatility.

(C) the same value.

10. Tim Brospack is generating a binomial interest rate tree assuming a volatility of 15%. Current 1-year spot rate is 5%. The 1-year forward rate in the second year is either a low estimate of 5.250% or a high estimate of 7.087%. The middle 1-year forward rate in year three is estimated at 6.25%. The upper node 1-year forward rate in year three is closest to:

(A) 7.747%

(B) 6.445%

(C) 8.437%

11. With respect to interest rate models, backward induction refers to determining:

(A) one portion of the yield curve from another portion.

(B) the current value of a bond based on possible final values of the bond.

(C) convexity from duration.

12. Sam Roit, CFA, has collected the following information on the par rate curve, spot rates, and forward rates to generate a binomial interest rate tree consistent with this data.

Maturity	Par rate	Spot Rate
1	5%	5.000%
2	6%	6.030%
3	7%	7.097%

The binominal free generated is shown below (one year forward rate) assuming a volatility level of 10%.

0	1	2
5%	7.7099%	C
	A	9.2625%
		B

Riot also generated another tree using the same spot rates but this time assuming a volatility level of 20% as shown below:

0	1	2
5%	8.9480%	13.8180%
	5.9980%	9.2625%
		6.2088%

The one-year forward rate represented by B' is closest to:

(A) 7.5835%

(B) 8.7732%

(C) 7.4223%

13. Jill Sebelius, editor-in-chief of a monthly interest-rate newsletter uses the following model to forecast short-term interest rates:

$$dr = a(b - r)dt + \sigma\sqrt{r}dz$$

For the current newsletter, Sebelius has issued the following expectations:

a = 0.40, b = 3%, r = 2%.

Sebelius's model is most accurately described as the:

(A) Cox-Ingersoll-Ross model.

(B) Ho-Lee model.

(C) Vasicek model.

14. Sam Roit, CFA, has collected the following information on the par rate curve, spot rates, and forward rates to generate a binomial interest rate tree consistent with this data.

Maturity	Par rate	Spot Rate
1	5%	5.000%
2	6%	6.030%
3	7%	7.097%

The binominal free generated is shown below (one year forward rate) assuming a volatility level of 10%.

0	1	2
5%	7.7099%	C
	A	9.2625%
		B

Riot also generated another tree using the same spot rates but this time assuming a volatility level of 20% as shown below:

0	1	2

5%	8.9480% 5.9980%	13.8180% 9.2625% 6.2088%

The one-year forward rate represented by C' is closest to:

(A) 11.3132%

(B) 7.4223%

(C) 8.7732%

15. Increasing the number of paths generated in a Monte Carlo simulation is most likely to increase the:

(A) utility of the model.

(B) fundamental accuracy of the estimated value.

(C) statistical accuracy of the estimated value.

16. Sam Roit, CFA, has collected the following information on the par rate curve, spot rates, and forward rates to generate a binomial interest rate tree consistent with this data.

Maturity	Par rate	Spot Rate
1	5%	5.000%
2	6%	6.030%
3	7%	7.097%

The binominal free generated is shown below (one year forward rate) assuming a volatility level of 10%.

0	1	2
5%	7.7099% A	C 9.2625% B

Riot also generated another tree using the same spot rates but this time assuming a volatility level of 20% as shown below:

0	1	2
5%	8.9480% 5.9980%	13.8180% 9.2625% 6.2088%

Is the binominal tree using the 20% volatility assumption calibrated properly?

(A) The tree is not calibrated properly because it is not consistent with market prices.

(B) The tree is not calibrated properly because nodes are not appropriate standard deviations apart.

(C) The tree is calibrated properly.

17. Why is the backward induction methodology used to value a bond rather than a forward induction scheme?

(A) Future interest rate changes are difficult to forecast.
(B) The convexity of a bond changes over time.
(C) The price of the bond is known at maturity.

18. Jill Sebelius, editor-in-chief of a monthly interest-rate newsletter uses the following model to forecast short-term interest rates:

$$dr = a(b - r)dt + \sigma\sqrt{r}dz$$

For the current newsletter, Sebelius has issued the following expectations:
a = 0.40, b = 3%, r = 2%.
Based on Sebelius's estimates, over a sufficiently long period of time, the expected value of the short-term interest rate is closest to:
(A) 2.4%
(B) 2%
(C) 3%

19. For a 3-year, semiannual coupon payment bond, the number of interest rate paths that would be generated using the pathwise valuation is closest to:
(A) 4
(B) 32
(C) 64

20. A 3-year, 3% annual pay, $100 par bond is valued using pathwise valuation. The interest rate paths are provided below:
The value of the bond in path 3 is closest to:

Path	Year 1	Year 2	Year 3
1	2%	2.8050%	4.0787%
2	2%	2.8050%	3.0216%
3	2%	2.0780%	3.0216%
4	2%	2.0780%	2.2384%

The value of the bond in path 3 is closest to:
(A) $100.02
(B) $99.88
(C) $101.85

21. The government bond spot rate curve is given below:

Maturity (years)	Spot rate
0.5	1.25%
1.0	1.30%
1.5	1.80%
2.0	2.00%
2.5	2.20%

3.0	2.25%
3.5	2.28%
4.0	2.30%

Compute the issue price of a 3-year, 3% semiannual coupon government bond with a par value of $100.

(A) $102.15

(B) $102.20

(C) $104.09

22. A binomial model or any other model that uses the backward induction method cannot be used to value a mortgage-backed security (MBS) because:

(A) the prepayments occur linearly over the life of an interest rate trend (either up or down).

(B) the cash flows for an MBS only depend on the current rate, not the path that rates have followed.

(C) the cash flows for the MBS are dependent upon the path that interest rates follow.

23. A 3-year, 3% annual pay, $100 par bond is valued using pathwise valuation The interest rate paths are provided below:

Path	Year 1	Year 2	Year 3
1	2%	2.8050%	4.0787%
2	2%	2.8050%	3.0216%
3	2%	2.0780%	3.0216%
4	2%	2.0780%	2.2384%

The value of the bond in path 1 is closest to:

(A) $101.88

(B) $98.77

(C) $100.18

24. Tim Brospack is generating a binomial interest rate tree assuming a volatility of 15%. Current 1-year spot rate is 5%. The 1-year forward rate in the second year is either a low estimate of 5.250% or a high estimate of 7.087%.The middle 1-year forward rate in year three is estimated at 6.25%. The lower node 1-year forward rate in year three is closest to:

(A) 5.342%

(B) 6.747%

(C) 4.63%

25. Using the following interest rate tree of semiannual interest rates what is the value of an option free bond that has one year remaining to maturity and has 5% coupon rate with semi-annual coupon payments.

Today	6 Months
	7.30%
6.20%	
	5.90%

(A) 97.53.

(B) 98.67.

(C) 98.98.

26. The process of stripping is most likely to be used to earn arbitrage profits in a situation where:

(A) one treasury bond trades at a lower price than another treasury bond with identical characteristics.

(B) a portfolio of treasury strips is trading for a lower price than an intact treasury bond.

(C) Security valuations are not consistent with the value additivity principle.

27. Which of the following is a correct statement concerning the backward induction technique used within the binomial interest rate tree framework? From the maturity date of a bond:

(A) the corresponding interest rates and interest rate probabilities are used to discount the value of the bond.

(B) a deterministic interest rate path is used to discount the value of the bond.

(C) the corresponding interest rates are weighted by the bond's duration to discount the value of the bond.

28. Sam Roit, CFA, has collected the following information on the par rate curve, spot rates, and forward rates to generate a binomial interest rate tree consistent with this data.

Maturity	Par rate	Spot Rate
1	5%	5.000%
2	6%	6.030%
3	7%	7.097%

The binominal free generated is shown below (one year forward rate) assuming a volatility level of 10%.

0	1	2
5%	7.7099% A	C 9.2625% B

Riot also generated another tree using the same spot rates but this time assuming a volatility level of 20% as shown below:

0	1	2
5%	8.9480%	13.8180%
	5.9980%	9.2625%
		6.2088%

The one-year forward rate represented by A' is closest to:

(A) 6.3123%

(B) 6.7732%

(C) 5.4223%

29. Which of the following choices is least-likely a property of a binomial interest rate tree?

(A) Higher volatility at higher rates.

(B) Mean reversion of interest rates.

(C) Non-negative interest rates.

30. Jill Sebelius, editor-in-chief of a monthly interest-rate newsletter uses the following model to forecast short-term interest rates:

$$dr = a(b - r)\,dt + \sigma\sqrt{r}dz$$

For the current newsletter, Sebelius has issued the following expectations:

a = 0.40, b = 3%, r = 2%.

According to the model used by Sebelius, volatility in the short-term in interest rate is most likely:

(A) negatively related to the current level of the short-term interest rate.

(B) positively related to the current level of the short-term interest rate.

(C) independent of the current level of the short-term interest rate.