Exam FM

Questions

1. A man borrows 1000 for 2 years at an annual effective rate of i. He has two payment options:

1. Pay 560 at the end of each year, or
2. Pay $K$ at the end of year 1 and 800 at the end of year 2.

Find $K$.

A) 329.42  B) 331.66  C) 334.82  D) 337.57  E) 341.65

2. A company has liabilities of 2000 payable in 1 year and 5000 payable in 3 years. The investments available to the company are the following zero-coupon bonds:

<table>
<thead>
<tr>
<th>Maturity (years)</th>
<th>Effective Annual Rate</th>
<th>Par</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.5%</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>7.5%</td>
<td>1000</td>
</tr>
</tbody>
</table>

Determine the cost for matching liabilities exactly.

A) 5903  B) 5935  C) 5952  D) 5970  E) 5988

3. A woman has a fixed rate mortgage on her home. Her payments are level and made at the end of the month. The principal repaid in the $20^{th}$ payment is 3 times the principal repaid in the $5^{th}$ payment. Find the rate of interest on this mortgage.

A) 6.8%  B) 7.0%  C) 7.2%  D) 7.4%  E) 7.6%
4. You are given the following \( n \)-year forward rates:

<table>
<thead>
<tr>
<th>Year</th>
<th>Forward Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.9%</td>
</tr>
<tr>
<td>1</td>
<td>3.7%</td>
</tr>
<tr>
<td>2</td>
<td>4.4%</td>
</tr>
<tr>
<td>3</td>
<td>5.2%</td>
</tr>
</tbody>
</table>

Find \( s_4 \).

A) 3.92%  B) 4.05%  C) 4.17%  D) 4.31%  E 4.46%

5. A man buys a 20-year annuity-immediate for 10,000. He receives annual payments of 910. He invests these payments in a fund that earns 7.5% annually. What is his annual yield on this investment?

A) 6.5%  B) 6.7  C) 6.9%  D) 7.1%  E) 7.3%

6. An investment pays 2000 at the end of year one and 4000 at the end of year three. It is purchased to yield 7.2% annual effective rate. What is the Macaulay duration for this investment?

A) 2.270  B) 2.301  C) 2.334  D) 2.358  E) 2.515

7. A woman buys two 5-year 1000 par bonds. The first has 7.5% semiannual coupons and is priced to yield 8% convertible semiannually. The second has 6% semiannual coupons and is priced to yield 7% convertible semiannually. The coupon payments from the two bonds are deposited in a fund that pays 6.8% convertible semiannually.

What is her annual effective yield for this combined investment?

A) 7.3%  B) 7.5%  C) 7.7%  D) 7.9%  E) 8.1%

8. The spot rate for year \( k \) is given by the equation

\[ s_k = 0.08 + 0.003k - 0.0015k^2. \]

Find the three-year forward rate implied by this yield curve.

A) 4.36%  B) 4.41%  C) 4.58%  D) 4.65%  E) 4.74%
9. A 10-year annuity-due pays 50 quarterly for the first 5 years and 100 quarterly for the last 5 years. The annuity earns at a nominal rate of 6% convertible quarterly. What is the present value of this annuity?

A) 1978  
B) 2034  
C) 2077  
D) 2119  
E) 2165

10. A 20-year annuity-immediate pays 100 a year for the first 10 years. Starting with the 11th payment, each payment is increased by 6% over the previous one. The annuity earns at an annual effective rate of 7%.

Find the present value of this annuity.

A) 1150  
B) 1185  
C) 1235  
D) 1262  
E) 1288

11. A special 3-year 1000 par bond has 8% annual coupons and has an effective annual interest rate of 7%. Find the Macaulay duration of this bond.

A) 2.5  
B) 2.6  
C) 2.7  
D) 2.8  
E) 2.9

12. A new company expects the dividends on its common stock to be 1 the first year and increase by 1 each year until it reaches 10. Thereafter it expects the dividend to grow by 3% each year. Assume an annual interest rate of 5%.

Calculate the price of this stock using the dividend discount model.

A) 344  
B) 351  
C) 356  
D) 365  
E) 372

13. A company has a loan of 100,000 to be repaid with 30 annual end of year level payments. The principal and the interest in the 21st payment are the same. Find the principal repaid in the 10th payment.

A) 1862  
B) 1871  
C) 1884  
D) 1901  
E) 1913

14. A man deposits money into a fund. For the first four years the fund accumulates at a nominal interest rate of 6% convertible quarterly. For the next six years the fund accumulates at a nominal discount 8% convertible semiannually.

For the 10 year period what is the equivalent force of interest?

A) 0.0719  
B) 0.0728  
C) 0.0731  
D) 0.0737  
E) 0.0742
15. A 20-year annuity-immediate has annual payments. The first payment is 1000. Subsequent payments decrease by 100 each year until they reach 100. The remaining payments stay at 100. The annual effective interest rate is 6.5%. Find the present value of this annuity.

A) 4708  B) 4765  C) 4815  D) 4853  E) 4894

16. A man buys a house for 100,000. He finances it for 30 years with level monthly payments made at the end of each month at a fixed interest rate of 7.5% convertible monthly. After 10 years he refinances the outstanding balance principal for 15 years at 6% convertible monthly. Calculate his new monthly payments.

A) 702.45  B) 717.68  C) 732.43  D) 750.65  E) 762.38

17. A woman is asked to invest 20,000 in a project. She is promised returns of 5,000 in one year, 6,000 in two years, 7,000 in three years and 10,000 in four years. Find the IRR for this investment.

A) 12.71%  B) 12.84%  C) 12.96%  D) 13.11%  E) 13.23%

18. Consider the following yield curve:

<table>
<thead>
<tr>
<th>Year</th>
<th>Spot Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.0%</td>
</tr>
<tr>
<td>2</td>
<td>2.5%</td>
</tr>
<tr>
<td>3</td>
<td>3.0%</td>
</tr>
<tr>
<td>4</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

A 4-year 1000 par bond has an annual coupon rate of 3.5%. Use the yield curve to find the price of this bond.

A) 980  B) 984  C) 989  D) 994  E) 999

19. A man buys a 10-year 1000 par bond with 7% semiannual coupons. The bond is priced to yield 6.5% convertible semiannually. The coupon payments are invested in a fund that earns 6% convertible semiannually.

His wife makes annual end of year payments of K into a fund that earns 6.5% annually. At the end of 10 years their accumulated funds are the same. Find K.

A) 126.28  B) 131.45  C) 139.25  D) 143.80  E) 151.38
20. For an unknown interest rate $i$, the following payments have the same present value:

1. $675$ at the end of two years.
2. $200$ at the end of one year and $500$ at the end of three years.

Find the value of $i$. (Assume $i < 100\%$)

A) 9.0%  B) 9.2%  C) 9.4%  D) 9.6%  E) 9.8%

21. The S&R index currently has a price of 1100. The price of a three month 1120-strike put is 71.32. The annual interest rate is 3.5% compounded continuously. What is the profit on this put in three months if the spot price then is 1080?

A) -84.35  B) -31.95  C) 0  D) 30.95  E) 83.52

22. Your home has a value of 340,000. Your annual insurance premium is 6,000 and your deductible is 25,000. If you look at your insurance as a put option, what is the strike price?

A) 315,000  B) 295,000  C) 280,000  D) 275,000  E) 270,000

23. An insurance company sells single premium deferred annuity contracts with return linked to a stock index, the time-t value of one unit of which is denoted by $S(t)$. The contracts offer a minimum guarantee return rate of $g=2.0\%$. At time 0, a single premium of amount $\pi$ is paid by the policyholder, and $\pi \times y\%$ is deducted by the insurance company.

In one year the insurance company will pay the policyholder $\pi \times (1 - y\%) \times \text{Max}[S(T)/S(0), (1 + g\%)]$, where $S(0) = 100$

You are given the following information:

i) Dividends are incorporated in the stock index. That is, the stock index is constructed with all stock dividends reinvested.

ii) The price of a one-year European put option, with strike price of $102$, on the stock index is $15.80$.

Determine $y\%$, so that the insurance company does not make or lose money on this contract.

A) 13.2%  B) 13.35%  C) 13.5%  D) 13.64%  E) 13.80%
24. Investor C buys the S&R index at time 0 for 1300 and buys a 1300-strike put with $T = .25$ for a price of 71.85. If the interest rate is $r = .035$, what is his minimum profit (loss)?

A) -82.33  B) -63.015  C) -57.64  
D) -83.91  E) There is no minimum

25. Near market closing time on a given day, the European call and put prices for a stock are available as follows:

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Call Price</th>
<th>Put Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>50</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>55</td>
<td>3</td>
<td>11</td>
</tr>
</tbody>
</table>

The options have expiration time $T = .5$. The continuously compounded annual interest rate is $r = .04$.

Mary constructs the following portfolio: Long two call options with strike price 40; short six call options with strike price 50; lend $2; and long some calls with strike price 55. The $2 she lends is obtained from the sale and purchase of the options.

What is her profit at $T = .5$ if the price of the stock is 52 at that time?

A) 2  B) 5.02  C) 4  D) 6.08  E) 14.04

26. Investor F sells a 1300-strike S&R put for 71.85 and a 1300-strike S&R call for 83.18. The interest rate is $r = .035$ and $T = .25$. What is his maximum profit?

A) 71.85  B) 83.18  C) 155.03  
D) 156.39  E) There is no maximum

27. A stock has current price $S_0 = 40$. The annual continuous interest rate is $r = .03$ and the continuous dividend yield is $\delta = .01$. You observe a one year prepaid forward price of 39.60. Which of the following is true?

A) No arbitrage is possible.  B) You can create an arbitrage by buying one prepaid forward and selling one share of the stock short  
C) You can create an arbitrage by selling the prepaid forward and buying one share of the stock.  
D) You can create an arbitrage by buying the prepaid forward and selling $e^{-0.01}$ shares of the stock short  
E) You can create an arbitrage by selling the prepaid forward and buying $e^{-0.01}$ shares of the stock
28. The S&R index has a spot price of $S_0 = 1300$. The continuous interest rate is $r = .03$ and the continuous dividend yield is $\delta = 0$. The one year forward price is 1339.59. You enter into a forward sale contract and buy the index. Which of the following positions is this equivalent to:

A) A short sale of the index.
B) Sale of a one year zero-coupon bond with $r = .03$
C) A reverse cash and carry hedge.
D) A cash and carry arbitrage
E) None of these.

In Problems 29-30, use the following table of quarterly oil forward prices and zero-coupon bond prices.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Forward Price</td>
<td>20.9</td>
<td>21.2</td>
<td>20.8</td>
<td>20.7</td>
</tr>
<tr>
<td>Zero-coupon bond price</td>
<td>.984</td>
<td>.969</td>
<td>.953</td>
<td>.935</td>
</tr>
</tbody>
</table>

29. Suppose you enter a three quarter oil swap. What payment per barrel will be made to you in the second quarter if the spot rate for the second quarter is 21.25?

A) .28  B) .22  C) .18  D) .12  E) .08

30. What is the guaranteed quarterly rate on a four quarter interest rate swap?

A) .0118  B) .0137  C) .0158  D) .0169  E) .0195
Solutions

1. We first need to find \( i \). We can use the BA II Plus and set
\[ N = 2, \; PMT = 560, \; PV = -1000 \; \text{and} \; FV = 0. \; \text{CPT}\; I/Y = 7.9 \]

To find \( K \) set
\[ 1000 = K/1.079 + 800/1.079^2. \; \quad K = 337.57 \]

*Answer D*

2. The company must invest the present value of 2000 in 1 year at 6.5\% plus the present value of 5000 in 3 years at 7.5\%

The cost is
\[ 2000/1.065 + 5000/1.075^3 = 1877.93 + 4024.80 = 5902.73 \]

*Answer A*

3. If \( P \) is the annual payment then the principal repaid in the 20\text{th} \text{ payment is} \( P v^{n-20+1} \). The principal repaid in the 5\text{th} \text{ payment is} \( P v^{n-5+1} \).

Dividing these we get \( v^{-15} = (1 + i)^{15} = 3. \) Then \( i = 3^{1/15} - 1 = 0.076. \)

*Answer E*

4. \( (1 + s_4)^4 = (1 + i_{0,1})(1 + i_{1,2})(1 + i_{2,3})(1 + i_{3,4}) \]
\[ = (1.029)(1.037)(1.044)(1.052) = 1.17195 \]
\[ s_4 = 1.17195^{1/4} - 1 = 0.0405 \]

*Answer B*

5. To get the accumulated amount of fund using the BA II Plus, set
\[ N = 20, \; I/Y = 7.5, \; PV = 0, \; PMT = -910. \; \text{CPT}\; FV = 39,407.26 \]

The annual yield rate is \( r = (39,407.26/10,000)^{1/20} - 1 = 0.071. \)

*Answer D*
6. The present values of these investments are  
\[
\frac{2000}{1.072} = 1865.67 \quad \text{and} \quad \frac{4000}{1.072^3} = 3246.95.
\]
The total is 5112.62. The weights for the Macaulay duration are  
\[
w_1 = \frac{1865.67}{5112.62} = 0.3649 \quad \text{and} \quad w_2 = \frac{3246.95}{5112.62} = 0.6351.
\]
\[
D = (1)(0.3649) + (3)(0.6351) = 2.270
\]

**Answer A**

7. Using the BA II Plus to get the price of the first bond, set  
\[
N = 10, \ I/Y = 4, \ PMT = 37.5, \ FV = 1000. \ CPT PV = -979.72.
\]
To get the price of the second bond, set  
\[
N = 10, \ I/Y = 3.5, \ PMT = 30, \ FV = 1000. \ CPT PV = -958.42
\]
The total price of the bonds is 1938.14.

To get the accumulation of the deposited coupon payments set  
\[
N = 10, \ I/Y = 3.4, \ PMT = -67.5, \ PV = 0. \ CPT FV = 788.22.
\]
Accumulation plus redemption values is 2788.22.

\[
(1 + r)^5 = \frac{2788.22}{1938.14} = 1.4386
\]
\[
r = 1.4386^{\frac{1}{5}} - 1 = 0.075
\]

**Answer B**

8. We need to find \( i_{3,4} \).

\[
1 + i_{3,4} = \frac{(1 + s_4)^4}{(1 + s_3)^3}
\]
\[
s_3 = 0.08 + 0.003(3) - 0.0015(9) = 0.0755
\]
\[
s_4 = 0.08 + 0.003(4) - 0.0015(16) = 0.068
\]
\[
i_{3,4} = \frac{(1.068)^4}{(1.0755)^3} - 1 = 0.0458
\]

**Answer C**
9. This annuity can be viewed as the difference between a 10-year annuity-due with payments of 100 and a 5-year annuity-due with payments of 50.

To get the present values of these annuities using the BA II Plus, first set the mode to BGN. For the 10-year annuity, set N = 40, I/Y = 1.5, PMT = -100, FV = 0. CPT PV = 3036.46

For the 5-year annuity set
N = 20, I/Y = 1.5, PMT = -50, FV = 0. CPT PV = 871.31

Present value of difference is 3036.46 – 871.31 = 2165.15.

Answer E

10. The present value of the annuity is

\[
100a_{\overline{10}|} + \frac{106}{1.07^{10}} \left[ \frac{1}{1.07} + \frac{1.06}{1.07} + \ldots + \left( \frac{1.06}{1.07} \right)^9 \right].
\]

\[
100a_{\overline{10}|} = 702.36
\]

\[
\left( \frac{106}{1.07^{10}} \right) \left[ \frac{1}{1.07} + \frac{1.06}{1.07} + \ldots + \left( \frac{1.06}{1.07} \right)^9 \right] = \left( \frac{106}{1.07^{10}} \right) \frac{1 - \left( \frac{1.06}{1.07} \right)^{10}}{1 - \left( \frac{1.06}{1.07} \right)} = 482.94
\]

The present value is 702.36 + 482.94 = 1185.30

Answer B

11. The Macaulay duration is

\[
D = [80v + 2(80)v^2 + 3(1080)v^3]/(80v + 80v^2 + 1080v^3)
\]

\[
v = 1/1.07 = .93458
\]

\[
D = 2859.32/1026.24 = 2.786
\]

Answer D
12. The dividends for the first 10 years form an increasing arithmetic sequence. The present value of these dividends is

\[
(Ia)_{10} = \frac{\left( \overline{a}_{10} - 10v^{10} \right)}{i} = \frac{8.1078 - 10(0.6139)}{0.05} = 39.376
\]

The dividends thereafter form a constant growth perpetuity. The present value of these dividends at time \( t = 10 \) years is

\[
P = \frac{D}{(i - r)} = \frac{10(1.03)}{(0.05 - 0.03)} = 515
\]

This is deferred for 10 years so the stock price is

\[
39.376 + \frac{515}{1.05^{10}} = 355.54
\]

Answer C

13. If \( P \) is the annual payment, the amount of principal repaid in the 21st is

\[
Pv^{30-21+1} = Pv^{10} = P/2. \text{ Hence } v^{10} = \frac{1}{2}.
\]

So \((1 + i)^{10} = 2\). The \( i = 2^{\frac{1}{10}} - 1 = 0.0718\).

Using the BA II Plus to get the payment, set

\[
N = 30, \text{ I/Y} = 7.18, \text{ PV} = -100,000, \text{ FV} = 0. \text{ CPT PMT} = 8,204.84
\]

The principal repaid in the 10th payment is

\[
8,204.84v^{30-10+1} = 8,204.84(1.0718)^{-21} = 1,912.85
\]

Answer E

14. If \( D \) is the amount deposited into the fund, the accumulation at the end of ten years is

\[
D(1.015)^{10}/(0.96)^{12} = D(2.0711).
\]

To get the force of interest, set \( e^{10\delta} = 2.0711\).

Then \( \delta = (1/10)ln(2.0711) = 0.0728\)

Answer B

15. The present value of this annuity is

\[
100(Da)_{10} + 100v^{10}a_{10}.\]

Then \( a_{10} = 7.189 \) and \( v^{10} = 0.5327\).

\[
(Da)_{10} = \frac{(10 - a_{10})}{0.065} = 43.246
\]

Present value of annuity is

\[
4,324.60 + 100(7.189)(0.5327) = 4,707.56
\]

Answer A
16. To compute the payment with the BA II Plus set
   \( N = 360, \ I/Y = 0.625, \ PV = 100,000, \ FV = 0. \) CPT PMT = -699.215.

   To get outstanding principal after 10 years, reset \( N = 240. \) Then
   CPT PV = 86,794.987. To get new payment, reset \( N = 180 \) and \( I/Y = 0.5. \)
   CPT PMT = - 732.425.

   \textit{Answer C}

17. To find the IRR put the BA II Plus in CF mode. Then enter the following
   cash flows: \( C_0 = -20,000, \ C_1 = 5,000, \ C_2 = 6,000, \ C_3 = 7,000 \) and \( C_4 = 10,000. \)
   Then IRR CPT = 13.23

   \textit{Answer E}

18. The price of the bond is
   \[
   P = \frac{35}{1.02} + \frac{35}{1.025^2} + \frac{35}{1.03^3} + \frac{1035}{1.04^4} = 984.38.
   \]

   \textit{Answer B}

19. The man’s accumulation (using \( I/Y = 3.0 \)) is \( 35s_{30} + 1000 = 1940.46. \)
    The wife’s accumulation (using \( I/Y = 6.5 \)) is

   \[
   K\bar{s}_{30} = K(13.4944)
   \]
   Therefore \( K = 1940.46/13.4944 = 143.797 \)

   \textit{Answer D}

20. Equating the present values of the two payments we get
   \[
   675v^2 = 200v + 500v^3. \]
   Dividing by \( v \) we get the following quadratic equation:
   \[
   500v^2 - 675v + 200 = 0.
   \]

   Using the quadratic formula we get 2 positive values for \( v \), 0.911 and
   0.439. The only meaningful root is \( v = 0.911, \) or \( i = .098. \)

   \textit{Answer E}

21. The put profit is
   \[
   \max (0,1120 - S_T) - 71.32e^{0.05(25)} = \max (0,1120 - 1080) - 71.95 = -31.95
   \]

   \textit{Answer B}
22. Let $V_T$ be the value of the house at time $T$. The payoff has value
\[
\max(0,340,000 - 25,000 - V_T) = \max(0,315,000 - V_T)
\]
This is the payoff of a put with $K = 315,000$.

**Answer A**

23. Using $g = .02, T = 1, S_0 = 100$, the total payoff is
\[
\pi(1-y)\max\left(\frac{S_1}{100}, 1.02\right) = \pi(1-y)\max(S_1, 102)
\]
\[
= \frac{\pi}{100}(1-y)[S_1 + \max(102 - S_1, 0)]
\]
The expression in square brackets is the payoff of a single share of the index and a put, while the two lead terms give the number of units of this combination the company needs to buy to pay off the single premium deferred annuity. The company wants to use the premium $\pi$ to buy the shares and the options needed. The cost of those shares and options today is
\[
\frac{\pi}{100}(1-y)[S_0 + \text{put cost}] = \frac{\pi}{100}(1-y)115.80 = 1.158\pi(1-y)
\]
To break even this cost must equal the premium collected.
\[
1.158\pi(1-y) = \pi \rightarrow y = .1364
\]
The required percentage is 13.64% 

**Answer D**

24. Buying the index and buying a put with strike 1300 creates a floor. The floor has the same profit function as a long call with strike 1300.

The minimum profit on the floor is the (negative) loss of the future value of the call premium when the call expires unexercised. By parity, the value of the call is 83.18. The minimum profit is
\[
-83.18e^{.035(25)} = -83.91
\]
Alternatively, we could write the profit for stock prices less than 1300 as the put strike payoff less the future value cost of the put premium and repayment of a loan of 1300 to buy the stock
\[
1300 - 71.85e^{.035(25)} - 1300e^{.035(25)} = -83.91
\]

**Answer D**
25. For Mary's portfolio the number of long calls at $K = 55$ is not given. However you can quickly figure out what it is.

The arbitrage lends $2$, so in order to have 0 outlay at the beginning there must be $2$ of excess cash obtained from the sale and purchase of calls. If there are $n$ long calls at $K = 55$ we have the following proceeds from options.

<table>
<thead>
<tr>
<th>Strike</th>
<th>40</th>
<th>50</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Long 2</td>
<td>Short 6</td>
<td>Long n</td>
</tr>
<tr>
<td>Proceeds</td>
<td>-22</td>
<td>+36</td>
<td>-3n</td>
</tr>
</tbody>
</table>

Since total proceeds are 2 to lend, we have

$$-22 + 36 - 3n = 2 \rightarrow n = 4$$

Mary has no out-of-pocket cost at time 0. She earns $2$ and invests it at the continuous rate $r = .04$. Her profit at time .5 is the future value of the invested $2$ + the sum of the payoffs of the options in the portfolio.

$$2e^{.02} + 2(52 - 40) - 6(52 - 50) + 4(0) = 14.04$$

*Answer E*

26. This is a written straddle. It assumes its maximum profit value at the strike price of 1300, where both sold options expire worthless and the writer retains the future value of the two premiums.

$$(71.85 + 83.18)e^{.035(25)} = 156.39$$

*Answer D*

27. The correct forward price is $S_0e^{-.01} = 40e^{-0.01} = 39.60$. Thus the market price is correct and there is no arbitrage.

*Answer A*

28. Your position is - LONG FORWARD + STOCK. This is equivalent to – BOND, or sale of a zero coupon bond at the interest rate $r = .03$ The forward price is the correct theoretical price.

*Answer B*
29. The swap price is

\[ P = \frac{\sum_{i=1}^{n} P(0,t_i) f_0(t_i)}{\sum_{i=1}^{n} P(0,t_i)} = \frac{20.9(.984) + 21.2(.969) + 20.8(.953)}{.984 + .969 + .953} = 20.97 \]

The spot price in the second quarter is 21.25, and the payment is 21.25 – 20.97 = .28

**Answer A**

30. The guaranteed interest rate is the four year par coupon bond rate.

\[ c = \frac{1 - P(0,4)}{P(0,1) + P(0,2) + P(0,3) + P(0,4)} \]

\[ = \frac{1 - .935}{.984 + .969 + .953 + .935} \]

\[ = .0169 \]

**Answer D**