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Student Name:

Financial Mathematics Final exam

Sunday, May 1st, 2016

1. At what rate of compound interest will 700 grow to 1200 in 5 years?

- A) 0.152 B) 0.076 C) 0.057 D) 0.114 E) 0.171

2. How many years does it take 700 dollars to accumulate to 1300 dollars at an effective annual rate of 7%?

- A) 12.199 B) 6.099 C) 4.575 D) 9.149 E) 13.724

3. If $i^{(7)} = 0.05$ what is the equivalent $d^{(7)}$?

- A) 0.04914 B) 0.04965 C) 0.05008 D) 0.05029 E) 0.04916

4. Ali deposits 600 dollars into a bank account. His account is credited interest at a nominal rate of interest of 6% convertible monthly. At the same time, Rayan deposits 600 dollars into a separate account. Peter's account is credited interest at a force of interest of δ . After 4.5 years, the value of each account is the same. Calculate δ .

- A) 0.0555 B) 0.0599 C) 0.0540 D) 0.0554 E) 0.0522

5. Suppose that a fund initially containing 5000 accumulates with a force of interest, $\delta(t) = 1/(1+t)$, for $t > 0$

What is the value of the fund after 8 years?

- A) 45,000 B) 47,000 C) 35,000 D) 30,000 E) 25,000

6. Fund A accumulates at a force of interest at time $0.05/(1+0.05t)$.

Fund B accumulates at a force of interest 0.05. We know that $A(0) = 2000$ and $B(0) = 1000$.

The amount in Fund C at any time t is equal to the sum of the amount in Fund A and Fund B.

Fund C accumulates at force of interest δ_t . Find δ_3 .



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A) $\frac{4+3e^{0.15}}{46+20e^{0.15}}$ B) $\frac{2+e^{0.15}}{92+2e^{0.15}}$ C) $\frac{3}{20}$ D) $\frac{1}{23}$ E) $\frac{2+e^{0.15}}{46+20e^{0.15}}$

7. A loan of 30,000 is to be repaid during 5 years with equal monthly payments of p. The interest rate for the first year is 3%, while the interest rate for the remaining 4 years is 8%. What is the balance after the 5th payment?

A) 27,618 B) 27,453 C) 27,379 D) 27,606 E) 27,368

8. A loan of 30,000 is to be repaid during 5 years with equal monthly payments of p. The nominal interest rate convertible monthly for the first year is 4%, while the nominal interest rate convertible monthly for the remaining 4 years is 11%. What is the interest component of the 16th payment?

A) 275.35 B) 137.67 C) 206.51 D) 103.26 E) 309.77

9. A loan of 10,000 is to be repaid as follows. Payments of p are to be made at the end of each month for 60 months and a balloon payment of 2,800 is to be made at the end of the 60th month as well. If the nominal interest rate convertible monthly is 5%, what is the balance at the end of the 17th month?

A) 8,302 B) 8,054 C) 8,139 D) 8,041 E) 8,249

10. A loan of 30,000 is to be repaid as follows. Payments of p are to be made at the end of each month for 36 months and a balloon payment of 8,100 is to be made at the end of the 36th month as well. If the nominal interest rate convertible monthly is 5%, what is the principal component of the 19th payment?

A) 812.04 B) 609.03 C) 304.52 D) 406.02 E) 913.55



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1. You invested, 14 years ago, a sum of 2,000 in a fund which earned interest at a rate of $i^{(4)}$ convertible quarterly. You now have 5276.67. If you keep the money in the fund for 4 more years, how much will you have?

- A) 10,443 B) 6,962 C) 4,641 D) 3,481 E) 9,283

2. Money accumulates in a fund at an effective annual interest rate of i during the first 5 years and at an effective annual interest rate of $2i$ thereafter. A deposit of 200 is made into a fund at time 0. It accumulates to 342.07 at the end of 11 years and to 797.58 at the end of 22 years. What is the value of the fund at the end of 8 years?

- A) 267 B) 272 C) 277 D) 261 E) 284

3. You have two options of repaying a loan:

(1) 72 monthly payments of 300 at the end of each month.

(2) A single payment of 20,302 at the end of x month

Interest rate is at a nominal annual rate of 6% compounded monthly. The two options have the same present value. Find x

- A) 22 B) 23 C) 21 D) 26 E) 20

4. A 38-year loan is to be repaid in equal annual payments. The amount of interest paid in the 11th payment is 72.39. The amount of interest paid in the 25th payment is 50.19. Compute the amount of interest paid in the 32nd payment.

- A) 40.19 B) 20.09 C) 30.14 D) 45.21 E) 15.07

5. A 38-year loan is to be repaid in equal annual payments. The amount of interest paid in the 11th payment is 2637. The amount of interest paid in the 25th payment is 1967. Compute the annual payment.

- A) 3,036 B) 2,983 C) 3,029 D) 2,926 E) 2,928

6. You deposit in a saving account \$1100 at the beginning of each year for 19 years. At the



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beginning of year 19 and for 10 years, you plan to withdraw a fixed amount X so to deplete what you accumulated in your saving account during the first 19 years. Find X if the effective rate of interest is 0.05 for the first 19 years and 0.04 thereafter.

A) 5,575.37 B) 4,181.53 C) 2,090.77 D) 2,787.69 E) 6,272.30

7. Ali has a 126,000 savings bond that pays monthly interest at an annual nominal rate of 0.0576-compounded monthly. Monthly interest payments are immediately deposited in an account that earns interest payable monthly at a rate of $i^{(12)}=0.1152$. Find the accumulated value of this account after the 60th deposit.

A) 73,146 B) 32,509 C) 48,764 D) 65,019 E) 24,382

8. A 14,000 par value 10-year bond with 8% annual coupons is bought at premium to yield an effective annual rate of 6%.

Calculate the interest portion of the 5th coupon.

A) 922.61 B) 1007.97 C) 970.23 D) 956.02 E) 878.01

9. Yield rates to maturity for zero coupon bonds are currently quoted at 8.35% for one-year maturity, 9.35% for two-year maturity, and 10.35% for three-year maturity. Let $i_{1,2}$ be the one-year forward rate for year two implied by current yields of these bonds. Calculate $i_{1,2}$.

A) 12.38% B) 11.36% C) 8.36% D) 7.36% E) 10.36%

10. Yield rates to maturity for zero coupon bonds are currently quoted at 9.93% for one-year maturity, 10.93% for two-year maturity, and 11.93% for three-year maturity. Let $i_{2,3}$ be the one-year forward rate for year three implied by current yields of these bonds. Calculate $i_{2,3}$.

A) 11.94% B) 12.94% C) 11.86% D) 12.36% E) 13.96%

1. A 1000 par value bond pays annual coupons of 80. The bond is redeemable at par in 30 years, but is callable any time from the end of the 10th year at 1050. Based on her desired yield rate, an investor calculates the following potential purchase prices, P :

- Assuming the bond is called at the end of the 10th year, $P=963$
- Assuming the bond is held until maturity, $P=911$



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The investor buys the bond at the highest price that guarantees she will receive at least her desired yield rate regardless of when the bond is called. The investor holds the bond for 20 years, after which time the bond is called.

Calculate the annual yield rate the investor earns.

- A) 9.29% B) 9.08% C) 8.87% D) 9.37% E) 8.81%

2. The face value of a 18-year bond is 4000. The bond pays yearly coupons. The bond's price is 3268.10. The interest rate is 8% convertible quarterly.

What is the current yield on the bond?

- A) 6.85% B) 8.41% C) 6.96% D) 8.27% E) 7.66%

3. At the beginning of the year, an investment fund was established with an initial deposit of 1,000. A deposit 2,000 is made at the end of each month for the first six months. Starting from the end of month 7, a withdrawal of 400 is made at the end of each month for 5 months for a total of 5 withdrawals. The amount in the fund at the end of the year is 12,430.

Calculate the dollar-weighted (money-weighted) yield rate earned by the fund during the year.

- A) 14.12% B) 17.39% C) 14.82% D) 16.99% E) 15.89%

4. A 10-year annuity. It pays X at the end of the first, $X(1+r)$ at the end of the second year, and in general it pays $X(1+r)^{j-1}$ at the end of the j^{th} year. If $X=2,000$ and $r=0.054$. Find the present value of this annuity at an annual effective rate of $i=8.2\%$.

- A) 16,474 B) 16,060 C) 17,132 D) 16,059 E) 16,019

5. A loan is amortized over 9 years with monthly payments at a nominal interest rate of 6% compounded monthly. The first payment is 3000 and is to be paid one month from the date of the loan. Each succeeding monthly payment will be 1% lower than the prior payment. How much was the value of the original value of the loan?

- A) 160,741 B) 160,441 C) 161,170 D) 161,205 E) 160,315



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6. Ali and Brian each open up new bank accounts at time 0. Ali deposits 600 into his bank account, and Brian deposits 150 into his. Each account earns the same annual effective interest rate.

The amount of interest earned in Ali's account during the 11th year is equal to X.

The amount of interest earned in Brian's account during the 16th year is also equal to X.

Calculate X.

- A) 3072.78 B) 3063.98 C) 3067.28 D) 3062.78 E) 3070.18

7. Ali buys a 10-year 2000 par value 7.54% bond with semi-annual coupons. The price assumes a nominal yield of 7.54%, compounded semi-annually.

As Ali receives each coupon payment, he immediately puts the money into an account earning interest at an annual effective rate of i .

At the end of 10 years, immediately after Ali receives the final coupon payment and the redemption value of the bond, Ali has earned an annual effective yield of 8% on his investment in the bond. Calculate i .

- A) 9.09% B) 8.97% C) 8.51% D) 8.80% E) 8.68%

8. Happy and financially astute parents decide at the birth of their daughter that they will need to provide 40,000 at each of their daughter's 18th, 19th, 20th and 21st birthdays to fund her college education. They plan to contribute X at each of their daughter's 1st through 17th birthdays to fund the four 40,000 withdrawals.

If they anticipate earning a constant 5% annual effective rate on their contributions,

Calculate X, assuming compound interest.

- A) 5489 B) 5119 C) 5130 D) 5831 E) 6038

9. Mary purchased a 14-year par value bond with semiannual coupons at a nominal annual rate of 5% convertible semiannually at a price of 1205.96. The bond can be called at par value 1470 on any coupon date starting at the end of year 11 after the coupon is paid. What is the minimum yield that Mary could receive, expressed as a nominal annual rate of interest convertible semiannually?

- A) 7.04% B) 7.31% C) 6.85% D) 6.89% E) 7.27%



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10. You are given the following information about the activity in two different investment accounts:

Account K			
		Activity	
Date	Fund Value Before Activity	Deposit	Withdrawal
January 1, 1999	100.00		
July 1, 1999	125.00		X
October 1, 1999	110.00	2X	
December 31, 1999	125.00		

Account L			
		Activity	
Date	Fund Value Before Activity	Deposit	Withdrawal
January 1, 1999	100.00		
July 1, 1999	125.00		X
December 31, 1999	102.14		

During 1999, the dollar-weighted (money-weighted) return for investment account K equals the time-weighted return for investment account L, which equals i . Calculate i .

- A) 9% B) 18% C) 13% D) 17% E) 12%