M329F *Theory of Interest*
Spring 2020
University of Texas at Austin
Sample In-Term Exam III
Instructor: Milica Čudina

Notes: This is a closed book and closed notes exam. The maximal score on this exam is 50 points.
Time: 50 minutes

TRUE/FALSE

1 (2)	TRUE	FALSE
2 (2)	TRUE	FALSE

MULTIPLE CHOICE

1 (5)	a	b	c	d	e
2 (5)	a	b	c	d	e
3 (5)	a	b	c	d	e
4 (5)	a	b	c	d	e
5 (5)	a	b	c	d	e
6 (5)	a	b	c	d	e
7 (5)	a	b	c	d	e
8 (5)	a	b	c	d	e

FOR GRADER'S USE ONLY:

T/F	1.	M.C.	**Σ**

2.1. TRUE/FALSE QUESTIONS.

Problem 2.1. (2 points) An \$800-par value, 10% 10-year bond with semiannual coupons is redeemable for \$1,020. It is purchased for \$880. Then, this bond is sold at a discount. *True or false?*

Problem 2.2. (2 points) If there are higher yield rates for shorter term investments, one obtains a normal yield curve. *True or false?*

2.2. Free-response problems.

Please, explain carefully all your statements and assumptions. Numerical results or single-word answers without an explanation (even if they're correct) are worth 0 points.

Problem 2.3. (8 points) You take out a 30-year, \$500,000 mortgage at an effective annual interest rate of 9%. The payments are level and take place at the end of every year. Along with your 8^{th} payment, you make an additional principal repayment of \$50,000.

(i) (3 pts) What is the outstanding balance after the extra payment is made?

(ii) (5 pts) You then refinance the outstanding balance with a new 15-year mortgage at a 5% effective annual interest rate. The new mortgage also has year-end level amortization payments. Find the amount of interest in the 4^{th} payment of the new mortgage.

2.3. MULTIPLE CHOICE QUESTIONS.

Please, note your answers on the cover page.

Problem 2.4. (5 points) *Source: Course 2, May 2003, Problem #42.*
A 10,000-par-value 10-year bond with 8% annual coupons which can be redeemed at par is bought to yield an annual effective rate of 6%. Calculate I_7 (i.e., the interest portion of the 7^{th} coupon).

(a) About 632
(b) About 642
(c) About 651
(d) About 660
(e) None of the above

Problem 2.5. (5 points) *Source: Rick Gorvett.*
By scenario A there is an offer to pay at the rate of \$10,000 per annum, continuously, for the next 10 years. By scenario B it is offered to pay the amount X at the end of each of the next 10 years. The force of interest applying to both scenarios is 12%. Find the value of X such that you are indifferent between these two scenarios in the sense that they have the same present values.

(a) $X \leq 10,000$
(b) $10,000 < X \leq 10,600$
(c) $10,600 < X \leq 10,900$
(d) $10,900 < X \leq 11,200$
(e) None of the above.

Problem 2.6. (5 points) *Source: Rick Gorvett.*
You make deposits continuously into an account at a time-varying rate of e^t at time t (in years). The deposits are made for ten years starting immediately, i.e., at time-0. The force of interest is constant at 7%. Which of the following is the closest to the **accumulated value** in your account at time 10?

(a) \$23,682.20
(b) \$25,780.40
(c) \$27,432.20
(d) \$28,123.30
(e) None of the above.

Problem 2.7. (5 points) *Source: Rick Gorvett.*
Roger takes out a \$400,000 loan for 30 years at an annual effective interest rate of 7.5%. The loan is repaid using the sinking fund method with level year-end sinking fund deposits. The sinking fund earns an effective annual interest rate of 4%. Which of the following is closest to the balance in the sinking fund after 22 years, right after the payment at that time is made.

(a) \$230,357
(b) \$244,258
(c) \$248,356
(d) \$250,355
(e) None of the above.

Problem 2.8. *Source: SoA, November 2000, Problem #44.*
Joe can purchase one of two annuities:

Annuity I: A 10$-$year decreasing annuity-immediate wit annual payments of $10, 9, 8, \ldots, 1$.

Annuity II: A perpetuity-immediate with annual payments. The perpetuity pays 1 in year 1, 2 in year 2, 3 in year 3, ..., and 11 in year 11. After 11, the payments remain constant at 11.

At an annual effective interest rate i, the present value of *Annuity II* is twice the present value of *Annuity I*. Calculate the value of *Anuity I*.

(a) 36.4
(b) 37.4
(c) 38.4
(d) 39.4
(e) None of the above.

Problem 2.9. *Source: SoA, May 2000, Problem #29.*
A firm has proposed the following restructuring for one of its 1000 par value bonds. The bond presently has 10 years remaining to maturity. The coupon rate on the existing bond is 6.75% per annum paid semiannually. The current nominal semiannual yield on the bond is 7.40%. The company proposes suspending coupon payments for four years with the suspended coupon payments being repaid, **with accrued interest**, when the bond comes due. Accrued interest is calculated using a nominal interest rate of 7.40% convertible semiannually. Calculate the market value of the restructured bond.

(a) 755

(b) 805

(c) 855

(d) 905

(e) None of the above.

Problem 2.10. *Source: SoA, May 1993, Problem #15.*
A 1000 bond with annual coupons is redeemable at par at the end of 10 years. At a purchase price of 870, the yield rate is i. The coupon rate is $i - 0.02$. Calculate i.

(a) 6.7%

(b) 7.2%

(c) 7.7%

(d) 8.2%

(e) None of the above.

Problem 2.11. *Source: SoA, November 1992, Problem #16.*
Dick purchases an $n-$year, 1000 par value bond with 12% annual coupons at an annual effective yield of $i > 0$. The book value of the bond at the end of year 2 is 1479.65, and the book value of the bond at the end of year 4 is 1439.57. Calculate the purchase price of the bond.

(a) 1510
(b) 1515
(c) 1519
(d) 1523
(e) None of the above.

Problem 2.12. *Source: SoA, November 1992, Problem #17.*
An investor purchases a 1000 bond redeemable at par that pays 8% semiannual coupons and matures in 10 years. The bond will yield 7% convertible semiannually to maturity. If the bond is called in five years, the minimum redemption value the investor needs to realize the same yield is X. Determine X.

(a) 1036
(b) 1042
(c) 1048
(d) 1054
(e) None of the above.

Problem 2.13. *Source: SoA, November 1989, Problem #15.*
A stock is currently selling at 80 per share to yield 10% per annum, compounded semiannually. The stock is expected to pay dividends at the end of each year forever. The next dividend (payable one year from now) is 2 and is expected to increase at a rate of X% per year. Calculate X.

(a) 7.00
(b) 7.25
(c) 7.50
(d) 7.75
(e) None of the above.

Problem 2.14. You are given the following prices $P(0,k)$ of zero-coupon bonds redeemable at time$-k$ for \$1:

$$P(0,1) = 0.9615, \quad P(0,2) = 0.9157, \quad P(0,3) = 0.8688, \quad P(0,4) = 0.8227, \quad P(0,5) = 0.7761.$$

Find the level swap interest rate for the interest-rate swap associated with a five-year loan for \$100,000 with interest-only, annual, end-of-year payments.

(a) About 0.038
(b) About 0.04
(c) About 0.045
(d) About 0.05
(e) None of the above.