Here are some extra problems over chapter 7, 10, and 11. This is not to be confused with a final exam.

1. Jake will invest in a project that requires an investment of \$2,000 at time 0 and an additional investment of \$1,500 at $t = 1$. The project returns \$1,800 at $t = 3$, \$1,200 at time $t = 4$ and \$2,000 at time $t = 6$.

   (a) Find the net present value for Jake for this project at an annual effective rate of 4%.

   (b) Compute the internal rate of return(IRR) for this investment. Give your answer to 4 decimal digits.

2. David deposits \$800 at the beginning of each year for 8 years in a fund earning an annual effective interest rate of 7%. The interest from this fund is paid out annually and can only be reinvested at an effective annual rate of 4%. At the end of 8 years, David liquidates both accounts.

   (a) How much money does David have at this time?

   (b) What is David's overall yield rate(IRR) for this investment? Hint think time line and use the calculator.

3. Mark is paying off a loan from John with payments made at the end of each month. Mark will make 18 payments of \$700 to pay off the loan. The loan was financed at a nominal rate of 6% compounded monthly.
   What is John's annual effective yield for this investment, if John reinvest the payments from Mark at a nominal rate of 4% convertible monthly?

4. Beth purchases a 1000 par value 10-year bond with 8% semiannual coupons for 925. She is able to reinvest her coupon payments at a nominal rate of 5% convertible semiannually. Calculate her nominal annual yield rate convertible semiannually over the ten-year period.

5. On January 1, a fund is worth 100,000. On June 1after a deposit of 30,000 the fund value is 150,000. On October 1, after 50,000 is withdrawn, the fund value is 80,000. On January f1 of the following year, the fund is worth 120,000.

   (a) Calculate the dollar-weighted rate of return using the simple interest approximation.

   (b) Calculate the time-weighted rate return.

6. On January 1, 2011, Bob initiated an investment account with the following value and deposit/withdrawal activity during the year. NOTE: The account values represent the amount in the account immediately before the deposit or withdrawal activity on that date.

Date	Account Value	Activity
January 1	10,000	–
June 30	12,000	X
December 31	10,000	–

   The time-weighted and dollar-weighted rates of return on the account during 2011 are equal. Find the non-zero value of X–both its magnitude and whether it is a deposit or a withdrawal.

7. On January 1, an investment account is worth 50,000. On may 1, the value has increased to 52,000 and 8,000 of new principal is deposited. At time t, in years, $(4/12 < t < 1)$ the value fo the fund has increased to 62,000 and 10,000 is withdrawn. On January 1 of the next year, the investment account is worth 55,000. The dollar-weighted rate of return (using the simple interest approximation) is equal to the time-weighted rate of return for the year. Calculate t.

8. On January 1, an investment fund was opened with an initial balance of 5000. Just after the balance grew to 5200 on July 1, an additional 2600 was deposited. The annual effective yield rate for this fund was 9.0% over the calendar year. Calculate the time-weighted rate of return for the year.

9. The following table shows the annual effective interest rates credited to an investment fund by calendar year of investment.

Calendar year of original investment	Investment year rates %			Portfolio rates	Calendar year of portfolio rates
y	i_1^y	i_2^y	i_3^y	i^{y+3}	y+3
2008	6.0%	6.5%	5.5%	5.0%	2011
2009	6.3%	6.0%	6.2%	5.5%	2012
2010	5.4%	5.6%	5.8%	4.0%	2013
2011	6.0%	6.5%	5.5%	5.0%	2014
2012	6.3%	6.0%	6.2%	5.5%	2015
2013	7.0%	6.3%	5.7%	6.0%	2016
2014	7.2%	7.5%	7%		
2015	8%	8.3%			
2016	7%				

An investment of $2500 is made at the beginning of 2010 and 2012. Find the total amount of this investment at the end of 2013.

   (a) Use the Investment year method. Compute the total amount of an investment at the end of 2015 for an investment of 2,000 made at the start of 2011.

   (b) Use the portfolio method. Compute the total amount of an investment at the end of 2015 for an investment of 2,000 made at the start of 2011.

10. Here are the prices for bonds paying annual coupons and having a par value of $100.

Maturity (term)	Annual coupon	price per $100 of par
1	8%	100.935
2	5%	101.751
3	4%	94.757

   (a) Using the bootstrap method, find the one, two and three year spot rates implied by these prices.

   (b) Using thsese spot rates, compute the price of a three year bond with an annual coupon of 12% and par value of $2500.

   (c) What is the level yield of the bond in part b.

11. Suppose the term structure of interest rates is as follows:

Term	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	7 yr	8 yr
Annual Spot rate	1.0%	2.3%	3.6%	4.2%	5.1%	6.0%	6.2%	8.0%

    (a) compute f_3

    (b) Find the 2-year forward rate starting at time 4 that is implied by these spot rates.

    (c) compute ${}_4f_3$

12. Suppose you are given the following forward rate(annual effective).

    $f_0 = 3\%$, $f_1 = 4\%$, $f_2 = 5\%$, $f_3 = 6\%$, $f_4 = 7\%$, and $f_5 = 8\%$,

    (a) Using this information, compute s_2

    (b) Using this information, compute the price of a four year bond with an annual coupon of 8% and face value of \$300 and is redeemed for \$325.

13. Consider a yield curve defined by the following equation:

$$s_k = 0.08 + 0.001k - 0.001k^2$$

    where s_k is the annual effective rate of return for zero coupon bonds with maturity k years. Let j be the one-year effective rate during year 5 that is implied by this yield curve. Calculate j

14. David will receive payments of at the times indicated in the table. Assume the current annual rate of interest is 5%.

time	1	4	7	10
payment	900	600	1100	800

    (a) Calculate the net present value of this investment.

    (b) Calculate the Macaulay duration for this investment.

    (c) Calculate the Modified duration for this investment.

    (d) Calculate convexity for this investment

15. Calculate the duration of a common stock that pays dividends at the end of each year into perpetuity. Assume that the dividend is constant, and that the effective rate of interest is 15%.

16. There is a loan obligation to pay \$3,500 two years from today and another \$3,500 four years from today. Assuming the annual effective rate of interest is 8%,

    (a) find the modified duration (volatility) of this loan.

    (b) Find the convexity of the loan.

17. The current price of an annual coupon bond is \$97. The yield to maturity is an effective rate of 12%. At this yield, you know $\bar{d} = 8.3$ and $\dfrac{d^2P}{di^2} = 62000$. Estimate the price of the bond if the interest rate decreases by three-quarters of a percentage point to 11.25%.

    (a) Use a first order Taylor approximation as discussed in class.

    (b) Use a second order Taylor approximation as discussed in class.

18. A certain financial institution must pay liabilities of \$2,500 at the end of two years and \$1,500 at the end of five years. The current market interest rate is 8%, and the yield curve is assumed to be flat at any time. To cover these liabilities, the institution purchases bonds in the following amounts and terms:

    - A 1-year zero coupon bond with face value of \$1,000.
    - A 3-year zero coupon bond with face value of \$2,084.67.
    - A 6-year zero coupon bond with face value of \$925.81.

    Calculate the Macaulay duration of the asset portfolio. Round to 4 decimal places.

19. A portfolio has the following bonds and a cash flow. Calculate the Modified duration of the portfolio.

    - Bond A has semi-annual coupons at 4%, with a modified duration of 21.3 years and was purchased for \$870.
    - Bond B is a 3-year bond annual coupons of 5% with a face value of \$2,000 and a yield rate of 7%.
    - The cash flow is a a set of level payments from an 8,000 loan that is being paid off with level annual payments at the end of each year for 5 years. The interest on the loan is charged at 7% compounded annually.

20. A company must pay liabilities of 1000 at the end of the year 1 and 3000 at the end of year 2.

    The only investments available are:

    - one-year zero coupon bonds with an annual effective yield of 5%
    - Two year bonds with 10% annual coupons with an annual effective yield of 6%.

    The company constructed a portfolio that creates an exact cash flow matching strategy for these liabilities. What was the total purchase price of this portfolio?

21. A company must pay liabilities of 1000 at the end of the year 1 and X at the end of year 2.

    The only investments available are:

    - one-year zero coupon bonds with an annual effective yield of 5%
    - Two year bonds with 10% annual coupons with an annual effective yield of 6%.

    The company constructed a portfolio that creates an exact cash flow matching strategy for these liabilities. The total purchase price of this portfolio is 1,783.76.

    Calculate the amount invested in the one-year zero-coupon bonds.

22. An insurance company accepts an obligation to pay \$7,000 at the end year 1, pay \$8,000 at the end of year 2, and pay \$9,600 at the end of year 3. The insurance company purchases a combination of the following three bonds in order to exactly match its obligation.

    - Bond 1: 1-year 4% annual coupon bond with yield rate of 9%.
    - Bond 2: 2-year zero coupon bond with yield rate of 7%.
    - Bond 3: 3-year 10% annual coupon bond with yield rate of 8%.

    (a) What face amount of each bond should the insurance company buy to do this? Clearly label each answer, and round each answer to the nearest cent.

    (b) What price should the insurance company pay for the 3-year bond?

23. A company has liabilities of 573 due at the end of year 2 and 701 due at the end of year 5. A portfolio comprises two zero-coupon bonds, Bond A and Bond B. Determine which portfolio produces a Redington immunization of the liabilities using an annual effective interest rate of 7%.

    (a) Bond A: 1-year, current price 500; Bond B: 6-years, current price 500

    (b) Bond A: 1-year, current price 572; Bond B: 6-years, current price 428

    (c) Bond A: 3-years, current price 182; Bond B: 4-years, current price 1092

    (d) Bond A: 3-years, current price 637; Bond B: 4-years, current price 637

    (e) Bond A: 3.5-years, current price 1000; Bond B: not used