Capital Markets
Homework #2 (Due in class)
Preparation for Wednesday, November 3, 2004

Topic: US Treasury Strips and Treasury Bonds and Notes

Please clearly indicate "Homework #2" in the header of your turned-in answers for proper grade recording.

Preparatory Readings:

> **RWJ, Chapters 5 (pp.106-112)**

> **Course Packet (CP-1), Fabozzi (4th edition), Chapter 1**. Skip the sections on "Amortization Feature" and " Embedded Options".

> **CP-2, Fabozzi, pp. 23-27, 33-39, and 122-136**

> **On P drive, in the course folder, *CMBondPricing.doc***

> **On P drive, in the course folder, *CMBondBuilder.xls*** is a handy bond-math calculator

These problems can be done on an advanced financial calculator or spreadsheet. If you do not have a calculator with "bond math" embedded in it (HP12C or higher), there are functions in Excel which will do the job. It is critical that you understand the "big picture" of the mathematics behind the Excel functions. **Give your answers to 3 decimal places.**

1. *Treasury Strips (see CP-2 Fabozzi p.135 for definition) pay no coupon payments, so they sometimes are called zero-coupon bonds. There are only two cash flows associated with strips – one in present value, one in future value. What are they? The convention for quoting US Treasury and U.S. corporate bond yields assumes semi-annual compounding, even for strips that pay no coupon payments.)*

   Assume you purchased on January 14th, 1997 at $73:03 (per $100 face value) a $100,000 position in a U.S. Treasury strip maturing January 15, 2002 (i.e. 73 and 3/32nds per $100 was the asked price you were quoted). Settlement date is Jan. 15, 1997. (*Please note that the settlement date is the day when money changes hands. The price and yield of a bond should be calculated using this date*.)

   a) Define precisely what the cash flows you will pay and receive if you buy and hold the bond to maturity.

   b) What is the yield to maturity on this strip at that price for you as the purchaser?

c) Suppose on the same day, the same Treasury Strip was quoted at a yield to maturity of 6.5%, what would the price be?

2. *A US Treasury note, bond, or strip is characterized with the following six essential parameters:*
   - *Face Value*
   - *Maturity Date*
   - *Settlement Date*
   - *Coupon*
   - *Price*
   - *Yield to Maturity*

In general, Face Value, Maturity Date, Settlement Date, and Coupon (usually quoted as a percentage of the face value) are known and are inputs. Then a T-bond (or a T-note) is often quoted in the market in one of the following two ways – in price per $100, or in a percentage number called "yield", i.e. Yield to Maturity (YTM), which is really the internal rate of return, if a bond is held until maturity and all coupons are reinvested at that YTM. In another words, YTM is the rate of return that makes the PV of a bond's cashflows (including coupon payments and the principal payments at maturity date) equal to its price that an investor pays today (i.e., the settlement date). Knowing the $ quote for a bond, you should be able to solve quickly for the bond's yield (YTM), and vise versa. These tasks can be carried out with a bond-math-enabled calculator or certain Excel functions or BondBuilder.xls.

Suppose the U.S. Treasury issued $500 million face value of 10 year, 7.5% bonds on January 15, 1995 at par value. Coupon interest is paid **semi-annually** with the face value due in 10 years (1/15/2005).

a) On January 14, 1996, this bond is priced in the market to yield 8%, of course using semi-annual compounding. Calculate the correct price you will pay for a bond with face value of $100 on 1/15/96 (settlement date). Therefore, what would the total price be for $500 million of face value?

b) If, on the other hand, the yield-to-maturity of these bonds is 7%, what is their price for each $500 million of face value?

c) Suppose someone purchased these bonds on January 14, 1996 (settlement date: 1/15/1996) at $97:08, what would the yield to maturity be?

3. Suppose the U.S. Treasury also issued $1,000 million face value, 7.5%, 30-year bonds on January 15, 1996 (which is the issue and settlement date). Coupon interest is paid **semi-annually** with the face value payable in 30 years (1/15/2026).

a) If these bonds were priced in the market at 94 (i.e. $94 purchase price for each $100 of face value on 1/15/96), what is the yield to maturity?

b) If the price was 101, what is the yield to maturity?

c) What is the general relationship among price, coupon, yield and par value?

d) In Question 2a vs. Question 3b, it happens that for one of these yields, the price is above par (above 100% of face value), while in the other problem, the price is below par. Why is that? What does it have to do with the maturity differences in the two bonds?

e) What does "Yield to Maturity" of a bond really *mean*? Is it an accurate representation of the *actual* rates one earns in the economy each period? What are the pitfalls of using YTM as a complete summary statistic of a bond's value?

4. *If you purchase a bond in between two coupon dates, you will receive but you are not entitled to the complete first coupon payment. You should "share" this coupon payment with the previous owner of this bond. The amount of the coupon payment he is entitled to is called **accrued interest**. The longer the previous owner holds the bond, the more coupon payment he is entitled to. The calculation is fairly simple as explained in CP-2 Fabozzi. Accrued Interest is not included in WSJ quotes, but it is calculated and charged to you, as part of **the invoice price**, when you purchase the bond. If you are using bond functions on the calculator, the setting should be **Actual/Actual (A/A)** mode for Treasury Bonds.*

Suppose that the settlement date (the date when the buyer and seller exchange cash for bond) on the bonds in Questions 2 and 3 are February 14th, 1996, instead of January 15th, 1996. Suppose also that the YTMs on the bonds are 7.0% for the 10-year and 7.1% for the 30-year. What are the quoted prices (in the WSJ) on the two bonds and what are the "invoice" prices (i.e., what an investor must write a check for to purchase the bond)?