

Security Analysis and Portfolio Management

Problem Set #1

Section I: Fixed Income Valuation

- 1) Your father is about to retire. His firm has given him the option of retiring with a lump sum of \$50,000 or an annuity of \$8,000 for 10 years. Which is worth more if the discount rate is: i) 6%; ii) 18%?
2. a) A bond offers eight annual coupon payments of \$8 and will repay its face value of \$100 at the end of eight years. You observe that other similar bonds have yields to maturity of 10%. How much is this bond worth? If the coupons are paid semi-annually, how much is the bond worth?

b) If the bond in a) has coupon payments of \$12 annually, how much is the bond worth? If the coupons are paid semi-annually how much is the bond worth?

c) Compare the bonds price from part a) with bond prices for bonds with the same coupon, but with 10 years to maturity. Do the same with the bonds in b). What do you observe about the relationships between the prices?
3. Define the "current yield" and explain its relationship to the yield to maturity.
4. Explain how it may be profitable to "ride the yield curve".

Section II. More on Time Value of Money

1. You are in the market for a house. Your effective all-in market borrowing rate for a house mortgage from a bank is 10%. One of the houses you are considering purchasing has an assumable \$200,000, 5 year mortgage at 8%, with a 20 year amortization. The asking price on the house is \$400,000. What is the value of the concessionary financing for this house?
2. A bond offers semi-annual coupon payments of \$3 (i.e, it is a 6% coupon bond) and will repay its face value of \$100 at the end of five years. You observe that other similar bonds have yields to maturity of 8%. How much is this bond worth? If the coupons are paid quarterly, how much is the bond worth?
3. A bond offers semi-annual coupon payments \$5 (i.e., it is a 10% coupon bond) and will repay its face value of \$100 at the end of twenty years. The bond is currently selling for \$84.95. What is the offered yield to maturity on the bond?
4. What is a perpetuity? Derive the formula for pricing such a security when: coupons are fixed and paid annually; coupons are fixed and paid quarterly; the coupon is variable and equal to the current interest rate times the par value of the perpetuity.

5. Calculate the durations of a 3 year, 4% coupon bond, a 3 year 8% coupon bond and a 3 year 10% coupon bond-- all priced to yield 8% to maturity. How much would the value of a 3 year, 4% coupon bond change if interest rates increased from 8% to 12%? What would the duration formula predict? If you hold equal amounts of the three bonds in your portfolio, what is the duration of your bond portfolio?
6. Demonstrate that (Maccaulay) duration is equal to the elasticity of the bond's price with respect to a change in interest rates.

Section III: Term Structure Behaviour

1. The following is a list of prices for (riskless) zero-coupon bonds of various maturities: 1 year, \$97.10; 2 year, \$92.50; 5 year, \$74.70; 10 year, \$50.80; 30 year, \$13.10. Calculate: the yields to maturity of each bond; and, all possible implied forward rates.
2. Briefly explain the relationship between expectations of future interest rates and implied forward rates calculated from the current term structure of interest rates in the expectations, liquidity preference and market segmentation hypotheses.
3. Suppose you put together the following portfolio:
 - a) Purchase one pure discount (zero coupon) bond with a 20 year maturity, with par value of \$1 million.
 - b) Sell short 1.92 pure discount bonds with 5 year maturities and par value of \$1 million per unit. The full value of the short sale proceeds is immediately available.
 - c) Invest \$1,127,490 in bonds with zero duration.

Assume that the yield to maturity on all bonds is 5% initially.

- a) What was the initial investment in the portfolio?
- b) Compute the Macaulay duration of the assets and of the liability.
- c) If the yield to maturity for all assets and liabilities immediately rises to 6%, what is the net value of the portfolio (value of assets less value of liabilities)?
- d) If the yield to maturity of all assets and liabilities immediately falls to 4%, what is the net value of the portfolio?
- e) If yields remain unchanged, what is the value of the portfolio in one year?