Booth School of Business
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Problem Set #1
Risk and Return, Bonds and Interest Rates

You may work on this problem set in groups of up to four people. Hand in one solution per group. You may discuss the problems only with members of your group. Answers should be typed (or printed legibly) and are due **at the beginning of the week 3 class.**

1. Today you bought 100 shares of ABC Inc. at \$100 per share. A year from now ABC will pay a dividend of \$2 per share for sure. The price of ABC a year from now is uncertain and depends on the state of the economy. A year from now the economy will either be in a recession, a state of "normal" growth, or a boom with probabilities of 30%, 40%, and 30% respectively. After analyzing ABC you determine that the price of ABC a year from now in these various states of the economy will be:

State of the Economy	Price of ABC
Recession	\$80
Normal Growth	\$110
Boom	\$130

   What is the expected return over the next year to your investment in ABC? What is the standard deviation of that return?

2. Suppose that the term structure is currently flat so that bonds of all maturities have yields to maturity of 10%. Currently a 5-year coupon bond with annual coupons (with the first one due in 1 year) and face value of \$1,000 is selling at par.

   (a) What is the current price of the 5-year bond? What are the annual coupons in dollar terms?

   (b) A year from now interest rates will depend on the stance of monetary policy. If monetary policy is "tight" the yields to maturity on all bonds will be 12%. If monetary policy is "loose" the yields to maturity on all bonds will be 8%. If you sell the bond a year from now when monetary policy is tight what will be the return to your investment over the year? If you sell the bond a year from now when monetary policy is loose what will be the return to your investment over the year?

3. You are an investment manager for Lemon County. You are given the following information about the yields of U.S. Treasury strips (which are zero-coupon, or pure discount, bonds which pay \$100 at maturity): $y_1 = 3\%$, $y_2 = 4\%$, $y_{29} = 6.1\%$, and

$y_{30} = 6.0\%$, where y_j is the yield-to-maturity on a j-year strip. Assume that all cash flows are riskless and we can borrow and lend at the stated rates. You buy $50,000$ 30-year strips and partially finance these by issuing $5,000$ 2-year strips (i.e., you are borrowing money by promising to pay $\$500,000 = 5,000 \times \$100$ in two years).

(a) How much of Lemon County's money are you investing (i.e., what is the net investment)?

(b) Suppose that one second after you make the above investments, the Federal Reserve Board announces that it is taking steps to raise interest rates. Assume that the yields on all of the strips immediately increase by one percentage point (i.e., $y_1 = 4\%$, $y_2 = 5\%$, $y_{29} = 7.1\%$, and $y_{30} = 7.0\%$). By how much (in dollars and in percentage terms) does the value of the county's investment change due to the unexpected announcement?

(c) After the announcement, what are the forward rates of interest f_2 and f_{30}?

4. We see the following yield curve for discount, or zero–coupon, bonds.

Maturity	Yield to Maturity
1 year	6%
2 years	7%
3 years	8%

(a) If the *fair* price for a *4*-year annuity paying \$100 per year is \$334.57, what is the yield to maturity on a four year zero–coupon bond?

(b) Suppose that you wish to lock in a loan in year 2 to be repaid in year 3 (cash received in year 2 and interest plus principal returned in year 3). The amount of the loan is \$20 Million. What pattern of discount bond holdings could you use to construct this loan *now*? That is, you will be buying and selling different bonds. How many bonds of what maturity will you buy? How many bonds of what maturity will you sell?

(c) What is the implied forward rate between year 2 and year 3?

5. A six-month zero-coupon bond with face value \$100 sells for \$99.46, a one-year zero-coupon bond sells for \$97.23, and an 18-month zero-coupon bond sells for \$90.50. Suppose a new coupon bond, making semi-annual coupon payments, is issued today with face value \$100, maturity of 18 months, and a semi-annual coupon payment of 9% (the 9% is expressed as an annual rate).

(a) Calculate the no-arbitrage price of the coupon bond today.

(b) Calculate the implied forward rates in this economy.

(c) If the liquidity preference theory is correct and there exists a liquidity premium of 0.5% per period, what is the market's expectation of the price the bond will sell for in one year? 1 year = 2 periods here.