

1. On April 1, ABC on North Pleasant St decides it will need sometime late this summer, 50 pounds of hops to brew its beer. The spot price for one pound of hops is \$1. A futures contract, with contract size 10 pounds of hops and delivery date Oct 1, has a futures price of \$9. ABC decides to take a long position on **four** futures contracts.

On August 1, ABC decides that it needs the hops. Hops are now \$0.75 a pound and the futures price has dropped to \$8. It closes its position and buys the hops. How much money did it pay, overall, for the 50 pounds? Assume all risk free interest rates are 0%.

2. The S&P index price is currently \$1115. The risk-free rate is 5%. You take a short position in a 10 month futures contract on the S&P. Recall that the contract size is 250 shares of S&P.

- (a) What is the futures price? What is the value of your position?
- (b) Suppose the price of the S&P in six months from now is \$1200. What is the value of your position?

3. (a) Portfolio M441 consists of a 3-year zero coupon bond with principal \$2 million and a 2-year zero-coupon bond with principal \$1 million. The yields on both bonds are 7%. Find the duration of the portfolio.

- (b) A third bond, Bond AAA, has a duration of 2.5 years and a bond price of \$985. Suppose the M441 portfolio manager wants to hedge her portfolio using Bond AAA. What should she do?

- (c) Suppose she did **NOT** hedge, and the yield goes up by 5 basis points, what is the approximate change in value of her portfolio? Use part (a).

4. A 6 month zero-coupon bond with principal \$100 costs \$98. A 12 month bond with principal \$50 and paying 8% coupons costs \$51. Coupons are paid semi-annually.

- (a) Find the 6-month and 12-month zero (spot) rates.
- (b) Convert the 6-month zero rate, which is compounded continuously, into the equivalent rate with quarterly compounding.
- (c) Find the forward rate from 6 months to 12 months.
- (d) Find the yield of the 12-month bond.

5. Lex Luther owns Krypton as part of a long term investment. Lex can buy Krypton at \$1000 an ounce and sell it at \$990 an ounce. He can borrow and lend money at 5% (compounded continuously). Let F_0 denote the futures price of one ounce of Krypton with delivery in one year. What is the range of values F_0 can take without providing Lex an arbitrage opportunity? Assume there are no storage costs.