Practice Problem Set

BUSS386 Futures and Options

1 Value at Risk

Consider a position consisting of a $100,000 investment in asset A and a $100,000 investment in asset B. Assume that the daily volatilities of both assets are 1% and that the coefficient of correlation between their returns is 0.3. What is the 5-day 99% VaR for the portfolio? Assume that asset prices follow the normal distribution.

2 Value at Risk

A company has a position in bonds worth $6 million. The modified duration of the portfolio is 5.2 years. Assume that only parallel shifts in the yield curve can take place and that the standard deviation of the daily yield change (when yield is measured in percent) is 0.09. Use the duration model to estimate the 20-day 90% VaR for the portfolio. Explain carefully the weaknesses of this approach to calculating VaR.

3 Value at Risk

Consider a position consisting of a $300,000 investment in gold and a $500,000 investment in silver. Suppose that the daily volatilities of these two assets are 1.8% and 1.2% respectively, and that the coefficient of correlation between their returns is 0.6. What is the 10-day 97.5% VaR for the portfolio? By how much does diversification reduce the VaR?

4 Interest Rate Conversion

A bank quotes you an interest rate of 14% per annum with quarterly compounding. What is the equivalent rate with (a) continuous compounding and (b) annual compounding?

5 Bond Pricing

The six-month and one-year zero rates are both 10% per annum. For a bond that has a life of 18 months and pays a coupon of 8% per annum (with semiannual payments and one having just been made), the yield is 10.4% per annum. What is the bond's price? What is the 18-month zero rate? All rates are quoted with semiannual compounding.

6 Par Yield

Suppose that the 6-month, 12-month, 18-month, and 24-month zero rates are 5%, 6%, 6.5%, and 7% respectively (continuously compounded). What is the two-year par yield?

7 Forward Rates

Suppose that zero interest rates with continuous compounding are as follows:

Maturity (months)	Rate (% per annum)
3	8.0
6	8.2
9	8.4
12	8.5
15	8.6
18	8.7

Calculate forward interest rates for the second, third, fourth, fifth, and sixth quarters.

8 Forward Rate Agreements

A bank can borrow or lend at LIBOR. Suppose that the six-month rate is 5% and the nine-month rate is 6%. The rate that can be locked in for the period between six months and nine months using an FRA is 7%. What arbitrage opportunities are open to the bank? All rates are continuously compounded.

9 Forward Rate Agreements

The 6-month, 12-month, 18-month, and 24-month zero rates are 4%, 4.5%, 4.75%, and 5% with semiannual compounding.

1. What are the rates with continuous compounding?
2. What is the forward rate for the six-month period beginning in 18 months?
3. What is the value of an FRA that promises to pay you 6% (compounded semiannually) on a principal of $1 million for the six-month period starting in 18 months?

10 Bond Prices and Interest Rate

The following table gives the prices of bonds:

Bond Principal ($)	Time to Maturity (yrs)	Annual Coupon ($)*	Bond Price ($)
100	0.5	0.0	98
100	1.0	0.0	95
100	1.5	6.2	101
100	2.0	8.0	104

*Half the stated coupon is paid every six months.

1. Calculate zero rates for maturities of 6 months, 12 months, 18 months, and 24 months.
2. What are the forward rates for the periods: 6 months to 12 months, 12 months to 18 months, 18 months to 24 months?
3. What are the 6-month, 12-month, 18-month, and 24-month par yields for bonds that provide semiannual coupon payments?
4. Estimate the price and yield of a two-year bond providing a semiannual coupon of 7% per annum.

11 Duration

What does duration tell you about the sensitivity of a bond portfolio to interest rates? What are the limitations of the duration measure?

12 Duration

A five-year bond with a yield of 11% (continuously compounded) pays an 8% coupon at the end of each year.

1. What is the bond's price (face value of 100)?
2. What is the bond's duration?
3. Use the duration to calculate the effect on the bond's price of a 0.2% decrease in its yield.
4. Recalculate the bond's price on the basis of a 10.8% per annum yield and verify that the result is in agreement with your answer to (c).

13 Duration of Portfolios

Portfolio A consists of a one-year zero-coupon bond with a face value of $2,000 and a 10-year zero-coupon bond with a face value of $6,000. Portfolio B consists of a 5.95-year zero-coupon bond with a face value of $5,000. The current yield on all bonds is 10% per annum.

1. Show that both portfolios have the same duration.

2. Show that the percentage changes in the values of the two portfolios for a 0.1% per annum increase in yields are the same.

3. What are the percentage changes in the values of the two portfolios for a 5% per annum increase in yields?