

CMSC 5718 Introduction to Computational Finance

Sample revision questions

The following questions are aimed to give you an idea of the type of questions that can appear in the final exam. Those questions will likely be shorter than the ones given here. Furthermore, note that:

- i) topics that appear in this set may or may not be examined.
- ii) additional topics not included in the 3 questions below can appear in the final exam.

Note that Q1(i) and Q1(ii) are not relevant to our current syllabus.

Question 1 Knowledge of financial products (20 marks)

Your friend's mother wants to invest some money (about HKD 100,000) and you went with her to meet a bank's investment advisor. The advisor recommended three products, the details of which are given below:

Product	Bond A	Bond B	Structured Note C
Issuer	Hong Kong Government	Company X	Bank Y
Maturity	2 years	2 years	2 years
Coupon	Zero coupon	4.50%p.a., pays once a year at each year's end	6%p.a., pays once a year at each year's end
Face value at maturity	\$100	\$100	\$10000
Price today	\$94.50	To be decided	\$10000

There is an extra condition for Structured Note C

Product	Structured Note C
Extra condition	If share price of Hang Seng Bank (stock code 0011) is below \$100 at maturity, you would get back 100 shares of Hang Seng Bank instead of the face value of \$10000

- i. (2 marks) Calculate the annualized yield and duration of Bond A
- ii. (2 marks) Calculate the price and duration of Bond B, given the yield of this bond is 3.50%p.a. (annual compounding convention).
- iii. (4 marks) Using an interest rate of 3%p.a. to discount the cash flows and given that the price of 100 Hang Seng Bank options is worth \$850 today, calculate the bank's commission charge for Structured Note C as of today.
- iv. (4 marks) Assume that you have chosen Structured Note C and you could re-invest the coupon that you received at the end of year 1 at an interest rate of 4%p.a. for 1 year. Calculate the realized compound yield of Structured Note C, assuming that Hang Seng Bank's share price is HKD 96 at maturity.
- v. (8 marks) Knowing that Structured Note C is linked to the performance of share prices while she heard that it is easy to make money in the stock market, your friend's mother thought that the Note is very attractive and the yield could be much higher than the other two products. She has dreams of becoming rich in two years time. The advisor said nothing against this and is keen to sell the product. You feel uncomfortable about the situation and think that something doesn't sound right.

Which product would you recommend to your friend's mother? Your answer should include an analysis of the potential gain/loss of each product and the risks involved. You should also comment on the scenarios if your friend's mother needs to withdraw the money before the maturity of the product is reached.

Question 2 Portfolio theory and investments (12 marks)

Jane is 27 years old and has just inherited HKD 500,000 from a rich relative. Since she has no experience in investments, she asked for advice from her friend Gordon. Being a conservative investor, Gordon recommended her to invest 50% of the money in government bonds and the remaining portion in some funds. After some research, he came up with the following estimates:

	Expected return (%p.a.)	Standard deviation	Correlation with Government bonds
Government Bonds	3.80%	3.40%	
Global Equity Fund A	10.10%	14.50%	0.50
Commodities Fund B	8.40%	11.00%	0.25

- i. (2 marks) Calculate the expected return and standard deviation of a portfolio with half the money in the government bonds and the other half in Fund A.
- ii. (2 marks) Repeat the calculation in (i) by replacing Fund A with Fund B.
- iii. (5 marks) Which combination is a better choice? Distinguish between the choice that Jane would make according to the type of investor that she belongs to: risk averse, risk neutral or risk seeking.
- iv. (3 marks) Jane intended to choose Fund B as it seems to have a lower risk. Another friend, Peter, boasting his knowledge of “theory of investment”, claims that

“Lower risk/higher return are achievable by adding some high risk investments to the portfolio.”

Is this statement correct? Give brief reasons to support your answer

Question 3 Professional trading strategies (20 marks)

(a) Option strategies (11 marks)

Maturity	Strike	Call option price	Put option price	Interest rate (annual compounding)
1 year	\$85	\$7.720	\$11.744	3%p.a.

- i. (2 marks) State the put-call parity relationship which must be followed by option prices assuming no arbitrage.
- ii. (2 marks) Calculate the current price of the stock given that the dividend yield = 0.
- iii. (3 marks) Use the put-call parity relationship and the information given above to construct a strategy which effectively gives you a short position in the stock.
- iv. (4 marks) You think the stock price would move substantially in one year's time, so you construct a "long straddle" strategy from the options given above. If you consider the price that you need to pay to enter this strategy, it would generate a loss if the stock price stays within a certain range at maturity.
 - Calculate the price of entering the strategy today, and hence the equivalent price at maturity. Draw the payoff profile of this strategy
 - Calculate the range of stock prices at maturity where you would suffer a loss.

(b) Equity index futures and index arbitrage (9 marks)

Today is March 9, 2013. At 3:20pm, the Hang Seng Index (HSI) is trading at 23930. At the same time, the March HSI futures contract (maturity date March 29, 2013) is trading at 23770. HKD interest rate between March 9 and March 30 is 2.4% p.a. It is estimated that dividends of the equivalent of 103 index points (today's present value) would be expected between March 9 and March 30.

- i. (2 marks) What is the fair value of the March futures contract? (interest is to be calculated using the simple interest rate convention, i.e. $1+rt$, where t is the time in years assuming that there are 365 days in a year)
- ii. (4 marks) Briefly describe a low risk strategy that you could adopt if you want to make a profit from the information given above. What is the anticipated profit for each contract, given that transaction costs of 20 index points would be incurred? (1 index point = HKD 50).
- iii. (3 marks) Discuss some practical problems that could be encountered if you want to trade the equivalent of 100 futures contracts in carrying out the strategy in (ii) above.