The University of Hong Kong

FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE

COMP 7802 Introduction to financial computing

Date: December 20, 2014 **Time: 2:30pm–4:30pm**

Time allowed : 2 hours
Student I.D. : _____

Only approved calculators as announced by the Examinations Secretary can be used in this examination. It is candidates' responsibility to ensure that their calculator operates satisfactorily, and candidates must record the name and type of the calculator used on the front page of the examination script.

Brand and type of calculator : _____

Candidates are permitted to bring to the examination one piece of A4-sized paper with printed or written notes on both sides.

Answer ALL questions.
Write all your answers in the space provided.

Question	Score
1	/ 20
2	/ 10
3	/ 10
4	/ 10
5	/ 40
6	/ 10
Total	/ 100

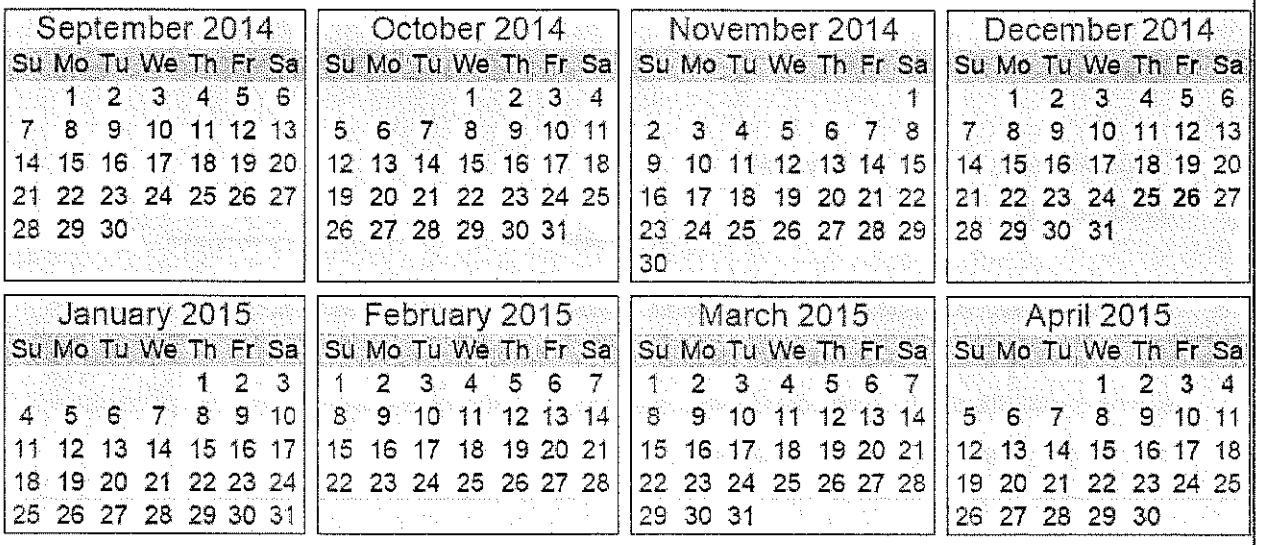
1. [20 points]

On 16 October 2014

GBP LIBOR - 3 months 0.55963%

GBP LIBOR - 6 months 0.69019%

Assume that year basis is 365, days to spot is 2.



September 2014

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October 2014

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November 2014

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
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16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December 2014

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

January 2015

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February 2015

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March 2015

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April 2015

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

a. [4 points]What is the start dates and maturity dates of the 3-month and 6-month LIBOR? Note that besides weekends, only the 25th and 26th of December and 1st of January are holidays.

	Start Date	Maturity Date
3-month LIBOR		
6-month LIBOR		

b. [5 points]Show the expression for calculating the theoretical 3v6 FRA rate and show the result (a percentage with 5 decimal points accuracy).

c. [5 points]Show the expression for calculating the continuously compounded rate for the 3-month LIBOR and show the result (a percentage with 5 decimal points accuracy).

d. [6 points]Show the equation for calculating a fixed rate with quarterly interest payment, that is,

i. the 1st interest payment date is the same as the 3-month LIBOR maturity

ii. the 2nd interest + principal payment date is the same as the 6-month LIBOR maturity

The NPV of a 6-month deposit using the fixed rate (with 2 interest payments) should be the same as that of a deposit using the 6-month LIBOR. Solve the equation and show the fixed rate (a percentage with 5 decimal points accuracy).

2. [10 points]

a. [3 points] Invest $2,000 now and receive 3 yearly payments of $100, $120 and $2140 respectively. Use 6% as the discount rate. What is the NPV (show your expression and NPV with 4 decimal points accuracy)?

b. [7 points] The quoted rate on a US T-bill with 50 days to maturity is 2% (discount basis). Use 360 as the year basis.

i. [3 points] How much would you have to pay (2 decimal points accuracy) for the bill, for a $1,000,000 deal?

ii. [2 points] If you hold the T-bill to maturity, what is your yield (annualized by taking 365 / Days to Maturity)?

iii. [2 points] If you hold the T-bill for 30 days and sell it for $998,000, what is your yield (annualized by taking 365 / Days to Maturity)?

3. [10 points] Today is 1 May 2006. Given the following market data of an IRS:

Notional amount:	10 million
Start of swap:	3 May 2006
Maturity of swap:	3 May 2007 (Note that 2004 is a leap year)
Receive(Fixed leg):	? % (semi-annual ACT/365)
Pay (Floating leg):	LIBOR (semi-annual ACT/365)

Zero-coupon discount factors:

3 May 2006: 0.999602858

3 Nov 2006: 0.963202331

Rates:

$3\ Nov\ 2006 - 3\ May\ 2007$ 7.0439%

a. [2 points] Suppose a company would like to enter the above IRS deal with a counterparty. What is the "ideal" NPV of the IRS on 1 May 2006?

b. [3 points] Calculate the discount factors on 3 May 2007.

c. [4 points] Show the equation for calculating the swap rate, that is, rate of the fixed leg.

d. [1 points] Solve the equation in part (c).

4. [10 points] True or False:
   a. [2 points] FRA settlements are discounted.
   b. [2 points] Yields on Treasury Bills are usually higher than those on Commercial Paper.
   c. [2 points] When a trader expects interest rates to rise, he sells future contracts.
   d. [2 points] A zero coupon instrument A is quoted at a discount basis of 5%. Another zero coupon instrument B is quoted at a yield basis of 5% with the same maturity as A. Instrument B has a better return.
   e. [2 points] A flat yield curve indicates that interest rates will drop in the future.

5. [40 points] On a given day, the Stock Index level is 23000 near the market closing. The European call and put option prices quoted for the Stock Index in the market as follows:

Strike Price	Call Price	Put Price
22800	$550	$200
23000	$460	$240
23200	$308	$380

All options are of the same expiration date. The remaining time to maturity is 90 days and the current risk free rate is 2.5% per annum. The day / year convention is ACT/360.

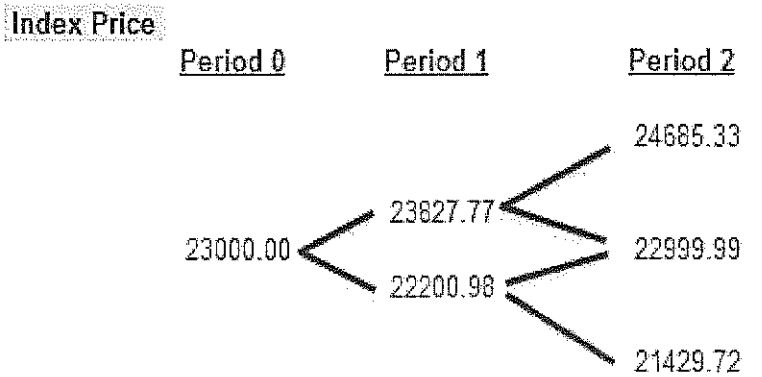
a. [6 points] Based on the information above, please advise which Call Option is in-the-money and explain? Please show the expression for calculating the intrinsic value and time value of that Option.

b. [6 points] Please advise which Put Option is out-of-money and explain? Please show the expression for calculating the intrinsic value and time value of that Option as well.

c. [6 points] Mr. A said that by observing the information above, there is arbitrage opportunity for Option at a Strike 23200. Please explain with appropriate basic option theory if his observation is correct?

d. [22 points] Mr. A wants to calculate the European Put Option theoretical price at a strike 22,800 using 2 steps binomial model. The Cox, Ross & Rubinstein methodology is adopted in his financial model.

The index price volatility is estimated to be 10% per annum. For simplicity sake, Mr. A assumes the current risk free rate is continuously compounding risk free rate. In his working, he first constructed the two-period binomial tree for the index price for each nodes as follows:

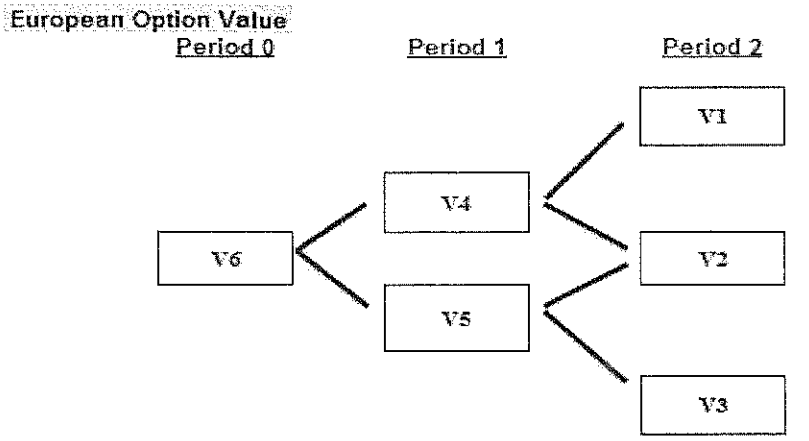


i. [5 points] Mr. A asked your help to calculate below intermediary parameters based on Cox, Ross & Rubinstein methodology. Please show the expression of your calculation of each intermediary parameter (round the calculated results to the nearest 6 decimal points).

- Δt = period interval in each binomial nodes
- DF = discount factor in each binomial nodes
- u = up jump size
- d = down jump size
- p = risk neural probability of up jump size

ii. [13 points] Mr. A would like your help to finish the remaining work of European Put Option theoretical price calculation using two-period binomial model per Cox, Ross & Rubinstein methodology. The following two-period binomial tree for European Option price calculation is provided by Mr. A.

Please show your calculation and result of each items from V1 to V6 and the computed European Put Option theoretical price. (For all calculated results, please round to the nearest 2 decimal points.)



iii. [4 points] Based on your European Put Option theoretical price result in 5.ii above, calculate the corresponding theoretical price of European Call Option at a strike of 22800 based on the Put-Call parity theory. Please show your expression for calculation (round the calculated results to the nearest 2 decimal points).

6. [10 points] The following market data for HKD dollar is available from the broker screen for the rates (in %) of respective finacial instruments.

Date 26 October 2014

Cash DEPO		3 month FRA		Interest Rate Swaps	
ON	1.00	1x4	2.45	1Y	3.10
1W	1.25	2x5	2.60	2Y	3.13
1M	1.50	3x6	2.70	3Y	3.15
2M	2.00	6x9	2.80	4Y	3.20
3M	2.25			5Y	3.25
				7Y	3.50
				10Y	3.75

Mr. A is working on the financial model to construct the market yield curve. The following assumptions are made:

- day / year convention is ACT / 365
- holiday effect is ignored

In his worksheet model, the following discount factors for Money Market information are calculated.

MM Discount Factor

Tenor	From	To	Period	Dt
O/N	26/10/14	27/10/14	1	0.999973
1Wk	26/10/14	02/11/14	7	0.999760
1M	26/10/14	26/11/14	31	0.998728
2M	26/10/14	26/12/14	61	0.996669
3M	26/10/14	26/01/15	92	0.994361

i) [4 points] He would like to seek your help to calculate the discount factor on 26/3/2015. Please show your expression for calculation. (the calculated results are rounded to nearest 6 decimal points)

ii) [6 points] He would like to calculate the discount factor on 26/7/2015 as well. Please demonstrate to him the relevant steps and calculations. (the calculated results are rounded to nearest 6 decimal point)

END OF PAPER