UNIVERSITY OF BRADFORD

DERIVATIVES PRICING & RISK MANAGEMENT (MSc)

MAN4258M

03 May 2013 **16:00 – 17:00 hours**

Main

This is a **CLOSED BOOK** examination

Available time: 1 hour

You should attempt any **TWO** questions from the **FOUR** available. All questions are equally weighted.
You should answer every part of the question you attempt.

If you attempt more than two questions, then you will be awarded marks for your two highest scoring answers.

Marks are awarded for complete answers and not "just for the final result". A complete answer defines the notation, specifies the assumptions used, clearly explains the steps involved in the calculation, and provides a reasonable interpretation of the result, where relevant.

No programmable calculators are permitted.

Tables of the cumulative standard Normal distribution are appended.

Use the 30/360 day convention for all financial calculations.

Answer any two questions from the four available. All questions are equally weighted. You should answer every part of the question you attempt.

Question 1

a. Explain the similarities and differences between a FRA (forward rate agreement) and a forward contract on non-zero coupon bond.

[Marks awarded: 10%]

b. A semi-annual coupon bond, having a notional £100 par value, with a 6% annual coupon has a time-to-maturity of exactly 8 years. Determine the current price for this bond when its annual YTM is 5.4%.

[Marks awarded: 25%]

c. The current 6-month and 12-month annualized spot interest rate are 4.0% and 4.4%, respectively. Determine the one-year forward price for this 6% semi-annual coupon bond.

[Marks awarded: 25%]

d. On the maturity date for the forward bond contract, the annual YTM for this bond is reported to be 5.8%. Assuming that the forward contract is cash settled, determine the profit (loss) on this forward contract for the short position.

[Marks awarded: 30%]

e. Discuss how speculators can profit from a forward bond contract when they believe that an increase in the bond's YTM is expected.

[Marks awarded: 10%]

Question 2

a. The annualized spot $LIBOR interest rates for an assumed riskfree instrument are recorded in the following table for five different maturities:

Maturity	Rate (%)
3-months	2.70%
6-months	2.85%
9-months	3.00%
12-months	3.10%
15-months	3.15%

Determine the implied current price for a 3-month Eurodollar futures contract, for (i) 6-month and (ii) 12- month delivery dates.

[Marks awarded: 25%]

b. A bank opens 10 long 3-month Eurodollar contract with a Futures price of 95.48. (The number of contracts = 10, contract size is $1 million, and the long position entails lending.) The futures price for the same contract on the date of maturity of the contract is 96.71. Ignoring all mark-to-market gains and losses until the maturity date, determine the amount gained or lost on the futures contracts,

[Marks awarded: 25%]

c. On February 4th 2013, the following futures prices for maize (corn) are recorded on the CBT (Chicago Board of Trade) for six different contract dates. The contracts are priced according to US cents per bushel and the contract size is 5000 bushels (=127 metric tons).

Contract month	Price	Volume	Open interest
March	734.25	159.1	471.4
May	736.25	58.6	272.4
July	727.50	39.3	181.5
September	617.75	8.3	62
December	593.75	25.7	244.7
March	604.25	0.9	15.8

Using theoretical futures pricing and other relevant issues, discuss the evolution of futures prices for the various monthly contracts.

[Marks awarded: 25%]

d. It is now October 2008. A company anticipates that it will purchase 1 million pounds of copper in August 2010. The company has decided to hedge its risk by using futures contracts traded in COMEX division of CBOT. Each contract has a delivery quantity of 25000 pounds. Contracts with maturities up to 13 months in the future are considered to have sufficient liquidity to meet the company's needs. Assume that the market prices (in cents per pound) today and at future dates are as follows:

Date	Oct. 2008	Feb. 2009	Aug. 2009	Feb. 2010	Aug. 2010
Spot price	72.00	69.00	65.00	77.00	88.00
Mar. 2009 futures price	72.30	69.10			
Sept. 2009 futures price	72.80	70.20	64.80		
Mar. 2010 futures price		70.70	64.30	76.70	
Sept. 2010 futures price			64.20	76.50	88.20

Ignoring the time value of money, determine the profit (loss) on an effective hedging strategy using futures contracts, and discuss your results.

[Marks awarded: 25%]

Question 3

a. Discuss the assumptions and limitations of the Black-Scholes option pricing formula.

[Marks awarded: 15%]

b. A company is negotiating with its bank on the issue of a 4-year annual coupon bond with a notional par value of £100. The zero-coupon bond price, also for a notional par value of £100, adjusted for the risk characteristics of this company, are reported for the various maturities in the following table:

Maturity (years)	Zero-Coupon Bond Price
1	94.34
2	87.34
3	80.50
4	73.50

Determine the par coupon.

[Marks awarded: 25%]

c. The bank recommends an equity-linked bond. For each bond of this type, the company would continue to make regular annual coupon payments, but on the redemption date, the bond holder would have the right to convert the principal to one unit of equity. Currently, its equity price is £90, continuous dividend yield is 2%, and annual volatility is 25%. Given the following riskfree par £100 zero-coupon bond prices for the various maturities:

Maturity (years)	Zero-Coupon Bond Price
1	96.15
2	90.70
3	85.16
4	79.21

Determine the par coupon for this modified bond.

[Marks awarded: 50%]

d. Discuss whether or not equity-linked bonds would be issued by both stable performing companies, such as utilities, and high growth but volatile performing companies such as leading-edge hi-tech firms.

[Marks awarded: 10%]

Question 4

a. A mineral asset extraction company mining copper is considering the use of a combination option for hedging its exposure to copper prices. The current price of copper is $600 per metric tonne. Over the next 12 months, the company expects to sell 1000 metric tonnes of copper in ten equal installments. It has been advised to buy 1000 American-style put option contracts on copper with a 12-month maturity at the exercise price $620, and to sell 1000 American-style call option contracts on copper with a 12-month maturity at the exercise price $600. The contract size for options on copper is 1 metric tonne. The premiums for the American 12-month call and put options at various exercise prices are recorded in the following table:

Exercise price	Call premium	Put premium
$600	$70	$18
$620	$22	$70

Ignoring the time value of the premium, determine the profit profile for the combination option and the corresponding effective selling price.

[Marks awarded: 25%]

b. Using your results of part (a), discuss the advantages and limitations of using the combination option for hedging the copper price exposure of the mining company. Propose an alternative hedging instrument that limits some of the disadvantages of the said combination option.

[Marks awarded: 15%]

c. The current price of a non-dividend paying asset is £4.00 and its expected annual volatility over the next 3 months is expected to be 35%. Create the binomial lattice representing the evolution of the asset price based on 3 equal periods, each having a length of 1 month.

[Marks awarded: 20%]

d. Using the binomial lattice created in part (c), determine the European call and put option prices for this asset, having an expiration date of 3 months and an exercise price of £4.00. The annualized risk-free rate for a 3 month loan period is 3.5%.

[Marks awarded: 30%]

e. Using the results of part (d), demonstrate the put-call parity relationship.

[Marks awarded: 10%]

Table for N(x) when $x \leq 0$

	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
0.0	0.50000	0.49601	0.49202	0.48803	0.48405	0.48006	0.47608	0.47210	0.46812	0.46414
-0.1	0.46017	0.45620	0.45224	0.44828	0.44433	0.44038	0.43644	0.43251	0.42858	0.42465
-0.2	0.42074	0.41683	0.41294	0.40905	0.40517	0.40129	0.39743	0.39358	0.38974	0.38591
-0.3	0.38209	0.37828	0.37448	0.37070	0.36693	0.36317	0.35942	0.35569	0.35197	0.34827
-0.4	0.34458	0.34090	0.33724	0.33360	0.32997	0.32636	0.32276	0.31918	0.31561	0.31207
-0.5	0.30854	0.30503	0.30153	0.29806	0.29460	0.29116	0.28774	0.28434	0.28096	0.27760
-0.6	0.27425	0.27093	0.26763	0.26435	0.26109	0.25785	0.25463	0.25143	0.24825	0.24510
-0.7	0.24196	0.23885	0.23576	0.23270	0.22965	0.22663	0.22363	0.22065	0.21770	0.21476
-0.8	0.21186	0.20897	0.20611	0.20327	0.20045	0.19766	0.19489	0.19215	0.18943	0.18673
-0.9	0.18406	0.18141	0.17879	0.17619	0.17361	0.17106	0.16853	0.16602	0.16354	0.16109
-1.0	0.15866	0.15625	0.15386	0.15151	0.14917	0.14686	0.14457	0.14231	0.14007	0.13786
-1.1	0.13567	0.13350	0.13136	0.12924	0.12714	0.12507	0.12302	0.12100	0.11900	0.11702
-1.2	0.11507	0.11314	0.11123	0.10935	0.10749	0.10565	0.10383	0.10204	0.10027	0.09853
-1.3	0.09680	0.09510	0.09342	0.09176	0.09012	0.08851	0.08691	0.08534	0.08379	0.08226
-1.4	0.08076	0.07927	0.07780	0.07636	0.07493	0.07353	0.07215	0.07078	0.06944	0.06811
-1.5	0.06681	0.06552	0.06426	0.06301	0.06178	0.06057	0.05938	0.05821	0.05705	0.05592
-1.6	0.05480	0.05370	0.05262	0.05155	0.05050	0.04947	0.04846	0.04746	0.04648	0.04551
-1.7	0.04457	0.04363	0.04272	0.04182	0.04093	0.04006	0.03920	0.03836	0.03754	0.03673
-1.8	0.03593	0.03515	0.03438	0.03362	0.03288	0.03216	0.03144	0.03074	0.03005	0.02938
-1.9	0.02872	0.02807	0.02743	0.02680	0.02619	0.02559	0.02500	0.02442	0.02385	0.02330
-2.0	0.02275	0.02222	0.02169	0.02118	0.02068	0.02018	0.01970	0.01923	0.01876	0.01831
-2.1	0.01786	0.01743	0.01700	0.01659	0.01618	0.01578	0.01539	0.01500	0.01463	0.01426
-2.2	0.01390	0.01355	0.01321	0.01287	0.01255	0.01222	0.01191	0.01160	0.01130	0.01101
-2.3	0.01072	0.01044	0.01017	0.00990	0.00964	0.00939	0.00914	0.00889	0.00866	0.00842
-2.4	0.00820	0.00798	0.00776	0.00755	0.00734	0.00714	0.00695	0.00676	0.00657	0.00639
-2.5	0.00621	0.00604	0.00587	0.00570	0.00554	0.00539	0.00523	0.00508	0.00494	0.00480
-2.6	0.00466	0.00453	0.00440	0.00427	0.00415	0.00402	0.00391	0.00379	0.00368	0.00357
-2.7	0.00347	0.00336	0.00326	0.00317	0.00307	0.00298	0.00289	0.00280	0.00272	0.00264

-2.8	0.00256	0.00248	0.00240	0.00233	0.00226	0.00219	0.00212	0.00205	0.00199	0.00193
-2.9	0.00187	0.00181	0.00175	0.00169	0.00164	0.00159	0.00154	0.00149	0.00144	0.00139
-3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00104	0.00100
-3.1	0.00097	0.00094	0.00090	0.00087	0.00084	0.00082	0.00079	0.00076	0.00074	0.00071
-3.2	0.00069	0.00066	0.00064	0.00062	0.00060	0.00058	0.00056	0.00054	0.00052	0.00050
-3.3	0.00048	0.00047	0.00045	0.00043	0.00042	0.00040	0.00039	0.00038	0.00036	0.00035
-3.4	0.00034	0.00032	0.00031	0.00030	0.00029	0.00028	0.00027	0.00026	0.00025	0.00024
-3.5	0.00023	0.00022	0.00022	0.00021	0.00020	0.00019	0.00019	0.00018	0.00017	0.00017
-3.6	0.00016	0.00015	0.00015	0.00014	0.00014	0.00013	0.00013	0.00012	0.00012	0.00011
-3.7	0.00011	0.00010	0.00010	0.00010	0.00009	0.00009	0.00008	0.00008	0.00008	0.00008
-3.8	0.00007	0.00007	0.00007	0.00006	0.00006	0.00006	0.00006	0.00005	0.00005	0.00005
-3.9	0.00005	0.00005	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003
-4.0	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002

Table for N(x) when $x \geq 0$

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.50000	0.50399	0.50798	0.51197	0.51595	0.51994	0.52392	0.52790	0.53188	0.53586
0.1	0.53983	0.54380	0.54776	0.55172	0.55567	0.55962	0.56356	0.56749	0.57142	0.57535
0.2	0.57926	0.58317	0.58706	0.59095	0.59483	0.59871	0.60257	0.60642	0.61026	0.61409
0.3	0.61791	0.62172	0.62552	0.62930	0.63307	0.63683	0.64058	0.64431	0.64803	0.65173
0.4	0.65542	0.65910	0.66276	0.66640	0.67003	0.67364	0.67724	0.68082	0.68439	0.68793
0.5	0.69146	0.69497	0.69847	0.70194	0.70540	0.70884	0.71226	0.71566	0.71904	0.72240
0.6	0.72575	0.72907	0.73237	0.73565	0.73891	0.74215	0.74537	0.74857	0.75175	0.75490
0.7	0.75804	0.76115	0.76424	0.76730	0.77035	0.77337	0.77637	0.77935	0.78230	0.78524
0.8	0.78814	0.79103	0.79389	0.79673	0.79955	0.80234	0.80511	0.80785	0.81057	0.81327
0.9	0.81594	0.81859	0.82121	0.82381	0.82639	0.82894	0.83147	0.83398	0.83646	0.83891
1.0	0.84134	0.84375	0.84614	0.84849	0.85083	0.85314	0.85543	0.85769	0.85993	0.86214
1.1	0.86433	0.86650	0.86864	0.87076	0.87286	0.87493	0.87698	0.87900	0.88100	0.88298
1.2	0.88493	0.88686	0.88877	0.89065	0.89251	0.89435	0.89617	0.89796	0.89973	0.90147
1.3	0.90320	0.90490	0.90658	0.90824	0.90988	0.91149	0.91309	0.91466	0.91621	0.91774
1.4	0.91924	0.92073	0.92220	0.92364	0.92507	0.92647	0.92785	0.92922	0.93056	0.93189
1.5	0.93319	0.93448	0.93574	0.93699	0.93822	0.93943	0.94062	0.94179	0.94295	0.94408
1.6	0.94520	0.94630	0.94738	0.94845	0.94950	0.95053	0.95154	0.95254	0.95352	0.95449
1.7	0.95543	0.95637	0.95728	0.95818	0.95907	0.95994	0.96080	0.96164	0.96246	0.96327
1.8	0.96407	0.96485	0.96562	0.96638	0.96712	0.96784	0.96856	0.96926	0.96995	0.97062
1.9	0.97128	0.97193	0.97257	0.97320	0.97381	0.97441	0.97500	0.97558	0.97615	0.97670
2.0	0.97725	0.97778	0.97831	0.97882	0.97932	0.97982	0.98030	0.98077	0.98124	0.98169
2.1	0.98214	0.98257	0.98300	0.98341	0.98382	0.98422	0.98461	0.98500	0.98537	0.98574
2.2	0.98610	0.98645	0.98679	0.98713	0.98745	0.98778	0.98809	0.98840	0.98870	0.98899
2.3	0.98928	0.98956	0.98983	0.99010	0.99036	0.99061	0.99086	0.99111	0.99134	0.99158
2.4	0.99180	0.99202	0.99224	0.99245	0.99266	0.99286	0.99305	0.99324	0.99343	0.99361
2.5	0.99379	0.99396	0.99413	0.99430	0.99446	0.99461	0.99477	0.99492	0.99506	0.99520
2.6	0.99534	0.99547	0.99560	0.99573	0.99585	0.99598	0.99609	0.99621	0.99632	0.99643
2.7	0.99653	0.99664	0.99674	0.99683	0.99693	0.99702	0.99711	0.99720	0.99728	0.99736

2.8	0.99744	0.99752	0.99760	0.99767	0.99774	0.99781	0.99788	0.99795	0.99801	0.99807
2.9	0.99813	0.99819	0.99825	0.99831	0.99836	0.99841	0.99846	0.99851	0.99856	0.99861
3.0	0.99865	0.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99896	0.99900
3.1	0.99903	0.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
3.2	0.99931	0.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950
3.3	0.99952	0.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
3.4	0.99966	0.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
3.5	0.99977	0.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983
3.6	0.99984	0.99985	0.99985	0.99986	0.99986	0.99987	0.99987	0.99988	0.99988	0.99989
3.7	0.99989	0.99990	0.99990	0.99990	0.99991	0.99991	0.99992	0.99992	0.99992	0.99992
3.8	0.99993	0.99993	0.99993	0.99994	0.99994	0.99994	0.99994	0.99995	0.99995	0.99995
3.9	0.99995	0.99995	0.99996	0.99996	0.99996	0.99996	0.99996	0.99996	0.99997	0.99997
4.0	0.99997	0.99997	0.99997	0.99997	0.99997	0.99997	0.99998	0.99998	0.99998	0.99998