DIPLOMA WINTER 2008 EXAMINATION

FINANCIAL DERIVATIVES

DATE OF EXAM Thursday 4 December 2008

3 HOURS 2.00 pm – 5.00 pm

RUBRIC SECTION A - ***ALL*** questions in this section are to be answered

SECTION B
SECTION C
} Answer FOUR questions in total from Sections B and C, at least TWO questions from Section B and ONE from Section C. The remaining question may be from EITHER Section.

Candidates are reminded that no marks will be awarded for illegible work

NOTES TO CANDIDATES

1. Please insert your Candidate Number on the cover of your Answer Book. *Do not insert your name.*
2. Show *all* workings in your Answer Book.
3. Candidates may attempt the sections in any order. Please indicate clearly in your Answer Book which questions you are answering.
4. Please insert in the box provided on the cover of your Answer Book the numbers of the questions you have attempted in the order in which they appear in the Answer Book.
5. You may use the calculator provided or one approved by the Securities & Investment Institute.
6. You must hand your Answer Book to an invigilator before you leave the Examination Hall. *Failure to do so will result in disqualification.*
7. The decision of the Securities & Investment Institute is final and no correspondence will be entered into concerning the grade awarded.
8. Once submitted, the examination scripts become the property of the Securities & Investment Institute and will not be returned to candidates.

PLEASE TURN OVER WHEN INSTRUCTED

SECTION A TOTAL 20 MARKS

Answer ALL questions in this section

1 Give a brief description of the behaviour of the delta and gamma of an up and out (knockout) European call option. Delta and gamma diagrams may be helpful. *(4 marks)*

2 You own a European call option on a non-dividend paying stock with a strike of 90. The current price of the stock is 100, and you assess the annual volatility of the stock as 20%. Assuming the delta and gamma of the option are 0.823 and 0.019 respectively, what is the Value at Risk (VAR) for the option over a two week time horizon at a 95% one-sided confidence interval? *(4 marks)*

3 Calculate the probability of exercise within the Black-Scholes framework for a three month 2.5% out of the money European call option on the FTSE-100 index. Assume the following inputs:

INDEX LEVEL	4000
3-MONTH INTEREST RATE (CONTINUOUSLY COMPOUNDED)	4%
DIVIDEND YIELD (CONTINUOUSLY COMPOUNDED)	2.5%
ANNUAL VOLATILITY	25%

(4 marks)

4 Determine the net cash flow from the point of view of an investor who has entered into a $100 million notional principal equity swap with a bank, where the bank will pay the total return on the S+P 500 index every six months and the investor pays 6-month Libor.

The payment date is 15 November 2008. The S+P 500 index on 15 May was 1423 and 6-month Libor was 2.95%. Assume the S+P 500 dividend yield on a 365 day year basis is 0.50% per annum for the period, and the final value of the index on 15 November 2008 is 1050. *(4 marks)*

5 It is October 27 and you own £20,000,000 of the UK Treasury 4.5% 7/3/19 Gilt. Estimate how many long December Gilt futures you will require as a hedge through to the expiration date of the contract on December 31. The following information is available for the Gilt held and the Cheapest to Deliver gilt against the futures contract, which is the UK Treasury 8% 7/6/21 Gilt.

	GILT	**PRICE**	**YIELD**	**CONVERSION FACTOR**	**BASIS POINT VALUE**
8%	7/6/21	132.74	4.557	1.143056	0.11432
4.5%	7/3/19	99.99	4.502	6.8862197	0.08216

(4 marks)

SECTION B

Answer FOUR questions in total from Sections B and C,
TWO questions from Section B and ONE from Section C.
The remaining question may be from EITHER Section.
All questions in these sections carry 20 marks.

6 You are provided with the following information for two non-dividend paying stocks:

STOCK	PRICE	ANNUAL VOLATILITY
ABC	1000	25%
XYZ	975	30%

The returns on the two stocks are estimated to be 50% correlated, and the annual rate of interest is 5% continuously compounded.

a) Estimate the price of an option giving you the right to exchange stock XYZ for stock ABC in one year's time. *(6 marks)*

b) What is the price of a best of share receipt giving you the right to take delivery of a share of either ABC or XYZ in one year's time, and how does it relate to the price of the option in a)? *(4 marks)*

c) Analyse the sensitivity of the option price in a) to a 0.05 change in the correlation coefficient. *(6 marks)*

d) Discuss how you might set about hedging such correlation risks. *(4 marks)*

7 You are a corporate treasurer who desires to hedge a £100,000,000 6-month lending exposure commencing on April 15. The current date is February 20, and it is not a leap year. You observe the following three month sterling (short sterling) interest rate futures prices. The current 3-month spot Libor rate is 4.00%.

MONTH	MAR	JUN	SEP	DEC	MAR	JUN
PRICE	96.20	96.10	95.80	95.50	95.40	94.35
DELIVERY DATE	18/3	17/6	16/9	16/12	17/3	16/6

(Assume settlement is same day and that dates are business days)

a) Determine the effective lending rate you can lock in. *(6 marks)*

b) Estimate the best hedge with short sterling futures to offset the exposure and minimise interest rate and basis risk. *(10 marks)*

c) Discuss any reasons why you believe the hedge you have designed may be imperfect in practice. *(4 marks)*

8 You are provided with the following market information for the UK equity market:

EQUITY INDEX LEVEL	4000
INDEX ANNUAL VOLATILITY	20%
EQUITY INDEX YIELD	2% (continuously compounded)

(Assume that interest rates in the UK are flat at 5% per annum (continuously compounded))

a) Estimate the price of a 2.5% in the money three month call option using a three-step binomial model. *(6 marks)*

b) Reprice the option on the basis of an equity risk premium of 4% per annum. *(4 marks)*

c) Demonstrate how a delta hedge of the option performs under the assumption of no risk premium and a 4% risk premium. Assume the index rises in the first period, falls in the second period, and rises again in the third period. *(10 marks)*

9 Provide concise but detailed discussions of the following statements concerning financial derivatives.

a) Synthetic CDO (collateralised debt obligation) investments are significantly more risky than the equivalent conventional CDO investments for an investor. *(6 marks)*

b) There should be a systematic relationship between the prices of basic asset swaps and credit default swaps. *(7 marks)*

c) Pricing Libor in arrears and constant maturity swaps based simply on the conventional discount function gives rise to arbitrage opportunities. *(7 marks)*

10 You are provided with the following discount factors for US dollars and Euros:

PERIOD	**USD**	**EURO**
1-YEAR	0.980000	0.970875
2-YEAR	0.959300	0.936200
3-YEAR	0.935600	0.902210
4-YEAR	0.915950	0.872620
5-YEAR	0.889260	0.839250

You are informed that the current FX sport rate is USD 1.25 to the Euro, and that USD/Euro basis swaps can be done at spreads of -2/+2 basis points.

a) Determine the fair fixed rate on a three year maturity CMS (constant maturity swap) based on the 2-year swap rate. *(6 marks)*

b) Estimate the fair fixed US dollar rate to receive in exchange for paying a fixed Euro rate of 3.50% for four years. *(7 marks)*

c) Show how a US financial institution receiving USD and paying Euro in the swap analysed in b) could hedge out the interest rate and FX risks. *(7 marks)*

11 A client asks you to analyse a structured product where, at the end of one year, you will be required to buy 5,000 shares of a company at a price of 95, and a further 10,000 shares at 95 if the prevailing price in one year is below 95. You obtain the following information concerning the stock:

ANNUAL VOLATILITY	30%
ANNUAL DIVIDEND YIELD (continuously compounded)	2.5%
ONE YEAR INTEREST RATE (continuously compounded)	5.0%
CURRENT STOCK PRICE	100

a) Analyse the structure of the product. *(4 marks)*

b) Determine a fair price for the product. *(10 marks)*

c) Discuss how you would set about hedging the product risks from the point of view of the issuer. *(6 marks)*

SECTION C

All questions carry 20 marks.

12 Discuss the impact of credit default swaps, and associated credit structures, on the origins and development of the 2007 – 2008 credit crisis. *(20 marks)*

13 Equity option markets in the second half of 2008 have been characterised by doubling or trebling of implied volatilities, major jumps and discontinuities in equity prices, very illiquid markets, and huge and rapid swings in option prices. Discuss the issues involved in the risk management of equity derivatives books in such circumstances. *(20 marks)*

14 Volatility and variance swaps, and futures and options based on underlying volatility indices, have been a major growth area of derivatives in recent years. Describe the various types of volatility products, and their potential uses for financial institutions and corporates. *(20 marks)*

15 Direct short selling of equities by hedge funds and others has become a controversial practice recently. Discuss how different forms of derivative could be used to duplicate such short selling strategies. *(20 marks)*

TABLE FOR $N(x)$ when $x \leq 0$

This table shows values of $N(x)$ for $x \leq 0$. The table should be used with interpolation. For example

$$\begin{aligned} N(-0.1234) &= N(-0.12) - 0.34[N(-0.12) - N(-0.13)] \\ &= 0.4522 - 0.34 \times (0.4522 - 0.4483) \\ &= 0.4509 \end{aligned}$$

x	.00	.01	.02	.03	.04	.05	.06	.07	.08	. 09
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-3.0	0.0014	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
-3.6	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-4.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE FOR $N(x)$ when $x \geq 0$

This table shows values of $N(x)$ for $x \geq 0$. The table should be used with interpolation. For example

$$\begin{aligned} N(0.6278) &= N(0.62) + 0.78[N(0.63) - N(0.62)] \\ &= 0.7324 + 0.78 \times (0.7357 - 0.7324) \\ &= 0.7350 \end{aligned}$$

x	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9986	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000