CHARTERED INSTITUTE FOR SECURITIES & INVESTMENT

DIPLOMA WINTER 2010 EXAMINATION

FINANCIAL DERIVATIVES

DATE OF EXAM Thursday 9 December 2010

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 Chartered Institute for Securities & Investment.
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. Once submitted, the examination scripts become the property of the Chartered Institute for Securities & Investment and will not be returned to candidates.

PLEASE TURN OVER WHEN INSTRUCTED

SECTION A TOTAL 20 MARKS

Answer ALL questions in this section

1 You own a European call option on a non-dividend paying stock with a strike of 95. 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 0.7000 and 0.0150 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)*

2 You are provided with the following information for the December 2011 Treasury Bond future contract.

Cheapest to Deliver Bond 6.75% 15/8/2026

8/11/10 Clean Price (Settlement 9/11/10) = 141-17

Dirty Price = 143.1400

March Futures Price = 130-22

CTD Conversion Factor = 1.0750

Actual Repo Rate = 0.137% Per Annum

Implied Repo Rate = -0.428% Per Annum

a) Estimate the gross basis for the bond. *(2 marks)*

b) Estimate the net basis for the bond. *(2 marks)*

3 You observe the following set of 3-month call option prices. Determine the maximum arbitrage profit that can be produced with this set of option prices.

STRIKE PRICE	515	520	525	530	535
OPTION PREMIUM	165	137	106	85	66

(4 marks)

4 Determine the fair value of a digital European option which will pay 100 if the FTSE-100 index is at or above 6000 in six months time and zero if it is below. Assume the current level of the index is 5750, the six-month interest rate is 0.5%, the index dividend yield is 1.5%, and the index volatility is 20%. The interest rate and dividend yield are provided on a continuously compounded basis. *(4 marks)*

5 For the Black Derman Toy (BDT) and Hull White (HW) interest rate derivative pricing models, answer the following questions:

a) What assumptions are made about the distribution of interest rate changes in the two models? *(2 marks)*

b) Would you expect the models to overprice or underprice out of the money bond options? State why. *(2 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 observe the following discount function and interest rates for sterling:

	PAR RATE	ZERO RATE	DISCOUNT FACTOR
12-MONTH	1.0000	1.0000	0.990099
24-MONTH	1.5000	1.5038	0.985185
36-MONTH	2.0000	2.0239	0.980163

You have the following anticipated cash flows:

IN 15-MONTHS TIME	+£20,000,000
IN 30-MONTHS TIME	-£15,000,000

a) Calculate the current present value of your book assuming linear interpolation of the zero interest rates. *(4 marks)*

b) Estimate the book's equivalent cash flows at 12, 24 and 36 months. *(6 marks)*

c) Show how the risks of those equivalent cash flows can be eliminated by appropriate positions in par swaps. *(6 marks)*

d) Comment on any residual interest rate risks that remain. *(4 marks)*

7 You own the following equity portfolio:

STOCK	NUMBER OF SHARES	SHARE PRICE (USD)	MARKET VALUE (USD)	BETA	SPECIFIC RISK	TOTAL RISK
ABC	100,000	50	5,000,000	1.40	6%	28.64%
DEF	125,000	75	9,375,000	0.75	10%	18.03%
XYZ	150,000	80	12,000,000	1.25	12%	27.73%

The annual market risk or volatility is estimated at 20% per annum. The current date is August 10 and the stock index is currently trading at 1000. The September stock index futures contract (delivery date September 17) is trading at 1005. The point value of the futures contracts is USD 250.

a) Calculate the number of futures contracts required for a full hedge of the equity portfolio through to the delivery date of September 17. *(4 marks)*

b) What locked-in value of the portfolio do you anticipate at the delivery date? *(4 marks)*

c) Estimate the Value at Risk (VAR) for the hedged equity portfolio at a 95% confidence interval over the period August 10 – September 17. *(6 marks)*

d) At the delivery date of September 17, the following stock prices are observed:

STOCK INDEX	900
ABC	USD 45
DEF	USD 68
XYZ	USD 70

Analyse the results of the futures hedge, and explain the differences between the anticipated and actual hedge performance. Compare that difference with your VAR estimate. *(6 marks)*

8 Provide a brief considered assessment of the following statements regarding derivatives and derivative markets:

a) Replication of derivatives based on multiple underlying assets represents a viable and economic approach to international asset allocation for a large portfolio. *(7 marks)*

b) A symmetric hedging strategy may have more favourable risk characteristics than a delta hedging strategy for a portfolio of out of the money put options where the underlying asset returns are subject to jumps. *(7 marks)*

c) Reverse Knock In Options provide a suitable mechanism for crash insurance for equity portfolios. *(6 marks)*

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

EQUITY INDEX LEVEL = 5500

INDEX VOLATILITY = 20% PER ANNUM

EQUITY INDEX YIELD = 2% (CONTINUOUSLY COMPOUNDED)

Assume interest rates in the UK are flat at 1% (continuously compounded).

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

b) Demonstrate the results of a delta hedge of the put option if the market falls in the first period, rises in the second period, and falls again in the third period. *(10 marks)*

c) Explain the risks of delta hedging strategies in practice. *(4 marks)*

10 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	25%
ANNUAL DIVIDEND YIELD (continuously compounded)	1.5%
ONE YEAR INTEREST RATE (continuously compounded)	2.0%
CURRENT STOCK PRICE	100

a) Explain 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)*

11 You are provided with the following set of option prices on a non-dividend paying stock. The current date is November 15 and all the options mature on February 15 next year. The sterling three-month interest rate is 2%, and the price of the stock is 1000.

STRIKE	PUT	CALL
950	25	80.5
975	34	72
1000	44	56
1025	56	42
1050	68	31

a) Identify the various types of arbitrage trade, if any, that exist with this set of option prices, and illustrate the most profitable trade for each type of arbitrage. *(14 marks)*

b) Discuss the practical difficulties of implementing these types of trades in actual traded option markets. *(6 marks)*

SECTION C

All questions carry 20 marks.

12 You observe a new structured product which has a 5 ½ year life, and which will pay out four times any rise in the FTSE-100 index from its original level up to a maximum gain of 100%. Even if the index declines, the product will pay all the original investment back unless the FTSE-100 index declines by more than 50% during the life of the product. If the 50% level is breached on any daily close, the investor's capital will be reduced by the percentage decline, if any, in the index over the product's life. The final value of the index will be measured as the average of the closing daily index values in the last three months of the product. Assuming the arranger of the product wishes to cover all the risks in the product, explain what exposures it will need to cover. Also, explain the risks faced by an investor in the product.

13 Discuss the advantages and disadvantages of the major approaches you are aware of for the estimation of Value at Risk (VAR) for derivatives portfolios. Do you believe the setting of limits on VAR is sufficient to control the market risks of a complex derivatives portfolio in an investment bank?

14 Discuss the implications of the credit crisis of 2008-09 for the valuation and modelling approaches most often used for different types of credit derivatives.

15 It was claimed apparently that the published returns for the funds operated by Mr Madoff were based on a so-called split-strike conversion strategy. Explain the basis of such strategies, and whether they could reasonably produce such a pattern of low volatility/high returns in practice.

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