

KASNEB

CIFA PART III SECTION 6

DERIVATIVES ANALYSIS

FRIDAY: 26 May 2017.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

- (a) Argue three cases for the existence of derivatives markets in your country. (6 marks)
- (b) Justify why a portfolio manager would prefer to create a put option synthetically instead of buying it in the market. (2 marks)
- (c) Differentiate between "strip hedge" and "stack hedge" as used in derivatives trading. (2 marks)
- (d) A non-dividend paying stock has a call option. The price of the stock is Sh.49. The strike price is Sh.50. The risk free-rate is 5%. The time-to-maturity is 0.3846 years and the volatility is 20%. There are 365 days in a year.

Required:

- (i) The option's theta. (4 marks)
- (ii) The change in the option's delta when price increases by 10%. (2 marks)
- (iii) The change in the option's value when volatility increases to 21% from 20%. (2 marks)
- (iv) The change in the option's value when risk-free rate increases to 6% from 5%. (2 marks)

Hint:

$$\text{Option theta} = \frac{-S_0 N'(d_1) \sigma}{2\sqrt{T}} - rKe^{-rT} N(d_2)$$

$$\text{Option gamma} = \frac{N'(d_1)}{S_0 \sigma \sqrt{T}}$$

$$\text{Option vega} = S_0 \sqrt{T} N(d_1)$$

$$\text{Option rho} = Ke^{-rT} N(d_2)$$

$$\text{Where: } N'(d_1) = 0.40112$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

(Total: 20 marks)

QUESTION TWO

- (a) Discuss three factors that could affect an option's time value. (3 marks)
- (b) (i) Explain the term "interest rate cap" in relation to derivatives markets. (1 mark)
- (ii) An institution has issued a floating rate note for which the interest rate is reset after every 90 days, using the prevailing 90-day spot interest rate. The next reset date is due in 42 days' time. The institution has purchased an interest rate cap with a maturity of 42 days and cap rate of 5.50%. The amount involved is Sh.10 million. The 90-day spot interest rate at 42 days is 5.80%.

Required:

The pay-off to the cap.

(2 marks)

- (c) Andrew Makori is a global equity manager who manages a Sh.95 million large capitalisation United States (US) equity portfolio and he is currently forecasting that equity markets will decline soon. Andrew prefers to avoid the transactions cost of making sales but intends to hedge Sh.15 million of the portfolio's current value using Standard and Poor (S & P) 500 index futures. Andrew realises that his portfolio will not track the S & P 500 index exactly. He decides to perform a regression analysis on his actual portfolio returns versus the S & P futures returns over the past year. This regression analysis will indicate a risk minimising beta of 0.88 with a coefficient of determination (R^2) of 0.92.

Futures Contract Data

S & P 500 futures price	Sh.1,000
S & P 500 Index	999
S & P 500 Index multiplier	250

Required:

- (i) The number of futures contracts required to hedge Sh.15 million of the equity manager's portfolio. (3 marks)
- (ii) Advise Andrew Makori on three alternative methods that he should use to replicate the futures strategy. (6 marks)
- (d) A box spread consists of options with exercise prices of Sh.75 and Sh.85. The call prices are Sh.16.02 and Sh.12.28 for exercise prices of Sh.75 and Sh.85 respectively. The put prices are Sh.9.72 and Sh.15.18 for exercise prices of Sh.75 and Sh.85 respectively. The options expire in six months and the discrete risk free-rate is 5.13%.

Required:

- (i) The profit of the box spread at expiration. (2 marks)
- (ii) Show that this box spread is priced such that an attractive opportunity is available. (3 marks)

(Total: 20 marks)

QUESTION THREE

- (a) Explain two uses of index futures. (2 marks)
- (b) Evaluate three advantages of interest rate collar. (3 marks)
- (c) Diamond Financial Services (DFS) offers fixed income portfolio management services to institutional investors. DFS would like to execute a duration changing strategy for a Sh.150 million bond portfolio of a particular client. This portfolio has a modified duration of 8. DFS plans to change the modified duration to 6 by using a futures contract priced at Sh.150,000 which has an implied modified duration of 7. The yield beta is 1.5. After one year, the yield on the bond has decreased by 30 basis points. The bond portfolio increases in value by 1.5% and the futures price increases to Sh.152,000.

Required:

The overall gain on the portfolio. (3 marks)

- (d) Kemeloi Capital is a money management firm that specialises in turning the idle cash of its clients into equity index positions at very low cost. The firm has a new client with Sh.500 million of cash that it would like to invest in the small cap equity sector. Kemeloi Capital would like to construct the position using a futures contract on a small cap index.

Additional information:

1. The futures price is 1,500.
2. The multiplier is 100.
3. The contract expires in six months.
4. The underlying small cap index has a dividend yield of 1%.
5. The risk free rate is 3% per annum.

Required:

Determine how the cash could be equitised using a futures contract. (3 marks)

- (e) Melly Odhiambo, a corporate treasurer at Suneka Ltd. needs to hedge the risk of the interest rate on a future transaction. The risk is associated with the rate on the 180-day London Inter-bank Offer Rate (LIBOR) in 30 days. The relevant term structure of LIBOR is given as follows:

30 day LIBOR	5.75%
210 day LIBOR	6.15%

20 days later, interest rates are expected to move significantly downward to the following:

10 day LIBOR	5.45%
190 day LIBOR	5.95%

On the expiration day, 180 day LIBOR is expected to be 5.72%. Melly Odhiambo decides to long this forward rate agreement (FRA) for a notional principal of Sh.20 million.

Required:

- (i) Compute the market value of the FRA, 20 days later. (2 marks)
- (ii) Calculate the payment to be made to or by the company so as to settle the FRA contract on its expiration. (2 marks)
- (f) John Omulundo, an investment manager, holds an asset portfolio with a total market value of Sh.105 million. The allocation of the portfolio is as follows:
1. Sh.65 million is invested in a broadly diversified portfolio of domestic stocks.
 2. Sh.40 million is invested in the stocks of Jimbo Corporation.

The investment manager wishes to reduce exposure to Jimbo Corporation stocks by Sh.30 million. The manager plans to achieve this objective by entering into a three-year equity swap using the Standard and Poor (S & P) 500 market index.

Assume that settlement is made at the end of each year and the return on S & P 500 market index is -3 percent.

Required:

- (i) Explain the structure of the equity swap. (2 marks)
- (ii) Calculate the net cash flow for the swap at the end of the year. (3 marks)
- (Total: 20 marks)**

QUESTION FOUR

- (a) Although there is a clear similarity between forward contracts and futures contracts, critical distinctions nonetheless exist between the two.

Required:

In relation to the above statement, explain five differences between forward contracts and futures contracts. (5 marks)

- (b) A long forward contract on a non-dividend paying stock was entered some time ago. It has 6 months to maturity. The risk-free rate of interest with continuous compounding is 10% per annum. The stock price is Sh.25 and the delivery price is Sh.24.

Required:

The value of the forward contract. (3 marks)

- (c) A six-month European call option on the spot price of gold exists. The strike price is Sh.1,200. The six-month futures price of gold is Sh.1,240. The risk free-rate of interest is 5% per annum and the volatility of the futures price is 20%.

The option is the same as a six-month European option on the six-month futures price.

Required:

The value of the option. (4 marks)

- (d) A portfolio manager is entering into a two-year swap in which his firm will receive the rate of return on the Russell 2,000 index and will pay a fixed interest rate. The swap has annual payments. The fixed rate of the swap to be initiated is 4.99%. The Russell 2,000 index is at 757.09 at the beginning of the swap and the notional principal of the swap is Sh.100 million. One hundred days later, the Russell 2,000 index is at 723.86 and the term structure is presented below:

Term structure of LIBOR interest rates 100 days later

Days (T)	Lo (T)	Bo (T)
260	0.0442	0.9691
620	0.0499	0.9209

Note: Calculations are on a 360-day year basis.

Where, T = Time to expiration
 L0 (T) = LIBOR rate to time T
 B0 (T) = Discount factor of Sh.1 from time T to the present

Required:

The market value of the firm's position in the swap 100 days after the initiation of the swap. (4 marks)

- (e) Silvia Makena is concerned about the risk level of a client's equity portfolio. The client has 60% of this portfolio invested in two equity positions: Hope Industries and Hummer Securities.

Stock	Shares	Stock price (Sh.)
Hope Industries	375,000	26.20
Hummer Securities	300,000	34.00

Silvia investigates whether a privately negotiated equity swap could be used to reduce the risk of the Hope Industries and Hummer Securities holding. A swap dealer offers Silvia the following two options:

- The dealer will receive the return on 250,000 shares of Hope Industries and 200,000 shares of Hummer Securities from client.
- The dealer will pay the client the return on an equivalent amount on the Russell 3,000 index.

The dealer demonstrates the quarterly cash flows of this transaction under the assumptions that Hope Industries is up 2%, Hummer Securities is up 4% and the Russell 3,000 index is up 5% for the quarter.

Required:

The payoff to the client in the equity swap. (4 marks)

(Total: 20 marks)

QUESTION FIVE

- (a) Kansanga Ltd., a Ugandan company exports products to Kenya. Kansanga Ltd. has just closed a sale worth Kenya shillings (KES) 200,000,000. The amount will be received in two months. Since it will be paid in KES, the Ugandan company bears the exchange rate risk. In order to hedge this risk, Kansanga Ltd. intends to use a forward contract that is priced at Uganda shillings (UGX).

$$1 \text{ KES} = 28,544 \text{ UGX}$$

Required:

- (i) Illustrate how the company would go about constructing the hedge. (3 marks)
- (ii) Explain what happens when the forward contract expires in two months. (1 mark)
- (b) Emase Omanyala, a Certified Investment and Financial Analyst (CIFA), is a risk manager at Baraka Asset Managers (BAM). Emase works with individual clients to manage their investment portfolios. One client, John Mwajuma, is worried about how short-term market fluctuations over the next three months might impact his equity position in Mnazi Moja Corporation. While John is concerned about short-term downside price movements, he wants to remain with investments in Mnazi Moja Corporation shares as he remains positive about its long-term performance. John has asked Emase to recommend an option strategy that would keep him with investments in Mnazi Moja Corporation shares while protecting against a short-term price decline.

Emase gathers the following information to explore various strategies to address John's concerns:

Table 1:

Mnazi Moja Corporation European Options				
Exercise price (Sh.)	Market call price (Sh.)	Call delta	Market put price (Sh.)	Put delta
55.00	12.83	4.7	0.24	-16.7
65.00	3.65	12.0	1.34	-16.9
67.50	1.99	16.5	2.26	-15.3
70.00	0.91	22.2	3.70	-12.9
80.00	0.03	35.8	12.95	-5.0

Additional information:

1. Mnazi Moja Corporation's current share price is Sh.67.79.
2. Each option has 106 days remaining until expiration.

Another client, Samuel Momanyi, is a trader who does not currently own shares of Mnazi Moja Corporation. Samuel has told Emase that he believes that Mnazi Moja Corporation shares will experience a large move in price after the upcoming quarterly earnings release in two weeks. However, Samuel tells Emase that he is unsure of the direction that the stock will move. Samuel asks Emase to recommend an option strategy that would allow him to profit should the share price move in either direction.

A third client, Anthony Murungi does not currently own Mnazi Moja shares and has asked Emase to explain the profit potential of three strategies using options in Mnazi Moja Corporation: a bull call spread, a strangle and a butterfly spread. In addition, Anthony asks Emase to explain the gamma of a call option. In response, Emase prepares a memo to be shared with Anthony that provides analysis on three option strategies:

- Strategy 1: A strangle position at the Sh.67.50 strike option.
Strategy 2: A bull call spread using the Sh.65 and Sh.70 strike options.
Strategy 3: A butterfly spread using the Sh.65, Sh.67 and Sh.70 strike call options.

Required:

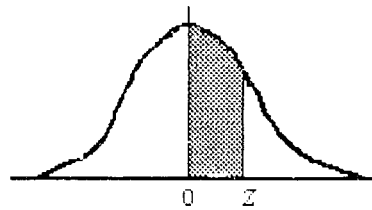
- (i) Citing appropriate reason(s), explain the option strategy that Emase should recommend to John Mwajuma. (2 marks)
- (ii) Citing appropriate reason(s), explain the option strategy that Emase should recommend to Samuel Momanyi. (2 marks)
- (iii) Based on the information given above on Mnazi Moja Corporation's European options, estimate the share price at expiration at which strategy 1 would be profitable. (3 marks)
- (iv) In relation to the data given in Table 1 above, estimate the maximum profit, on a per share basis, from investing in strategy 2. (3 marks)
- (v) Using the information given in Table 1 above, and assuming that the market price of Mnazi Moja Corporation's shares at expiration is Sh.66, estimate the profit or loss, on a per share basis, from investing in strategy 3. (3 marks)
- (vi) In the context of the data given in Table 1 above, determine the strike price of the call option with the largest gamma. (3 marks)

(Total: 20 marks)

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z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000