

# King's College London

UNIVERSITY OF LONDON

This paper is part of an examination of the College counting towards the award of a degree. Examinations are governed by the College Regulations under the authority of the Academic Board.

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**Candidate No:** ..... **Desk No:** .....

MSC EXAMINATION

CMFM03 FINANCIAL MARKETS (2010-2011)

SUMMER 2011

TIME ALLOWED: TWO HOURS

FULL MARKS WILL BE AWARDED FOR COMPLETE ANSWERS TO FOUR QUESTIONS. ONLY THE BEST FOUR QUESTIONS WILL COUNT TOWARDS GRADES A AND B, BUT CREDIT WILL BE GIVEN FOR ALL WORK DONE FOR LOWER GRADES.

WITHIN A GIVEN QUESTION, THE RELATIVE WEIGHTS OF THE DIFFERENT PARTS ARE INDICATED BY A PERCENTAGE FIGURE.

IMPORTANT, PLEASE READ: In the case of numerical answers, a concise numerical formula will suffice. For example,  $x = \frac{1}{2}(3 + 8)$  instead of  $x = 5.5$  will receive full marks.

NO CALCULATORS ARE PERMITTED.

**TURN OVER WHEN INSTRUCTED**

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1. This is a question about interest rates, bond pricing and floating rate notes. Assume that the 6-month, 12-month, 18-month and 24-month zero rates are  $r_0^{6m,6m} = 2\%$ ,  $r_0^{1y,6m} = 2.25\%$ ,  $r_0^{18m,6m} = 2.5\%$  and  $r_0^{2y,6m} = 5\%$  respectively, with semiannual compounding.
- (a) What is the one-year rate with (a) annual compounding and (b) quarterly compounding? [20%]
  - (b) What is the forward rate for the 6-month period beginning in 12 months? [30%]
  - (c) What is the value of the FRA that promises to pay 6% (compounded semiannually) on a principal of \$5 million for the 6-month period starting in 18 months? [30%]
  - (d) What equation solves the par yield with semiannual compounding of a 2-year bond paying semiannual coupons? [20%]

**End of Question 1**

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2. These are questions about swaps. Assume that the term structure of continuously compounded zero rates for the USD and the GBP are both flat and are equal to  $r_{USD} = 2\%$  and  $r_{GBP} = 3\%$ , respectively. The current value of the exchange rate is  $X = 1.60 \frac{GBP}{USD}$ . Also assume that credit risk is negligible.
- (a) A bank agreed to pay  $r_s = 5\%USD$  per annum and to receive 3-month LIBOR USD in return on a notional principal of \$10M USD with quarterly payments. The swap has a remaining life of 14 months. The 3-month LIBOR rate 1 month ago was 7%. What is the present value of the swap? [30%]
  - (b) Under the term of the swap agreement, a bank pays USD LIBOR semiannually on a nominal of 10M USD and receives GBP LIBOR semiannually on a nominal of 5M GBP. The swap will last 2 more years and at maturity nominals are exchanged. What is the PV in USD of this swap? [35%]
  - (c) Consider a swap paying 3% in USD semiannually on a nominal of 15M USD and receiving GBP LIBOR quarterly on a nominal of 10M GBP. The swap matures in 2 years and at maturity nominals are exchanged. What is the PV in USD of this swap? [35%]

**End of Question 2**

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3. This is a question about European options.
- (a) Consider three call options of the same maturity and strikes  $K_1, K_2, K_3$  respectively, such that  $K_1 < K_2 < K_3$  and  $K_2 - K_1 = K_3 - K_2$ . Can the price of the option of strike  $K_2$  be strictly greater than the average between the prices of the options of strikes  $K_1$  and  $K_3$ ? [25%]
  - (b) Same question as in (a) but assuming we have three put options. [25%]
  - (c) The price of a European call maturing in 6 months with strike \$30 is \$2. The underlying stock price is \$29. A dividend of \$0.50 is expected in 2 months and again in 5 months. Assume also that continuously compounded interest rates are constant at 2%. What is the price of a European put maturing in 6 months struck at \$30? [25%]
  - (d) Consider a European option on the underlying  $S$  of maturity in 1 year and payoff  $S^2/100$ . Suppose the spot price is  $S_0 = \$10$ . Suggest an approximate replication strategy for this derivative by means of positions in a bond maturing in one year, the stock itself and several call options. Can one make use of put options instead of call options for replication purposes? [25%]

**End of Question 3**

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4. This is a question about foreign exchange options in the Black-Scholes model. Consider a stock whose spot price is  $S_0 = \$10$  and whose volatility is  $\sigma = 20\%$ . Also assume that the short rate is constant at  $r = 3\%$ .
- (a) Value a European option with payoff  $S^2/100$  and maturity in one year under the Black-Scholes model. [50%]
  - (b) Consider a European option with payoff  $(\frac{S}{10})^\alpha$  and maturity in one year. Compute the parameter  $\alpha$  so that this option is worth \$1. [50%]

**End of Question 4**

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5. This is a miscellaneous question.
- (a) Explain under what circumstances a bank is subject to credit risk when it negotiates two offsetting interest rate swaps. [20%]
  - (b) Assuming that there is no counterparty credit risk, explain why a physically settled swaption can be regarded as an option on a fixed rate annuity. [20%]
  - (c) Same question as (b) but in case there is counterparty credit risk. [20%]
  - (d) Derive a put-call parity relation for European swaptions. [20%]
  - (e) A company has an issue of executive stock warrants outstanding. Should dilution be taken into account in the valuation of these options? Explain. [20%]

**End of Question 5**

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