Certified International Investment Analyst

EXAMINATION II:

Fixed Income Valuation and Analysis

Derivatives Valuation and Analysis

Portfolio Management

Questions

Final Examination

March 2016

Question 1: Fixed Income Valuation and Analysis / Fixed Income Portfolio Management (56 points)

In your role as fund manager you are asked to make a valuation of a number of corporate bonds. Consider the following bonds (they are all "option-free" bonds):

Table 1:

- Bond A: Corporate bond issued by company X, senior unsecured bond, rating BBB, annual coupon 3% (paid semi-annually), expiry in 3 years, redemption price at 100.00 and YTM 2.75%.
- Bond B: Corporate bond issued by bank Y, senior guaranteed bond, rating AA, annual coupon 2% (paid annually), expiry in 5 years, redemption price at 100.00 and YTM 1.45%.
- Bond C: Corporate bond issued by bank Z, subordinated tier 2, rating BB, zero coupon bond, expiry in 7 years, redemption price at 100.00 and YTM 4.00%.

a) First analyze and comment on the different credit risk structures implied in the three bonds. Then sort them according to an increasing credit risk. (6 points)

b) Calculate the "relative yield spread" for bonds A and C relative to bond B. (3 points)

c) The market is quoting the swap spot curve (zero coupon rates), the bank Y guaranteed bonds credit spreads (flat curve for all the expiries) and bank Y zero coupons stripped from 100 notional of Bond B (with credit risk similar to guaranteed bonds) as follows:

Table 2:

Years	Swap spot curve	Credit spread	Bank Y stripped zero coupon bonds
1	0.50%	0.20%	1.982
2	0.75%	0.20%	1.961
3	0.95%	0.20%	1.930
4	1.15%	0.20%	1.887
5	1.26%	0.20%	94.861

Notes:
*assumed yield convention: 30/360 daycount-convention, annual compounding.
**the credit spread is meant as the number of basis points to add to the swap spot curve (parallel shift).
***the "Bank Y stripped zero coupon bonds" are listed present values respectively for coupon payments of 2 for the first four years and coupon + final repayment of 102 in the 5th year.

Verify whether the bond B fulfills the condition of static no-arbitrage compared to a series of bank Y zero coupon bonds stripped from 100 notional of Bond B (with guaranteed bonds similar credit risk). In case the no-arbitrage condition is not verified, indicate what trade it is necessary to implement in order to take a profit from this arbitrage for a nominal amount of EUR 100 million. Show your calculations. Do not consider transaction costs. (8 points)

d) The head of investments asks you to carry out the analysis of the base rates risk volatility (risk-free or quasi risk-free rates) for the bonds of Table 1.

d1) Complete Table 3 calculating the missing values. Show your calculations.

Table 3:

	Price	Duration	Convexity
Bond A	?	2.89	9.47
Bond B	102.634	?	27.679
Bond C	75.992	7	?

(8 points)

d2) For bond B calculate the relative price change (in %) following a yield curve parallel shift of +25 basis points, specifying both the price change due to the price duration only and also due to the price convexity. [Note: If you have not answered question d1) consider the duration of bond B as 4.75.] (6 points)

d3) Suppose you create an equally-weighted portfolio with the three bonds of Table 1. Calculate the portfolio duration and the portfolio convexity. Note: If you have not answered question d1) use the following data:

Table 4:

	Duration	Convexity
Bond A	2.70	9.50
Bond B	4.75	30.00
Bond C	7.00	50.00

(6 points)

d4) Because of the problems due to higher loan loss provisions, the market is forecasting a likely higher credit risk for the subordinated lower tier 2 debt instruments issued by bank Z in the next year. Three more subordinated lower tier 2 bonds are quoted in the market in addition to bond C (Table1):

Table 5:

- Bond D: Corporate bond issued by bank Z, subordinated tier 2, rating BB, zero coupon bond, expiry in 7 years, redemption price at 100.00. The bond is a puttable bond that can be exercised by the bondholder in one year from now. The relevant yields are the following: Yield to put 1.00%; Yield to maturity 4.00%.
- Bond E: Corporate bond issued by bank Z, subordinated tier 2, rating BB, zero coupon bond, expiry in 7 years, redemption price at 100.00. The bond is a callable bond that can be exercised by the issuer in one year from now. The relevant yields are the following: Yield to call 1.00%; Yield to maturity 4.00%.
- Bond F: Corporate bond issued by bank Z, subordinated tier 2, rating BB, zero coupon bond, expiring in 1 year, redemption price at 100.00 and Yield to maturity 1%.

Forecasting a likely higher short term credit spread volatility for bank Z subordinated lower tier 2 bonds (in a period of time of about 1 year), indicate which bond among C, D,

E and F would be better to choose in order to protect your investment from the short term credit spread volatility, with a constraint to maintain a medium/long term investment horizon. Explain your answer. No calculations are needed. (5 points)

e) You consider implementing trading strategies on generic European government bonds. The two trading strategies considered are the following:

- Duration trade
- Convexity trade

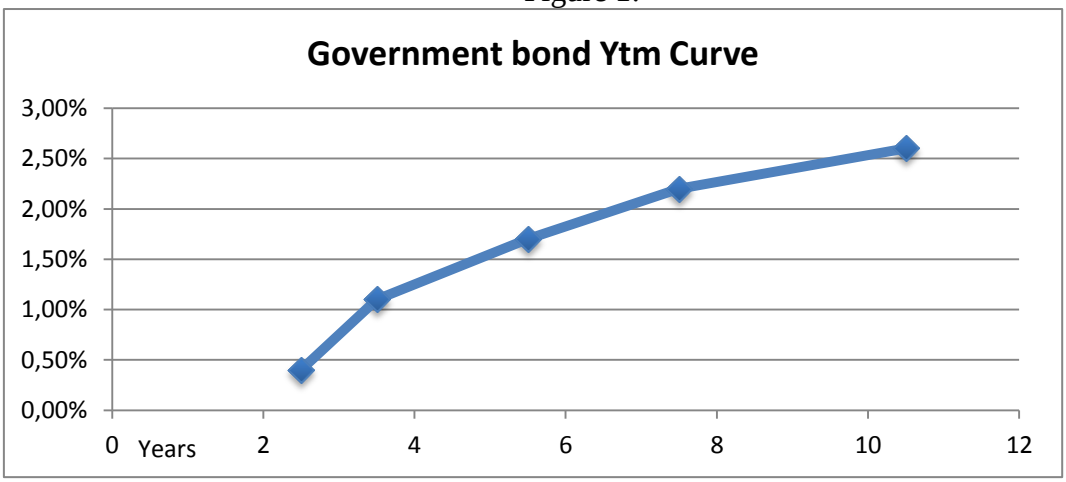
For the sake of simplicity, the generic European government bonds curve is made by the following benchmarks:

Table 6:

	Price	YTM	Mod. Duration
Bond G 4.00% 2/2017 (>2yrs)	108.70	0.40%	2.33
Bond H 4.5% 2/2018 (>3yrs)	111.42	1.10%	3.20
Bond I 4.50% 2/2020 (>5yrs)	114.50	1.70%	4.85
Bond J 5.00% 3/2022 (>7yrs)	119.40	2.20%	6.22
Bond K 5.00% 3/2025 (>10yrs)	122.10	2.60%	8.17

Notes:
*the Prices include the accrued interest (dirty prices).
** the YTM is calculated on annual compounding 30/360.

Figure 1:



e1) According to the last two years historical data about the YTM spread between 2 year and 10 year bonds, you forecast a likely flattening of the YTM curve. Supposing that you are not holding any position on the mentioned bonds and that you can borrow European government bonds at a negligible cost, you decide to implement a duration trade between 2 year and 10 year bonds. The strategy is "duration neutral" (i.e. in inverse proportion to durations: therefore the portfolio total duration is zero) and the nominal amount of the 2 year bond is EUR 10,000,000 at the inception of the strategy. Explain what trades you have to implement on the market (buy or sell) on the two bonds and determine the nominal amount of the trade for the 10 year bond (round to a multiple of EUR 1,000) and the full counter-value of the trades on 2yr and 10yr bonds. (6 points)

e2) From the observation of the YTM curve convexity in the 5 years expiry area, and supposing that you are not holding any position on the mentioned bonds and that you can borrow European government bonds at a negligible cost, you decide to implement a convexity trade "bullet to barbell" (to profit from an increase in curvature of the yield curve) on the 2yr, 5yr and 10yr bonds. The strategy has to be "duration neutral" (i.e. total portfolio duration = zero) and the total portfolio value has to be zero (i.e. longs = shorts). Assuming that the nominal amount of the 5 year bond is EUR 10,000,000 at the inception of the strategy; explain what trades you have to implement on the market (buy or sell) on the three bonds and determine the nominal amount of the trades for the 2 year and 10 year bonds (round to a multiple of EUR 1,000) and the full counter-value of the trades on 2yr, 5yr and 10yr bonds. (8 points)

Question 2: Derivative Valuation and Analysis **(39 points)**

Today is September 21st, 2015, and you are a relationship manager working for a private bank in Geneva. A client visits you and shows you a term-sheet which describes an option strategy named 'condor' on the Swiss stock Sulzer Ltd. (a company specialized in industrial machinery and equipment, surface technology, and rotating equipment maintenance). The strategy consists in buying one call option contract with strike K1 = 90, in selling one call with strike K2 = 95, in selling one call with strike K3 = 105 and in buying one call with strike K4 = 110, all European type options on the stock Sulzer Ltd and maturing in 6 months. Currently Sulzer is quoted at 100 CHF. 1 option contract refers to 100 shares, and relevant option data is given in the following Table:

Strike of the call	Price	Delta
K = 90	13.15	0.76
K = 95	9.93	0.66
K = 105	5.18	0.44
K = 110	3.59	0.34

a) At the beginning you have to answer some basic questions concerning the strategy.

a1) What is the initial cost of the condor strategy? (3 points)

a2) Find the value V_T of the long 'condor' strategy at maturity as a function of the price S_T of the underlying, i.e. complete following table:

$$V_T = \begin{cases} \ldots\ldots\ldots\ldots & (\text{if } S_T < 90) \\ \ldots\ldots\ldots\ldots & (\text{if } 90 \le S_T < 95) \\ \ldots\ldots\ldots\ldots & (\text{if } 95 \le S_T < 105) \\ \ldots\ldots\ldots\ldots & (\text{if } 105 \le S_T < 110) \\ \ldots\ldots\ldots\ldots & (\text{if } S_T \ge 110) \end{cases}$$

(6 points)

a3) Find the maximum profit of the strategy, the maximum loss, and the break-even point(s) of the strategy [i.e. the values of the underlying at maturity for which the profit of the strategy results zero]. Then plot the graph of the profit/loss at maturity as a function of the price of the underlying S_T [ignore interest on the initial option premium of the strategy]; indicate all the relevant values. (9 points)

b) What are the expectations on the evolution of the underlying security for an investor buying the condor strategy? (3 points)

c) How can you realize a long condor strategy by using bull call spreads? [i.e. try to replicate the condor strategy as a sum of bull call spread strategies]. (4 points)

d) Replicate the long condor strategy only by using put options [i.e. try to replicate the condor strategy as a sum of put options]. (5 points)

e) The initial cost of the condor realized by means of put options will be higher, lower or the same as the one of the condor realized by means of call options? Motivate your answer [Hint: to answer use the put-call parity relationship]. (5 points)

f) Assume that, shortly after you have bought the strategy [at the conditions described in the above Table] you need to go abroad for a week, and your principal asks you to neutralize temporarily the strategy. Describe and explain the position you need to take on the underlying security in order to implement a delta hedge. (4 points)

Question 3: Derivatives / Derivatives in Portfolio Management (33 points)

The Nikkei share price index is currently at 20,000 JPY, and there are futures and European options with the index as underlying asset that mature in 6 months and are traded on the market. The strike prices and current prices of the traded options are as shown below.

Strike price K	Call price $C_0(K)$	Put price $P_0(K)$
19,000	1,912	540
20,000	1,325	933
21,000	875	1,464

The 6-month simple risk-free rate is 4% (annualized).

Assume that dividends can be ignored. Also assume that all futures and options mature in 6 months time from now, and that 1 trading unit is 1,000 times the Nikkei share price index. [In other words, if 1 unit of an option with a strike price of K has a price of C JPY, the purchase of 1 trading unit of the option costs $1{,}000 \cdot C$ JPY.]

a) Assuming that there is no arbitrage opportunity (no-arbitrage condition), answer the following questions about the relationships among asset prices.

a1) When the risk-free interest rate (annualized) is r_f and the current value of the Nikkei share price index is S_0, express the current price F_0 of a Nikkei share price index futures maturing in 6 months as a function of r_f and S_0. Calculate F_0 when $r_f = 4\%$ and $S_0 = 20{,}000\,\text{JPY}$. (4 points)

a2) Let $C_0(K)$ be the current price of a 6 months European call option with strike price K, and $P_0(K)$ the current price of a 6 months European-style put option with the same strike price K. Draw a payoff diagram at maturity for a position in which you sell 1 trading unit of the put option and buy 1 trading unit of the call option. (3 points)

a3) Write a relationship for $C_0(K), P_0(K), K, F_0$ and r_f under the no-arbitrage condition. (3 points)

b) Mr. A is an investor managing a stock portfolio currently valued at JPY 2 billion whose rate of return tracks the Nikkei index. He is considering the use of options to hedge his portfolio.

b1) In order to hedge his portfolio, Mr. A first purchases a put option with a strike price of JPY 19,000 to set a floor on the portfolio in 6 months' time (option maturity).

How many trading units of options should Mr. A purchase at this time? Calculate the floor value of the portfolio's net position (including costs) in 6 months achieved by this transaction. Assume that all costs to purchase the options are borrowed at the current risk-free rate and repaid in 6 months. (5 points)

b2) In addition to purchasing the put options in b1), he also sells 30 trading units of call options with a strike price of JPY 21,000. Find the value of the floor of the portfolio's net position (including costs) in 6 months. (Assume that the proceeds from the sale of the option are invested at the risk-free rate for 6 months.) Draw a graph of the relationship between the value of the portfolio's net position (including costs) in 6 months and the value of the Nikkei average in 6 months. (6 points)

b3) Mr. A wants to synthesize the put option position proposed in b1) with a futures dynamic hedge. How many units of futures should he trade per-unit put option, and in which direction (buy or sell) should he trade them if the delta of the put option is -0.28 and the delta of the futures is 0.98? (3 points)

c) Mr. B, an investor, wants to earn a profit by trading options based on forecasts for the Nikkei share price index.

c1) Mr. B takes a position in which he is long 1 trading unit (= 1,000 units) each in put options and call options with strike prices of JPY 20,000. Draw a graph of the relationship between the return earned from this position in 6 months and the Nikkei share price index in 6 months. Show the value of the Nikkei share price index in 6 months that minimizes the return from this position in 6 months, and the amount of return at that time. Assume that current borrowings at the risk-free rate fund all option purchases that all of them are repaid in 6 months. (5 points)

c2) Having taken the position described in c1), what is Mr. B's forecast for the Nikkei share price index over the next 6 months? Explain briefly, and explicitly state your reasons. (4 points)

Question 4: Portfolio Management **(40 points)**

You are the Head of Tactical Asset Allocation at SP1 Asset Management Ltd and your team is analyzing the performance of three components (simply denoted A, B, C), of the EUROSTOXX 50, which could be particularly relevant for your investment decisions in next year.

After observing the historical price series for the last three years, your colleagues have corrected the ex-post values with more information on fundamentals. Then, you estimate the expected returns for the next year as $\overline{\mathrm{R}}_{\mathrm{A}} = 0.12\ (=12\%)$, $\overline{\mathrm{R}}_{\mathrm{B}} = 0.06$ and $\overline{\mathrm{R}}_{\mathrm{C}} = 0.085$, and the corresponding variance/covariance matrix as:

$$\begin{pmatrix} \sigma_A^2 = 0.09 & 0.0175 & 0.041 \\ 0.0175 & \sigma_B^2 = 0.0625 & 0.0225 \\ 0.041 & 0.0225 & \sigma_C^2 = 0.04 \end{pmatrix}$$

Where $\mathrm{Cov}(\mathrm{R}_{\mathrm{A}}, \mathrm{R}_{\mathrm{B}}) = 0.0175$

a) Calculate the Sharpe ratio of each component, where the annualized risk-free return is 1% $(\mathrm{R}_{\mathrm{F}} = 0.01)$. Then comment on the results and on the use of the Sharpe ratio as a performance index. (7 points)

b) You plan to invest in a portfolio [P1] defined by the following weights: $x_A = 0.3$, $x_B = 0.5$ and $x_C = 0.2$. According to the risk/return tradeoff, compare your portfolio choice [P1] with the alternative proposal of your team to invest in an equally weighted portfolio [P2] of the three components. Justify your answer with appropriate calculations. (10 points)

c) Now, you are considering investing in a stock portfolio consisting of only two of the three components A, B, C (short positions are not allowed). Discuss whether each combination gives the benefit of the diversification effect in terms of lower variance. [Hint: compare the ratio of any two component volatilities with the corresponding correlation coefficient.] (9 points)

d) By applying the Sharpe's Single Index Model, you have computed the following parameters of the three components (A, B, C) and the benchmark (M), that is the EUROSTOXX 50:

	α_i	β_i	Q_i
A	-0.025	0.76	0.15
B	-0.014	1.30	0.07
C	0.030	0.97	0.11
M	0.055	1.00	0.12

Where $\alpha_M = \overline{R}_M$, $Q_i = \sigma_{\varepsilon_i}^2$ and $Q_M = \sigma_M^2$.

Calculate the expected returns on portfolios [P1] and [P2] defined in Question b) and comment on the result. (10 points)

e) You plan to invest in a portfolio with a beta of 1 with respect to the benchmark EUROSTOXX 50. The portfolio is composed of only two of the stocks A and B analyzed in Question d). Calculate the variance and determine the optimum weights for a portfolio with a combination of stocks A and B only. [Hint: given two risky assets, the weights to be invested in each security are obtained easily from the formula used to calculate the beta of the portfolio.] (4 points)

Question 5: Portfolio Management **(12 points)**

Your firm has been tracking the performance of two portfolio managers. Both started with the firm at the same time. The company has followed a practice of moving USD 50 million from the portfolio of the portfolio manager with the lower annual performance to the portfolio of the manager with the higher performance. The record of the two portfolios is given below:

	Portfolio A (millions)	Portfolio B (millions)
Year 1		
Beginning investment	100	100
Value end of year 1	112	106
Year 2		
Cash in/out flow start of year 2	+50	-50
Value end of year 2	178.2	62.72
Year 3		
Cash in/out flow start of year 3	-50	+50
Value end of year 3	134.61	123.992

At a meeting of the board, an argument arises over which manager has the better return performance over the last three years. One very vociferous board member maintains that it is obvious: "Both managers were treated the same. Each was given USD 100 million to start, each was given another USD 50 million, and each had USD 50 million taken away. Clearly, manager A has a higher ending value and return, and is the better manager." He also suggests looking at the internal rate of return (IRR).

a) Indicate why the internal rate of return (IRR) would be an inappropriate measure of performance in this case. (4 points)

b) Present a short analysis of the comparative performance of the two managers, on the assumption that the managers are not responsible for the cash inflows/outflows, and indicate which manager had the better performance over the three years. (8 points)