EDHEC BUSINESS SCHOOL

MSc in Financial Engineering

25_M2_NI_FENG_S1_CCO_FIN_2764

ADVANCED FIXED INCOME AND CREDIT

GROUP ASSIGNMENT

Submission date: **October 31st 2024**

Lecturer: Thibault Lair

INSTRUCTIONS:

- **Assignment type:** Group assignment
- **Assignment instructions:**
  - Groups should work independently.
  - If something is not clear, please make a reasonable assumption and continue. Please highlight your assumptions so that I can identify them when grading the assignment.
  - You are allowed to use Excel or a programming language such as Python or R to answer the questions.
  - In case of questions, channel your questions through a group representative.
- **Submission instructions:**
  - Submit your assignment by email and through Blackboard, by October 31st 2024 midnight (Paris time).
  - You should submit a single pdf or word file containing all your answers to the questions as well as the personal information of all group members (school identifier, first and last name). Different files per questions are not allowed.
  - You are allowed to attach additional files (e.g. Excel, Python, R) to support your answers. Submitting them will allow for grading partially your reasoning in case of erroneous final answer. Please reference them in your main document if you want them to be considered.
- **Case study:**
  - The assignment is based on a Harvard Business School case study "Deutsche Bank: Finding Relative Value Trades". You can download the case and the associated data by using the below links:
    - Case: https://hbsp.harvard.edu/tu/35f6a172
    - Data: https://hbsp.harvard.edu/tu/7f4e8352

CASE STUDY: Deutsche Bank: Finding Relative Value Trades

QUESTION 1: Bootstrapping

Q1.1:

Solve for the prices of discount bonds given the market prices of coupon bonds and identify the zero-coupon yields[1] from the prices of zero-coupon bonds.

Q1.2:

Compare the zero-coupon yields from Deutsche Bank's model (in Exhibit 4 of the case) to the market zero-coupon yields, and identify which zero-coupon bonds Deutsche Bank should buy, and which ones they should sell.

Q1.3:

Is this strategy (of buying some bonds and selling others) a risk-free arbitrage strategy?

QUESTION 2: Cubic splines

Q2.1:

Estimate the cubic splines' function that uses as knots 2-, 5-,10-, 15- and 20-year zero-coupon yields. Describe succinctly the methodology and document any choice made in the estimation. Plot the discount function (i.e., the cubic splines based ZC yields) against the zero-coupon yields obtained in Q1.1.

Q2.2:

Discuss when using those new 'spline-based' zero-coupon yields estimates instead of the one implied by the bootstrapped zero-coupon bonds in Q1.1 is appropriate. Please justify and discuss whether this affects the conclusions reached in Q1.2?

Q2.3:

Re-estimate the cubic splines' function only using as knots 5- and 20-year zero-coupon yields. Plot the discount function against the one obtained in Q2.1. Discuss how changing the knots affects the estimated discount function.

QUESTION 3: Nelson Siegel model

Q3.1:

Estimate the discount function according to the Nelson-Siegel-Svensson model. Describe succinctly the methodology and document any choice made in the estimation. Plot it against the zero-coupon yields obtained in Q1.1.

Q3.2:

Compare the fit of the two models from Q2.1 and Q3.1. Discuss the differences.

Q3.3:

Estimate and plot the factor loadings and contributions from the different factors affecting the shape of the spot zero-coupon curve. Explain their key drivers.

[1] Be mindful of the yield and compounding convention used in the case study. Adopt a consistent approach throughout the assignment.

QUESTION 4: Hedging

Q4.1:

To estimate the sensitivity of any instrument or portfolio to the 10-year rate changes, i.e., its 10-year key rate duration (KRD), you will shock the 10-year rate by 50bps. Discuss what the impact is on the zero coupon yield curve estimated in Q2.1? Plot the difference.

Q4.2:

Assume you own a 1 million $ portfolio that is equally invested in all bonds. What is the KRD of your portfolio to this scenario? Describe your approach to estimating this exposure.

Q4.3:

Estimate and plot the KRDs of your portfolio for all maturities, when applying the same shock individually to all zero-coupon yields. Plot and interpret the results.

QUESTION 5: Portfolio strategy

Q5.1:

You expect the bootstrapped zero-coupon curve from Q1.2 to steepen according to the following function, where ε is a random noise and $\bar{T}$ is the average bond maturity in your sample:

$$y^{T}_{Steepen} = y^{T} + [(T - \bar{T})/\bar{T} * 0.0050] + \varepsilon$$
$$\varepsilon \sim N(0, 0.0025)$$

Plot the new curve according to your expectations against the bootstrapped zero-coupon. Split the deterministic component of your expectation from the stochastic one originating from the random noise ε term.

Q5.2:

Re-estimate the discount function using the Nelson-Siegel-Svensson methodology, applied in Q3.1. Value all coupon paying bonds accordingly and identify the cheap and expensive bonds given their current market prices. Discuss.

Q5.3:

Propose a diversified zero-cost long-short portfolio strategy that aims at harvesting the mispricing identified in the previous questions. Assume your initial wealth is 100$ and your financing costs are null. How much should you invest in which bonds? What is your expected return?