cardano

Assignment

Quant developer

2024

Introduction

To gain better insight in our candidates we would like you to complete this assignment. The assignment reflects (in a stylised way) some of the tasks you will be supporting within Cardano.

From the moment of receiving this assignment you have a week to complete it. We do not expect you to take a full working week to complete it, but the period of a week has been chosen such that it is possible for candidates to complete this in addition to their regular work.

Please complete the programming part of this assignment in Python or contact us if you want to use another programming language. We ask you to send the working code, together with a brief explanation, to us. We will assess the quality of your submission, and if it matches our expectations, we will invite you for the next round of interviews, when we – among other things – will ask you to present your results in a short five-minute presentation.

Liabilities

Cardano is competing in a Request for Proposal (RfP) where we can win a mandate for the pension fund Fun & Games (PFFG). The most important criterion for selecting a manager is their proposal to hedge their interest rate risk. To gain insight in the interest rate risk we have been supplied with the liabilities of PFFG (we refer to the spreadsheet supplied with the assignment). The liabilities are represented as fixed cash flows. To support our pitch, you are asked to carry out the following assignments

Assignment

1. Create a pricer that allows you to calculate the present value of the pension fund's liabilities and determine its current present value. Use the supplied interest rate and assume the term structure is flat.

   By pricer we mean a function or object that, given the relevant inputs, produces a present value.
2. Determine the sensitivity of the liabilities for a 1 basis point (= 0.01%-point) change in the level of interest rates, also known as the DV01.
3. Determine the modified duration of the liabilities.

cardano

Bonds

To hedge the interest rate risk of PFFG we have the choice out of 3 different nominal government bonds. The bonds pay annual fixed coupons until the end of their maturity (we refer to the spreadsheet supplied with the assignment for specific information on the bonds).

Assignments

4. Create a function that generates all bond cash flows given its coupon and maturity.
5. For each bond determine its price, DV01 and modified duration.

Hedging

Now we have gained insight in the liabilities of PSS and available hedging instruments, it is time to formulate a proposal to manage the interest rate risk of PSS.

Assignments

6. Which bond would you use to hedge the interest rate risk of PFFG, and why?
   Choose one bond only.

7. PFFG would like to hedge 50% of their interest rate risk. How much notional of the bond you have chosen would you have to purchase to achieve that?

Hedge analysis

The hedge you have arrived at hedges 50% of the interest rate risk of PFFG. Cardano does not dynamically hedge its client's liabilities, but periodically rehedges if the hedge ratio breaches a certain limit.

Assignments

8. To gain insight on how often we may need to rehedge for PFFG, please visualise the hedge ratio of PFFG over the next six months. Assume we have put your preferred hedge from assignment 7 in place and assume that the interest rate term structure changes as indicated in the spreadsheet supplied.

cardano

Funding ratio analysis

PFFG currently has a funding ratio of 80%. It would like to analyse how dependent the expected time to full funding is on the assumed rate of return on the asset portfolio.

Assignments

9. Assume nominal rates will be constant and equal to 1.5% in the coming years. Plot the expected time to full funding as a function of x, if the assets grow at the nominal interest rate + $x\%$.