SF2942: ASSIGNMENT 2
IMMUNIZATION

Due on October 21, 10:00 am.

Assignment

In this lab you will use Quantlab to perform immunization of a particular cash flow. That is, given a cash flow to be used as the liability, your task is to create a portfolio such that the net value of the portfolio and the liability is immune, in the sense discussed in class and in the textbook, to changes in the zero-rate curve.

The liability consists of quarterly payments over 10 years. To construct your portfolio you will have market data for a collection of Swedish government bonds, including prices, coupon amounts and the accompanying cash flow times, with different maturities.

Quantlab

In Quantlab, you should select the bonds you want to use as hedging instrument, say j of them. You will then be able to construct a zero-rate curve based on a chosen instrument (not one of those used for hedging) for the involved cash flow times and maturities.

To conduct a principal component analysis, you must chose a window length for the historical data to be used, as well as the increment over which changes in the zero-rate should be computed (quarterly in Example 3.16). This is done in your workspace and as output you will receive a correlation matrix and associated eigenvectors. You can choose the number of eigenvectors to display (they are sorted in accordance with their respective eigenvalues).

In your Quantlab workspace you will also have the present prices of the liability and hedging instruments, computed with the obtained zero-rate curve, as well as the sensitivities (gradient) of these prices with respect to the different interest rates. Note here that the bonds will have different cash flow times and the displayed gradients **do not** include zeros for the components that correspond to interest rates that do not affect the underlying bond. Thus, you must match the reported sensitivities to the correct cash flow times (i.e., the correct component in the gradient); the cash flow times for the individual bonds are reported.

With the present prices $P_L(\mathbf{r})$, $P_k(\mathbf{r})$, $k = 1, \ldots, j$, gradients $\nabla P_L(\mathbf{r})$, $\nabla P_k(\mathbf{r})$, $k = 1, \ldots, j$ and the eigenvectors from the PCA, you can now perform the immunization step. Note that this is the only task that you cannot carry out in Quantlab.

Report

The report should cover the steps outlined above and provide the relevant numerical data. You should specify the set of bonds you opted to consider as viable assets for your immunization portfolio, and argue for your choice of portfolio (i.e., the choice of portfolio weights), e.g., providing economic reasons for your particular choice (if necessary).

Things that **must** be included: Instrument used to determine the zero rates, what bonds are used as hedging instruments, the window length and increment used in the PCA, portfolio weights and the corresponding price of the portfolio.