

## **Market Risk – ESILV – 2022-2023**

You will be partly evaluated on this project. You will work in groups of two students of the same TD group (an odd number of students must lead to a “group” of one student: I will not allow groups of three students). Before the end of **Thursday 29<sup>th</sup> December**, you will send by mail to your TD teacher your report in pdf (explain briefly what you did in addition to the result) as well as the files/code that you created to answer the questions (please, put the code related to each question in the report). The choice of the programming language is free (you can even mix different languages), but the use of packages is forbidden.

### **Question A (Ex2, part of Q1 of TD1)**

From the time series of the daily prices of the stock Natixis between January 2015 and December 2016, provided with TD1, estimate a historical VaR on price returns at a one-day horizon for a given probability level (this probability is a parameter which must be changed easily). You must base your VaR on a non-parametric distribution (Epanechnikov Kernel).

### **Question B (Ex2, Q5 and Q6 of TD2)**

**a** – Calculate the expected shortfall for the VaR calculated in question A. How is the result, compared to the VaR?

**b** – Calculate the volatility, as well as the upper and lower semi-deviations for the Natixis stock for each of the four years in your dataset. What can you conclude about the riskiness of each of these years for this stock?

### **Question C (Ex2, Q3 and Q4 of TD3)**

With the dataset provided for TD1 on Natixis prices, first calculate daily returns. You will then analyse these returns using a specific method in the field of the EVT.

**a** – Determine the extremal index using the block or run de-clustering, for the two tails of the distributions.

**b** – Propose an adaptation of the EVT VaR which takes into account the dependence of the returns.

### **Question D (Ex2, Q3 and Q4 of TD4)**

**a** – Estimate all the parameters of the model of Almgren and Chriss. Is this model well specified?

**b** – In the framework of Almgren and Chriss, what is your liquidation strategy (we recall that you can only make transactions once every hour).

### **Question E (Q2 and Q3 of TD5)**

With the dataset provided for TD5:

**a** – With Haar wavelets and the dataset provided with this tutorial, determine the multiresolution correlation between all the pairs of FX rates, using GBPEUR, SEKEUR, and CADEUR (work with the average between the highest and the lowest price and transform this average price in returns on the smallest time step). Do you observe an Epps effect and how could you explain this?

**b** – Calculate the Hurst exponent of GBPEUR, SEKEUR, and CADEUR. Determine their annualized volatility using the daily volatility and Hurst exponents.