Market Risk – ESILV – 2023-2024

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 single "group" of one student: I will not allow groups of three students). Before the end of **Thursday 28th 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 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.

Any plagiarism, use of ChatGPT or other software that automatically generates text, code or images is dishonest for academic work and is therefore strictly prohibited. Any violation of this rule for part of your work will result in a grade of 0 for the entire project.

Question A (Ex2, part of Q1 and of Q2 of TD1)

a – 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 (biweight Kernel, that is $K(u) = \frac{15}{16}(1-u^2)^2 \mathbb{1}_{|u|\leq 1}$).

b – Which proportion of price returns between January 2017 and December 2018 exceed the VaR threshold defined in the previous question? Do you validate the choice of this non-parametric VaR?

Question B (Ex2, Q5 of TD2)

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

Question C (Ex2, Q1 and Q2 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 – Estimate the GEV parameters for the two tails of the distribution of returns, using the estimator of Pickands. What can you conclude about the nature of the extreme gains and losses?

b – Calculate the value at risk based on EVT for various confidence levels, with the assumption of iid 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 (Q4 of TD5)

With the dataset provided for TD5, build a portfolio containing the three FX rates, with equal weights. Determine the volatility of this portfolio for different time scales (from 15 minutes to roughly 1 week) using two different methods:

a – Determine the correlation matrix at each scale using wavelets. Determine the volatility vector with a scaling thanks to the Hurst exponents. From the correlation matrix and the volatility vector, calculate the covariance matrix and conclude about the volatility of the portfolio.

b – Determine the volatility directly from the series of prices of the portfolio and justify your methodological choices (for example with overlapping returns or not).