

MA477 : Midsem Exam

Instructor: Dr. Arabin Kumar Dey

1 Notes:

- Please do not violate the honor code.
- Use Python or R to make your code.
- Upload a separate report file (handwritten or typed out) to answer all the questions in text. Please submit all documents (Code, report etc) in Google form sent in your mailbox.
- Total Marks : 20; Exam Duration : 2 hr.

2 Assignments:

1. Consider two independent loans, represented by two loss indicator variables $1_{D_A}, 1_{D_B} \sim B(1; p)$ with, e.g., $0.006 \leq p < 0.01$. Assume LGDs equal to 100% and exposures equal to 1. Define two portfolios A and B, each consisting of one single of the above introduced loans. Then, for the portfolio losses $X_A = 1_{D_A}$ and $X_B = 1_{D_B}$ show that Value at risk at confidence level 0.99 does not hold subadditivity property. [2 marks]
2. Let $F(x) := 1 - (\kappa/(\kappa + x))^\alpha$ for $\alpha > 0, \kappa > 0$ and $x \geq 0$ denote the CDF of the Pareto distribution. By considering the normalizing sequences $c_n = \alpha n^{-\frac{1}{\alpha}}/\kappa$ and $d_n = \kappa n^{1/\alpha} - \kappa$ of the order $c_n^{-1}X + d_n$, show that $F \in MDA(H_\xi)$ or F belongs to the

domain of attraction of Frechet distribution. Identify the shape parameter in Frechet.
[2 marks]

3. Monthly simple returns of Merck stock. Calculate multi-step (make your own choice) VaR for the given heteroscedastic model for both simple return and log-return. [4 marks]

4. Prove that unconditional distribution of the residuals contains outliers at particular time in a stationary GARCH(1, 1) process. [2 marks]

5. Daily returns of GE stock. Suppose that you hold a long position of the stocks valued at \$1 million dollars.

(a) Assume the daily returns are independent identically distributed random variables. Fit a generalized Pareto distribution with threshold 2.5, what is the expected shortfall when the 1% VaR is used? Calculate the same for both simple and log-return. [2 marks]

(b) Fit a suitable mean series for the above time series data (both simple and log-return). Calculate One day VaR at level 0.99 using peak over threshold method. Use the relation between Expected shortfall and VaR to calculate the Expected shortfall at level 0.99 too. [4 marks]

(c) Use local block bootstrap to generate the above time series for log-return. Calculate non-parametric VaR based on the subsamples. [4 marks]