Due Date: June 4 and 5 for Section 01 and 85, respectively.

This assignment is concerned with VaR. Assume that the tail probability of interest is 1% and the portfolio consists of two stocks, namely Golman Sachs (GS) and Exxon-Mobil (XOM). The sample period is from January 3, 2000 to December 31, 2009 with 2515 observations. For Questions 1 to 4, assume that you hold (long position) both stocks valued at $1 million each. Transform the returns into log returns.

1. Consider the GS stock only.
   - Calculate the VaR of your position for the next trading day using the RiskMetrics method at the time point \( T = 2515 \). You must estimate the IGARCH(1,1) model without constant to obtain the parameter value needed in the calculation. What is the associated expected shortfall?
   - Build a GARCH(1,1) model for the log return series with Gaussian innovations. What is the VaR based on the fitted model for the next trading day? What is the corresponding expected shortfall?
   - Build a GARCH(1,1) model with Student-\( t \) innovations for the log return series. What is the VaR for the next trading day based on the fitted model?

2. Again, consider the daily log returns of GS stock. The goal here is to use EVT to estimate risk. Using blocks of size 21, fit a generalized extreme value distribution to a proper return series. Write down the estimates and their standard errors. Compute the 1% VaR of your financial position based on the fitted parameters. What is the 1% VaR of your financial position for the next 10 trading days?

3. Again, consider the log returns of the GS stock. Fit a generalized Pareto distribution to the return series with threshold 3.0%. Based on the fitted model, what is the 1% VaR of your position? What is the associated expected shortfall? Repeat the analysis using threshold 4.0%. Are the results sensitive to the choice of thresholds?

4. Consider now the log returns of XOM stock. Calculate the VaR using RiskMetrics method. Also, what is the VaR for the combined position of GS and XOM stocks?
5. Consider a new portfolio that holds a short position of $1 million in GS stock, but a long position of $1 million in XOM stock. Obtain the VaR (at the 1% level) of the portfolio for the next trading day at $T = 2515$ if (a) RiskMetrics is used and (b) GARCH(1,1) models with Gaussian innovations are used.