

1. (5 points) **Volatility Modeling**

1. Load the *EUROSTOXX50* dataset as a modern time series object into your working environment and plot it.
2. Use the AIC and autocorrelation tests to find an adequate ARMA-GARCH specification¹ for the log-returns. Consider normal as well as t-distributed residuals.
3. Does your result support the premise of volatility clustering?
4. Use a GJR-GARCH(1,1) model to check whether leverage effects are present in the data.
5. Use an EGARCH(1,1) for the same purpose. What can be inferred?

2. (5 points) **Downside Risk Modeling**

1. Compute and plot the empirical distribution function of the *EUROSTOXX50* log-returns.
2. What is the whole-sample empirical VaR and ES at the 99% level?
3. Compute time-varying estimates of VaR (99%) and ES (99%) with Historical Simulation. Use data from the previous 250 trading days in each period.
4. Plot the log-returns together with the computed VaR and ES series in a time series graph.

5. Backtest your VaR estimates for violation independence as well as correct conditional and unconditional coverage.