R exercises: week 2

Financial Econometrics

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CHAPTER 4 : Parameter estimation

1. Inspect carefully the R file `Estimate_ML_GARCH.R` and make the following changes:
   - Set the starting value of the parameter values for α and β equal to $(\alpha_1, \beta_1) = (0.3, 0.5)$;
   - Use the last 10 years of daily log-returns of NASDAQ as data sample.
2. Use the R file `Estimate_ML_GARCH.R`, with the changes of the previous question, to obtain:
   - The ML estimate from a GARCH(1,1) for the last 10 years of daily log-returns of NASDAQ;
   - An estimate of the covariance matrix of the ML estimator;
   - 95% confidence intervals for all the parameters of the GARCH(1,1), i.e. $(\omega, \beta_1, \alpha_1)$;
3. Write an R function that calculates the average log-likelihood function for an ARCH(1) model[1]. Then do the following:
   - Use this function to estimate and ARCH(1) for the dataset `stock_returns.txt`.
   - Obtain the covariance matrix of the ML estimator;
   - Obtain 95% confidence intervals for all the parameters of the ARCH(1), i.e. (ω, α_1);

[1] Have a look at the R file `llik_fun_GARCH.R`, which provides the average log-likelihood for a GARC(1,1)

CHAPTER 5: Econometric analysis with GARCH models

1. Inspect carefully the R file `analysis_GARCH.R`. Then, estimate a GARCH(1,1) model for the last 15 years daily log-returns of Microsoft (MSFT). Obtain the residuals and test for normality. Are squared residuals normally distributed? Finally, check for residual autocorrelation in squared residuals. Is there residual autocorrelation?
2. For the model estimated in the previous question, obtain and plot the conditional VaR at level $\alpha = 0.05$ and $\alpha = 0.01$ for Microsoft (MSFT).
3. For the model estimated in Question 1, obtain out-of-sample forecasts of the variance of y_{T+h}, $\sigma_T^2(h)$, with $h = 1, \ldots, 30$, for Microsoft (MSFT). Is the unconditional variance estimated from the model a good approximation for $\sigma_T^2(2)$? And for $\sigma_T^2(30)$?
4. Repeat questions 1, 2 and 3 but now using an ARCH(1) model instead of a GARCH(1,1). Comment on the results.
5. Use R to compare the fit of the following models using AIC and BIC on the data set `stock_returns.txt`

   - ARCH(1)
   - GARCH(1,1)

   Which model would you select?