Christoffersen

Chapter 1

1. From the S&P 500 prices, calculate daily returns and plot prices and returns.
2. Calculate the mean, standard deviation, skewness and kurtosis of returns. Plot a histogram of the returns with the normal distribution imposed as well. [The normal distribution can be obtained with the NORMDIST function. Pay attention to kurtosis versus excess kurtosis].
3. Calculate the first through 100 lag autocorrelation, and plot them against the lag order.
4. Calculate the first through 100 lag autocorrelation of squared returns, and plot them against the lag order.
5. Set the initial variance to the variance of the entire sequence of returns. Then use EWMA formula with λ=0.94 to compute the time series of variances.
6. Compute standardized returns and calculate the mean, standard deviation, skewness and kurtosis of the standardized returns. Compare them with those found in question 2.
7. Calculate daily, 5-day, 10-day and 15-day nonoverlapping log returns. Calculate the mean, standard deviation, skewness and kurtosis for all four return horizons. Do the returns look more normal as the horizon increases?

Chapter 2

1. Estimate the simple GARCH(1,1) model on the S&P 500 daily log returns using the MLE Maximum Likelihood Estimation technique. Let the variance of the first observation be equal to the unconditional variance, Var(R(t)). Set the starting values of the parameters to α=0.1 and β=0.85, and ω=Var(R(t))(1-α-β) = $(0.01)^2$.(0.05)=0.000005. Re-estimate the equation using variance targeting, that is, set: ω=Var(R(t))(1-α-β) and use Solver to find α and β only. Check how the estimated parameters and persistence differ from the variance model in Chapter 1 (1.5).

   Se ha insertado una pestaña con la estimación por Maxima Verosimilitud del modelo RiskMetrics para la serie del S&P 500 del ejercicio anterior. El resultado se compara (desfavorablemete) con la estimación del ejercicio 1, con variance targeting.

2. Include a leverage effect in the variance equation. Estimate:

   $\sigma_{t+1}^2 = \omega + \alpha(R_t - \theta\sigma_t)^2 + \beta\sigma_t^2$, with $R_t = \sigma_t z_t \; and \; z_t \sim N(0,1)$. Set starting values to α=0.1 and β=0.85, ω= 0.000005 and θ=0.5. What is the sign of the leverage parameter? Explain how the leverage effect is captured in this model. Plot the autocorrelations for lag 1 through 100 for R_t^2 as well as R_t^2 / σ_t^2 and compare the two.

3. Include the option implied volatility VIX series from the Chicago Board Options Exchange (CBOE) as an explanatory variable in the GARCH equation, Use MLE to estimate:

   $\sigma_{t+1}^2 = \omega + \alpha(R_t - \theta\sigma_t)^2 + \beta\sigma_t^2 + \gamma VIX_t^2 / 252$, with $R_t = \sigma_t z_t \; and \; z_t \sim N(0,1)$. Set starting values to α=0.04 and β=0.5, ω= 0.000005, θ=2 and γ = 0.07.

4. Run a regression of daily squared returns on the variance forecast from the GARCH model with a leverage term. Include a constant term in the regression:

$R_{t+1}^2 = \beta_0 + \beta_1 \sigma_{t+1}^2 + \varepsilon_{t+1}$. (Excel has function LINEST to estimate regression equations). What is the fit of the regression as measured by the R^2? Is the constant term significantly different from zero? Is the coefficient on the forecast significantly different from one?

5. Run a regression using the range instead of the squared returns as proxies for observed variance, that is, regress: $\frac{1}{4\ln 2} D_{t+1}^2 = \beta_0 + \beta_1 \sigma_{t+1}^2 + \varepsilon_{t+1}$. What is the fit of the regression as measured by the R^2? Is the constant term significantly different from zero? Is the coefficient on the forecast significantly different from one? Compare your results to those in question 4.

Chapter 3

1. Convert the TSE (Toronto Stock Exchange) prices into US$ using the $US/CAD exchange rate. Normalize each time series of closing prices by the first observation and plot them
2. Calculate daily log returns and plot them on the same scale. How different is the magnitude of variations across the different assets?
3. Construct the unconditional covariance and the correlation matrices for the returns of all assets. What are the determinant values?
4. Calculate the unconditional 1-day 1% Value at Risk for a portfolio consisting of 20% in each asset. Calculate also the 1-day 1% Value at Risk for each asset individually. Compare the portfolio VaR with the sum of individuals VaRs. What do you see?
5. Estimate a simple GARCH(1,1) model for the variance of the S&P 500, the US$/Yen FX rate and the TSE in US$. Set starting values to α=0.06, β=0.93, ω=0.00009.
6. Standardize each return using its GARCH standard deviation from question 5. Construct the unconditional correlation matrix for the standardized returns of the three assets. This is *the constant conditional correlation (CCC) model*.
7. Use MLE to estimate λ in the exponential smoother version of the dynamic conditional correlation (DCC) model for the two bivariate systems consisting of the S&P 500 and each of the two other series (US$/Yen and Toronto Stock Exchange (TSE) index in US$). Set the starting value of λ to 0.94. Calculate and plot the correlations as well as the 1-day, 1% VaR for the CCC model from question 6 and the exponential smoother DCC model. (Notice that we estimate bivariate systems here for convenience of computation I Excel. The models considered can easily be estimated for large sets of assets simultaneously, as is pointed out in the lecture notes).
8. Estimate the GARCH DCC model for the bivariate systems from question 7. Set the starting values to α=0.05 and β=0.9. Plot the dynamic correlations. Calculate and plot the 1-day, 1% VaR for the CCC model from question 6 and the GARCH DCC mod