Exercise 5

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1. (a) In the file `sp500`, construct the returns, produce a correlogram of the squared residuals, and interpret it.

   (b) Perform an ARCH-LM test by regressing the returns on an intercept.

   (c) Compute the historical volatility and plot it.

   (d) Compute the EWMA volatility and plot it.

   (e) Find a suitable GARCH/TGARCH/EGARCH model. Start with a GARCH(1, 1) or an ARCH(6) model, and determine whether it needs to be adjusted.

   (f) Make a plot of the volatility estimates that your model generates, and of the NIC.

   (g) Forecast the volatility for $T + 1$.

2. (a) Show that
$$\widehat{\sigma}^2_{t+1,EWMA} = \lambda\widehat{\sigma}^2_{t,EWMA} + (1 - \lambda)r_t^2, \qquad 0 < \lambda < 1.$$