1. Consider the Apple stock only. Let $r_t$ be the negative log return.
   • The estimated coefficient is 0.972. VaR for the next trading day is $1,000,000 \times 0.03392124 = $33,921.2 The expected shortfall is $38,862.4. For 10-trading days, the VAR is $107,268.4.
   • The fitted model is
     \[ r_t = -0.00203 + a_t, \quad a_t = \sigma_t \epsilon_t, \quad \epsilon_t \sim N(0, 1) \]
     \[ \sigma_t^2 = 8.35 \times 10^{-6} + 0.054a_{t-1}^2 + 0.932\sigma_{t-1}^2. \]
     The VAR is $35,107.5, and ES = $40,517.3.
   • The fitted model is
     \[ r_t = -0.0016 + a_t, \quad a_t = \sigma_t \epsilon_t, \quad \epsilon_t \sim t_{5.16}^\ast \]
     \[ \sigma_t^2 = 4.22 \times 10^{-6} + 0.044a_{t-1}^2 + 0.959\sigma_{t-1}^2. \]
     The VAR is $39,088.0 and ES = $52,909.8.

2. The estimates and their standard errors are $(\xi, \sigma, \mu) = (0.1574, 0.0154, 0.0305)$ with standard errors $(0.0583, 0.0011, 0.0014)$. The VaR is $57,603.0$ and 10-day VAR is $82,806.2$

3. For threshold 3.5%, we have VaR = $61,410.6$ and ES = $85,103.6$. For threshold 4.5%, we have Var = $60,870.1$ and ES = $85,803.6$. In this particular case, the results are not sensitive to the choice of threshold.

4. For PG stock, we have VaR = $15,360.5$ and ES = $17,598.0$.
   Since the sample correlation is 0.276. The VaR for the portfolio is $40,917.2$
   If time-varying correlation is used, we have correlation 0.192. Therefore, for the portfolio, we have VaR = $39,833.2$

5. For short position of Apple stock, we have VaR = $33,921.2$ as before. For the portfolio, the correlation changes sign. Therefore, the VaR is $33,150.7$.
   For GARCH modeling, the short position implies that the sign of the mean equation of AAPL changes. So that, for AAPL, VaR = $42,273.0$. For PG stock, the VaR is $17,671.2$. Consequently, the VaR for the portfolio is $41,072.3$. 

Due Date: June 5 (Campus) and June 7 (Weekend), 2014.