1. Compute the historical volatility of the VIX using each of the following frequencies and time periods. (Remember, volatility is reported for annual returns.)
   (a) The year 2008, based on monthly returns.
   (b) The year 2008, based on daily returns.
   (c) The year 2013, based on monthly returns.
   (d) The year 2013, based on daily returns.

2. Compute the implied volatility of the VIX as of today (the day that you work this problem). Do this by using the current price or the closing price of the VIX for the previous day and by using the midpoint between the bid and ask prices shown in Yahoo! Finance. You can use the R function in RQuantLib or other software, if you’d prefer. There are several parts, so write reusable code. The only handwork will be entering the prices because I do not believe it would be very easy to get them directly from the URL.
   (a) Do this for the March calls at each of the 5 strike prices above the current price. Plot the results on a 2-D graph in which the vertical axis is the implied volatility and the horizontal axis is the strike price.
   (b) Repeat this using the March puts, except for the 5 strike prices below the current price.
   (c) Repeat for the April, May, June, July, and August calls but do not print your plots. Now, make a 3-D perspective plot (you can use persp in R or any similar function). Note that the horizontal plane is defined by an axis for strike price with 10 points at which there are observations and another one for month with 6 points at which there are observations.

3. Consider the model
   \[ A_t = \sigma_t \epsilon_t \]
   \[ \sigma_t^2 = 1 + 2A_{t-2}^2, \]
   where \( \epsilon_t \) iid \( \sim N(0, 1) \).
   Let \( A_1 = a_1 = 1 \) and \( A_2 = a_2 = 2 \). Now, for \( t = 3, 4, \ldots, 200 \), simulate values for \( A_t \).
   Using your simulated data, fit each of the following models and discuss your results.
   GARCH(1,0), GARCH(2,0), and GARCH(2,1). (You can use garchFit in the R fGarch package.)