時間序列 HW4

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1. **Generate the first 200 data points from the following GARCH model**

   我運用 R 語言來模擬資料，利用 garchSim 來生成 AR(2)+GARCH(1,1)的資料。程式碼如下：

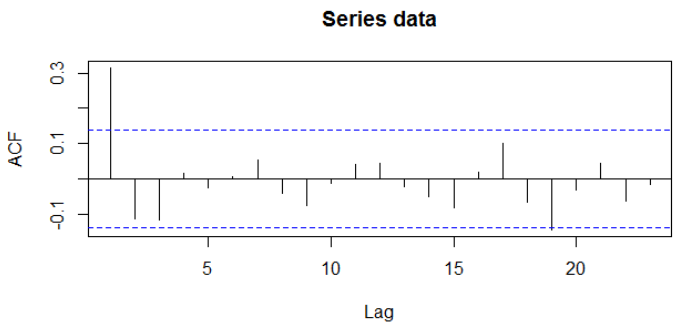
   ```
   spec = garchSpec(model = list(ar = c(0.3,-0.3)+0.1 , alpha = c(0.12)+0.1, beta = c(0.09)), cond.dist = "snorm")   #生成資料資訊
   data = garchSim(spec, n = 200)   #生成資料個數
   ```

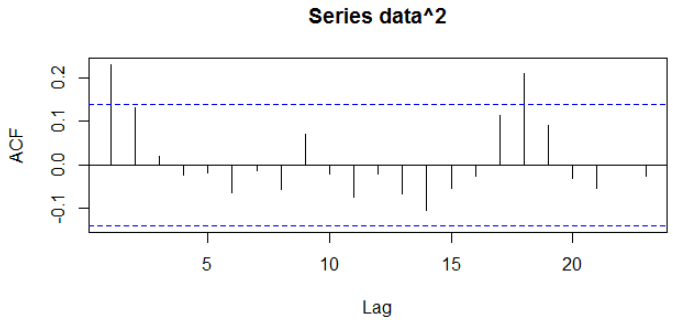
2. **Draw the ACF graphs for the simulated r_t, r_t^2, and $|r_t|$.**

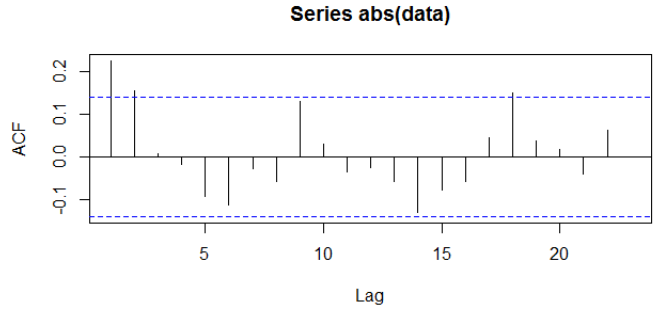
   利用 acf 即可產生繪圖。程式碼如下：

   ```
   library(TSA)   #引入套件
   acf(data)   #第一期資料有顯著相關
   acf(data^2)   #前幾期資料有顯著相關
   acf(abs(data))   #前幾期資料有顯著相關
   ```

   圖形如下圖：







3. **PSuppose you know the mean function is in an ARMA(p,q) form, but you don’ t know p and q. Fit the mean function.**

   利用 auto.arima 即可分析出可能的 p 和 q。程式碼如下：

   auto.arima(data, trace=TRUE)

   產生分析如下圖：

```
 Now re-fitting the best model(s) without approximations.

 ARIMA(3,0,1) with zero mean     : -2103.192

 Best model: ARIMA(3,0,1) with zero mean

Series: data
ARIMA(3,0,1) with zero mean

Coefficients:
          ar1     ar2      ar3     ma1
      -0.4838  0.1388  -0.2402  0.8878
s.e.   0.4278  0.1748   0.0891  0.4357
```

   所以是 ARIMA(3,0,1)的組合。

4. **Now, based on the mean function you obtained in 3., fit the GARCH**

model.

使用 ugarchfit 就可以分析出 GARCH 的主要成分。程式碼如下：

```
spec <- ugarchspec(   variance.model = list( submodel = NULL,
                external.regressors = NULL, variance.targeting = FALSE),
mean.model = list(armaOrder = c(3, 1), external.regressors = NULL,
distribution.model = "norm", start.pars = list(), fixed.pars = list()))


garch <- ugarchfit(spec = spec, data , solver.control = list(trace=0))
```

結果：

```
Conditional Variance Dynamics
-----------------------------------
GARCH Model      : sGARCH(1,1)
Mean Model       : ARFIMA(3,0,1)
Distribution     : norm

Optimal Parameters
------------------------------------
        Estimate  Std. Error    t value Pr(>|t|)
mu     -0.000162    0.000106 -1.534544 0.124896
ar1    -0.403767    0.198268 -2.036474 0.041703
ar2     0.137407    0.114887  1.196016 0.231690
ar3    -0.179473    0.069937 -2.566223 0.010281
ma1     0.780211    0.182607  4.272629 0.000019
omega   0.000000    0.000000  0.082152 0.934526
alpha1  0.027588    0.020338  1.356425 0.174964
beta1   0.962032    0.021212 45.353718 0.000000
```

可以知道是 GARCH(1,1)且知道係數。

5. **Do a forecasting of r_t and σ_t^2 for t = 201 to 210.**

利用 fGarch 可以模擬 data 中的資料，並產生 10 筆衍生資料。程式碼如下：

```
library(fGarch)
model = garchFit(formula = ~ garch(1, 1), data = data, cond.dist = "norm",
include.mean = TRUE)
fcst= predict(model,n.ahead=10)
mean.fcst=fcst$meanForecast
```

結果如下圖：

	meanForecast	meanError	standardDeviation
1	-0.0001349447	0.001081675	0.001081675
2	-0.0001349447	0.001223580	0.001223580
3	-0.0001349447	0.001285945	0.001285945
4	-0.0001349447	0.001314736	0.001314736
5	-0.0001349447	0.001328291	0.001328291
6	-0.0001349447	0.001334727	0.001334727
7	-0.0001349447	0.001337795	0.001337795
8	-0.0001349447	0.001339260	0.001339260
9	-0.0001349447	0.001339961	0.001339961
10	-0.0001349447	0.001340296	0.001340296