Series 2

Introduction to Computational Finance

Return no later than March 10th, 2020

1 Correlation of two series

Let be two normal random variables $a_1 \sim N(0,1)$ and $a_2 \sim N(0,2^2)$, generating $X = a_1 + 2a_2$ and $Y = 2a_1 + a_2$. Using `R`, one can generate series of X and Y with

```
set.seed(0);
n=10000;
a1=rnorm(n,mean=0,sd=1);
a2=rnorm(n,mean=0,sd=2);

X=a1+2*a2;
Y=2*a1+a2
```

Compute the correlation between X and Y. What is to be expected in terms of X and Y relationship ? Draw the graph of realizations of X vs. realizations of Y. Is the slope equal to the correlation coefficient ? Comment on this last point.

2 Hidden sine

Compute the ACF of the function you saw during the course, which is a sine function to which a gaussian noise is added.

```
T=10;
x <- rnorm(100) + sin(2*pi*1:100/T)
```

Letting T vary, plot the ACF and comment on the impact of T on the ACF ?

3 Modeling emperical series

On Moodle, you will find a file with the daily EUR_USD price evolution with the following data structure:

```
timestamp bid ask
```

where `timestamp` denotes the time (in miliseconds) measured starting from `01 Jan 1970 00:00:00.000`.

Using these empirical daily data of EUR_USD price evolution:

- Plot the evolution of the temporal serie. Is it stationary?
- Plot as well the time evolution of the returns. Is it stationary?
- Compute and plot the ACF of the stationary serie.
- Make a regression of this serie using an AR(1) model with `ar` proposed in `R` and with the analytical expressions seen during the course.
- Does the quality of the regression improve when the order of the AR model increases?

Report

Each student is expected to give back a personal work consisting of a report in PDF format presenting his/her results and answering the questions of the exercise, as well as the script used to generate the presented results. Both report and script have to be uploaded on Moodle (IFC/Serie2).