

# Données et Statistiques en Finance : modèles d'agents : TP4

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# Aims

1. To implement Franke & Westerhoff's model.
2. To explore the behaviour of this model.
3. To calibrate this model.

# 1. Implement Franke and Westerhoff model

- Write a function that accepts parameters and that returns the vector  $r_t$ .
- Note : you must impose  $|x_t| \leq 1$  in the code

## 2. Explore FW model's behaviour

What empirical facts does this model reproduce?

1. For  $\phi = 0.18$ ,  $\chi = 2.35$ ,  $\mu = 0.01$ ,  $\nu = 2.57$ ,  $\alpha_0 = -0.15$ ,  $\alpha_x = 1.35$ ,  $\alpha_d = 11.4$ ,  $\sigma_f = 0.79$ ,  $\sigma_c = 1.91$ , and at least 10000 iterations, plot  $r_t$  as a function of  $t$ . Comment.
2. Plot  $P(|r| > R)$ .
3. Using powerlaw package, estimate the tail exponent  $c$  of  $P(|r| > R) \propto R^{-c+1}$ . Comment.
4. Vary  $\phi$ ,  $\chi$ ,  $\alpha_0$  (independently) in order to understand how  $c$  depends on these parameters. Does the value of  $c$  uniquely determine the model parameter set?

### 3. Calibrate this model

- Download the `rt.csv.gz` file which contains the output of a simulation of F-W model with unknown parameters  $\phi, \chi, \alpha_0$ .
- 1. Exploration : plot  $P(r > R)$  (from the file) and estimate its tail exposant. Comment.
- 2. Let us denote by  $c_{\text{file}}$  the above exponent and  $c_{\text{model}}$  the one produced by a model with a given parameter set. One write the cost function

$$K = (c_{\text{file}} - c_{\text{model}})^2.$$

Find the parameter set that minimises  $K$  with

- 2.1 `scikit.optimize.minimize`. Note : if a parameter must be positive (say), do make it explicitly positive in the code of FW model. Otherwise, weird effects may occur.  
Why does a straightforward optimization fail to be of much help?
- 2.2 By *tâtonnement* (trial and error, manually). Use your understanding of how  $c$  depends on the parameters from question 2.

### 3. Calibrate II

3. Run at least 20 times F-W model with the parameter set that you think minimises  $K$ . For each run, estimate  $c_{run}$  and compute the average and standard deviation over all the runs.

1. is the average over these runs close to  $c_{file}$ ?
2. is the uncertainty on the average  $c$  over the runs large?