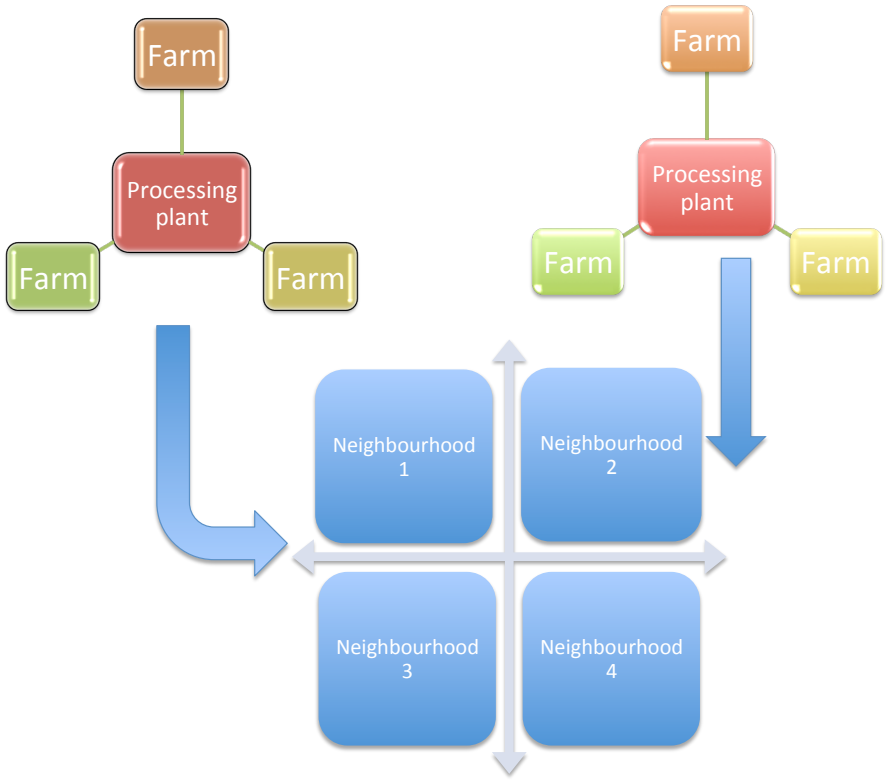
Data Science to Global Challenge kick-off workshop: Possible contributions of Mathematics

Enrico Scalas
Department of Mathematics
School of Mathematical and Physical Sciences
University of Sussex

Example 1: Corn Supply Chain



Example 2: Corn Prices in Milan, Italy in 2016

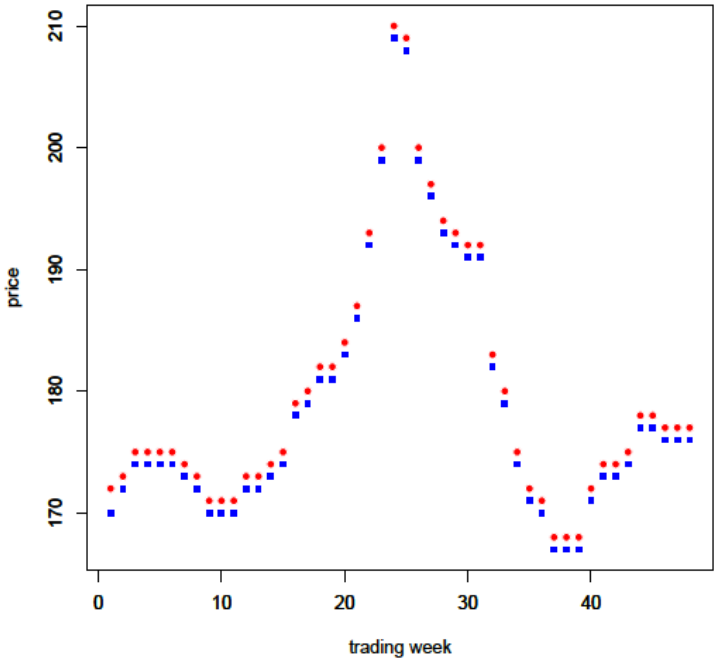


Figure 9: Price of corn *Granoturco nazionale* as a function of time in euro for Milan agricultural market. Red circles represent the maximum price and blue squares the minimum price.

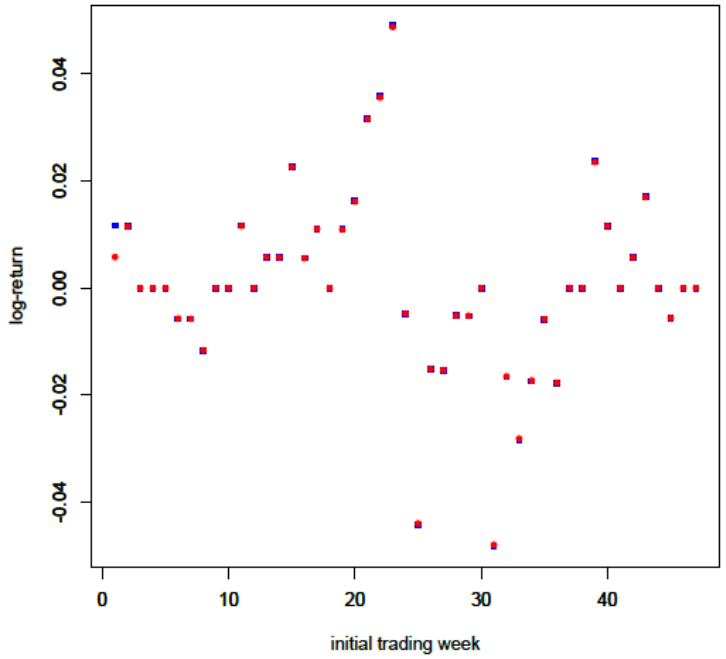


Figure 10: Log-returns of corn prices *Granoturco nazionale* as a function of time for Milan agricultural market. Red circles represent the log-returns for maximum price and blue squares log-returns for minimum price.

Understanding agricultural markets is essential to avoid food crises

Example 3: Modeling of Corn Prices

The features of the return time series outlined above as well as the modality with which prices are determined in the weekly session (the chair of the meeting proposes a price, participants may propose to increase or decrease it and an average variation is determined) suggest the use of a simple finite range random walk [10] for the price. To be more specific, a random walk X_t on $\mathbb{Z}$ is considered and an interval $\Lambda = [-L, +R]$ is used in $\mathbb{Z}$ as space of jumps (as in [11]). For each $z \in \Lambda$, a time-homogeneous transition probability $p_z = \mathbb{P}(X(t+1) = x + z | X(t) = x)$ is assigned so that

$$\sum_{z \in \Lambda} p_z = 1.$$

This process can only be considered as an approximation for small t of the behaviour of agricultural prices. In fact, for instance, if $p_{-L} > 0$, X_t can become negative for $t > X_0/L$. A Monte Carlo algorithm producing a simulation of this process is listed in the Appendix on methodology.

A price time series simulated with this model with $L = R = 10$ and a particular choice of p_z is presented in Fig. 35, whereas Fig. 36 reports the corresponding log-returns.

Example 3: Modeling Corn Prices

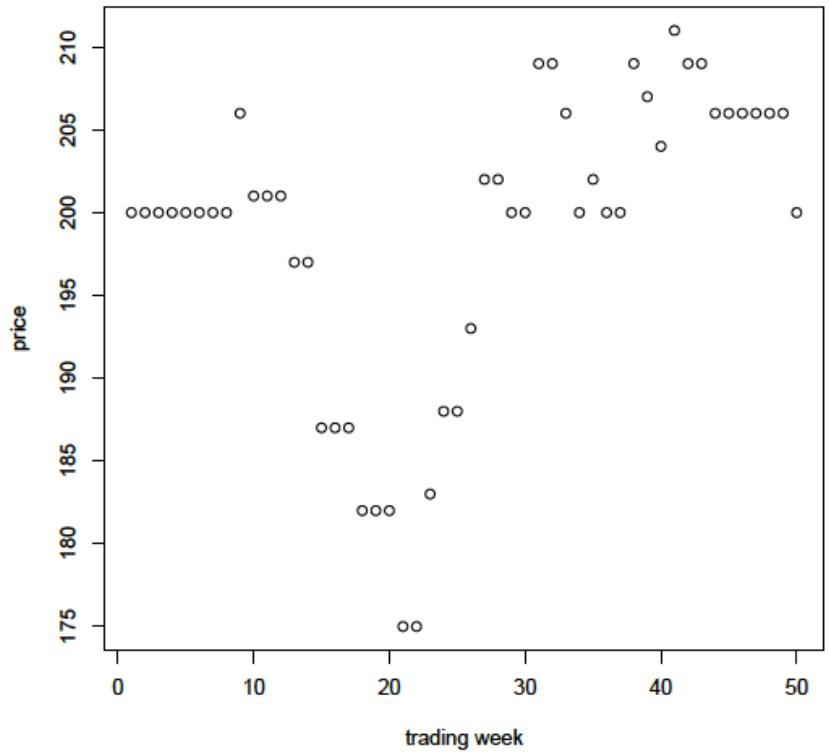


Figure 35: Simulated price as a function of time. The initial price is set at 200 euros with $L = R = 10$ and the length of the time series is 50. The probability vector has the weights given in the program listed below.

Example 3: Modeling Corn Prices

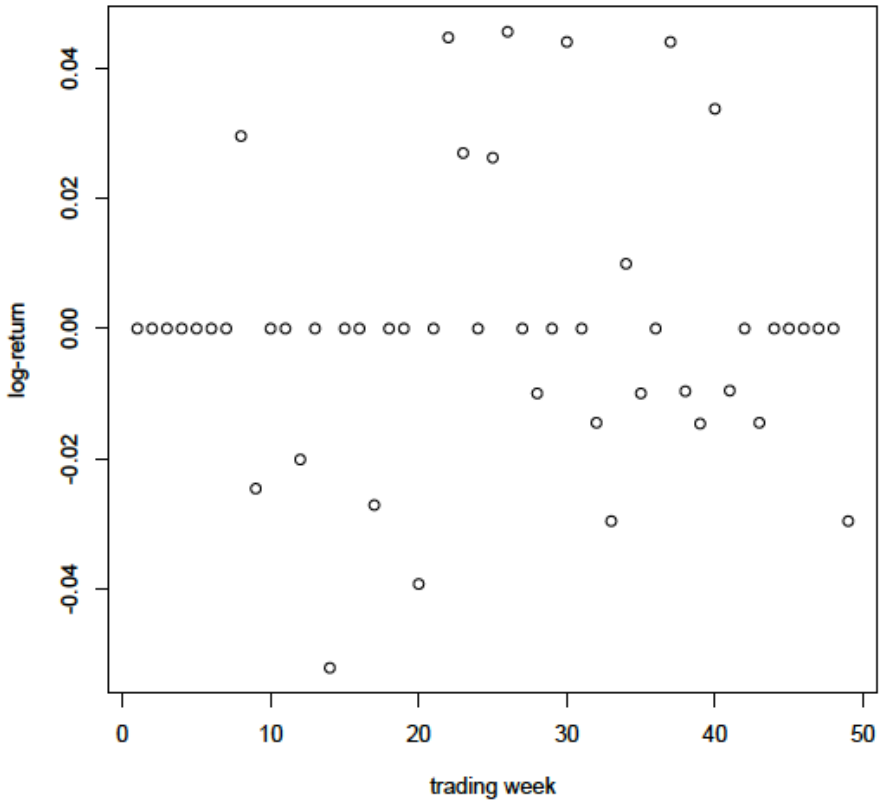


Figure 36: Log-returns of simulated price.

Other contributions from Mathematics

- Bayesian analysis
- Data mining
- Numerical analysis of physical and socio-economic systems
- Probabilistic modelling
- Complex networks
- …