Water Resources Engineering and Management

Exercises Lecture 7: Time series analysis and modelling

31/03/2025

Exercise 1: Autoregressive model

Consider the model autocorrelation functions aside and decide which one might correspond to:

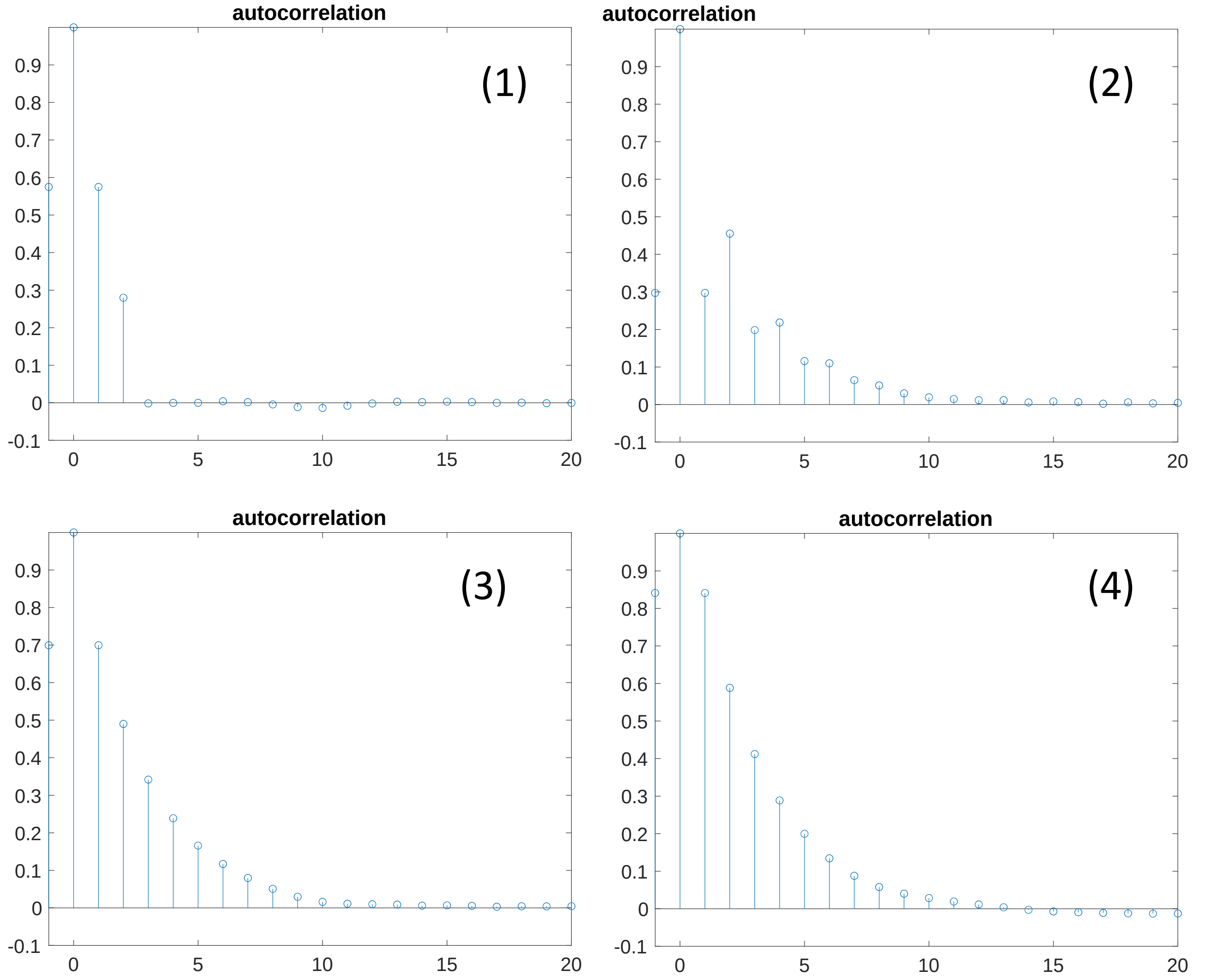
a) an AR(1) model with ϕ_1=0.7;

b) a MA(2) model;

c) an AR(2) model;

d) an ARMA (1,1) model;

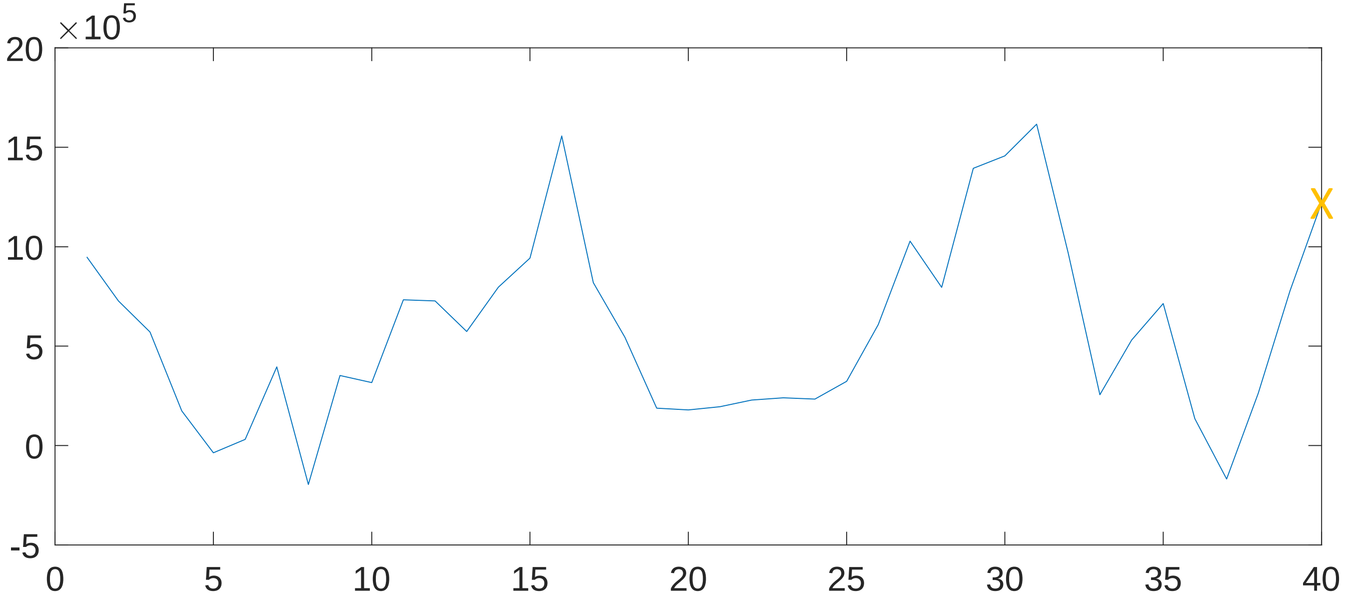
Justify your choice



Exercise 2: annual river data

Consider the time series shown in figure, which counts of 40 years of total annual river flows. For management reasons, you are required to elongate the series up to 50 years, knowing that:

- the steady mean is 720000 m^3/year;
- the coefficient of variation is 0.625;
- the autocorrelation at the first two years lag is 0.65 and 0.42, respectively;
- the last value (X) of the actual series is 1221070 m^3/year.



Build the additional 10 years of data by using an adequate stochastic model assuming the 10 years standardized white gaussian noise are

0.6046 0.6142 -0.0321 -1.0519 -1.1045
0.7405 -1.6821 -0.2949 0.1405 1.0930

Exercise 3. time series

Generate a time-series (h) based on the Poisson Process (PP) with mean jump α equal to 10 and average frequency λ equal to 1/7 with N=10^4 number of data points.
Assume that jump and intertime values are exponentially distributed (i.e. $p(x)=1/A\ \mathrm{Exp}[-x/A]$, with x the generic variable and A its mean. $p(x)$ represent the probability distribution function (pdf).
Generate the corresponding Compound Poisson Process (q) with exponential decay $e^{-t/\tau}$ and τ = 3, using the jumps already generated.

For the Poisson Process, calculate the associated histograms and autocorrelation functions.
For the Compound Poisson Process, calculate the histograms and autocorrelation functions corresponding to the arrival points after the exponential decay.

What if only the first 10^2 data points are considered?