

Introduction to Stochastic Systems

Stochastic systems deal with data analysis (modeling, prediction and classification) under uncertainty in the measured variables.

The variables are always measured and stored in a discrete time - i.e. sampled with a proper period of sampling. The time is written as the index $y_t, t = 1, 2, \dots$.

The main groups of variables are the target variable y_t and the explanatory variables $x_t = [x_1, x_2, \dots, x_n]'$ which should explain the behaviour of y_t .

The description of variables is done by their distribution (probability or density function). The description of the target variable is called **model**

$$f(y_t|x_t)$$

Mostly the model is given in a parametric form

$$f(y_t|x_t, \Theta)$$

where Θ are model parameters. E.g. the normal distribution is given by the parameters μ - expectation and r - variance. If the parameters are not known, they are **estimated** from the measured data.

The model is mostly not the final goal. For us the task will be **prediction** (estimation of the future values of the target) or **classification** (sorting data into classes). The classes can be given or estimated. The process of forming classes is called **clustering**.