

# Probability Model For An Autoregressive Model

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## 1 Autoregressive Model

Let  $AR(K)$  denote an autoregressive model of order  $K$ , which is defined as

$$y_n = \alpha + \sum_{k=1}^K \beta_k y_{n-k} + \epsilon_n \quad (1)$$

where  $\alpha$  is a constant,  $\beta_1, \dots, \beta_K$  are the parameters of the  $AR(K)$  model, and  $\{\epsilon_n\}$  is assumed to be a white noise series with mean 0 and variance  $\sigma^2$ .

## 2 Probability Model

Here we use an improper prior for  $\alpha, \beta$  and  $\sigma$  to illustrate the idea. A weakly informative prior or informative prior could be added if more knowledge of the parameters is available. The probability model for this  $AR(K)$  model is described as:

$$y_n \sim \text{Normal}(\mu_n, \sigma)$$

$$\mu_n = \alpha + \sum_{k=1}^K \beta_k y_{n-k}$$

$$\alpha \sim \text{Uniform}(-\infty, \infty)$$

$$\beta \sim \text{Uniform}(-\infty, \infty)$$

$$\sigma \sim \text{Uniform}(0, \infty)$$