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**Discrete Models**  
Suppose that a time series of  $q+1$  data points

is given. A *likelihood function*  $L$  gives the probability that the mechanism relative to all other possible outcomes [132] log scale,  $w_i = \ln y_i$  is a realization of the random variable

$$L(\theta_1, \dots, \theta_p, v)$$

where  $p(w_i|w_{i-1})$  is the joint probability distribution function pdf with mean  $\ln f(y_{i-1}, \theta_1, \dots, \theta_p)$  and variance  $v$ . Thus,

$$p(w_i|w_{i-1}) = \frac{1}{\sqrt{2\pi v}} \exp\left(-\frac{1}{2v}(w_i - \ln f(y_{i-1}, \theta_1, \dots, \theta_p))^2\right)$$

and

$$L(\theta_1, \dots, \theta_p, v) = \prod_{i=1}^q \frac{1}{\sqrt{2\pi v}} \exp\left(-\frac{1}{2v}(w_i - \ln f(y_{i-1}, \theta_1, \dots, \theta_p))^2\right)$$

The *maximum likelihood parameter estimates* are those  $\theta_1, \dots, \theta_p, v$  that maximize  $L(\theta_1, \dots, \theta_p, v)$ , or equivalently that maximize  $\ln L(\theta_1, \dots, \theta_p, v)$ . A calculation shows

$$(1.1) \quad \ln L(\theta_1, \dots, \theta_p, v) = -\frac{q}{2} \ln(2\pi) - \frac{q}{2} \ln v - \frac{1}{2v} \sum_{i=1}^q r_i^2(\theta_1, \dots, \theta_p),$$

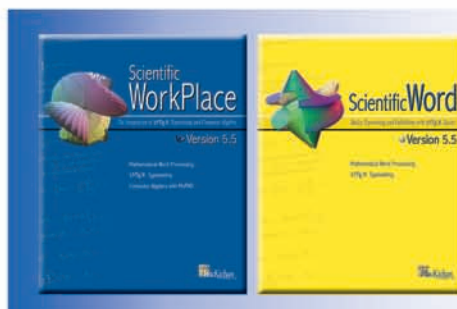
where

$$r_i(\theta_1, \dots, \theta_p) \doteq \ln y_i - \ln f(y_{i-1}, \theta_1, \dots, \theta_p) = \ln \left( \frac{y_i}{f(y_{i-1}, \theta_1, \dots, \theta_p)} \right)$$

are the log-residuals. The critical points  $(\theta_1, \dots, \theta_p, v)$  of  $L$  are zeroes of the derivative

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