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Scoring algorithm

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In statistics, Fisher's **scoring algorithm** is a form of Newton's method used to solve maximum likelihood equations numerically.

Sketch of Derivation [edit]

Let $Y_1, \ldots, Y_n$ be random variables, independent and identically distributed with twice differentiable p.d.f. $f(y; \theta)$, and we wish to calculate the maximum likelihood estimator (M.L.E.) θ^* of θ. First, suppose we have a starting point for our algorithm θ_0, and consider a Taylor expansion of the score function, $V(\theta)$, about θ_0:

$$V(\theta) \approx V(\theta_0) - \mathcal{J}(\theta_0)(\theta - \theta_0),$$

where

$$\mathcal{J}(\theta_0) = -\sum_{i=1}^{n} \nabla\nabla^\top\big|_{\theta=\theta_0} \log f(Y_i; \theta)$$

is the observed information matrix at θ_0. Now, setting $\theta = \theta^*$, using that $V(\theta^*) = 0$ and rearranging gives us:

$$\theta^* \approx \theta_0 + \mathcal{J}^{-1}(\theta_0)V(\theta_0).$$

We therefore use the algorithm

$$\theta_{m+1} = \theta_m + \mathcal{J}^{-1}(\theta_m)V(\theta_m),$$

and under certain regularity conditions, it can be shown that $\theta_m \to \theta^*$.

Fisher scoring [edit]

In practice, $\mathcal{J}(\theta)$ is usually replaced by $\mathcal{I}(\theta) = \mathrm{E}[\mathcal{J}(\theta)]$, the Fisher information, thus giving us the **Fisher Scoring Algorithm**:

$$\theta_{m+1} = \theta_m + \mathcal{I}^{-1}(\theta_m)V(\theta_m).$$

See also [edit]

- Score (statistics)

References [edit]

Jennrich, R. I., & Sampson, P. F. (1976). Newton-Raphson and related algorithms for maximum likelihood variance component estimation. Technometrics, 18, 11-17.

Categories: Estimation theory