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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](#).

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Sketch of Derivation [\[edit\]](#)

Let Y_1, \dots, 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 $\theta_m \rightarrow \theta^*$.

Fisher scoring [\[edit\]](#)

In practice, $\mathcal{J}(\theta)$ is usually replaced by $\mathcal{I}(\theta) = \mathbb{E}[\mathcal{J}(\theta)]$, 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](#)

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