

# Methodology

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### Laplace implementation

In (todo:equation), we aim to have the  $\hat{\theta}$  that maximize  $l_{Lap}(\theta|Y)$ . In addition, in (todo:equation), we need the value of  $X_{\theta}$  for  $\hat{\theta}$ , this  $X_{\theta}$  and  $\theta$  have to be optimized simultaneously; we use Newton-Raphson method to in Laplace approximation to achieve this.

Also, we compare the results of our self-implementated Laplace approximation with TMB built-in Laplace approximation. ...