

$$\begin{aligned}
\pi(\sigma^2|\mathbf{x}) &= \int_{-\infty}^{\infty} \pi(\mu, \sigma^2|\mathbf{x})d\mu \\
&\propto (\sigma^2)^{-\alpha-\frac{n}{2}-1} \exp \left[-\frac{1}{\sigma^2} \left(\beta + \frac{1}{2} \left(\sum_{i=1}^n x_i^2 - n\bar{x}^2 + \frac{ns_0}{n+s_0}(\bar{x}-\mu)^2 \right) \right) \right]. \quad (3.15)
\end{aligned}$$