Approximate Blocked Gibbs

- Joint approximate conditional posterior in blocked Gibbs
  - Likelihood is approximated

$$p\left(\alpha_j,\gamma_j \mid \text{rest}\right)=\prod_{i=1}^{I} N\left(\alpha_j+\beta_j x_{1,ij}+\gamma_j x_{2j} \mid \log y_{ij},\frac{1}{y_{ij}}\right) N\left(\alpha_j \mid \mu_\alpha,\sigma_\alpha^2\right) N\left(\gamma_j \mid \mu_\gamma,\sigma_\gamma^2\right)$$

- More approximation

$$p\left(\alpha_j,\gamma_j \mid \text{rest}\right)\sim N\left(\alpha_z \mid \mu_z,\sigma_z^2\right), z=\alpha_j\gamma_j\prod_{i=1}^{I}\left(\alpha_j+\beta_j x_{1,ij}+\gamma_j x_{2j}\right)$$

$$\mu_z=\mu_\alpha\mu_\gamma\prod_{i=1}^{I}\log y_{ij}$$

$$\sigma_z^2=\left(\mu_\alpha^2+\sigma_\alpha^2\right)\left(\mu_\gamma^2+\sigma_\gamma^2\right)\prod_{i=1}^{I}\left(\log^2 y_{ij}+\frac{1}{y_{ij}}\right)-\mu_z^2$$

  - Refs.: Approximating the Distribution for Sums of Products of Normal Variables, Robert Ware and Frank Lad, 2003.