Hessian:

$$X^t_{pq\times np}\Delta_{npq\times np}A^{-1/2}_{np\times np}R^{-1}_{np\times np}A^{-1/2}_{np\times np}\Delta_{npq\times np}X_{np\times pq}$$

Where

- $\Delta_i = \left(\frac{\partial \boldsymbol{\mu}_i}{\partial \boldsymbol{\beta}}\right)^t_{pq\times p} = \frac{1}{\alpha^2_{i0}}(\alpha_{i0}diag(\alpha_i) - \alpha_i\alpha_i^t) \otimes \mathbf{x}_i$
- $\Delta = blockdiag(\Delta_i)$
- $A_{jj_i} = 1/\sqrt{v}$, where v is the variance of a Dirichlet RV for a given α_{ij}
- $A = blockdiag(A_i)$
- R: working correlation matrix.

After Week 3 meeting:

The GEE equations (gradient) (in block matrix form) are:

$$\Delta V_i^{-1}(\mathbf{Y}_i - \boldsymbol{\mu}_i) = \mathbf{0}$$

and the hessian is

(Because we are using fisher scoring and the expectation of $(Y_i - \mu_i) = 0$)