

$$\begin{pmatrix} M_{11} & 0 \\ 0 & M_{22} \end{pmatrix} \begin{pmatrix} M_{11}^{-1} & 0 \\ 0 & M_{22}^{-1} \end{pmatrix}$$

$$= \begin{pmatrix} M_{11} M_{11}^{-1} + 0 & 0 + 0 \\ 0 + 0 & 0 + M_{22} M_{22}^{-1} \end{pmatrix}$$

$$= \begin{pmatrix} I & 0 \\ 0 & I \end{pmatrix}$$

$$Z^T M^{-1} Z = \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}^T \begin{pmatrix} M_{11}^{-1} & 0 \\ 0 & M_{22}^{-1} \end{pmatrix} \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}$$

$$= \begin{pmatrix} z_1^T & z_2^T \end{pmatrix} \begin{pmatrix} M_{11}^{-1} z_1 \\ M_{22}^{-1} z_2 \end{pmatrix}$$

$$= z_1^T M_{11}^{-1} z_1 + z_2^T M_{22}^{-1} z_2$$