4.2 (c)

$$\hat{\Sigma}_B \beta = \frac{N_1 N_2}{N^2} (\hat{\mu}_2 - \hat{\mu}_2)(\hat{\mu}_2 - \hat{\mu}_1)^T \beta = C(\hat{\mu}_2 - \hat{\mu}_1)$$

where C = Scalar

Returning to eqn 4.56, Since $\hat{\Sigma}_B \beta = C(\hat{\mu}_2 - \hat{\mu}_1)$ then

$$(N-2)\hat{\Sigma}\beta = C^*(\hat{\mu}_2 - \hat{\mu}_1) \quad \text{where } C^* = \text{Scalar}$$

$$\Rightarrow \hat{\beta} = C^{**} \hat{\Sigma}^{-1}(\hat{\mu}_2 - \hat{\mu}_1) \quad \text{where } C^{**} = \frac{C^*}{N-2} = \text{Scalar}$$

$$\Rightarrow \hat{\beta} \propto \hat{\Sigma}^{-1}(\hat{\mu}_2 - \hat{\mu}_1)$$