2.50 The multivariate Student's t-distribution is given by 2.162:

$$St(\mathbf{x}|\boldsymbol{\mu}, \boldsymbol{\Lambda}, \nu) = \frac{\Gamma(\nu/2 + D/2)}{\Gamma(\nu/2)} \frac{|\boldsymbol{\Lambda}|^{1/2}}{(\pi\nu)^{D/2}} \left(1 + \frac{\Delta^2}{\nu}\right)^{-D/2-\nu/2}$$

Applying an approximation to Gamma function as $\nu \to +\infty$ as per this formula where $\Gamma(x+\alpha) = \Gamma(x)x^{\alpha}$ as $x \to +\infty$:

$$= \left(\frac{\nu}{2}\right)^{D/2} \frac{|\boldsymbol{\Lambda}|^{1/2}}{(\pi\nu)^{D/2}} \left(1 + \frac{\Delta^2}{\nu}\right)^{-D/2-\nu/2}$$

$$= \left(\frac{1}{2\pi}\right)^{D/2} \frac{1}{|\boldsymbol{\Lambda}|^{-1/2}} \left(1 + \frac{\Delta^2}{\nu}\right)^{-D/2-\nu/2}$$

$$= \left(\frac{1}{2\pi}\right)^{D/2} \frac{1}{|\boldsymbol{\Lambda}|^{-1/2}} \left(1 + \frac{\Delta^2}{\nu}\right)^{-D/2} \left(1 + \frac{\Delta^2}{\nu}\right)^{-\nu/2}$$

Using the limit $lim_{x\to+\infty}(1+1/x)^x = e$ from link, when we apply $\nu \to +\infty$, we get:

$$= \left(\frac{1}{2\pi}\right)^{D/2} \frac{1}{|\boldsymbol{\Lambda}|^{-1/2}} \left(1 + \frac{\Delta^2}{\nu}\right)^{-D/2} \left(\left(1 + \frac{\Delta^2}{\nu}\right)^{\nu/\Delta^2}\right)^{-\Delta^2/2}$$

$$= \left(\frac{1}{2\pi}\right)^{D/2} \frac{1}{|\boldsymbol{\Lambda}|^{-1/2}} (1)^{-D/2} e^{-\Delta^2/2}$$

$$= \left(\frac{1}{2\pi}\right)^{D/2} \frac{1}{|\boldsymbol{\Lambda}|^{-1/2}} exp\left\{-\Delta^2/2\right\}$$

$$= \frac{1}{(2\pi)^{D/2}} \frac{1}{|\boldsymbol{\Lambda}^{-1}|^{1/2}} exp\left\{-\frac{1}{2}(\mathbf{x} - \boldsymbol{\mu})^T \boldsymbol{\Lambda}(\mathbf{x} - \boldsymbol{\mu})\right\}$$

which is a Gaussian distribution comparable to equation 2.43.