4b. $F(x) = \frac{1}{\pi}\arctan\left(\frac{x - x_0}{\gamma}\right) + \frac{1}{2}$

$F^{-1}(x) = \gamma \cdot \tan\left(\pi\left(x - \frac{1}{2}\right)\right) + x_0$

$x_{1/2}$: $\frac{1}{2}$ quantile $= 0.5$
$x_{1/4}$: $1/4$ quantile $= 0.25$
$x_{3/4}$: $3/4$ quantile $= 0.75$

Matching

(i) x_0 : $F^{-1}(x_{1/2}) = \gamma \tan\left(\pi\left(x_{1/2} - \frac{1}{2}\right)\right) + x_0$

$F^{-1}(x_{1/2}) = \gamma \tan\left(\cancel{\pi \cdot \underbrace{\left(0.5 - \frac{1}{2}\right)}_{0}}\right) + x_0$

$= x_0$

Estimates generated from data : 0.0144

$\therefore \; x_0 \approx 0$

(ii) γ : $\frac{F^{-1}(x_{3/4}) - F^{-1}(x_{1/4})}{2} = \frac{1}{2}\left[\gamma \tan\left(\pi\left(x_{3/4} - \frac{1}{2}\right)\right) + \cancel{x_0} - \gamma \tan\left(\pi\left(x_{1/4} - \frac{1}{2}\right)\right) + \cancel{x_0}\right]$

$= \frac{\gamma}{2}\left[\tan\left(\pi\left(0.75 - \frac{1}{2}\right)\right) - \tan\left(\pi\left(0.25 - \frac{1}{2}\right)\right)\right]$

$= \frac{\gamma}{2}\left[\tan(\pi(0.25)) - \tan(\pi(-0.25))\right]$

$= \frac{\gamma}{2}[\approx 2] \rightarrow \gamma$

Estimates generated from data : 1.915

$\therefore \; \gamma \approx 2$