## [nex80] Generating exponential and Lorentzian random numbers

Given is a sequence of uniformly distributed random numbers $x_1, x_2, \ldots$ with $0 < x_i < 1$ as produced by a common random number generator.

(a) Find the transformation $Z = Z(X)$ which produces a sequence of random numbers $z_1, z_2, \ldots$ with an exponential distribution:

$$P_Z(z) = \frac{1}{\zeta} e^{-z/\zeta}, \quad \zeta > 0.$$

(b) Find the transformation $Y = Y(X)$ which produces a sequence of random numbers $y_1, y_2, \ldots$ with a Lorentzian distribution:

$$P_Y(y) = \frac{1}{\pi} \frac{a}{y^2 + a^2}, \quad a > 0.$$

**Solution:**