1. WCDR Analytic Formula

WCDR(Worst Case Default Rate)

$$\mathrm{WCDR}(1y, \alpha, \mathrm{PD}, \rho) = N\left(\frac{\left(N^{-1}(PD) + \sqrt{\rho}N^{-1}(1-\alpha)\right)}{\sqrt{1-\rho}}\right)$$

$$\mathrm{UnExpected\ \ Loss} = \mathrm{F} \times \mathrm{WCDR} \times \mathrm{LGD}$$

$$\mathrm{Expected\ \ Loss} = \mathrm{F} \times \mathrm{PD} \times \mathrm{LGD}$$

$$\mathrm{Risk\ \ Capital} = (\mathrm{UEL} - \mathrm{EL}) \times Maturity_{Adj}$$

$$\beta = \left(0.11852 - 0.05478 \cdot \mathrm{Ln}(\mathrm{PD})\right)^2$$

$$\mathrm{Maturity_{Adj}} = \frac{1+(\mathrm{R}-2.5)\times\beta}{1-1.5\times\beta}$$