Note: μ is the observed expectation value, and σ is the standard error of μ.
For $\mu > 0$ condition:

$$\begin{aligned}
P(x \geq 0|\mu_{opt}) = & \quad \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu_{opt})^2}{2\sigma^2}} = P(x \geq 0|\mu_{opt} = x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-x)^2}{2\sigma^2}} & = \frac{1}{\sigma\sqrt{2\pi}} \\
P(x < 0|\mu_{opt}) = & \quad \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu_{opt})^2}{2\sigma^2}} = P(x < 0|\mu_{opt} = 0) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-0)^2}{2\sigma^2}} & = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{x^2}{2\sigma^2}} \\
R(x \geq 0) = & \quad P(x \geq 0|\mu)/P(x \geq 0|\mu_{opt}) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}/\frac{1}{\sigma\sqrt{2\pi}} & = e^{-\frac{(x-\mu)^2}{2\sigma^2}} \\
R(x < 0) = & \quad P(x < 0|\mu)/P(x < 0|\mu_{opt}) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}/\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{x^2}{2\sigma^2}} & = e^{\frac{2x\mu-\mu^2}{2\sigma^2}}
\end{aligned}$$

$$\begin{aligned}
-x_u^2 + 2x_u\mu - \mu^2 = 2x_l\mu - \mu^2 \\
\Rightarrow -x_u^2 + 2x_u\mu = 2x_l\mu \\
\Rightarrow x_l = x_u - \frac{x_u^2}{2\mu}
\end{aligned}$$

For $\mu < b$ condition:

$$\begin{aligned}
P(x \leq b|\mu_{opt}) = & \quad P(x \leq b|\mu_{opt} = x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-x)^2}{2\sigma^2}} & = \frac{1}{\sigma\sqrt{2\pi}} \\
P(x > b|\mu_{opt}) = & \quad P(x > b|\mu_{opt} = b) & = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-b)^2}{2\sigma^2}} \\
R(x \leq b) = & \quad P(x \leq b|\mu)/P(x \geq 0|\mu_{opt}) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}/\frac{1}{\sigma\sqrt{2\pi}} & = e^{-\frac{(x-\mu)^2}{2\sigma^2}} \\
R(x > b) = & \quad P(x > b|\mu)/P(x < 0|\mu_{opt}) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}/\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-b)^2}{2\sigma^2}} & = e^{\frac{(2x-(\mu+b))(\mu-b)}{2\sigma^2}}
\end{aligned}$$

$$\begin{aligned}
-x_u^2 + 2x_u\mu - \mu^2 = 2x_l(\mu - b) - \mu^2 + b^2 \\
\Rightarrow -x_u^2 + 2x_u\mu - b^2 = 2x_l(\mu - b) \\
\Rightarrow x_l = \frac{2x_u\mu - x_u^2 - b^2}{2(\mu - b)}
\end{aligned}$$