**Theorem 1** (ISHA Guarantee)**.** *Fix $\delta \in (0,1)$. Under Assumptions 1 and 2, for any $\epsilon > 0$ define*

$$\begin{aligned}
z_{n,\epsilon} :=& \frac{\log(2\log_2(n)/\delta)}{\nu_0(\mu_* + \epsilon)} \max\left\{1, 64R\log(4n\log_2(n)/\delta) \sup_{x \geq \mu_*+\epsilon} (x-\mu_*)^{-2}\nu_0(x)\right\} \\
\leq& \log(2\log_2(n)/\delta) \max\Bigg\{\frac{1}{\nu_0(\mu_*+\epsilon)}, \\
& 64R\log(4n\log_2(n)/\delta)\left(\epsilon^{-2} + \frac{1}{\nu_0(\mu_*+\epsilon)}\int_{x=\mu_*+\epsilon}^{\infty} \frac{1}{(x-\mu_*)^2} d\nu_0(x)\right)\Bigg\}.
\end{aligned}$$

*If ISHA is run with $n$ arms and $T = \lceil n\log_2(n)\rceil$ total pulls where $n \geq z_{n,\epsilon}$ then with probability at least $1-\delta$ the single arm returned is no greater than $\mu_* + \epsilon$.*

**Theorem 2** (ISHA Guarantee, $\alpha$ version)**.** *Fix $\delta \in (0,1)$. Under Assumptions 1 and 2, for any $\epsilon > 0$ define $\alpha = \nu_0(\mu_* + \epsilon)$ and*

$$\begin{aligned}
z_{n,\epsilon} :=& \frac{1}{\alpha}\log\left(\frac{2\lg(n)}{\delta}\right) \max\left\{1, 64R\log\left(\frac{4n\lg(n)}{\delta}\right) \sup_{x \geq \mu_*+\epsilon} (x-\mu_*)^{-2}\nu_0(x)\right\} \\
\leq& \log\left(\frac{2\lg(n)}{\delta}\right) \max\Bigg\{\frac{1}{\alpha}, \\
& 64R\log\left(\frac{4n\lg(n)}{\delta}\right)\left(\frac{1}{\epsilon^2} + \frac{1}{\alpha}\int_{x=\mu_*+\epsilon}^{\infty} \frac{1}{(x-\mu_*)^2} d\nu_0(x)\right)\Bigg\}.
\end{aligned}$$

*If ISHA is run with $n$ arms and $T = \lceil n\log_2(n)\rceil$ total pulls where $n \geq z_{n,\epsilon}$ then with probability at least $1-\delta$ the single arm returned is no greater than $\mu_* + \epsilon$.*

Number of arms required satisfies both of:

$$n \geq \frac{1}{\alpha}\log\left(\frac{2\lg(n)}{\delta}\right) \tag{1}$$

$$n \geq 64R\log\left(\frac{2\lg(n)}{\delta}\right)\log\left(\frac{4T}{\delta}\right)\left(\frac{1}{\epsilon^2} + \frac{1}{\alpha}\int_{x=\mu_*+\epsilon}^{\infty} \frac{1}{(x-\mu_*)^2} d\nu_0(x)\right) \tag{2}$$