

Simplifying Regret

	Mean reward upon head	Loss w.r.t. best coin (Red in this case)	No. of times tossed
Coin 1	μ_1	0	$N_1(T)$
Coin 2	μ_2	$\mu_1 - \mu_2 = \Delta_2$	$N_2(T)$
⋮	⋮	⋮	⋮
Coin K	μ_K	$\mu_1 - \mu_K = \Delta_K$	$N_K(T)$

$$\text{Total expected reward} = \mu_1 \times \mathbb{E}[N_1(T)] + \mu_2 \times \mathbb{E}[N_2(T)] + \cdots + \mu_K \times \mathbb{E}[N_K(T)]$$

$$\text{Total expected regret} = 0 \times \mathbb{E}[N_1(T)] + \Delta_2 \times \mathbb{E}[N_2(T)] + \cdots + \Delta_K \times \mathbb{E}[N_K(T)]$$

Formal definition of regret

- **Over T iterations:** $\mu^\star =$ maximum mean among the arms (coins in this case)
- X_t be the outcome of the t -th coin toss
- **Regret over T iterations is**

$$\begin{aligned}\text{Reg}_T &= T \times \mu^\star - \text{Total expected reward} \\ &= T \times \mu^\star - \mathbb{E}[X_1 + X_2 + \cdots + X_T]\end{aligned}$$