Mitigating the Curse of Horizon in Monte-Carlo Returns

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Financial Analysts

Goal: We want $\mathcal{R} : \tilde{X} \to \mathbb{R}$ that represents the "hazard" for $\tilde{X} : \Omega \to \mathbb{R}$

Insurance Providers

Goal: We want $\mathcal{D} : \tilde{X} \to \mathbb{R}$ that represents the "uncertainty" for $\tilde{X} : \Omega \to \mathbb{R}$

ML Practitioners

Goal: We want $\mathcal{E} : \tilde{X} \to \mathbb{R}$ that represents the "non-zeroness" for $\tilde{X} : \Omega \to \mathbb{R}$

Risk Quadrangle

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Goal: We want $\mathcal{E} : \tilde{X} \to \mathbb{R}$ that represents the "non-zeroness" for $\tilde{X} : \Omega \to \mathbb{R}$

Observation: The three goals are not independent

Risk Quadrangle

$$
\begin{array}{ccccccc}
 & \text{risk} & \mathcal{R} & \longleftrightarrow & \mathcal{D} & \text{deviation} & \\
\text{optimization} & & \uparrow\downarrow & \mathcal{S} & \downarrow\uparrow & & \text{estimation} \\
 & \text{regret} & \mathcal{V} & \longleftrightarrow & \mathcal{E} & \text{error} &
\end{array}
$$

Diagram 1: The Fundamental Risk Quadrangle

Risk Quadrangle

$\mathcal{R}(X)$ provides a numerical surrogate for the overall hazard in X,
$\mathcal{D}(X)$ measures the “nonconstancy” in X as its uncertainty,
$\mathcal{E}(X)$ measures the “nonzeroness” in X,
$\mathcal{V}(X)$ measures the “regret” in facing the mix of outcomes of X,
$\mathcal{S}(X)$ is the “statistic” associated with X through $\mathcal{E}$ and $\mathcal{V}$.

Diagram 2: The Quantifications in the Quadrangle.

Risk Quadrangle

Today: we focus on what relates all of these measures

$\mathcal{R}(\tilde{X})$

How should we give meaning to the statement

$$\tilde{X} \text{ "adequately" } \leq C$$

$$\mathbb{E}(\tilde{X}) \leq C$$

$$\mathbb{E}(\tilde{X}) + \lambda\sigma(\tilde{X}) \leq C$$

$$q_\alpha(\tilde{X}) \leq C$$

$$\sup(\tilde{X}) \leq C$$

$\mathcal{D}(\tilde{X})$

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