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3. The Probability Simplex of Discrete Distributions

The Probability Simplex

Discrete distribution



Let $E = \{a_1, \dots, a_K\}$ be a finite space and $(\mathbb{P}_{\mathbf{p}})_{\mathbf{p} \in \Delta_K}$ be the family of all probability distributions on E :

$$p_j = \mathbb{P}[X = a_j]$$

$$\Delta_K = \left\{ \mathbf{p} = (p_1, \dots, p_K) \in (0, 1)^K : \sum_{j=1}^K p_j = 1 \right\}.$$

► For $\mathbf{p} \in \Delta_K$ and $X \sim \mathbb{P}_{\mathbf{p}}$,

$$\mathbb{P}_{\mathbf{p}}[X = a_j] = p_j, \quad j = 1, \dots, K.$$

▶ 2:23 / 2:23

▶ 1.50x



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The Probability Simplex in K Dimensions :

The probability simplex in \mathbb{R}^K , denoted by Δ_K , is the set of all vectors $\mathbf{p} = [p_1, \dots, p_K]^T$ (note that we are using subscripts for vector indices for simplicity) such that

$$\mathbf{p} \cdot \mathbf{1} = \mathbf{p}^T \mathbf{1} = 1, \quad p_i \geq 0 \text{ for all } K$$

where $\mathbf{1}$ denotes the vector $\mathbf{1} = (1 \ 1 \ \dots \ 1)^T$. Equivalently, in more familiar notation,

$$\Delta_K = \left\{ \mathbf{p} = (p_1, \dots, p_K) \in [0, 1]^K : \sum_{i=1}^K p_i = 1 \right\}.$$

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