Lecture 8: The Monte Carlo method for estimating expectations

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Estimating the variance

Estimating the variance

- Take a random variable $X \sim p(x)$ and some function $g(x)$.
- We would like to estimate the variance:

$$V = \mathbb{V}[g(X)] = \mathbb{E}\left[\left(g(X) - \mathbb{E}[g(X)]\right)^2\right] = \mathbb{E}\left[\left(g(X) - I\right)^2\right]$$

known from previously

- Note that:

$$V = \mathbb{V}[g(X)] = \mathbb{E}[g^2(X)] - I^2$$

Estimating the variance

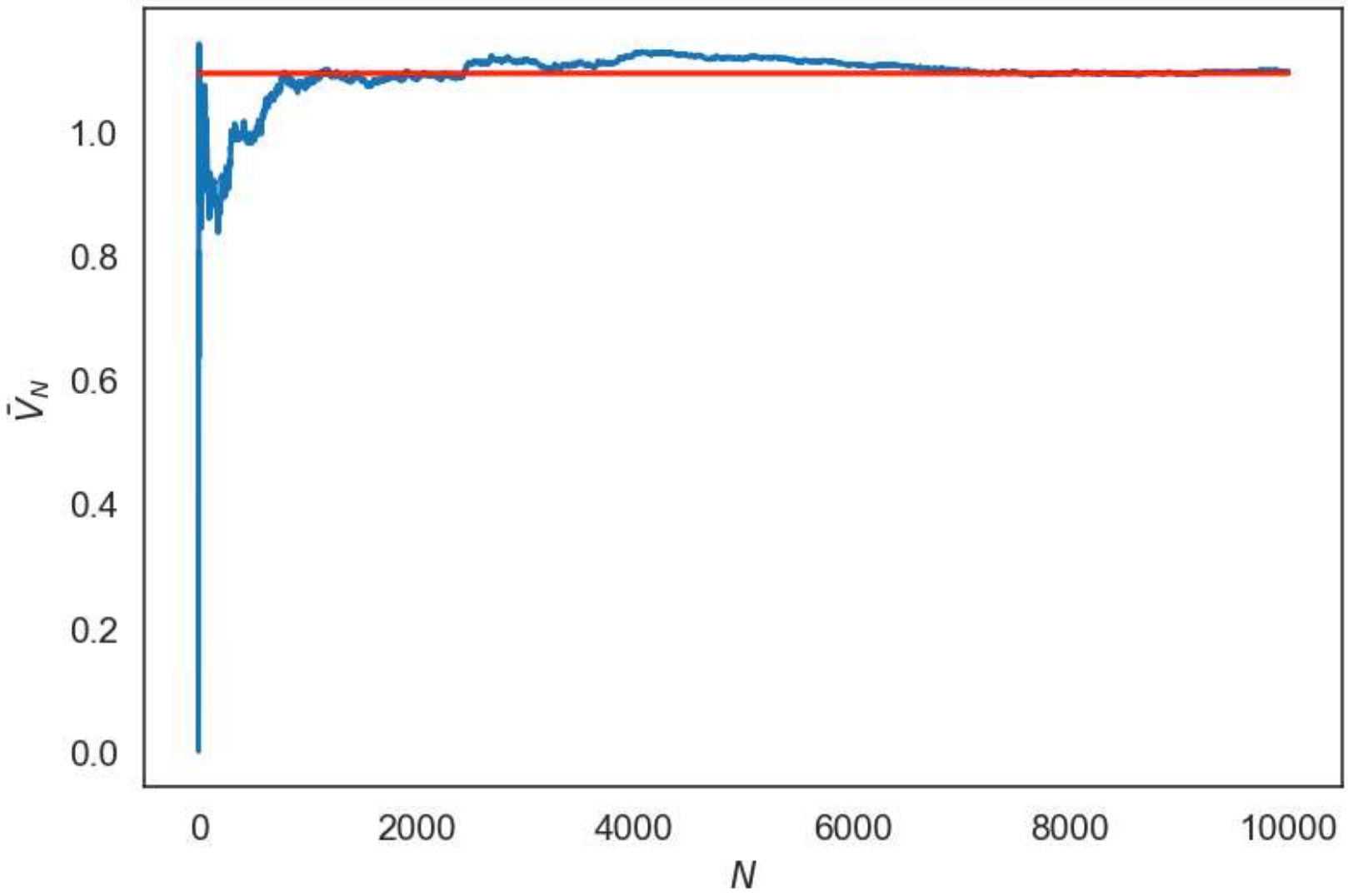
- Take $X_1, X_2, \ldots$ independent identical copies of X.
- Estimate the mean using a sample average:

$$\bar{I}_N = \frac{1}{N} \sum_{i=1}^{N} g(X_i)$$

- Estimate the variance by:

$$\bar{V}_N = \frac{1}{N} \sum_{i=1}^{N} g^2(X_i) - \bar{I}_N^2$$

Example: 1D variance



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