Monte Carlo vs Variational Inference

Monte Carlo

$$\mathbb{E}_{p(x)}\, f(x) \approx \frac{1}{M} \sum_{s=1}^{M} f(x_s)$$

$$x_s \sim p(x)$$

Unbiased estimate (larger M => better accuracy)

$$\mathbb{E}_{p(x)} \frac{1}{M} \sum_{s=1}^{M} f(x_s) = \mathbb{E}_{p(x)}\, f(x)$$