

$$\begin{aligned}1.) \mathbb{E}[(x - \mathbb{E}[x])^2] &= \int (x - \mathbb{E}[x])^2 p(x) dx \\&= \int (x^2 - 2x\mathbb{E}[x] + (\mathbb{E}[x])^2) p(x) dx \\&= \int x^2 p(x) dx + \int (-2x\mathbb{E}[x] + (\mathbb{E}[x])^2) p(x) dx \\&= \mathbb{E}[x^2] + \int \mathbb{E}[x](-2x + \mathbb{E}[x]) p(x) dx \\&= \mathbb{E}[x^2] + \mathbb{E}[x](-2\mathbb{E}[x] + \mathbb{E}[x]) \\&= \mathbb{E}[x^2] - (\mathbb{E}[x])^2\end{aligned}$$