

Remark 0.0.1. One can show that $X - \mathbb{E}(X|\mathcal{G})$ is orthogonal to $\mathbb{E}(X|\mathcal{G})$. That is,

$$\mathbb{E}[(X - \mathbb{E}(X|\mathcal{G})) \cdot \mathbb{E}(X|\mathcal{G})] = 0.$$