

$$\begin{aligned} V_t &= E \left\{ \sum_{k=1}^{\infty} \gamma^{k-1} r_{t+k} \right\} \\ &= E \left\{ r_{t+1} + \gamma \sum_{k=1}^{\infty} \gamma^{k-1} r_{t+1+k} \right\} \\ &\approx r_{t+1} + \gamma V_{t+1} \end{aligned}$$

$$TD\ error_t = r_{t+1} + \gamma V_{t+1} - V_t$$