

Recall the game

- Flip a coin
- If heads, roll one die, X is value
- If tails, roll two dice, X is the sum of the dice.
- Compute $\mathbb{E}[X]$

$$\begin{aligned}\mathbb{E}[X] &= \mathbb{E}[X|H]\mathbb{P}(H) + \mathbb{E}[X|T]\mathbb{P}(T) \\ &= \frac{7}{2} \cdot \frac{1}{2} + 7 \cdot \frac{1}{2} \\ &= \frac{7}{4} + \frac{7}{2} = \frac{21}{4}.\end{aligned}$$