Q2 Win → W
Loss → L

Transition matrix = $\begin{bmatrix} 0.8 & 0.2 \\ 0.3 & 0.7 \end{bmatrix}$

Let stationary distribution be

$\pi = [\pi_W, \pi_L]$

Solving $\pi P = \pi$ gives:-

$\pi_W = 0.6$ & $\pi_L = 0.4$

(a) Long run proportion of wins $= 0.6$

(b) Proportion of dinners:

$0.6 \times 0.7 + 0.4 \times 0.2 = 0.5$

(c) $E[\text{no. of games for dinner}] = \frac{1}{0.5} = 2$

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Q3
(a) Cat's transition matrix $= \begin{bmatrix} 0.2 & 0.8 \\ 0.8 & 0.2 \end{bmatrix}$

$\pi_{cat} = [0.5 \ \ 0.5]$

Mouse's transition matrix $= \begin{bmatrix} 0.7 & 0.3 \\ 0.6 & 0.4 \end{bmatrix}$

$\pi_{mouse} = \left[\frac{2}{3}, \frac{1}{3}\right]$

(b) Since cat and mouse move independently

$Z_n = (cat, mouse)$
is a markov chain in 4^{th} stage