

2) The equations determining $(\pi_0, \pi_1, \pi_2, \pi_3)$ are

$$\begin{cases} 0.75\pi_0 + 0.65\pi_2 = \pi_0 & \Rightarrow \pi_2 = \frac{5}{13}\pi_0 \\ 0.25\pi_0 + 0.35\pi_2 = \pi_1 & \Rightarrow \pi_1 = \frac{5}{13}\pi_0 \\ \cancel{0.35\pi_1 + 0.25\pi_3 = \pi_2} & \text{Strike this.} \\ 0.65\pi_1 + 0.75\pi_3 = \pi_3 & \Rightarrow \pi_3 = \pi_0 \end{cases}$$

with $\pi_0 + \pi_1 + \pi_2 + \pi_3 = 1$

$$\Rightarrow \pi_0 + \frac{5}{13}\pi_0 + \frac{5}{13}\pi_0 + \pi_0 = 1 \Rightarrow \pi_0 = \frac{13}{36}$$

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$$\Rightarrow \pi_0 = \pi_3 = \frac{13}{36}, \quad \pi_1 = \pi_2 = \frac{5}{36}$$

$$\Rightarrow (\pi_0, \pi_1, \pi_2, \pi_3) = \left(\frac{13}{36}, \frac{5}{36}, \frac{5}{36}, \frac{13}{36}\right)$$

So the fraction of days in which the stock increases is

$$\pi_0 + \pi_1 = \frac{13}{36} + \frac{5}{36} = \frac{18}{36} = \frac{1}{2}$$

3) The above calculation implies that the fraction of days in which the stock decreases is

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$$\pi_2 + \pi_3 = \frac{5}{36} + \frac{13}{36} = \frac{18}{36} = \frac{1}{2}$$