Numer.AI Assignment 1

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1 Problem 1

Given the resonating property of the Bazooka gun, it will try to transmit x signals per second in the next state, if it had been transmitting x signals per second currently. But there might be fluctuations in this behavious.

1.1 Modelling as a Markov Process

So to model the above problem as a Markov chain with infinite states, we need to define the set of states and a transition matrix. The set of states are labeled as $0, 1, 2, \ldots, \infty$ where each state represents the number of signals transmitted per second.

Now to get the transition matrix, we need to model the transition probabilities. Given that the Bazooka is in state x, it will try to remain in state x but could transmit more or lesser signals later. So it is reasonable to assume a poisson PMF, with the average number of signals transmitted per second being x.

So the transition matrix will have each term as follows

$$\begin{bmatrix} 1 & 0 & 0 & \cdots \\ \frac{1^0 e^{-1}}{0!} & \frac{1^1 e^{-1}}{1!} & \frac{1^2 e^{-1}}{2!} & \cdots \\ \frac{2^0 e^{-2}}{0!} & \frac{2^1 e^{-2}}{1!} & \frac{2^2 e^{-2}}{2!} & \cdots \\ \frac{3^0 e^{-3}}{0!} & \frac{3^1 e^{-3}}{1!} & \frac{3^2 e^{-3}}{2!} & \cdots \\ \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

In general, except for i = 0;

$$P_{ij} = \frac{i^j e^{-i}}{j!}$$

where P_{ij} represents the probability of transition from the i_{th} state to the j_{th} state.