IF STATE SPACE OF X IS DISCRETE,

X IS A DISCRETE RANDOM VARIABLE.

$$p_X(x) = \mathbb{P}(X = x)$$

MOMENTS

$$E[X^n] = \sum_{i \in S} i^n p_X(i)$$

STATE SPACE

ZEROTH MOMENT

$$E[X^0] = \sum_{i \in S} i^0 p_X(i) = 1$$

FIRST MOMENT

$$E[X] = \sum_{i \in S} i\, p_X(x) = \text{MEAN}$$

$$\mu_X$$

SECOND MOMENT

$$E[X^2] = \sum i^2 p_X(x)$$

$$E[(X-\mu)^2] = \text{VARIANCE}$$

σ_X^2

σ_X - STANDARD DEVIATION

FAMOUS DISCRETE RANDOM VARIABLES

- BERNOULLI

$X = 0 \quad \mathbb{P}(X=0) = 1-p$

$X = 1 \quad \mathbb{P}(X=1) = p$

$$E[X] = p$$

STOCHASTIC PROCESS OF INDEPENDENT IDENTICAL BERNOULLI RANDOM VARIABLES

$$X_t = [0\ 0\ \overbrace{0\ 1\ 1\ 0\ 1\ 0\ 0}^{n}\ 0 \ldots]$$

- GEOMETRIC

STATE SPACE

$$p_X(k) = (1-p)^{k-1}\cdot p \qquad k = \cancel{0}, 1, 2, 3, \ldots$$

ATTEMPTS BEFORE FIRST SUCCESS

$$\boxed{E[X] = \frac{1}{p}}$$ — PS2

- BINOMIAL

$$p_X(k) = \binom{n}{k} p^k (1-p)^{n-k}$$

OF SUCCESSES IN A SERIES OF n

PS2

$$\begin{bmatrix} p_A(t+1) \\ p_B(t+1) \end{bmatrix} = \begin{bmatrix} p_{A\to A} & p_{B\to A} & p_{C\to A} \\ p_{A\to B} & p_{B\to B} & p_{C\to B} \end{bmatrix} \begin{bmatrix} p_A(t) \\ p_B(t) \end{bmatrix}$$

$$\begin{bmatrix} P_C\,(t+1) \end{bmatrix} \quad \begin{bmatrix} \underbrace{P_{A \to C}}_{\text{COLUMNS } \Sigma = 1} & P_{C \to C} & P_{C \to C} \end{bmatrix} \begin{bmatrix} P_C(t) \end{bmatrix}$$

$$\begin{array}{c c}
\begin{array}{cccccc} S & E1 & E2 & E3 & I & END \end{array} & \\
\begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & & & 0 \\
0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & & & 0 \\
0 & 0 & 0 & & 0 & 1^{?}
\end{bmatrix} & \begin{array}{c} S \\ E1 \\ E2 \\ E3 \\ I \\ END \end{array}
\end{array}$$