IF STATE SPACE IS DISCRETE, X IS
A DISCRETE RANDOM VARIABLE

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

NOTATION $\qquad X \sim p_X(x)$ $\qquad \approx$

MOMENTS

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

$\nwarrow$ STATE SPACE

ZEROTH MOMENT

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

FIRST MOMENT

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

SYMBOL μ_X

SECOND MOMENT

$$E[X^2] = \sum_{i \in S} i^2 p_X(i) =$$

$$E[X^2] - \mu_x^2 = E[(x-\mu)^2]$$

$$= \text{VARIANCE}$$
$$\text{SYMBOL } \sigma_x^2$$

$$\sigma_x = \sqrt{\sigma_x^2} \qquad \text{STANDARD DEVIATION}$$

FAMOUS DISCRETE RANDOM VARIABLES

- UNIFORM BETWEEN a, AND b

- BERNOULLI $\quad X = 0 \quad P(X=0) = p_x(0) = 1-p$
  $$X = 1 \quad P(X=1) = p_x(1) = p$$

$$E[X] = p$$

STOCHASTIC PROCESS OF INDEPENDENT
BERNOULLI TRIALS

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

- GEOMETRIC

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

\# ATTEMPTS IN A SERIES OF
BERNOULLI TRIALS UNTIL FIRST

SUCCESS $X=1$

$$E[X] = \frac{1}{P}$$

• BINOMIAL

"CHOOSE"

$$P_X(k) = \binom{n}{k} P^k (1-k)^{n-k}$$

OF SUCCESSES $(X=1)$ IN A SERIES OF n BERNOULLI TRIALS

RECAP

$$\begin{bmatrix} P_A(t+1) \\ P_B(t+1) \\ P_C(t+1) \end{bmatrix} = \begin{bmatrix} P_{A\to A} & P_{B\to A} & P_{C\to A} \\ P_{A\to B} & P_{B\to B} & P_{C\to B} \\ P_{A\to C} & P_{B\to C} & P_{C\to C} \end{bmatrix} \cdot \begin{bmatrix} P_A(t) \\ P_B(t) \\ P_C(t) \end{bmatrix}$$

$M =$

COLUMNS MUST SUM TO UNITY

ASIDE REDNER

$$M \vec{P}^{t+1} = \vec{P}^t$$

TRANSPOSE!

$$\vec{P}^{t+1} = M \cdot \vec{P}^t$$

PS 2

	S	E1	E2	E3	I	END	
	0	0	0			0	S
	1	0	0	(E3→E1)		0	E1
	0	1	0			0	E2
	0	0	1			0	E3
	0	0	0			0	I
	0	0	0			1	END