

Hi AGAIN!

$X$  - STATE SPACE OF NUMBERS

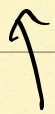
~ DISCRETE NUMBERS

$\{0, 1, 2, 3, \dots\}$

$X_t$   $\hookleftarrow$  INDEX - TIME

INDEX SET - DISCRETE

CONTINUOUS



STOCHASTIC PROCESS

$$p_x(i) = \mathbb{P}(X=i)$$

PROBABILITY MASS

PROBABILITY DISTRIBUTION

$$X \sim p_x(i)$$

MOMENTS

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

$\wedge$  STATE SPACE

ZEROth

0-th MOMENT

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

1st MOMENT

$$E[X] = \sum_{i \in S} i p_x(i) = \mu$$

EXPECTED VALUE

MEAN



2ND MOMENT  $E[X^2]$

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

$$= E[X^2] - \mu^2$$

VARIANCE

$\sigma$  - STANDARD  
DEVIATION

## FAMOUS DISCRETE RANDOM VARIABLES

• UNIFORM

• BERNOLLI

$$X = 0$$

$$1-p$$

$$X = 1$$

$$p$$

$$p \in [0, 1]$$

$$E[X] = p$$

STOCHASTASTIC PROCESS

$$X_t = \{0, 1, 1, 0, 0, 0, 1, 1, \dots\}$$

• GEOMETRIC

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

$$= P(X=k)$$

$$p \in [0, 1]$$

# ATTEMPTS IN SERIES OF BERNOLLI'S  
BEFORE  $X_t = 1$

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



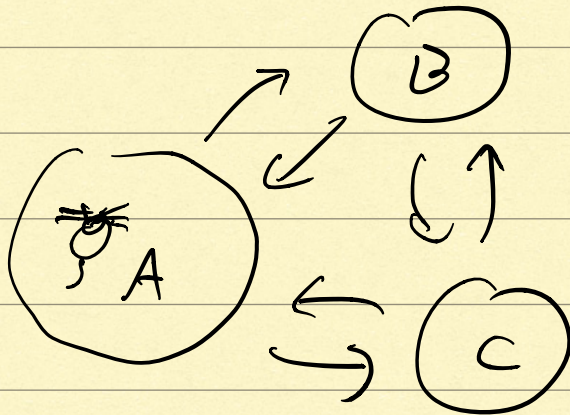
• BINOMIAL

$$p_X(k) = \binom{n}{k} p^k (1-p)^{n-k} \quad p \in [0,1]$$

$n$

# SUCCESSSES IN A SERIES OF  $n$  BERNOLLIIS.

## MARKOV CHAINS



$X_t$  - ROOM MOUSE  
IS IN AT  
TIME  $t$

ASSUMPTION

$$P(X_t = i \mid X_{t-1} = j, X_{t-2} = k \dots)$$

$$= P(X_t = i \mid X_{t-1} = j)$$

$$M = \begin{bmatrix} p_{11} & p_{13} \\ & p_{33} \end{bmatrix}$$

TRANSITION  
MATRIX

$$p_{ij} = P(X_{t+1} = i \mid X_t = j)$$



$$\begin{bmatrix} p_A(t+1) \\ p_B(t+1) \\ p_C(t+1) \end{bmatrix} = M \cdot \begin{bmatrix} p_A(t) \\ p_B(t) \\ p_C(t) \end{bmatrix} / \begin{bmatrix} p_A(0) \\ p_B(0) \\ p_C(0) \end{bmatrix}$$

DNA

