✓ WELCOME !

✓ ME, YOU

✓ PREMISE

    SYLLABUS

    SCHEDULE ← $\underset{=}{WK2}$

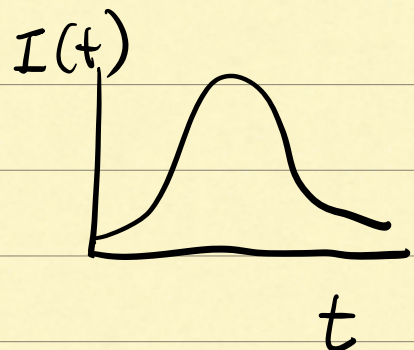   PROBLEM SETS

    GITHUB
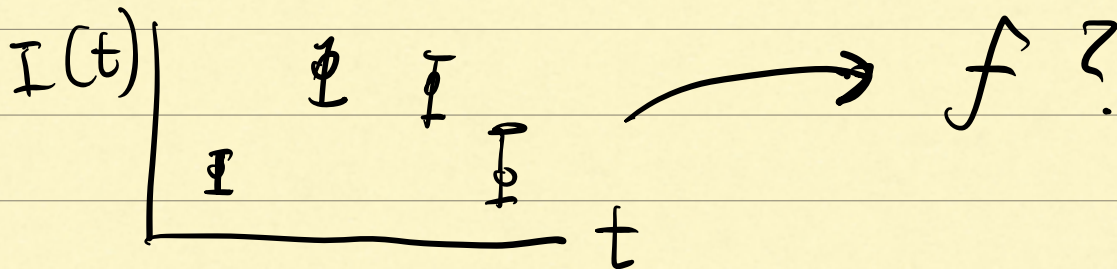
    AXIOMS OF
        PROBABILITY

     PS 1

MATH 227C:

   STOCHASTIC & STATISTICAL MODELING

     IN THE LIFE SCIENCES

$$\frac{d}{dt} \begin{bmatrix} S \\ E \\ I \\ R \end{bmatrix} = f(S, E, I, R)$$

INFECTED

$I(t)$ vs t

1   MODEL COMPLEXITY

$I(t)$ $\longrightarrow$ f ?

    t

2   FITTING, LEARNING THE MODEL

I

INTEGERS

EXTINCTION
TIME
3   DISTRIBUTION? MEAN?

AXIOMS OF PROBABILITY

X - RANDOM VARIABLE

$X \in$ STATE SPACE OR SAMPLE SPACE

EX. FLIP A COIN $\{H, T\}$
ROLL A DIE $\{1, 2, 3, 4, 5, 6\}$

ELEMENTS AND SETS IN THE STATE SPACE
ARE CALLED <u>EVENTS</u>.

EVENTS CAN BE COMBINED

$$e_1 \cup e_2 \qquad e_1 \cap e_2$$

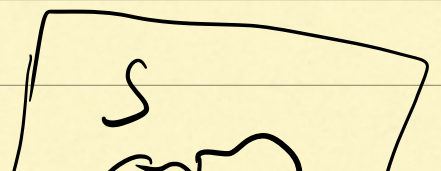UNION   INTERSECT
"OR"   "AND"

S - SAMPLE SPACE

$S \backslash e$ COMPLEMENT
"NOT"

X HAS A PROBABILITY FUNCTION

$$\mathbb{P}(e)$$

$. \quad 0 \leq \mathbb{P}(e)$

- $\mathbb{P}(S) = 1$

- IF $e_1 \cap e_2 = $ NOTHING THEN

$$\mathbb{P}(e_1 \cup e_2) = \mathbb{P}(e_1) + \mathbb{P}(e_2)$$

$\Rightarrow$ $\mathbb{P}(e) \leq 1$
$\mathbb{P}(\text{NOTHING}) = 0$

EX   FAIR DIE   SAMPLE SPACE =
$$\{1, 2, 3, 4, 5, 6\}$$

$e_A = \{ \text{EVEN} \} = \{2, 4, 6\}$

$e_B = \{ <3 \} = \{1, 2\}$

$$\mathbb{P}(e_A \cup e_B) = \mathbb{P}(\{1, 2, 4, 6\}) = \frac{4}{6}$$

$$\mathbb{P}(e_A) + \mathbb{P}(e_B) = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$$

CONDITIONAL PROBABILITY OF A GIVEN B

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

EX $P(e_A | e_B) = \frac{P(e_A \cap e_B)}{P(e_B)}$

$$= \frac{\frac{1}{6}}{\frac{2}{6}} = \frac{1}{2}$$

TWO EVENTS ARE <u>INDEPENDENT</u> IF

$$P(A \cap B) = P(A) \cdot P(B)$$

NOTE $P(A|B) = \frac{P(A \cap B)}{P(B)}$

$$= \frac{P(A) \cdot P(B)}{P(B)} = P(A)$$