

Hi!

TO DO
✓ WELCOME!

ME, YOU

PREMISE

SYLLABUS

PROBLEM SETS

GITHUB

AXIOMS OF PROBABILITY

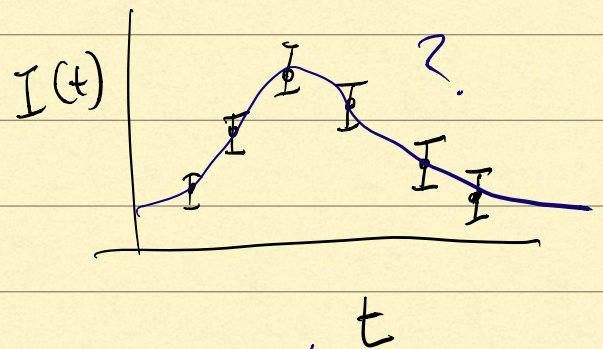
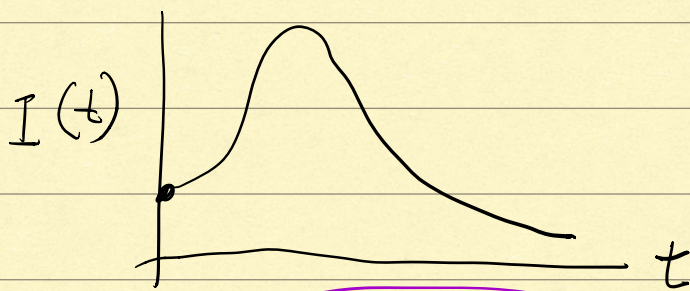
PS 1

WELCOME TO MATH 227C
STOCHASTIC & STATISTICAL MODELING
IN THE LIFE SCIENCES

CONTEXT

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

INFECTED



MODEL COMPLEXITY

SIMPLE \longleftrightarrow COMPLEX

LEARNING
PARAMETERS
&
MODELS



MEAN FIRST PASSAGE TIME

AXIOMS OF PROBABILITY

X - RANDOM VARIABLE

$X \in$ STATE SPACE OR SAMPLE SPACE

EX. FLIP A COIN $\{H, T\}$

ROLL DICE $\{1, 2, 3, 4, 5, 6\}$
 $(0, \infty)$

ELEMENTS AND SETS IN STATE SPACE

ARE EVENTS

EVENTS CAN BE COMBINED

$$e_1 \cup e_2$$

UNION
"OR"

$$e_1 \cap e_2$$

INTERSECT
"AND"

S - STATE
SPACE

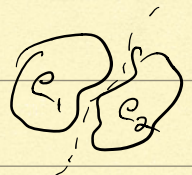
$$S \setminus e$$

COMPLEMENT
"NOT"

X HAS A PROBABILITY FUNCTION

$$P(e)$$

- $0 \leq P(e)$
- $P(S) = 1$
- IF $e_1 \cap e_2 = \text{NOTHING}$ THEN



$$P(e_1 \cup e_2) = P(e_1) + P(e_2)$$

$$P(e) \leq 1 \quad \text{ANY } e$$
$$P(\text{NOTHING}) = 0$$

EX. FAIR DIE



SAMPLE SPACE =

$$\{1, 2, 3, 4, 5, 6\}$$

$$e_A = \{\text{even}\} = \{2, 4, 6\} \Rightarrow P(e_A) = \frac{3}{6}$$

$$e_B = \{< 3\} = \{1, 2\} \Rightarrow P(e_B) = \frac{2}{6}$$

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

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

$$P(e_A \cup e_B) \neq P(e_A) + P(e_B)$$

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 INDEPENDENT IF

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

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

$$= \mathbb{P}(A)$$
