

TODO

✓. WELCOME!

✓. ME, YOU

✓. PREMISE

✓. SYLLABUS

✓. PROBLEM SETS

✓. SCHEDULE

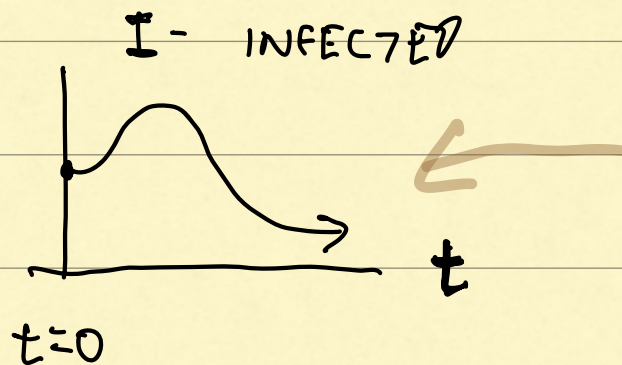
• AXIOMS OF PROBABILITY

• PS1

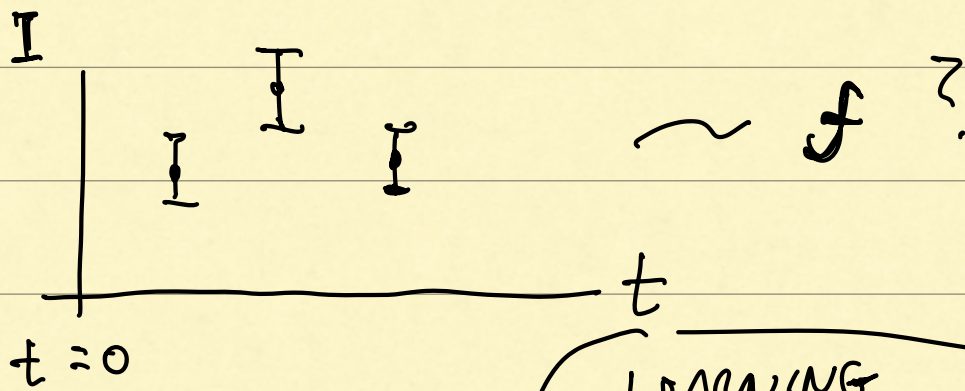
MATH 227C

STOCHASTIC & STATISTICAL

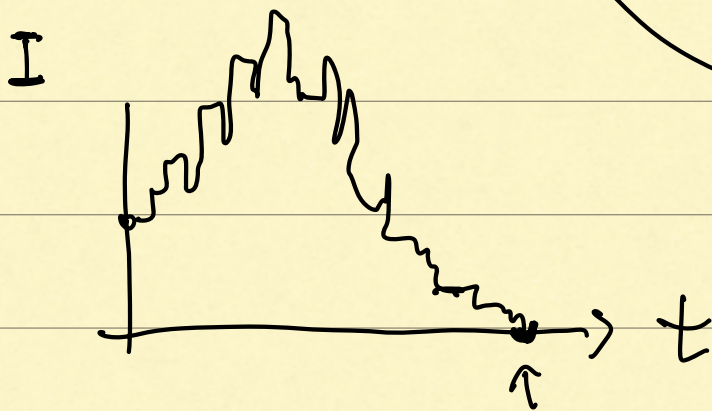
MODELING IN LIFE SCIENCES



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



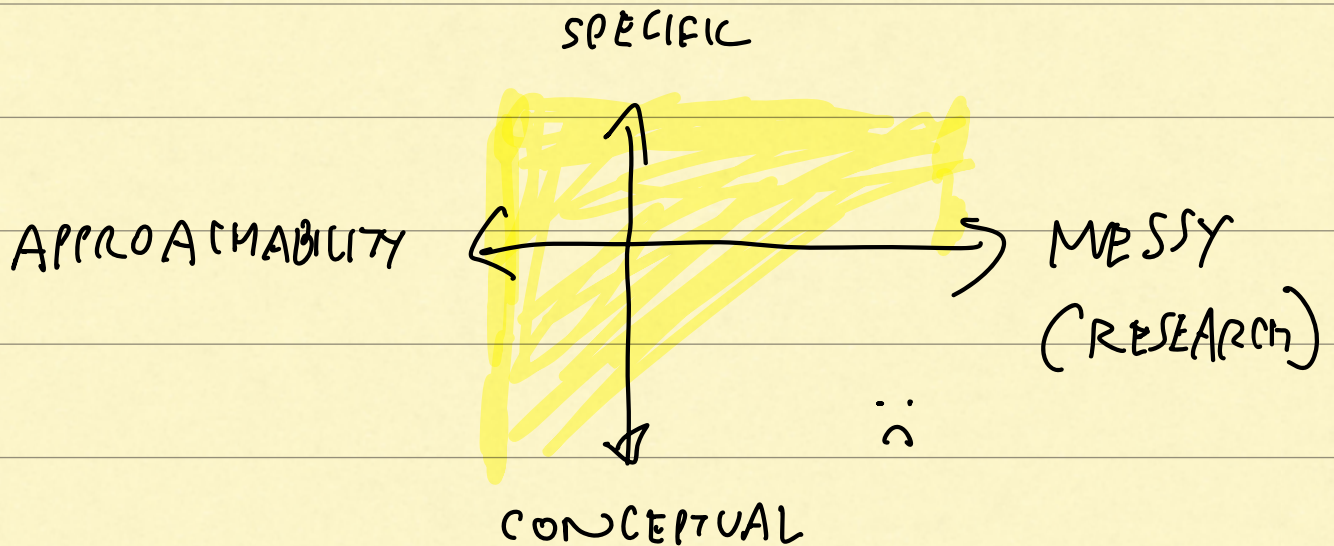
LEARNING,
REGRESSION,
STATISTICS



EXTINCTION

PROBABILISTIC MODELING

APPROACH



AXIOMS OF PROBABILITY

X - RANDOM VARIABLES

X \in STATE SPACE A.K.A SAMPLE SPACE

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

ROLL A DIE $\{1, 2, 3, 4, 5, 6\}$

ELEMENTS AND SUBSETS OF STATE SPACE

ARE CALLED EVENTS.

EVENTS CAN BE COMBINED

$e_1 \cup e_2$

UNION

"OR"

$e_1 \cap e_2$

INTERSECTION

"AND"

S - SAMPLE SPACE

$S \setminus e$ - COMPLEMENT "NOT"

X HAS A PROBABILITY FUNCTION

$$P(e)$$

- $0 \leq P(e)$ FOR ANY e
- $P(S) = 1$
- IF $e_1 \cap e_2 = \emptyset$ THEN

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

$$\Rightarrow P(e) \leq 1$$

$$P(\text{NOTHING}) = 0$$

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

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

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

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

$$\mathbb{P}(e_A \cap e_B) = \mathbb{P}(\{2,3\}) = \frac{1}{6}$$

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

CONDITIONAL PROBABILITY

"GIVEN"

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

$$\text{EX} \quad \mathbb{P}(e_A|e_B) = \frac{\frac{1}{6}}{\frac{2}{6}} = \frac{1}{2}$$

A AND B ARE INDEPENDENT IF

$$\mathbb{P}(A \cap B) = \mathbb{P}(A) \cdot \mathbb{P}(B)$$

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

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

$$= P(A)$$
