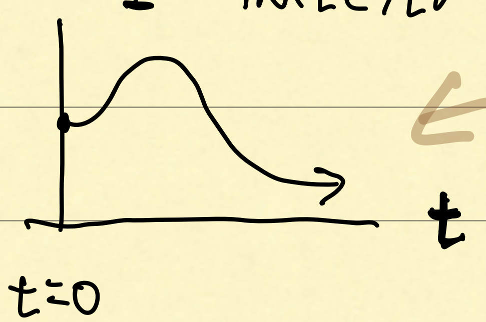
TODO

- ✓ WELCOME!
- ✓ ME, YOU
- ✓ PREMISE
- ✓ SYLLABUS
- ✓ PROBLEM SETS
- ✓ SCHEDULE
- AXIOMS OF PROBABILITY
- PS 1

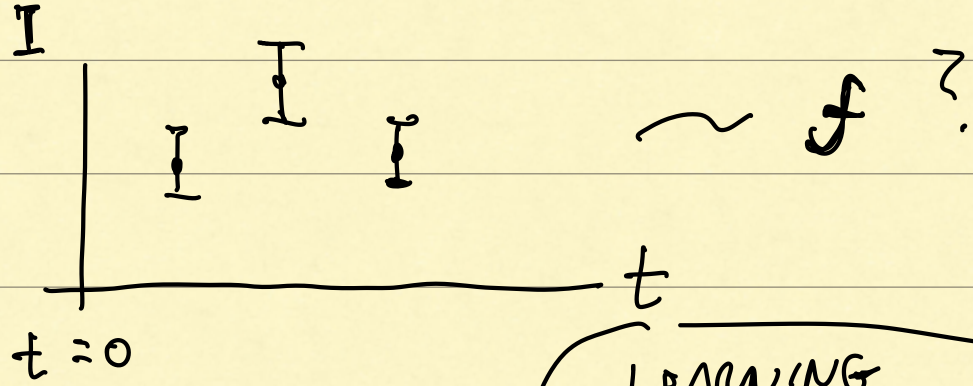
MATH 227C

STOCHASTIC & STATISTICAL MODELING IN LIFE SCIENCES

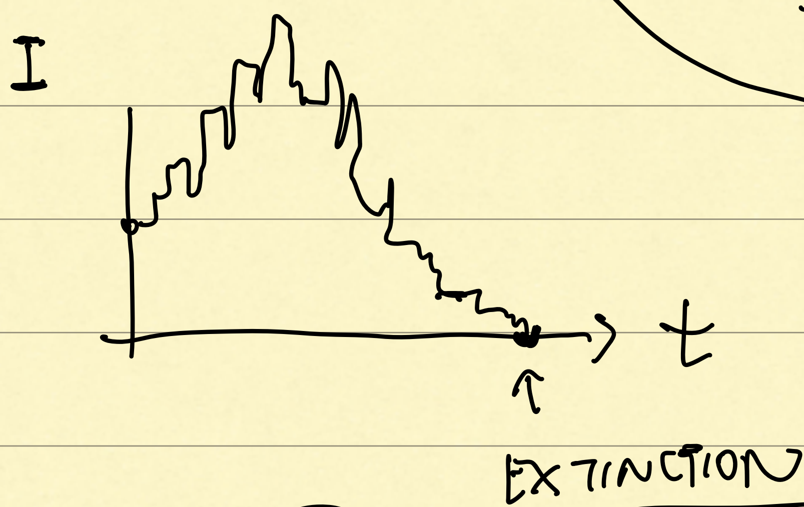
I - INFECTED



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

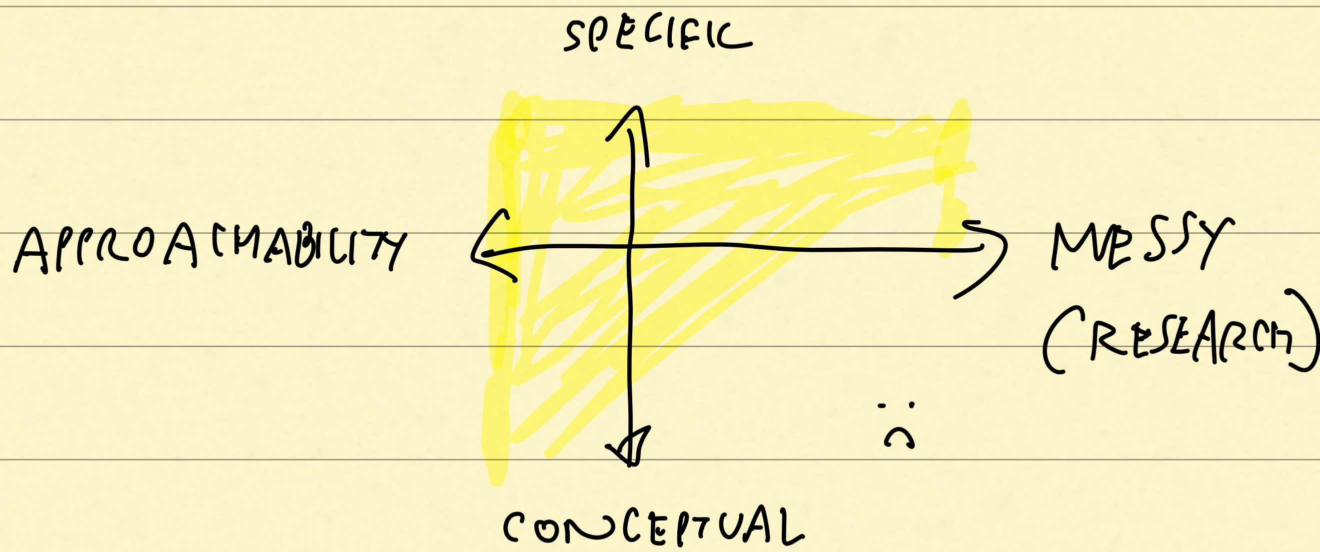


LEARNING,
REGRESSION,
STATISTICS



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 <u>EVENTS</u>.

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

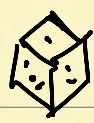
$$\mathbb{P}(e)$$

- $0 \leq \mathbb{P}(e)$ FOR ANY e
- $\mathbb{P}(S) = 1$
- IF $e_1 \cap e_2 = \emptyset$ 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  $S = \{1, 2, 3, 4, 5, 6\}$

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

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

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

$$\mathbb{P}(e_A \cap e_B) = \mathbb{P}(\{2\}) = 1/6$$

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

CONDITIONAL PROBABILITY

"GIVEN"

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

EX $$\mathbb{P}(e_A \mid e_B) = \frac{1/6}{2/6} = \frac{1}{2}$$

A AND B ARE INDEPENDENT IF

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

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

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

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