

$$\text{math 390: dim(output)} = 1$$

Models - Approximations &/or abstractions to reality/abs truth/systems/phenomena

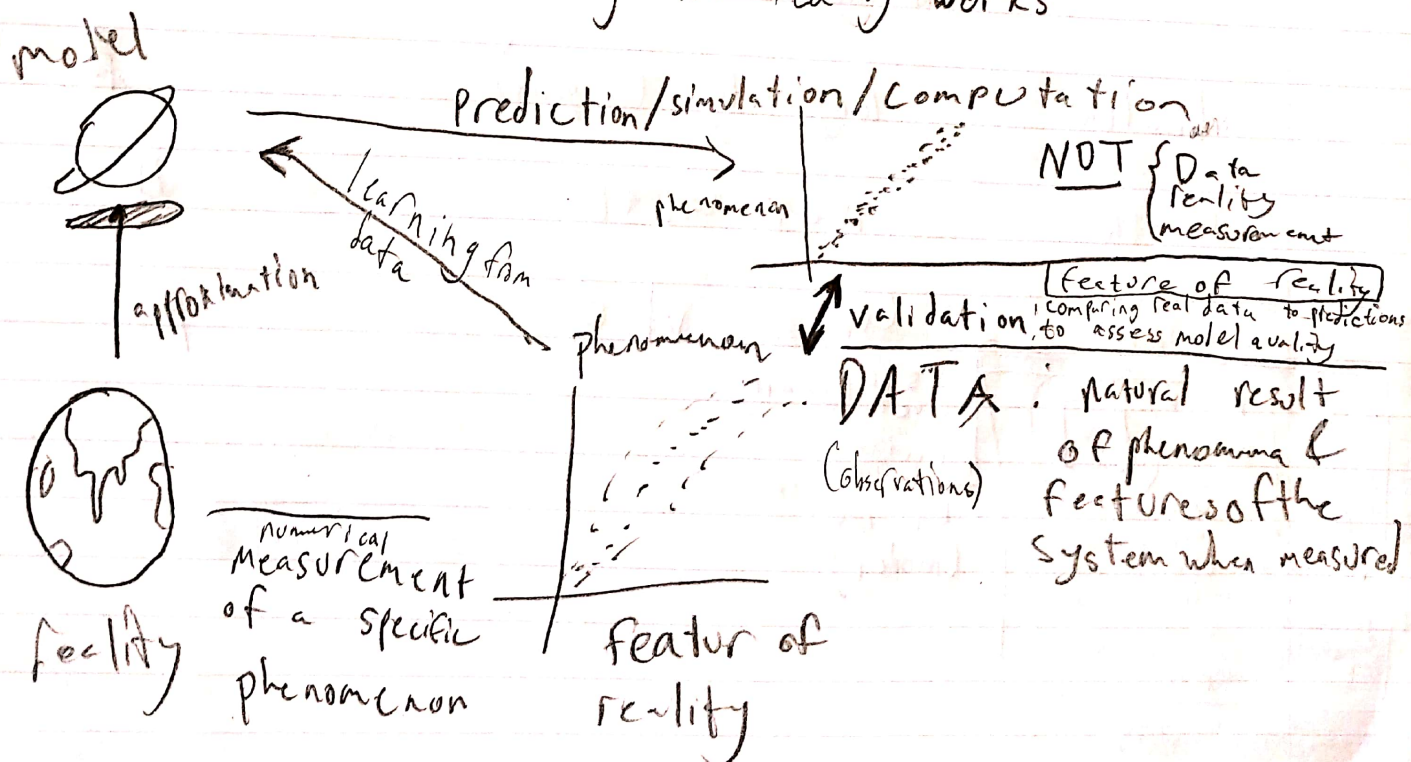
Model	Approx.
model plane	real plane
Streetmap	road sys
Wind tunnel	fast moving air
"early to bed... wise"	human success

"All models are wrong, but some are useful" - George Box
 They can serve purposes

approximations are always wrong

Two main Goals of models -

- 1) Prediction: the model will tell us what will happen to a certain phenomenon in a certain setting (TELLING THE FUTURE)
- 2) Explanation: understanding how reality works



Mathematical Models: functional relationship b/w numerical i/o

"Early to bed, early to rise, makes a man healthy, wealthy, & wise"

Model for human success in phenomena health, wealth, wisdom

This is a non-mathematical model, which is incorrect
To make this a mathematical model, quantify everything

"Early to bed, early to rise } features of the system
makes
a man healthy, wealthy, & wise " } phenomena

Variables
early to bed

metrics
avg bedtime as measured
by H mins after 6 PM (268
vs 363)

Symbol
b

early to rise

avg waketime as ...
... 4 am

w

health

longevity (in years)

l

wealth

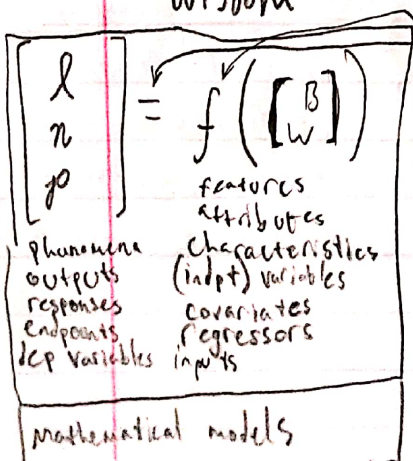
net worth

n

Wisdom

Connor v.l. 0

p



Is this really
true?
functional
relationship
b/w i/o
(model)

Assume reality can be explained by mathematical models, which means

$$y = t(z_1, z_2, \dots, z_t)$$

↑
One-dim
phenomenon we
are modelling

↑
Causal inputs

the true function that "nature" uses to create the measurement of the phenomenon

Phenomenon: Payback loan

$$y = \{ \text{pay back, not pay back} \}$$

$$y = \{ 0, 1 \} \xleftarrow{\text{encoding}} \text{output space } \mathcal{Y}$$

z_1 : has sufficient funds $\in \{0, 1\}$

z_2 : criminal intent $\in \{0, 1\}$

z_3 : access to branch

$$y = z_1 (1 - z_2) z_3$$

Big Problem: Total ignorant about z_i !
furthermore, we may not know $t(\cdot)$

Next best thing... Obtain features that approximate the causal information in z_1, z_2, \dots, z_t . Denote those features x_1, x_2, \dots, x_p

e.g.

x_1 : income / bank acct. balance

x_2 : prior criminal record

x_3 : have internet

x_4 : credit score