Math 390.4 01/29/18 ~Tuesday

"Models" are approximations and/or abstractions to reality/absolute truth/systems/phenomena.

Model	Reality
Model Airplane	Real Airplane
Street Map	Road System
Wind Tunnel	Fast Moving Air
"Early to bed, Early to rise, makes a man healthy, wealthy and wise."	Human Success

"All models are wrong, but some are useful." -George Box

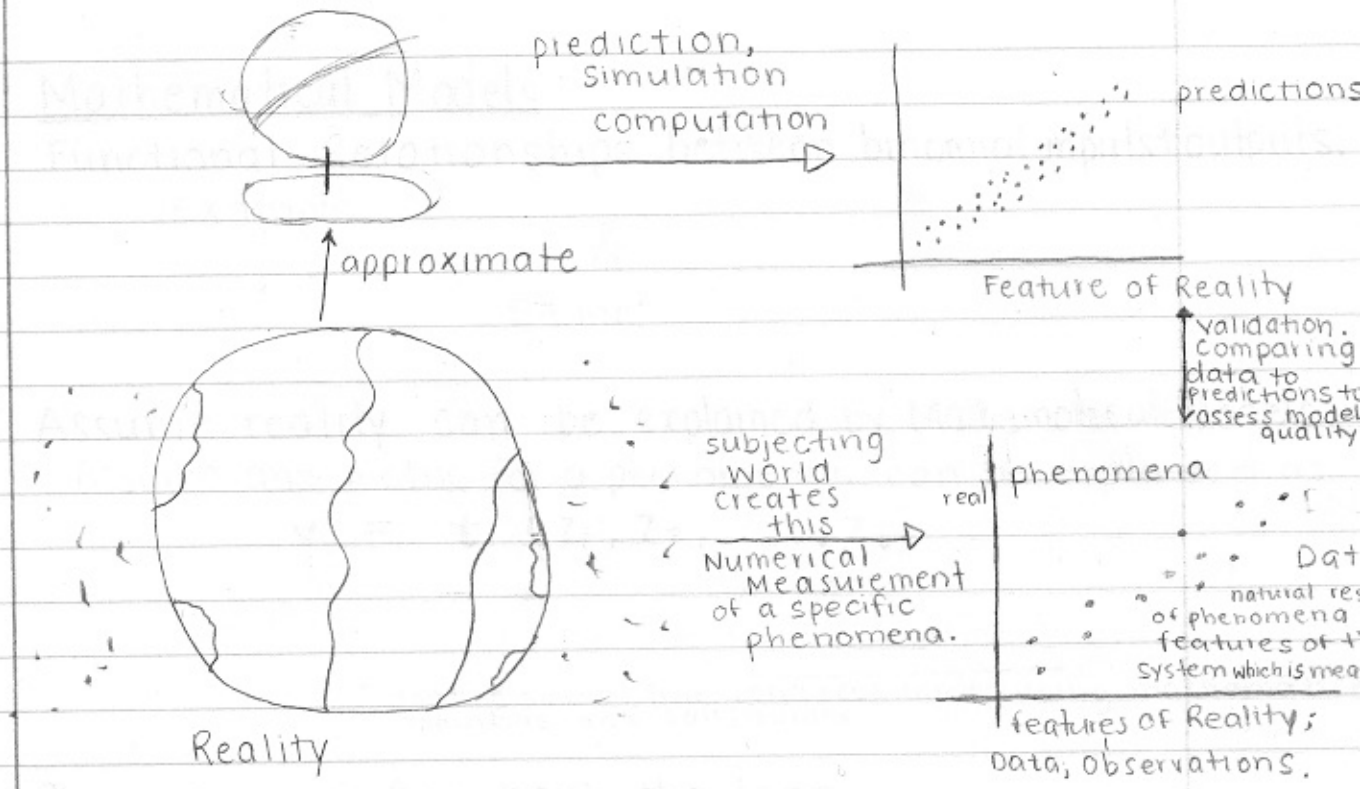
by definition, models are approximations which are technically wrong. They serve useful functions for us.

3.141593 ≠ π

Two main Goals of Models:

1. Prediction: the model will tell us what will happen to a certain phenomena in a certain setting.
2. Explanation: understanding how the universe works.

Example: Dropping piece of chalk
→ Theory of Gravity



Mathematical Models

"Early to bed, Early to rise
Makes a man Healthy, Wealthy, & Wise."
→ BUT TOO AMBIGUOUS!

Variable / Features	Metrics	symbo
• Early to Bed	average bed time in 24hr time (ex: 22h20 vs. 0:03) -or- as measured by # of minutes after 6pm. (Ex: 268 vs. 363)	b
• Early to Rise	average wake time is... 4am	w
• Health	Longevity in years	l
• Wealth	Networth	n
• Wisdom	some sort of test	s

With properly defined inputs/outputs f is called a Mathematical Models:

$$\begin{bmatrix} l \\ n \\ s \end{bmatrix} \overset{?}{=} f\left(\begin{bmatrix} b \\ w \end{bmatrix}\right)$$

↳ IS this true? NO

Math 390 dimension of output = 1 { phenomena outputs Endpoints dependent variables Responses?

Mathematical Models:

Functional Relationships between binomial inputs+outputs.

Example:

$$a = \frac{F}{m}$$

$$E = mc^2$$

Assume reality can be explained by Mathematical Models.

Assume any metric for a phenomenon can be explained as:

$$Y = t(Z_1, Z_2, \ldots, Z_t)$$

the true function that conduces inputs using mathematica operators and constraints.

Phenomenon: Pay back the loan.

$Y = \{$ pay back, not pay back $\}$

$Y \in \{ 0, 1 \}$ Encoding = y - output

Z_1: has sufficient funds day before $\in \{0,1\}$

Z_2: criminal intent $\in \{0,1\}$

Z_3: Access to Branch $\in \{0,1\}$

$$Y = t(Z_1, Z_2, Z_3) = Z_1(1 - Z_2)(1 - Z_3)$$

Big Problem: We are totally ignorant of the Z's and further we may not know t

Next best thing is to obtain features that approximate the causal information in $Z_1, Z_2, \ldots, Z_t$.

Denote these features $X_1, X_2, \ldots, X_p$.

you want X's to reflect Z's.

Ex) X_1: income, bank account balance

X_2: prior criminal record

X_3: Had internet

X_4: credit score.

* F is the mode
t is the real