MATH 342 2/1/2021

"Models" are approximations / abtraction to Reality / absolute truth / systems / phenomena.

Model	Phenomena
Model plane	real plane
street map	actual roads
"Early to bed, early to rise ~~most~~ makes a man healthy, wealthy and Wise"	Human health Human Wealth Human Wisdom "

"All models are wrong but some are useful" George Box 1984

By definition approximations which are not reality

Are good enough to be used for a practical purpose.

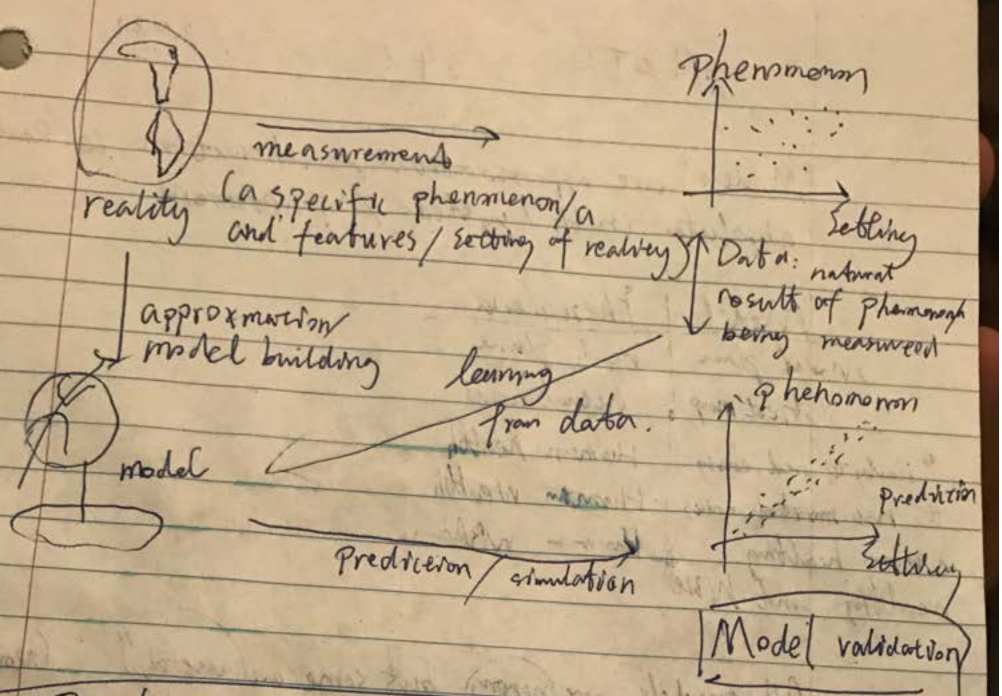
Ex: π is approximate 3.14, 3.14 is good enough

Models are generally used for 2 goals:

(1) Prediction: can the model tell us what will happen in a certain phenomenon in a certain setting.

(2) Explanation: How does reality really work? What cause phenomena to manifest?

(The purview of other courses)



Pre steps to modeling

(1) identify a phenomenon/a, you wish to predict/explain this is your target of the modeling procedure.
(2) figure out a way to measure it.
(3) Measure features/settings of the system/reality.

"Early to bed, early to rise makes a man healthy, wealthy, and wise"
Phenomena: human wealth, and wisdom.
Features / settings: bedtime, wake time.

This model is ambiguous! We don't know how to measure the settings and phenomena. In order to make this model unambiguous we need to establish "metrics". ways to numerically gauge phenom

Feature / phenomena	Metric	Symbol.
bedtime.	Average bedtime between 18 - 60 measured in hours past 5pm,	b
waketime	Average waketim measured in hours past 4am.	w
health	longevity / life span, QOL metric.	L
wealth	net worth at time of death	n
wisdom	take a test about situations and what you would do in situations and have a panel of old people provide answers	S

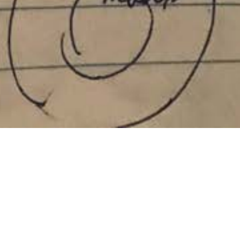
$$f\left(\begin{bmatrix} b \\ w \end{bmatrix}\right) = \begin{bmatrix} L \\ n \\ S \end{bmatrix}$$

model

2 inputs settings

3 phenomena outputs

since the inputs/outputs are numerical, f is called a "mathematical model"



Mathematical models are not physical. They are thinking ideas and abstractions. But they are extremely useful. We've been building them for ~ 4k years.

Ex: $F=ma$ $E=mc^2$

in this class we will only build models with ONE output.

For the purpose of this class, we assume the universe is mathematical.

Assume: a phenomenon denoted y, can be expressed as:

$$y = t(Z_1, Z_2, Z_3, \ldots, Z_t)$$

phenomenon, response, outcome, endpoint, dependent variable

causal inputs: the true drivers of the phenomenon. In reality we don't know.

Let's examine the phenomenon

y = pays back loan on time

$y \in \{0, 1\} = \mathcal{Y}$ output space.

0 = not, 1 = on-time

(convention: 1 is the "positive" event or the thing we want)

Models with output space of cardinality 2 are called "binary classification models"

The causal inputs are features or characteristics of the individual person. We don't know the causal model why people pay/don't pay. We are going to make one up just as an illustration.