Lecture 1:- 01.28.2020

"Models" are "approximators" or "abstraction" to "reality", "truth", "Phenomena"

Model	Reality
Model Airplane	Airplane
Map	Roads in a city
Wind tunnel	Fast moving air in the sky.
Early to bed, Early to rise, makes a man Wealthy!	Success of a person.

"All models are wrong, but some are useful" — George Box's Dictapher.

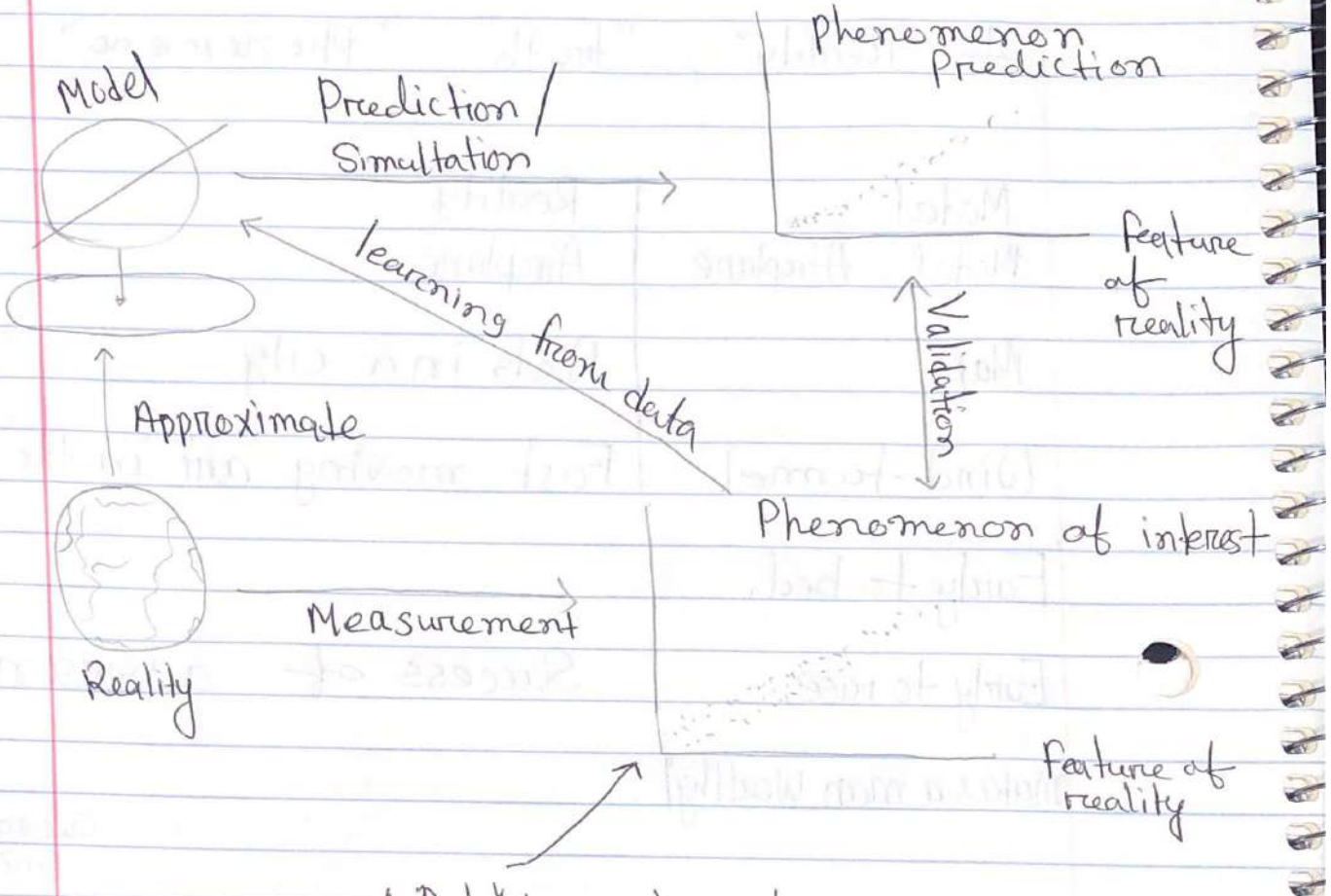
wrong ↓ by definition approximate

useful ↓ You can use it for some purpose.

~~The~~ Two main Goals:-

(I) Prediction:- Can the model Predict a future event of the phenomenon undere examinations.

(11) Explanations:- How the phenomenon Work? (Science)



'Data': natural resolves of measuring a phenomenon.

→ Ambiguous (unclear, has more meanings)

"Eately to bed, Early to rise, makes a man healthy, wealthy and wise."

What is this modelling?

(i) Health
(ii) Wealth
(iii) Wisedom

→ 3 different phenomenon

Output ↑

What are the features?

(i) Bedtime
(ii) Wake time.

Input ↑

To make this model concrete, We need numerical definitions.

We need "metrics". These;

→ Wake time

→ Health measured by longevity (l)

→ Weath measured by net worth +65 (m)

→ Wisedom measured by a test (s)

These define how to measure both phenomenon and feature of reality.

Metrics for bedtime (b),

Av bed time in # seconds and tenths from 17-00

from age 18-65.

Metric Evaluation:-

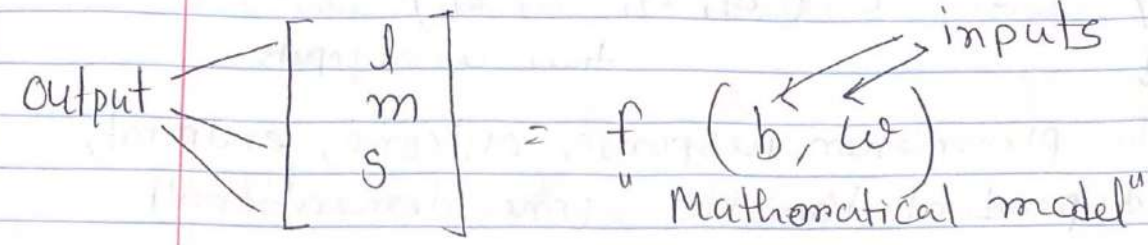
(1) Does it lap the feature? Yes

(2) It is easily unreadable and unambiguous? Yes. (e.g. 5.56B)

(3) Good resolution? Yes

(4) Is it monotonic?

We want to estimate f where



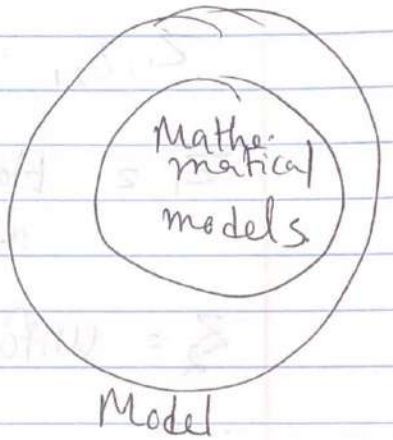
Prediction of phenomenon

Mathematical models are ideas and abstraction not physical existance. Mathematical models are at least 4,000 years old.

Example:-

$$a = F/m = f(m, F)$$

$$E = mc^2$$



Phenomenon → an observable fact or event.

deterministic

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

t → true function (unknown) that combines $z_1, z_2, \dots, z_t$.

$z_1, z_2, \dots, z_t$ → true causal inputs

Y → The phenomenon, response, outcome, endpoint, dependent Variable. (one-dimentional)

Phenomenon is payback morgage ($y=1$)

or not payback morgage ($y=0$)

$Y \in \{0,1\}$ = $\mathcal{Y}$ (output space)

Binary

"positive class"

What are the causal input?

$z_1, z_2, \dots, z_t$.

z_1 = Has the money $\in \{0,1\}$ at payback time.

z_2 = unforces emergency $\in \{0,1\}$

z_3: Criminal intense $\in \{0,1\}$

$t(z_1, z_2, z_3) = z_1(1 - z_2)(1 - z_3)$

Fundamental modeling problem:

You don't know the z's exact. Next best thing is obtain measurements that approximate the z's.

Call these measurement x's

$x_1 \rightarrow$ credit Score $\in R$

$x_2 \rightarrow$ Salary based on tax return $\in R_+$

$x_3 \rightarrow$ Miss loan previously $\in \{0, 1\}$

$x_4 \rightarrow$ Crime in past $\in \{0, 1\}$.