MATH 390.4 Lecture 1

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1 Models

Models are approximation or abstractions to reality, truth, phenomena. The following are representation of reality with their models.

Model	**Reality**
Model Airplane	Airplane
Maps	Roads in the City
Wind Tunnels	Fast moving air in the sky
Early to bed, early to rise, makes a Man healthy, wealthy and wise	Success of a person

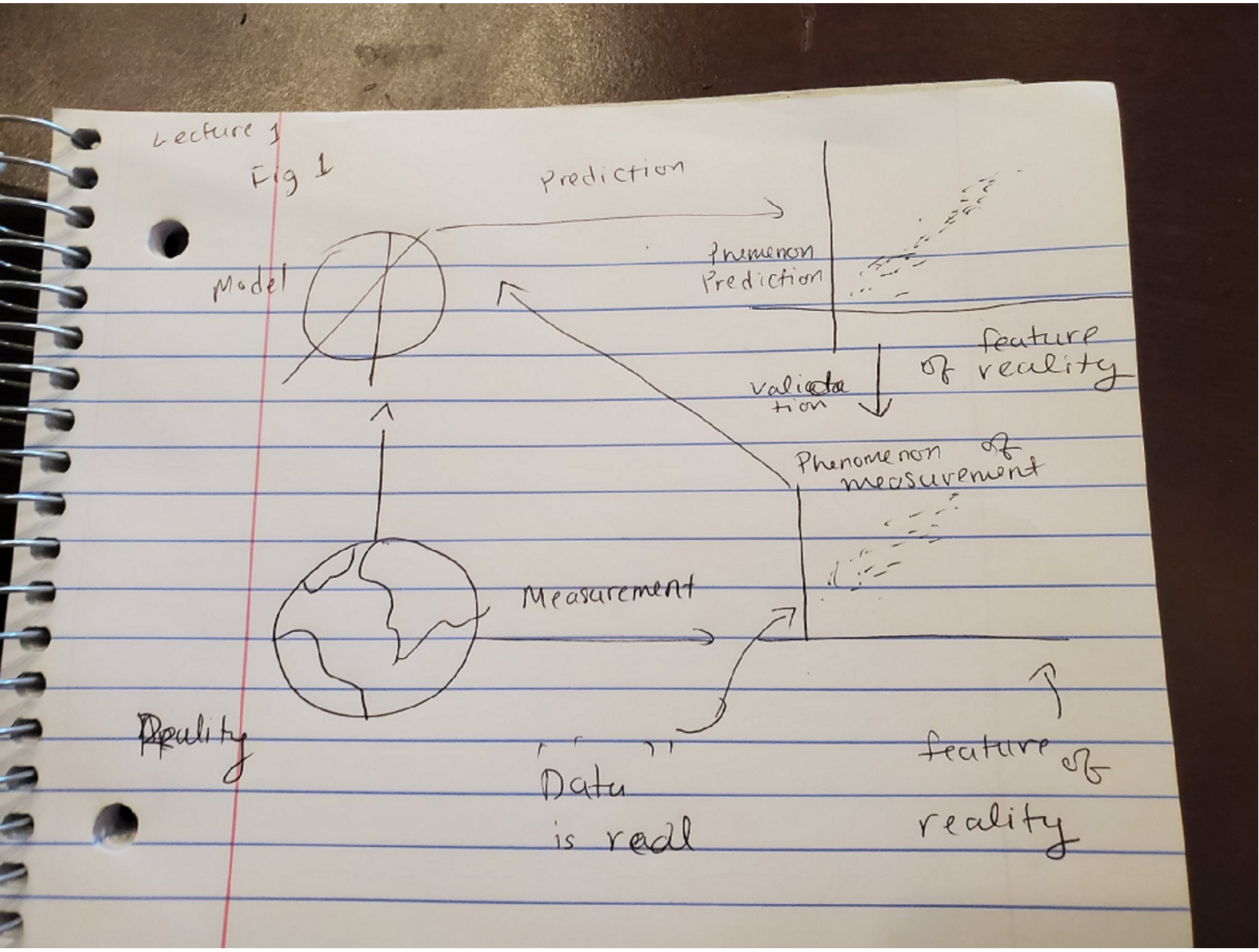
Phenomenal: Something unexplained that occurred often happens in nature "All models are wrong but some are useful" George Box and Draper 1984, wrong means by definition an approximation, useful means we can use the information from it for some purpose.

The goals of models are the following two goals :

Predictions : Can the model predict the future event of the phenomenon under examination?

Explaning how does the phenomenon work? (Science)

Earth is a reality we use a globe as an approximation of it. We measure the feature of reality



"Early to bed early to rise makes a man healthy. Wealthy, and wise" What is this modeling?

- Health
- Wealth
- Wisdom

These are 3 different phenomena.

The quote right now is ambiguous, we need numerical definitions to make this model concrete.

We need 'metrics'. These are define how to measure both phenomena and features of reality

What are the features?

- Bedtime (B)
- "Wake-time" (W)
- Health measured by longevity (L)
- Wealth measured by net-worth at 65 (M)
- Wisdom measured by a test (S)

Metric for Bedtime, average bedtime in 24-hour time in seconds and tenths of seconds from 17:00 from age 18-65

Metric Evaluation

1. Does it capture the feature/phenomena? Yes
2. Is it easily readable and unambiguous? 5.568 Yes

3. Does it have good resolution? Yes

4. Is it monotonic? Yes

We want to estimate f where

$$[LMS] = f(b, w)$$

"Mathematical Model"

Prediction of the Phenomena ([LMS])

Mathematical models are ideas and abstractions, not physical ideas

Mathematical models are at least 4 thousands years old. Examples

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

$$E = mc^2$$

Y = the phenomenon, response, outcome, signal, endpoint, dependent variable, (one-dimensional)

t = the function(unknown) that combines Z1. . . ..Zt.

Y = t(Z1,Z2,.....Zt)

Phenomenon is pay back mortgage (Y=1) or not pay back mortgage(Y=0)

Y is an element of 0,1 = Y (output space and its binary) By convention "1" from 0,1 is represented as the "positive class"

What are the causal inputs? Z1, Z2, ... Zt

Z1: Has the money at the payback time

$$Z1 \in 0, 1$$

Z2: unforeseen emergency

$$Z2 \in 0, 1$$

Z3: criminal intent

$$Z3 \in 0, 1$$

t(Z1,Z2,Z3) = Z1(1-Z2)(1-Z3)

Fundamental Modeling Problem: You don't know the Z's or t.

Next best thing is..... to obtain measurements that approximate the Z's.

Call the measurements X's

X1: Credit Score

$$X1 \in somepositivenumber$$

X2: Salary based on tax-return

$$X2 \in somepositivenumber$$

X3: Miss loan payment

$$X3 \in 0, 1$$

X4: Crime in past

$$X4 \in somepositivenumber$$