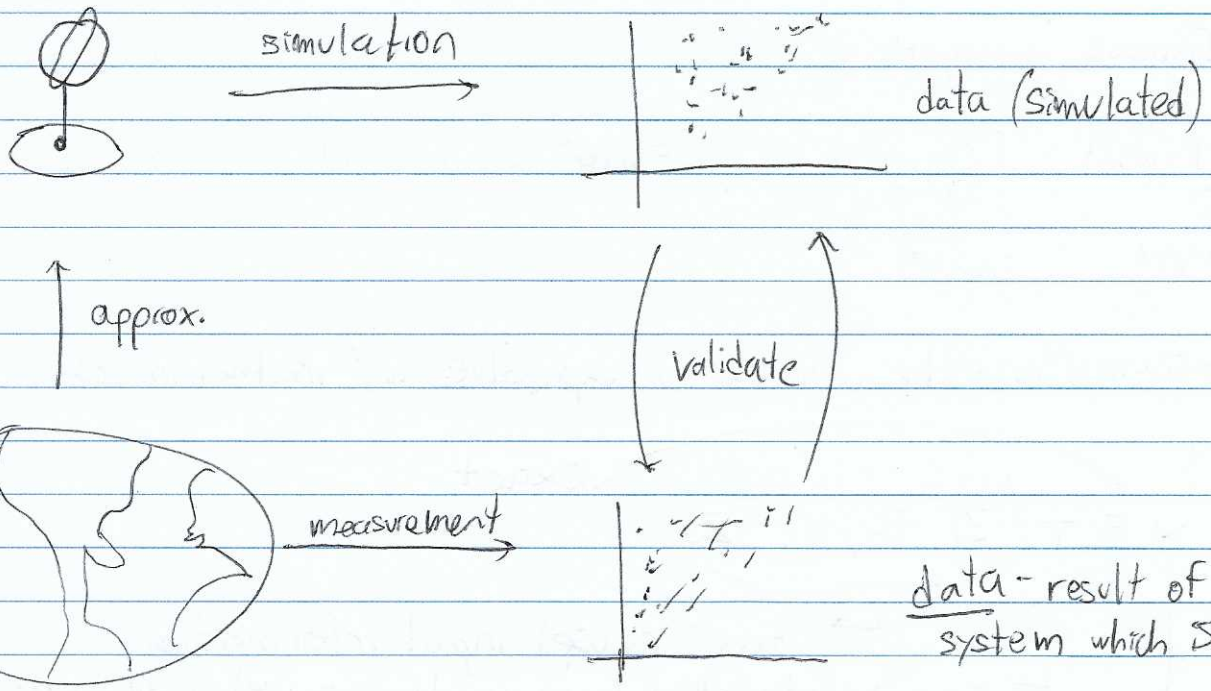
1/29/18 Lecture 1

"Models" are abstractions/approximations to reality/absolute truth/system/phenomenon.

(-The allegory of the cave)

model airplane ⟶ airplane
Street map ⟶ city streets
wind tunnel ⟶ air flow

"All models are wrong but some are useful" - George Box
- They are wrong because they are not part of reality
- They are useful because they can make predictions
- Explanation: Models might have low predictive powers but can explain things.
  What makes the world tick?
- Predictions: what happens in a certain situation?



Validation: Comparison of the measured data to the predictions. If they're "close" ⟹ the model is "good". If not, we can rebuild the model, iterate and get close.

Ex: "Early to bed, early to rise makes a man, healthy, wealthy, and wise"

$$\begin{bmatrix} \text{health} \\ \text{wealth} \\ \text{wisdom} \end{bmatrix} = f\begin{pmatrix} \text{bedtime} \\ \text{waketime} \end{pmatrix}$$

outputs (wisdom) inputs (bedtime, waketime)

Model is "imprecise". We need numbers for all of our variables and we need numerical measurements.

- bedtime: avg. 24hr time
- waketime: avg. 24hr time
- health:
- wealth:
- wisdom:

Mathematical Model ⊂ Models
-have numerical inputs/outputs related by an equal sign.

Famous examples:

$F = ma = f(m, a)$ $\quad E = mc^2$

F: output; m, a: inputs

assumption: the universe is explicable w/ mathematics

REALITY

$$y = f(z_1, z_2, \ldots, z_t)$$

exact

- y: output, response, outcome, endpoint, dependent variable
- f: true relationship between the causal inputs and the output
- $z_1, z_2, \ldots, z_t$: "true" causal input information

Creditworthiness example

$y \in \{\text{Creditworthy}, \text{uncreditworthy}\}$

$y \in \{0, 1\} = Y$

output space

True Causal inputs

z_1: has enough money at the time the loan is due $\in \{0,1\}$

z_2: unforseen emergency $\in \{0,1\}$

z_3: Criminal intent

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

Bigger Problem:
$\{z_1, z_2, z_3\}$ are unobservable, not able to be measured, unassessable

Smaller problem: don't know f.

For next time: Salary and Lauri's comment.