Apart from economic modeling (which is already widely integrated into decision-making), what fields, such as machine learning, network analysis, agent-based modeling, dynamical systems modeling, correlational big data mining, remote sensing, data fusion, simulation of physical systems, and so forth, are most likely to contribute to this as a goal, and how will they do so?

Tools to manipulate data

Tools to describe the past/present

Tools to predict

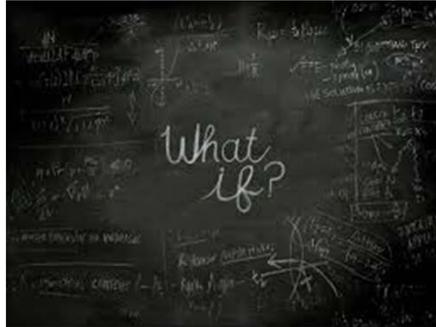It is not the method as much as what it is used for

Prediction:
It is not only about the future

- 'predict' some quantity/information you need
  - SMS categories in Uganda "Youth Speaks"
  - Medical diagnosis
  - Spam & Fraud
- 'predict' alternative pasts
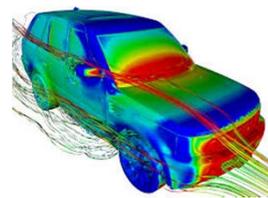 - what 'would have happened ….'

counterfactuals

Policy and Prediction

Counterfactuals
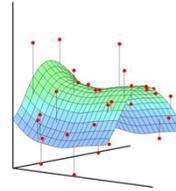

Simulation

$$y(t) = F^{-1}\left\{\frac{1}{1+4\pi^2 f^2}\right\} * F^{-1}\{G(f)\}$$

$$= \frac{e^{-|t|}}{2} * g(t)$$

$$= \frac{1}{2}\int_{-\infty}^{\infty} e^{-|t-\tau|} g(\tau) d\tau$$

- Start with a set of equations
- Results are as good as your assumptions
- Data is used to maybe tune and validation

Predictive Modeling = Function Approximation

- Start with data
- Results are as good as your data
- Little to no prior knowledge required

Potential & Limits of Predictive Modeling
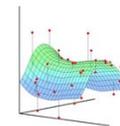

Very effective in scenarios with
- very detailed level (individuals)
- get better and better with more data
- same setting for use as training
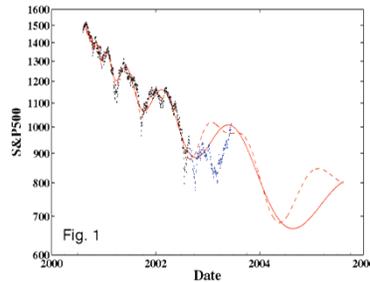- probabilistic relationships

NOT Suitable for scenarios with
- rare events: Katrina
- few instances: Countries
- totally new circumstances: ObamaCare

Predictive Modeling & Policy

Fig. 1

- Most of Policy is about Change: Extrapolation
  - with respect to time
  - with respect to circumstances

Will future decision makers in government and industry have better predictive tools when they consider policy alternatives?

- predictive tools have not changed much
- data has changed significantly

- use predictive modeling with caution
  - is PM even applicable?
  - do you have the right data?
  - quality control is extremely difficult
  - model is only as good as the person who build it

How will advances in the modeling and simulation of social and collective behaviors lead to better quantitative policy analysis?

Evaluating policy impact:

Causal Analysis

A/B Testing

- practical concerns
- amoral & unlawful with human subjects

Causal analysis on observational data

- Using targeted maximum likelihood to estimate causal impact (some form or PM)
- Can be done ex-post for different questions
- Use predictive modeling to control for confounding
- Data has to be 'rich' and cover all combinations of confounding and treatment

$$E[Y_{policy}] - E[Y_{no\ policy}]$$