Session 1: Introduction – Why Model?

1.1– Why Model?

- Intelligent Citizen of the World
- Clearer Thinking
- Understand and Use Data
- Decide, Strategize, and Design

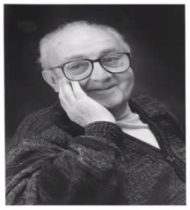
Collective Action
Wisdom of Crowds
Tipping Points
Markov Processes
Colonel Blotto
Spatial Voting
Decision Theory
Lyapunov Models
Linear Models
Learning Models
Economic Growth

Content somewhat like a visit to the zoo – touch on many different models and applications.
Quiz: This course will be like a visit to: (a) dentist, (b) Disneyland, (c) zoo, (d) grandmother's

Ans: (c) zoo

Section Structure: (a) The model with assumptions, results, and applications, (b) Technical details with measures, proofs, and practice problems, (c) Fertility – extent of model applicability to other similar problems

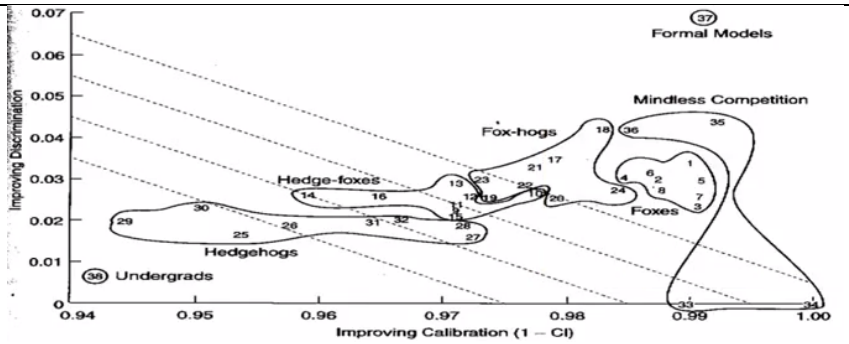
1.2 – Intelligent Citizens of the World



"essentially, all models are wrong, but some are useful" George E. P. Box

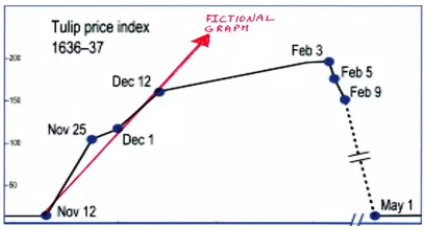
Models: The New Lingua Franca

Models for: Economics, Biology, Sociology, Political Science (Voting), Linguistics, Law, Game Theory (strategic behavior), Why? **Models are better than we are!**



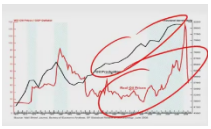
Phillip Tetlock "Expert Political Judgment" – Formal models outperform Hedgehog thinkers (single model) as well as Foxes Thinkers (many mental models). Discrimination vs. Calibration chart. Idea is to have skill with many 'formal models'. ***"Only people who do better than random are the people who use many formal models. And that's who we want to be." Scott E Page***

Bruce Bueno de Mesquita, International Conflict predictor. recent books include *The Dictator's Handbook: Why Bad Behavior Is Almost Always Good Politics* (Public Affairs Press, 2011); *The Predictioneer's Game: Using the Logic of Brazen Self-Interest to See and Shape the Future* (Random House, Inc., 2009); *The Strategy of Campaigning,* with Kiron Skinner, Sirhey Kudelia, and Condoleezza Rice (University of Michigan Press, 2007); and *The Logic of Political Survival*, with Alastair Smith, Randolph M. Siverson, and James D. Morrow (MIT Press, 2003). ***Models give guidance to blend with experience➔decision.***

Models are Fertile – Linguistic models can help determine who wrote a book, e.g., *The Federalist Papers*. Many (formal) Model Thinkers know best. Markov models mentioned.	***Models also make us Humble***. We tend to be linear thinkers – Tulip mania. Humility,  note how much we have to leave out.	**Case Schuller** housing price index  We will do best if we use multiple formal models.

1.3 – Thinking More Clearly

- Clarifying the relevant parts, name the parts. e.g., restaurant, customer, customer attributes (money, time, preferences), location, etc.
- Identify Relationships, e.g., game theory.
- Work through the logic
- Inductively Explore problem space
- Understand **Class of the Outcomes**
  - ***Equilibrium***
  - ***Cycle***
  - ***Random***
  - ***Complex***

  Oil Production & Price = Complex!
- Identify Logical Boundaries
  - Two heads are better than one vs Too many cooks spoil the broth
  - Find the balance, applicability, of each view.
- Communicate Ideas and logic behind predictions
  - Voter candidate preferences based on comparing their policy preference with the candidates thus implying voter likability.

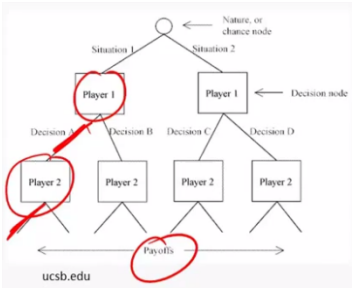
Quiz: Predict the circumference of a large loop around the earth that would have one meter of clearance all the way around? (a) 28,140 mi, (b) 31,280 mi, (c) 25,628 mi, (d) 25,000 mi + 6.28 m.

Analysis:

$C = \pi(D_e \text{ mi} + 2 \text{ m}) = \pi D_e \text{ mi} + 2\pi \text{ m}$

Ans:

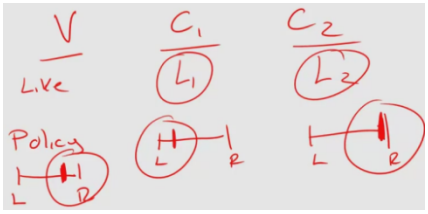
(d) 25,000 + 6.28 m,



Communicate –

Voting:

Likability + Policy (close to mine)

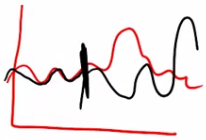


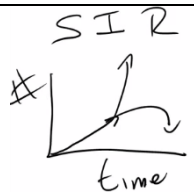
Summary:

Models help us think clearly. Now add data . . .

1.4 – Use and Understand Data

1. **Understand Patterns**, e.g., trends, type of behavior
2. **Predict points**, e.g., house cost vs. size based on cost/sq ft.
3. **Produce Bounds**, ranges, e.g., inflation in 10 years , range [0.5, 3.5%]
4. **Retrodict** – use past data to evaluate validity of models

   
5. **Predict *Other Outcomes***, models often provide other related outputs, e.g. heliocentric model, errors implied Neptune.
6. **Inform Data Collection** – what is relevant to study? e.g., Schools (teacher quality, parental support, $, technology, health, students, . . .)
7. **Estimate Hidden Parameters** - e.g. SIR model (Susceptible, Infected, Recovered)

8. **Calibrate** - fine tune model parameters with actual applications, e.g., forest fire risks

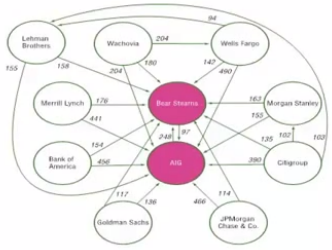
Quiz: Consider the following linear model. C = number of people per coffee shop for the 100 largest cities in the USA. T = average daily temperature. The model states that C = 1000 – 3T. If Phoenix has an average temperature of 60 degrees, then how many people per coffee shop does the model predict? (a) 940, (b) 180, (c) 820, (d) 720.

Analysis: $C = 1000 - 3T = 1000 - 3(60) = 820$

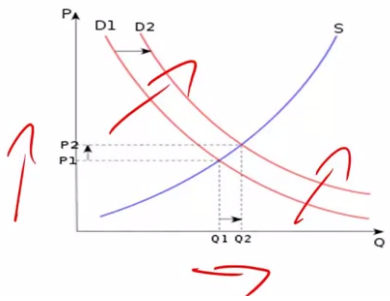
Ans: (c) 820

1.5 – Decide, Strategize, Design

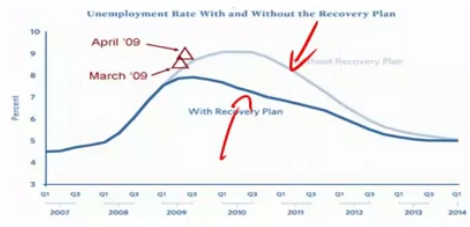
1. **Real Time Decision Aids** e.g., Co-Risk Feedbacks in the financial system. Captured correlation of success / failure between institutions, e.g., AIG vs. WFB vs. JP Morgan Chase, etc.



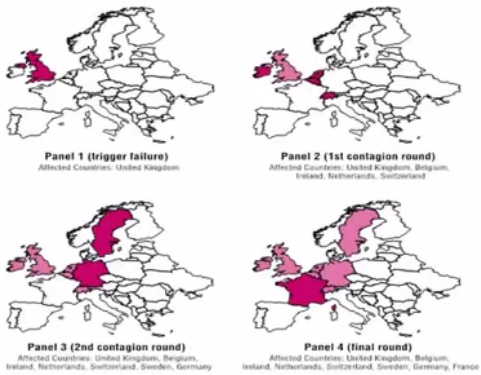
2. **Compare Statics**, e.g., demand curves



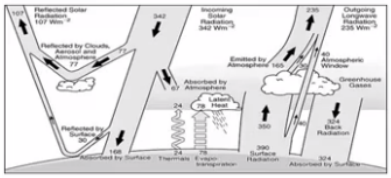
3. **Counterfactuals**, e.g., 2008 recovery plan



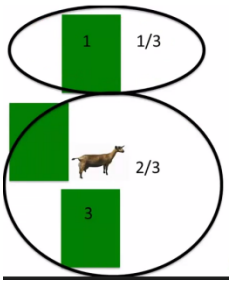
4. **Identify and Rank Levers (leverage points)** e.g., contagion path with UK financial failure



climate change leverage points



Quiz: Monty Hall Problem. Monty knows which door has a goat behind it and after you pick a door, Monty shows you one of the other doors that has a goat behind it. Should you stick with your original door or switch, why? (a) STICK, the probability of each closed door is ½, (b) SWITCH, the probability of the other closed door is just a little more than ½, (c) SWITCH, the probability of the other door is 2/3, (d) SWITCH, the other door definitely conceals the prize.

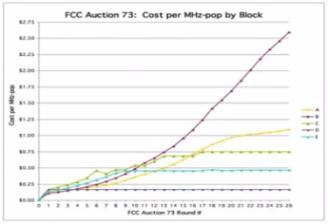


Ans: (c) SWITCH, P=2/3.

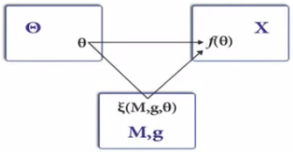
Explanation: Use 5 doors and let Monty be generous and show 3 doors with goats behind them so there is only your door and one other left. Thus there is 4/5 chance car is behind the other closed door.

Identify & Rank (cont.), e.g., climate change leverage points.

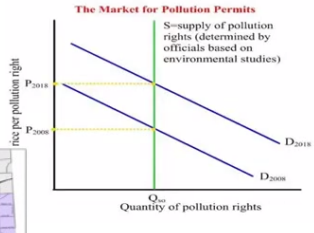
5. **Experimental Design.** e.g., FCC Spectrum Auctions



6. **Institutional Design.** e.g., ***Mount-Ryder*** diagram, Θ = environment, X = desired outcomes, Θ -> X represent social choice. However, implementation is via ξ(M,g,θ) mechanisms. Best Θ -> (M,g) -> $f_M(\theta)$ ~ f(θ)



7. **Help Choose Among Policies & Institutions,** e.g., Market for pollution permits or more urban green spaces. Consider unintended consequences.



Summary: Decide, Strategize, Design

1. Real Time Decision Aids
2. Comparative Statics
3. Counterfactuals*
4. Identify and Rank Levers
5. Experimental Design
6. Institutional Design
7. Help Choose Among Policies and Institutions.

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* (Logic) expressing what has not happened but could, would, or might under differing conditions