**Session 1: Introduction – Why Model?**

**1.1– Why Model?**

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

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| “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**

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| * 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 = π(De mi + 2 m) = πDe mi + 2π 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**

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| 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, . . .) | 1. **Estimate Hidden Parameters** - e.g.SIR model (Susceptible, Infected, Recovered) 2. **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:**  **Ans:** (c) 820 |

**1.5 – Decide, Strategize, Design**

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| 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      1. **Counterfactuals**, e.g., 2008 recovery plan      1. **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.   1. **Experimental Design.** e.g., FCC Spectrum Auctions 2. **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) -> fM(θ) ~ f(θ) 3. **Help Choose Among Policies & Institutions,** e.g., Market for pollution permits or more urban green spaces. Consider unintended consequences. |

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