Cognitive Bias in Military Decision Making and the Efficacy of Prediction Markets in Mitigation

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…the ultimate good desired is better reached by free trade in ideas — that the best test of truth is the power of the thought to get itself accepted in the competition of the market.

– Oliver Wendell Holmes

Military Decision Making Process* = Making Predictions

- Strategic Decision making, predictions rise in significance
- Campaign strategies predicated on expect actions of other states and reactions to US policies
- Force structures predicated on expected
  - national security requirements
  - expected threats
  - expected budget constraints

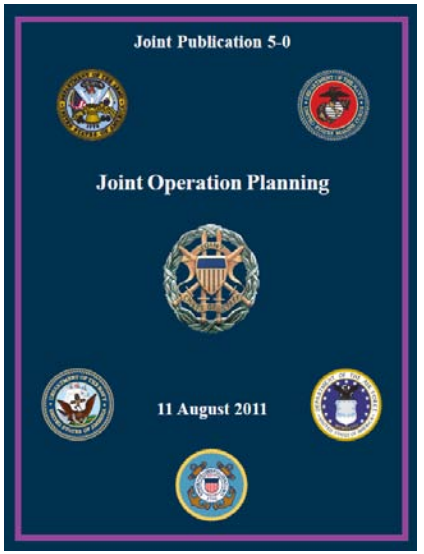
*Military Decision Making Process = MDMP

Military Not Well Suited to Making Good Predictions

- Hierarchical
- Culturally homogenous
- Traditional, consensus-based, obedient
- Lack of diversity and skepticism

Current Doctrine Fails Leads to Bad Predictions

- JP-5: “Commanders …[leverage] their knowledge, experience, judgment, and **intuition** to generate a clearer understanding of the conditions needed to focus effort and achieve success.”
  - Does not mitigate biases of influential and hierarchically powerful individual commanders
  - Operational commanders assume expertise arising from their experience (“believe their own OERs”)
  - Commanders forced to rely on faulty heuristics, learned in tactical environments, but which don’t translate to Operational or Strategic levels
  - Those heuristics generate multiple cognitive biases
- Commander’s decisions are not subject to rigorous skepticism necessary to eliminate or mitigate individual cognitive biases because of cognitive homogeneity.



Experts Suck at Predictions

- Humans can't process all information necessary to make informed decisions
- Therefore rely on heuristcis to "bound rationality"
- But that assumes
  - Perfectly defining problem
  - Identifying all criteria
  - Accurate weighting factors
  - Knowing all relevant alternatives
  - Accurately calculating perceived values (Bazerman, 1994)

MDMP Biases Pervasive

- Intuition adequate for 80% of simple and routine problems, but only 35% of complex problems (Adsit & London, 1997)
- Most common Cognitive Biases
  - Representativeness
  - Availability
  - Anchoring
- Impacts of biases
  - Nonregressive prediction
  - Neglect of base-rate information
  - Overconfidence
  - Overestimation of frequency (Kahneman, 2003)

MDMP Biases Persistent

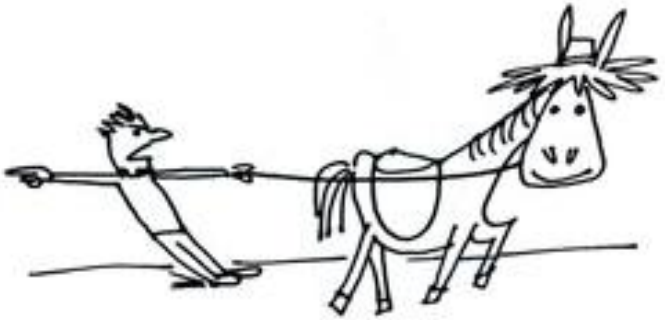
- Illusion of Validity
  - People predict by selecting outcome first that is most representative of inputs
  - The higher the “representativeness” the higher the confidence
- Weight of Variables
  - People better at selecting variables than determining weight (Bazerman)
  - Can’t integrate information consistently into valid predictions (Radiologists, Diagnosticians)

Probability Bias = Poor Risk Assessment

- Probabilities key to risk assessment
- Decision makers ascribe probability to what first seen, not what currently observe
- Misperception of chance and erroneous belief in random events evening out
- Predict based on vividness of description, not reliability of evidence
- Reject a win-lose gamble unless possible win is at least twice the size of possible loss (Kahneman, 2003)

Probability Bias Feeds Others

- Intuition makes decisions based on information's accessibility, not relevance
- Initial decisions will not be abandoned or changed (Anchoring Bias)
  - Invalidating decision takes much more information than making the initial decision
  - Information is recognized, but perceptions remain intact (Heuer, 1999)



MDMP Perpetuates Biases

- Mission Analysis phase is first, and sets all hypotheses
- Analysts and planners then bias themselves towards maintaining courses of action rather than reevaluate analysis
- “Cognitive tunnel vision” intensified in high stress environments (Tatarka, 2002)
- Leads to Sunk-Cost Fallacy
  - Not wanting to redo work
  - Professional reputation
  - Organization inertia
  - Consistent administrators perceived as better leaders than those who switch “lines of behavior” (Heuer)
- Escalation Bias (Bazerman)

Experience does not mitigate biases

- Experts most likely to suffer anchoring and adjustment biases (Neale & Norcroft)
- Tetlock “Expert Political Judgement”(2005)
  - 15 year longitudinal prediction study of experts
  - Expertise does not improve predictive accuracy or probabilistic weighting
  - Expert judgment far worse than regression, or even extrapolation (“Dart throwing chimps” better)
  - Worst judgment is on probabilistic determinations
  - Judgment worse in complex, “wicked” problems
  - Experts
    - over-predict change
    - Under predict “Black Swans”
    - attach “high likelihood to low-frequency events”

Cognitive Biases Intensified in Group Decision Making

- “Bad Cascade”
- Emphasize shared information over uniquely held information
- Group Polarization

Groupthink

- Janis, 1982
  - Loyalty in crisis leads to
    - Concurrence seeking
    - Over Optimism
    - Lack of vigilance
    - "Sloganistic" thinking
  - Replaces independent critical thinking
  - Fewer COAs
  - Won't reexamine COAs
  - Disconfirmation bias
- Sunstein, 2007
  - Failure to share information
  - Groups more likely to choose inferior option after discussion
  - Groups
    - "amplify" representativeness bias
    - Overconfident
    - Trust lawyers too much
    - Sunk-cost suckers
    - No better than individuals

What Is a Prediction Market?

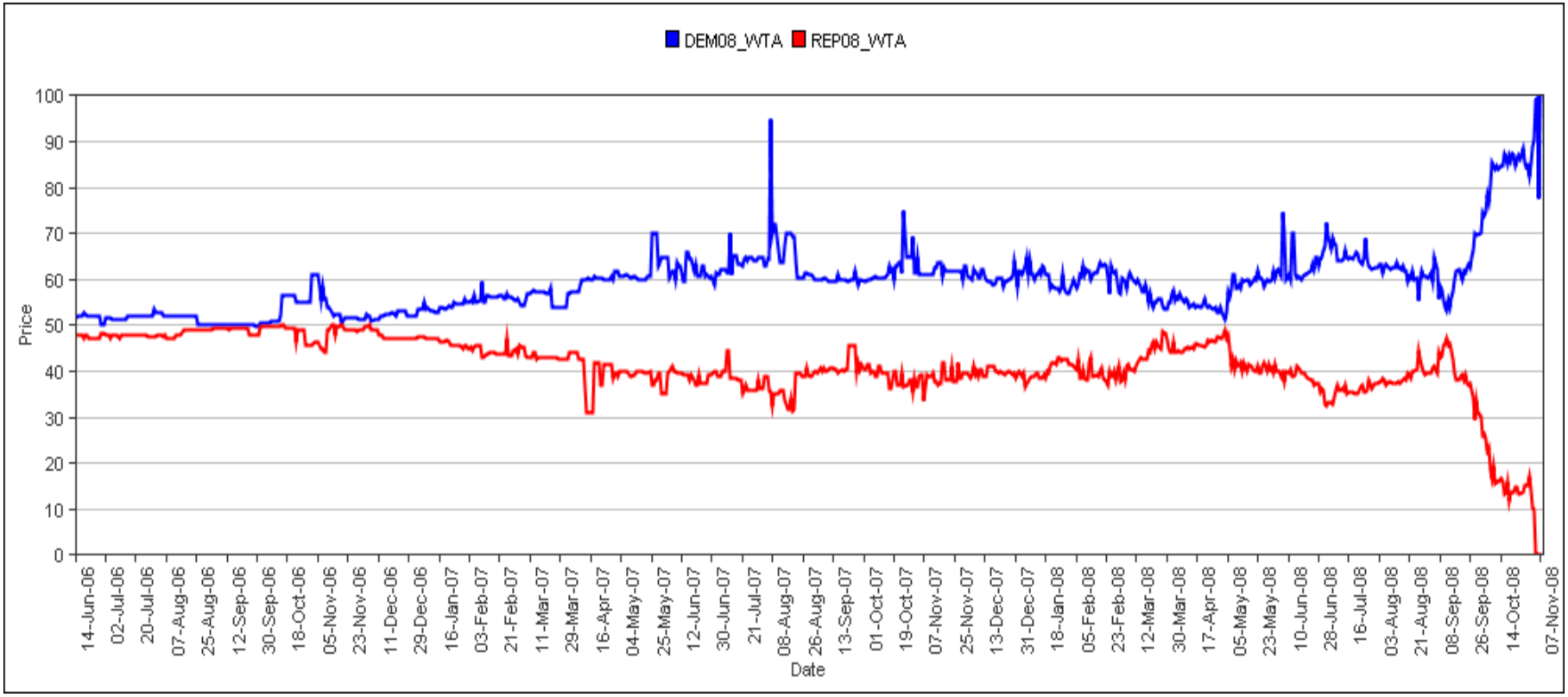
- Futures market for events
- Iowa Election Market
- Intrade, Inklings, Civics Exchange

Types of Prediction Markets

- **Probability estimate**
  - The US will bomb Syria by February 15, 2014.
- **Precise value estimate**
  - Number of voters in the next Iraqi parliamentary election.
- **Conditional**
  - US troop levels in Afghanistan will fall below 10,000 by December 31st, 2014, if the Republicans take the Senate
- **Combinatorial**
  - The Republicans take the Senate but the Democrats take the House.

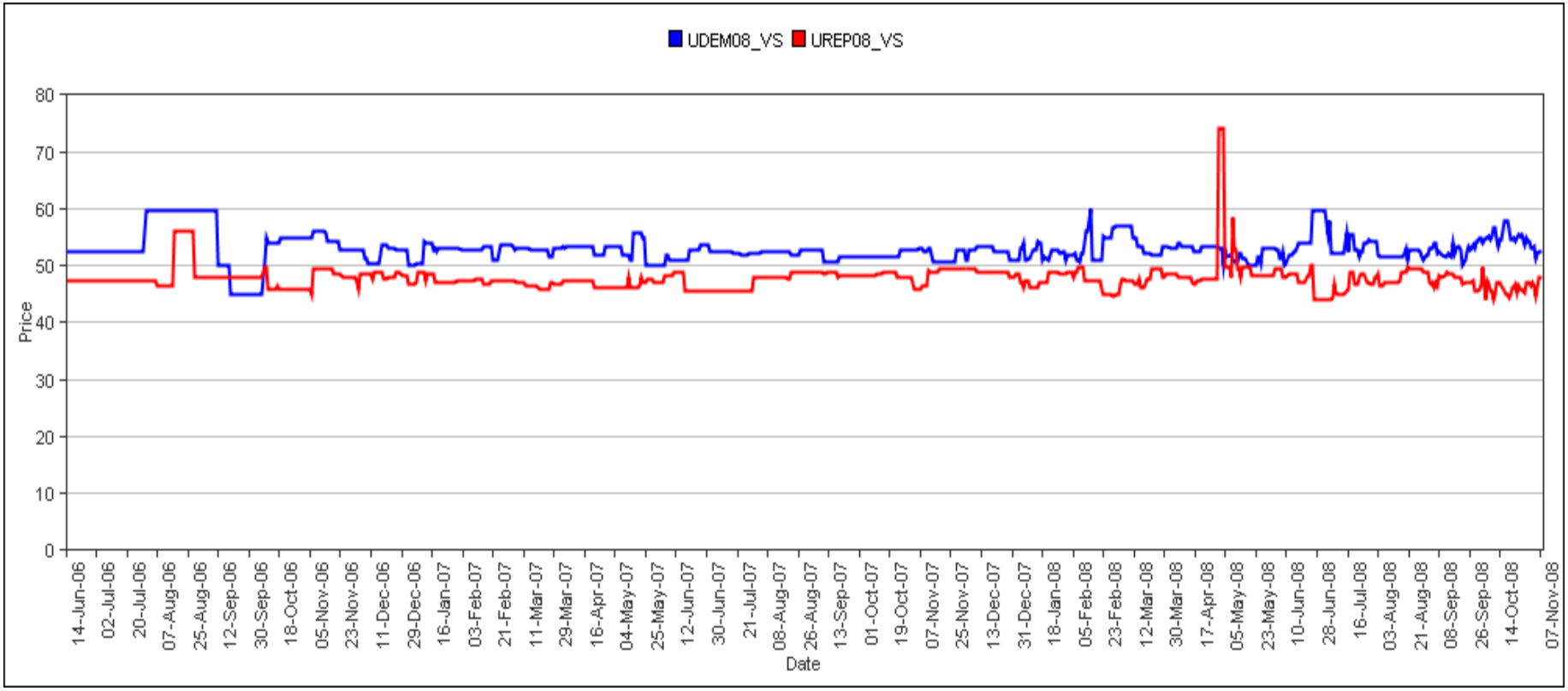
Probability Estimate

- 0 – 100% value
- Binary result



Precise Value Estimate

- Usually unbounded upper limit
- Can also be interval markets



Conditional

- 2nd event conditional on 1st
- Trade unwinds if 1st event does not happen
- Statistical intersection

Combinatorial

- Cardinal rank order determinations: 1^{st}, 2^{nd}, 3^{rd}
- Nominal rank order: A greater than B
- Multiple events

Market Scoring Rules

- Open trading
- Market-makers
- Pari-mutuel

Prediction Markets vs. Polls

- Francis Galton's ox
- Wolfers & Zitzewitz, 2006
  - Iowa Election Market beats Gallup Poll by 18%
  - HP, Google, Pfizer corporate markets
- Berg, Forsyth, et. al., 2000
  - Election Markets outperform polls 9-6
  - 20% greater accuracy
  - Individual traders still very biased and inaccurate, but collective market far more accurate
- Leigh & Woofer, 2005
  - Far more accurate
  - Less volatile
  - Better than standard extrapolation or regression models

Prediction Markets vs. Experts

- Wolfers & Zitzewitz, 2006
  - Hollywood Stock Exchange on box office receipts & Oscars
  - NFL sports games
- Tetlock, 2005
  - Extrapolation and Regression more accurate than experts
    - 150% extrapolation
    - 250% statistical models

Prediction Markets Overcome Biases

- Google Prediction Market
  - Traders express intensity of opinion by intensity of trade
  - i.e., traders self select
  - Self-selecting traders more rational than average traders
  - Traders mature with markets and reduction of individual biases (Berg & Neumann, 2006)

- Intel
  - Assimilated information quicker
  - Less volatile
  - More accurate

- Hewlett Packard
  - Incentives to hide, misrepresent or ignore information eliminated
  - Incentivizes acting on information
  - Avoided “thin trading”
  - Beat in-company experts 6 v 2

Prediction Markets for JIPOE

- Joint Intelligence Preparation of the Operational Environment (JIPOE)
  - To understand complex and interconnected environment
  - Provides a systems approach to re-aggregation of information
- Enemy Courses of Action
  - Most likely COA
    - Binary, probabilistic market
    - Extract a key variable, like date
  - Most dangerous COA
    - Need to know predicted success
    - Conditional but still determines specific estimate
    - "Assume enemy will attack friendly shipping with conventional subs. How much friendly tonnage will be sunk in first month?"

$$E(B|A) = p_A(p_B(x_B)) + c_t$$

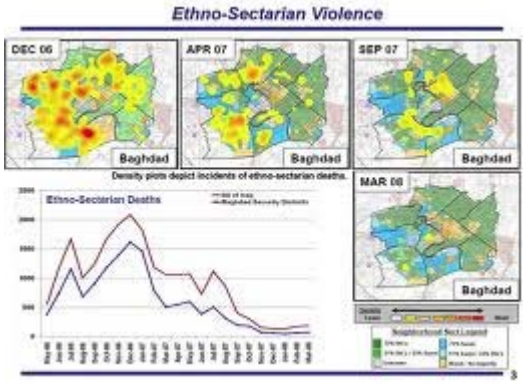
$E(B|A)$ = predicted value of *B* given *A*
B = predicted tons sunk
A = the enemy attacks friendly shipping with conventional submarines
p_A = the predicted probability the enemy attacks friendly shipping with conventional submarines
p_B = the predicted probability that the predicted tons will be sunk
x_B = the number of tons sunk,
c_t = the trader's transaction cost of conducting that trade.

Prediction Markets for MA

- Mission Analysis (MA)
  - Making lots of assumptions
  - All assumptions need branch plans – ugh
  - HHQ assumptions = facts
- Determining Assumption Risks
  - Risk = Probability and severity
  - Doctrine says more an art than science
  - Use intuition and judgment

Prediction Markets for COA Development

- Aggregate multiple prediction markets
  - Fair (2008) model of State-by-State elections
  - Rank order results of multiple prediction markets
  - “no condition…were x wins in State *i* and loses in State ranked higher than *i*”



- Prediction Markets integrate rank ordering of multiple markets
  - Since all States above the pivotal State *j* will go the way of State *j*, the probability for the entire nation is simply probability in State *j*.
  - Multiple regions for COA can be reduced to one region by finding the “tipping point”
  - Also defines the “knee in the curve”
  - Can also integrate variance amongst regions