REPLICATION CRISIS, PREDICTION MARKETS AND THE FUNDAMENTAL PRINCIPLE OF PROBABILITY
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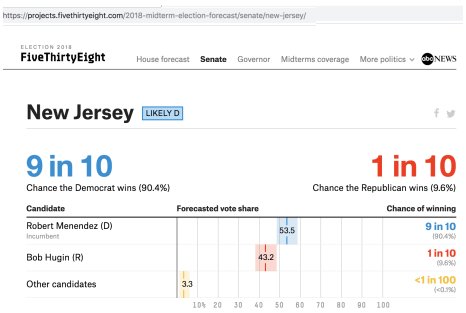
Goodhart's Law: When a measure becomes a target it ceases to be a good measure.

- *Theory*: P-value measures the amount of evidence data provides for a scientific hypothesis.
- *Practice*: P-value < 0.05 is the target that determines whether results are published.

Fundamental Principle of Probability

(1) If you assign a probability to an outcome happening, then you must accept a bet on the other side at the correct implied odds.
(2) Example: You claim that Clinton has 99% probability to win 2016 election (as Princeton Election Consortium did). This claim is meaningful only if you will offer 99-to-1 for a bet against Clinton.
(3) Application to Replication Crisis: When publishing a result, authors provide:
   (a) Replication criteria on which replication will be deemed successful.
   (b) Replication probability p determines implied odds $p/(1-p)$ of bet against replication.
   (c) Exposure Limit: Monetary amount that author backs up its claim.

Prediction Markets



Prediction Market: Pr(Menendez re-elected) = 0.78
538 Forecast: Pr(Menendez re-elected) = 0.90

Which is more accurate?

- If 538 estimate is right, the market is offering a 12% edge to bet on Menendez.
- Either (i) markets very inefficient or (ii) 538 estimates are unreliable. (Maybe both.)

Applied to Replication Crisis:

(1) When a paper is submitted for publication, a betting market opens up.
    Conditional on a replication attempt, the claimed results will replicate:
    YES: \$0.67
    NO: \$0.33
    - If replication attempt successful, **YES** worth \$1.00, **NO** worth \$0.00.
    - If replication unsuccessful, **YES** worth \$0.00, **NO** worth \$1.00.
    - If no replication attempt within (say) 1 year, then no action.
(2) Rationale: The market incentivizes accurate assessment of the replication probability.
(3) Journal uses market price in publication decision.
(4) If accepted, market probability published along with the article.

Comparison of FPP and Prediction Markets:

	Prediction Market	FPP
Replication Probability	Market-driven	Set by authors
Role of Probability	Publication Decision, Signaling	Price of real bets Skin in the game
Consequence if Probability too high	Type I error: Publication Author benefits	Author loses money/funds Challenger gains
Consequence if Probability too low	Type II error: Rejection Author penalized	Conservative estimate No harm, no foul
Author incentive	Overstate probability Deception	Understate probability Conservative
Information asymmetry	Between Market & Author	Price in or risk ruin
Challenges to paradigm	Upper hand for "normal science" New ideas suppressed	Equal footing with *status quo*

References:

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- R. Hanson. Could Gambling Save Science?