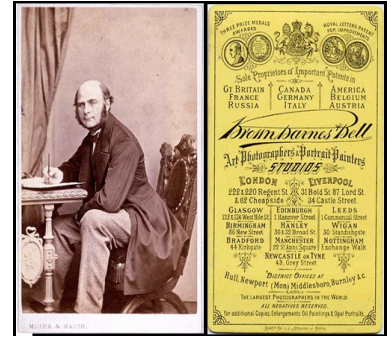
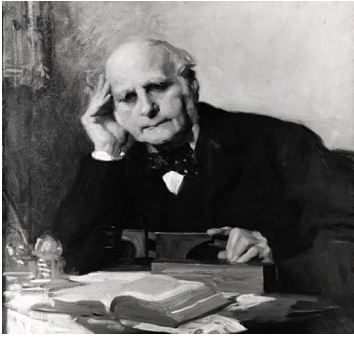


## Lecture 24: Wisdom of Crowds and Prediction Markets



### GALTON STUDY OF WEIGHT OF OXEN: Vox Populi

In these democratic days, any investigation into the trustworthiness and peculiarities of popular judgments is of interest. The material about to be discussed refers to a small matter, but is much to the point.

A weight judging competition was carried on at the annual show of the West of England Fat Stock and Poultry Exhibition recently held at Plymouth (England). A fat ox having been selected, **competitors bought** stamped and numbered cards, for 6d. each, on which to inscribe their respective names, addresses, and estimates of what the ox would weigh after it had been slaughtered and "dressed." Those who guessed most successfully received prizes. About 800 tickets were issued, which were kindly lent me for examination after they had fulfilled their immediate purpose. These afforded excellent material. The judgements were [unbiased] by passion and uninfluenced by oratory and the like. The sixpenny fee deterred practical joking, and the hope of a prize and the joy of competition prompted each competitor to do his best. The competitors included butchers and farmers, some of whom were highly expert in judging the weight of cattle; others were probably guided by such information as they might pick up, and by their own fancies. The average competitor was probably as well fitted for making a just estimate of the dressed weight of the ox, as an average voter is of judging the merits of most political issues on which he votes, and the variety among the voters to judge justly was probably much the same in either case.

After weeding thirteen cards out of the collection, as being defective or illegible, there remained 787 for discussion. I arrayed them in order of magnitudes of the estimates, and converted the *cwt.*, *quarters*, and *lbs.* in which they were made, into *lbs.*, under which form they will be treated.

According to the democratic principle of "one vote one value," the middlemost estimate expresses the *vox populi*, every other estimate being condemned as too low or high by a majority of the voters (for fuller explanation see One Vote, One Value, NATURE, February 28, p. 414). Now **the middlemost estimate is 1207 lb., and the weight of the dressed ox proved to be 1198 lb.; so the *vox populi* was in this case 9 lb., or 0.8 per cent. of the whole weight too high.** The distribution of the estimates about their middlemost value was of the usual type... clustered closely in its neighbourhood and became rapidly more sparse as the distance from it increased.

But they were not scattered symmetrically. One quarter of them deviated more than 45 lb. above the middlemost (3.7 per cent.), and another quarter deviated more than 29 lb. below it (2.4 per cent.), therefore the range of the two middle quarters, that is, of the middlemost half, lay within those limits. It would be an equal chance that the estimate written on any card picked at random out of the collection lay within or without those limits. In other words, the "probably error" of a single observation may be reckoned as  $1/2 (45 + 29)$ , or 37 lb. (3.1 per cent.). Taking this for the p.e. of the normal curve that is best adapted for comparison with the observed values, the results are obtained which appear in above table, and graphically in the diagram.

The abnormality of the distribution of the estimates now becomes manifest, and is of this kind. The competitors may be imagined to have erred *normally* in the first instance, and then to have magnified all errors that were positive. The lower half of the "observed" curve agrees for a large part of its range with a normal curve having the p.e. = 45, and the upper half with one having its p.e. = 29. **I have not sufficient knowledge of the mental methods followed by those who judge weights to offer a useful opinion as to the cause of this curious anomaly ...**

It appears then, in this particular instance, that the *vox populi* is correct to within 1 per cent. of the real value, and that the individual estimates are abnormally distributed in such a way that it is an equal chance whether one of them, selected at random, falls within or without the limits of -3.7 per cent. and +2.4 per cent. of their middlemost value. This result is, I think, more creditable to the trustworthiness of a democratic judgement

than might have been expected. The authorities of the more important cattle shows might do service to statistics if they made a practice of preserving the sets of cards of this description, that they may obtain on future occasions, and loaned them under proper restrictions, as these have been, for statistical discussion. The fact of the cards being numbered makes it possible to ascertain whether any given set is complete. Francis Galton.

**Distribution of the estimates of the dressed weight of a particular living ox, made by 787 different persons.**

| Degrees of the length of<br>Array 0°-100° |           | Estimates in<br>lbs. | Centiles                            |                     | Normal |
|-------------------------------------------|-----------|----------------------|-------------------------------------|---------------------|--------|
|                                           |           |                      | Observed Deviates<br>from 1207 lbs. | Normal p.e.<br>= 37 |        |
|                                           | 5         | 1074                 | -133                                | -90                 | +43    |
|                                           | 10        | 1109                 | -98                                 | -70                 | +28    |
|                                           | 15        | 1126                 | -81                                 | -57                 | +24    |
|                                           | 20        | 1148                 | -59                                 | -46                 | +13    |
| q1                                        | 25        | 1162                 | -45                                 | -37                 | +8     |
|                                           | 30        | 1174                 | -33                                 | -29                 | +4     |
|                                           | 35        | 1181                 | -26                                 | -21                 | +5     |
|                                           | 40        | 1188                 | -19                                 | -14                 | +5     |
|                                           | 45        | 1197                 | -10                                 | -7                  | +3     |
| <b>ACTUAL</b>                             |           | <b>1198</b>          |                                     |                     |        |
| <b><i>m</i></b>                           | <b>50</b> | <b>1207</b>          | 0                                   | 0                   | 0      |
|                                           | 55        | 1214                 | +7                                  | +7                  | 0      |
|                                           | 60        | 1219                 | +12                                 | +14                 | -2     |
|                                           | 65        | 1225                 | +18                                 | +21                 | -3     |
|                                           | 70        | 1230                 | +23                                 | +29                 | -6     |
| q3                                        | 75        | 1236                 | +29                                 | +37                 | -8     |
|                                           | 80        | 1243                 | +36                                 | +46                 | -10    |
|                                           | 85        | 1254                 | +47                                 | +57                 | -10    |
|                                           | 90        | 1267                 | +52                                 | +70                 | -18    |
|                                           | 95        | 1293                 | +86                                 | +90                 | -4     |

q1, q3, the first and third quartiles, stand at 25° and 75° respectively. *m*, the median or middlemost value, stands at 50°. The dressed weight proved to be 1198 lbs.

The Galton results is example of “wisdom of crowd” in which views of a group of people average to close to the actual. Better than ~95% of the individual guesses. It is also a prediction market, but there are examples of wisdom of crowd that are not prediction markets. If an election opinion poll asks how are you going to vote? that is not prediction market, but the opinion polls do reasonably well. Do they beat out opinion polls? “Ask the prediction question: who do you think will win? It beats who will vote for... our results suggest that expectations-based forecasts are much more powerful predictors of election outcomes.” (Rothschild and Wolfers, “ Forecasting Elections: Voter Intentions versus Expectations” Jan 2013)“

A majority believe President Obama will defeat Mitt Romney ... a Gallup poll found Wednesday. According to the survey, 54 percent said they thought Obama will win, 34 percent believe Romney will win, and 11 percent had no opinion. Those numbers have been fairly stable throughout the cycle, with Obama peaking in late August at 58 to 36 percent over Romney. The numbers contrast with Gallup's results of who likely voters will support in the election. In its most recent poll, 51% of likely voters said they would support Romney, compared to 46% who said they would support Obama... 86% of Democrats said they believed Obama would win, compared to 71% of Republicans who said Romney. Among independents, 52% said Obama and 32% said Romney.

Table 2: Forecasting the Presidential Election, by State

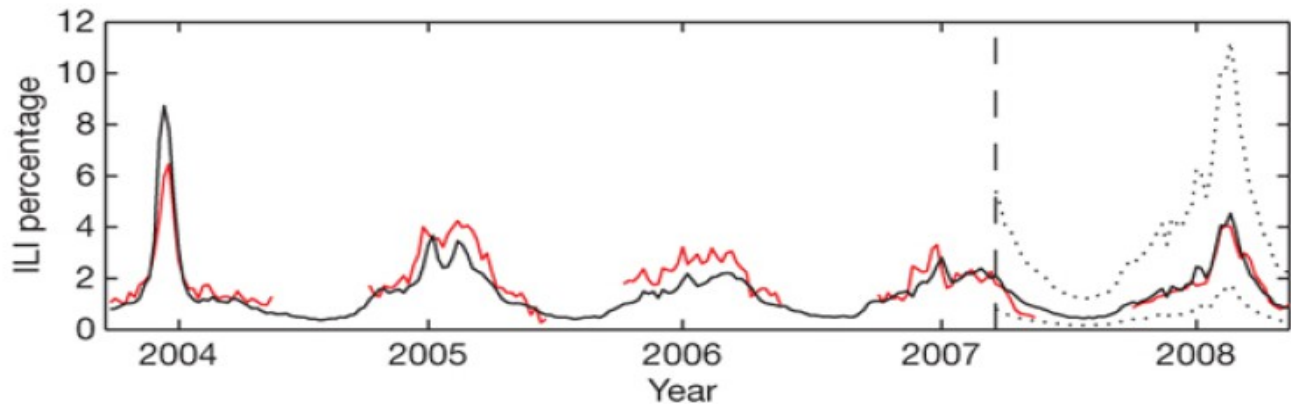
| Year             | Proportion of states where the winning candidate was correctly predicted by a majority of respondents to: |                    | Number of states surveyed |
|------------------|-----------------------------------------------------------------------------------------------------------|--------------------|---------------------------|
|                  | Expectation question                                                                                      | Intention question |                           |
| 1952             | 74.3%                                                                                                     | 58.6%              | 35                        |
| 1972             | 97.4%                                                                                                     | 100%               | 38                        |
| 1976             | 80.3%                                                                                                     | 77.6%              | 38                        |
| 1980             | 57.7%                                                                                                     | 41.0%              | 39                        |
| 1984             | 86.7%                                                                                                     | 68.3%              | 30                        |
| 1988             | 88.3%                                                                                                     | 56.7%              | 30                        |
| 1992             | 89.4%                                                                                                     | 77.3%              | 33                        |
| 1996             | 75.0%                                                                                                     | 67.5%              | 40                        |
| 2004             | 89.3%                                                                                                     | 67.9%              | 28                        |
| 2008             | 76.5%                                                                                                     | 76.5%              | 34                        |
| Totals:          | 279 of 345 correct                                                                                        | 239 of 345 correct | Difference:               |
| Average:         | 80.9%                                                                                                     | 69.3%              | 11.6%***                  |
| (Standard error) | (3.8)                                                                                                     | (5.4)              | (3.2)                     |

But *The Journal of Prediction Markets* (2011) 5 3, 64-74 **DO POLLS OR MARKETS FORECAST BETTER? EVIDENCE FROM THE 2010 US SENATE ELECTIONS. SAY NO DIFFERENCE**

**Example of wisdom of crowd without market:** “... analysing large numbers of Google search queries to track influenza-like illness in a population. Because the relative frequency of certain queries is highly correlated with the percentage of physician visits in which a patient presents with influenza-like symptoms, we can accurately estimate the current level of weekly influenza activity in each region of the United States, with a reporting lag of about one day. “

Detecting influenza epidemics using search engine query data

Jeremy Ginsberg, Matthew H. Mohebbi, Rajan S. Patel, Lynnette Brammer, Mark S. Smolinski & Larry Brilliant  
*Nature* 457, 1012-1014(19 February 2009)  
doi:10.1038/nature07634



A correlation of 0.85 was obtained over 128 points from this region to which the model was fit, whereas a correlation of 0.96 was obtained over 42 validation points. Dotted lines indicate 95% prediction intervals. The region comprises New York, New Jersey and Pennsylvania.

**What are prediction markets?** (<http://tippie.uiowa.edu/iem/faq.html#Real>) <https://www.predictit.org/>

Markets whose assets are tied to a particular event in the future.

Stock markets are mechanisms that allow people to buy and sell shares based on how they expect the firm's profits/other people's expectations of those profits fare in the future.

Betting markets are mechanisms whose assets depend on the outcome of an event – whether the dice comes up odd or even. Experts (bookies) set odds and adjust odds to balance predictions/bets.

Prediction markets generate a market "price" that reflects the probability of the event. Ideally they help forecast future events.

**Statement of economists (Science 16 May 2008, 878-888):** *Prediction markets are markets for contracts that yield payments based on the outcome of an uncertain future event, such as a presidential election. Using these markets as forecasting tools could substantially improve decision making in the private and public sectors.*

Parameters driving trading behavior are: degree of risk aversion and the distribution of beliefs. Prediction market prices estimate average beliefs about the probability an event occurs. They do well in sports betting, political races, etc <http://bpp.wharton.upenn.edu/jwolfers/Papers/Predictionmarkets.pdf>; [www.qmarkets.net/#resources/tutorials\\_pm\\_1](http://www.qmarkets.net/#resources/tutorials_pm_1); [www.ingentaconnect.com/content/ubpl/ipm](http://www.ingentaconnect.com/content/ubpl/ipm)

In any area where there are expert views, we can AGGREGATE the views via a market mechanism and generally do better than if we rely on ourselves or single experts.

Why prediction market should work

1. Based on different information from all participants – aggregating different guesses of ox weight with market balancing biases of different people
2. Provide feedback to participants. By noting fluctuations in market prices, traders learn about the beliefs of others and are motivated to collect and contribute more information; (but this risks herding effects).
3. Provide incentives to encourage participants to reveal their expertise in their trades and share knowledge anonymously
4. Market must rule out gaming such as "information cascades"

Consider alternative **ways to cumulate knowledge – cascade and expert dominance**

Meet and discuss so one person can influence another. The danger is **information cascade**. This is where my assessment influences yours. Say there are 2 urns: Not red urn has 1/5th red balls; Red urn has 1/2 red balls. The experimenter gives **each person** a ball chosen randomly from one of the urns. The persons say the urn they think the experimenter is using – NOT the color of ball they drew

Say first person got red ball. Rational to say Red urn – it has 1/2 red > 1/5<sup>th</sup> from A urn. Second has black ball. Thinks first guy must have red. One red and 1 black would most likely come from Red #2 says I guess it Red urn.

Third guy thinks, I picked black, but since the other two said red, best bet is Red

Fourth guy says, I have red, and others guessed Red. I go with Red

Fifth guy says, I have black, but if 4 people say red, must be so I will guess with everyone else ... B

**If each revealed what they found, would have said, 3 black and 2 red, best estimate is Not Red urn.**

The prediction market is based on written contracts of this form: **All contracts in this market (Movie\_SH) are winner-takes-all contracts. Liquidation values for these contracts will be determined by box office receipts for the movie "Sleepy Hollow" during the period Nov 19, 1999 to and including Dec 16, 1999.**

SH3OL \$1.00 if "Sleepy Hollow" official box office receipts for the 11/19/99-12/16/99 period are lower than or equal to \$30 million; zero otherwise

SH5OL \$1.00 if receipts are higher than \$30 million and lower than or equal to \$50 million; zero otherwise

SH7OL \$1.00 if receipts are higher than \$50 million and lower than or equal to \$70 million; zero otherwise

SH9OL \$1.00 if receipts are higher than \$70 million and lower than or equal to \$90 million; zero otherwise

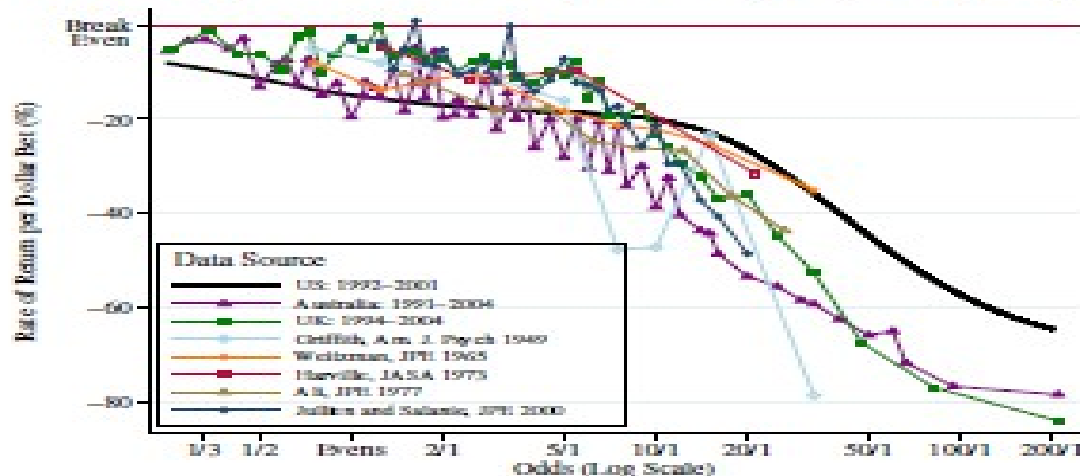
SH9OH \$1.00 if receipts are higher than \$90 million; zero otherwise

The price in winner-take all prediction market is estimate of probability. Why? If market is willing to pay 50 cents for the all-or-nothing \$1.00 contract that Red Sox win today, then market estimates that 1/2 of the time, Sox will win and get \$1.00 back, so this is equilibrium/market prediction.

Best evidence that it works are betting markets — not perfect but very good (Sauer, JEL, Dec 1998). If the odds are 2 to 1 on a horse, then 1/3rd of time will win. If the odds are 3 to 1, then 1/4th time it will win.

But even in such a well-developed market there are anomalies. In perfect market where bettors seek to maximize expected value with no risk aversion no bet should have positive expected value; and the expected value of all bets should be  $(1 - \text{transactions cost/bet}) \times \text{amount bet}$ . But there is favorite-longshot bias. You do better betting on the favorite.

Figure 3: The favorite-longshot bias is the most prominent pricing anomaly in sports betting.



Thaler and Ziemba “Anomalies: Parimutuel Betting Markets” Journal of Economic Perspectives, Spring 1988, p 168-174), list others.

### Other problems

- 1) Wealthy can put down more money ... lead to "wealth weighted" estimate of the event, which could differ from Vox Populi median or mean.
- 2) Risk aversion could lead people to be conservative. You think odds are 50/50 but will not bet at those odds because it pains you to risk losing. If risk-neutral person puts all money on favorite when market price is below their view of probability --> inaccurate prediction. Manski, "interpretation of prices in actual prediction markets requires knowledge of traders' risk preferences". Get correct odds from betting if no risk aversion and continuous distribution of views
- 3) If not real money, other preference may matter ... Justin Wolfers was top predictor on CNN presidential primary market prediction at one point. Why? He took high risk (with artificial money) to maximize chance of being top predictor ... and won. He was not revealing his best belief.
- 4) Traders could be non-representative of knowledgeable population.

Key to analysis are MARKET CLEARING and REVELATION OF TRUE BELIEFS

Gaming market — 2003 DARPA ran betting market in future events so government might be able to aggregate revealed wisdom. This produced news scandal about Pentagon betting market on terror attacks. Headlines warned that terrorists could bet on attack and make money on their attack. Danger that someone manipulates events to gain in the market.

**PREDICTION MARKETS:** <http://www.hsx.com/security/> hollywood stock exchange  
<http://www.biz.uiowa.edu/iem/index.cfm>; Only US exchange that is allowed to use real money <\$500  
<http://www.intrade.com/>; but Dublin company got into legal problems. On November 26th America's  
 Commodity Futures Trading Commission (CFTC) sued the company for allowing betting on the prices of products, such as oil and gold, which trade on derivatives markets it regulates. (In 2005 Intrade had promised the CFTC not to offer such contracts.) In response to the suit, the firm announced it would no longer let Americans trade on its site.

**Pioneering prediction markets company NewsFutures (2000-2010) has evolved into Lumenogic, the first consulting company entirely dedicated to delivering collective intelligence solutions to senior management**

In the first decade of the 21st century, NewsFutures created one of the best-known public prediction markets and led the development of enterprise-class prediction market services.

## Internal Firm Markets

Best Buy; “We sent e-mails to hundreds of people throughout the company and asked them what they thought our gift card sales would be in February 2005. The only information we gave them as the context for their predictions was simple, readily available data. We got some 190 responses and ran a simple average. It turned out to be 99.5 percent accurate, whereas the people ... paid to forecast this were five percentage points off. We ran a similar experiment later that year, when 350 random people predicted our holiday sales... the non-experts, off by just one tenth of 1 percent, were more accurate than the experts, who were off by 7 percent. These early experiments encouraged us to get into prediction contracts, and we have to date seen over 2,000 traders make a total of 70,000 trades on 147 contracts.” Policy rec: FIRE THE EXPERTS??

Google: We launched our prediction markets in April 2005, and since then we’ve asked about 275 different questions, and some 80,000 trades. Around one-quarter of our markets have to do with demand forecasting—for instance, “How many people will use Gmail in the next three months?” Another 30 percent concern the company’s performance—for example, will project deadlines be met? ... One important bias was optimism. **Outcomes that would be good for Google—such as getting lots of users—were slightly overpriced.** The market gave them a higher probability than it should have. The cause seems to be **new employees**, whose trades show that they are highly optimistic about our company. The external Google stock price also seems to play a role.

**When Google stock does well, the price of optimistic outcomes in the prediction markets also rises.** We also noticed that **traders under-priced extreme events**, both good and bad. When we floated contracts with five different outcomes—for example, forecasts about the number of Gmail users—the highest and the lowest outcome happened more often than the market expected... Our markets showed that beliefs are clustered, and these clusters are made up of individuals who physically sit and work close to each other, not only at the level of city and country, but at the microlevel of the office floor, measured in feet or meters between desks. (McKinsey Report, available at [http://faculty.haas.berkeley.edu/bo\\_cowgill/Popular/McKinseyQuarterlyPredictionMarketsArticle.pdf](http://faculty.haas.berkeley.edu/bo_cowgill/Popular/McKinseyQuarterlyPredictionMarketsArticle.pdf))



Wolfers and Zitzewitz (2005) conditions for prediction market prices to coincide with average beliefs of traders:

- 1-- Log utility based solely on expected \$ return --> No consumption such as bet on underdog/ home team etc
- 2- Wealth and beliefs uncorrelated (if correlated instead of average belief, get wealth-weighted belief)

The prediction market is in equilibrium when supply equal demand:

$$\int_{-\infty}^{\pi} y \frac{q - \pi}{\pi(1 - \pi)} f(q) dq = \int_{\pi}^{\infty} y \frac{\pi - q}{\pi(1 - \pi)} f(q) dq$$

If beliefs ( $q$ ) and wealth ( $y$ ) are independent, then this implies:

$$\pi = \int_{-\infty}^{\infty} q f(q) dq = \bar{q}.$$

What if utility is not log? Works ok for plausible other utility functions.

## **April 9, 2008 NYT on firm internal markets Betting to Improve the Odds By [STEVE LOHR](#)**

CORPORATIONS live and die by ideas, and many enterprises have used Web-based technologies, like blogs, wikis and social networks, to gather thoughts and hasten their way into new services, products and cost-saving steps.

Now executives say they are harnessing a new Web tool, called prediction markets ...to improve forecasting, reduce risk and accelerate innovation by tapping into the collective wisdom of the work force. ... Corporate prediction markets work like this: Employees, and potentially outsiders, make their wagers over the Internet using virtual currency, betting anonymously. They bet on what they think will actually happen, not what they hope will happen or what the boss wants. The payoff for the most accurate players is typically a modest prize, cash or an [iPod](#).

The early results are encouraging. "The potential is that prediction markets may be the thing that enables a big company to act more like a small, nimble company again," said Jeffrey Severts, a vice president who oversees prediction markets at [Best Buy](#), the electronics retailer.

The store chain has experimented with prediction markets on everything from demand for digital set-top boxes to store-opening dates. For example, Mr. Severts said that in the fall of 2006, the prices in a prediction market on whether a new store in Shanghai would open on time — in December 2006 — dropped sharply from \$80 a share into the \$40 to \$50 range. Players made yes-no bets, and the virtual dollar drop reflected increasing doubt that the store would open on time. Indeed, Best Buy's first store in China opened late but the warning signs from the prediction market helped prevent further slippage.

Best Buy plans to move beyond pilot projects in prediction markets to involve more workers throughout the company, starting next month. "It helps on two fronts, the speed and accuracy of information, so that management can move faster to deal with problems or exploit opportunities," Mr. Severts said.

... The idea is that the collected knowledge of many people, each with a different perspective, will almost surely be more accurate than an individual or small group or even experts. The concept has been championed by academic economists and was popularized by James Surowiecki's 2004 book "The Wisdom of Crowds."

... So far, most of the companies using prediction markets are doing so in limited ways, in one or two departments, testing the concept to see how it goes. But in the last few years, corporate experimentation has moved beyond high-tech businesses into other industries, including retailing, consumer packaged foods, hotels, health care, steelmaking and telecommunications. Today, analysts say, there are dozens of major corporations testing these markets. The field is attracting start-ups as well. In 2006, for example, Adam Siegel and Nate Kontny left [Accenture](#), the consulting firm, to found [Inkling Markets](#). Mat Fogarty had been director for financial planning at Electronic Arts, before founding [Xpree](#) last year.

"Prediction markets are starting to move into the mainstream, and they will really change the way companies are run in the future," said Emile Servan-Schreiber, the chief executive of NewsFutures.

At InterContinental Hotels, Zubin Dowlaty, vice president for emerging technologies, decided to create an online market last fall to "harvest and prioritize ideas" from within the hotel's 1,000-person technology staff. "We wanted to tap the creative class that may not be able to voice their ideas," Mr. Dowlaty said. With InterContinental's prediction market, players were asked to submit ideas anonymously, with a description and the benefit to customers and company. The bettors were given virtual tokens, each receiving 10 green ones to be placed on the best ideas and three red for bad ideas.

There were no limits on the number of times bettors could change their wagers as new ideas came to market, and the market was open for four weeks. The five top ideas (most green tokens), five bottom ideas (most red) and the top five bettors (most accurate, according to market consensus) were listed regularly. The winners got \$500, while second- and third-place finishers received \$250 each. The winners, Mr. Dowlaty said, were engineers, analysts and contractors, not managers. More than 200 people participated, submitting 85 ideas.

The winning ideas were suggestions to improve searching the company's Web site to find and book hotel rooms. Two projects have been started as a result of the market, Mr. Dowlaty said. ...

Setting up corporate prediction markets can be tricky. Public markets for presidential candidates will attract thousands of bettors, but a company may want to run a market only for people with expertise in a certain product or project. At Hewlett-Packard, researchers have been working on techniques and software to make even small prediction markets efficient.

**"We want to reduce the wisdom of crowds to the wisdom of 12 or 13 people," said Bernardo A. Huberman, director of the social computing lab at Hewlett-Packard.** Among the techniques, he said, are preliminary tests to assess "behavioral risk characteristics" of participants to shade predictions from people who are inherently risk seekers or risk averse.

...a group in the purchasing unit at H.P. began prediction markets on the price of computer memory chips three and six months ahead. The prediction markets, Dr. Huberman said, were up to 70 percent more accurate than the company's traditional forecasting models. The more accurate predictions, he said, can be used to finesse purchasing, marketing and product pricing decisions. The H.P. research project has become a service offering called Brain, for Behaviorally Robust Aggregation of Information in Networks. The service is now used in pilot projects by H.P. clients that include Swisscom,

which is trying it to predict demand for new services like Internet television on cellphones...GE is evaluating how broadly prediction markets could be used in the health care division, a \$17 billion-a-year unit, and elsewhere in the company. “We’ll know a lot more at the end of the year how much this becomes part of the decision-making process,” Mr. Linthicum said.

## Political betting markets in US

Rhode and Strumpf (2004): public and open political betting dates back to George Washington’s election. Organized election-betting markets have existed since the 1860s. From 1896 to 1924, the *New York Times*, *Sun*, and *World* provided price quotes almost daily... With these odds, those interested in the election could catch up quickly on its status using the aggregated beliefs of dispersed market participants to see who had the lead and by how much. Andrew Carnegie in 1904: “From what I see of the betting . . . I do not think that Mr. Roosevelt will need my vote. I am sure of his election.” Rhode and Strumpf (2004): public and open political betting dates back to George Washington’s election, and organized election-betting markets have existed since the 1860s. In 1916, the \$165 million exchanged in election-betting markets was more than double what was spent on election campaigns that year....the current odds were made widely available. From 1896 to 1924, the *New York Times*, *Sun*, and *World* provided price quotes almost daily... With these odds, those interested in the election could catch up quickly on its status using the aggregated beliefs of dispersed market participants to see who had the lead and by how much.

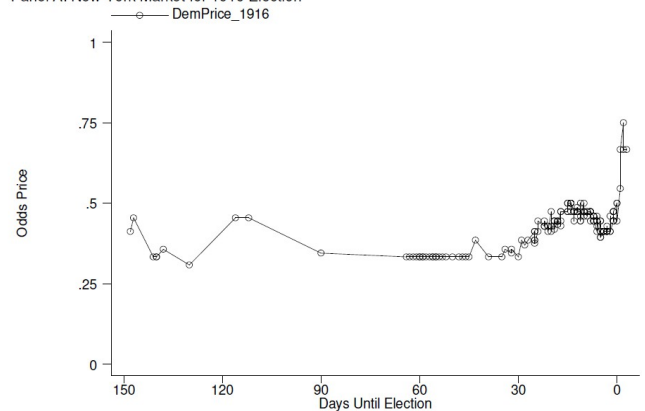
Andrew Carnegie in 1904: “From what I see of the betting . . . I do not think that Mr. Roosevelt will need my vote. I am sure of his election.” Erikson and Wlezien (2009) find that these markets predicted better in the era before scientific polling (election years 1880–1932) than in the era with scientific polling (1936–2008).

Table 1: New York Election Betting Volume

|      |                   |            |     |           |
|------|-------------------|------------|-----|-----------|
| 1916 | Woodrow Wilson    | Democratic | 277 | 9,129,606 |
|      | Charles E. Hughes | Republican | 254 | 8,538,221 |
|      | A. L. Benson      | Socialist  | 0   | 585,113   |

|         | New York Betting Volume    |                           |                                  |
|---------|----------------------------|---------------------------|----------------------------------|
|         | 2002 dollars<br>(millions) | Dollars per<br>Votes Cast | Dollars per<br>Campaign Spending |
| 1884    | 13.7                       | 1.36                      | 0.278                            |
| 1888    | 37.6                       | 3.30                      | 0.907                            |
| 1892    | 14.8                       | 1.23                      | 0.185                            |
| 1896    | 10.7                       | 0.77                      | 0.124                            |
| 1900    | 63.9                       | 4.57                      | 0.876                            |
| 1904    | 50.3                       | 3.72                      | 0.894                            |
| 1908    | 7.7                        | 0.52                      | 0.174                            |
| 1912    | 4.6                        | 0.30                      | 0.087                            |
| 1916    | 165.0                      | 8.90                      | 2.116                            |
| 1920    | 44.9                       | 1.68                      | 0.726                            |
| 1924    | 21.0                       | 0.72                      | 0.373                            |
| 1928    | 10.5                       | 0.29                      | 0.086                            |
| Average | 37.0                       | 2.28                      | 0.532                            |

Panel A: New York Market for 1916 Election



**Current: Public Markets with real money ruled illegal** : regulatory guidelines restricted the trading of “Event Futures” for real money (considered “swaps” by the CFTC). This has dampened prediction market development (including even politics) which use real money and are now a barrier to participation for many who expressed interest in participating but had no interest in confronting a regulatory haze. Intrade closed in March of 2013.

A functional Prediction Marketplace needs incentivised participants with open and easy access. Users need to be easily able to trade and to try hard to “win”, to be right...and they need certain motivations to try hard. It has always been our belief – and academic studies have shown – that money is the best motivator for that. That business model is not currently available to us in the US. By exploring non-financial motivations and leveraging new journalism and social media, Intrade 2.0 will provide a new angle of approach. ... the return of Tradesports.com as a real-money, skill based Fantasy Sports Trading Contest platform, launching in 2014. Tradesports.com will use the core Intrade trading platform to offer real money trading contests, based upon sporting events, similar to the way stocks and futures are traded. This is a new and LEGAL way to play fantasy sports contests for real money ... skill, strategy, timing, and reflexes are required to win. We believe our trading contest structure, coupled with new payout schedules, will properly motivate an informed group of traders to help us produce key sports data in real time about many aspects of a sporting event—true representations of the “wisdom of the crowd”.