



- “It's tough to make predictions, especially about the future”
- Yogi Berra
 - Legendary Yankees catcher



Not just Dollars



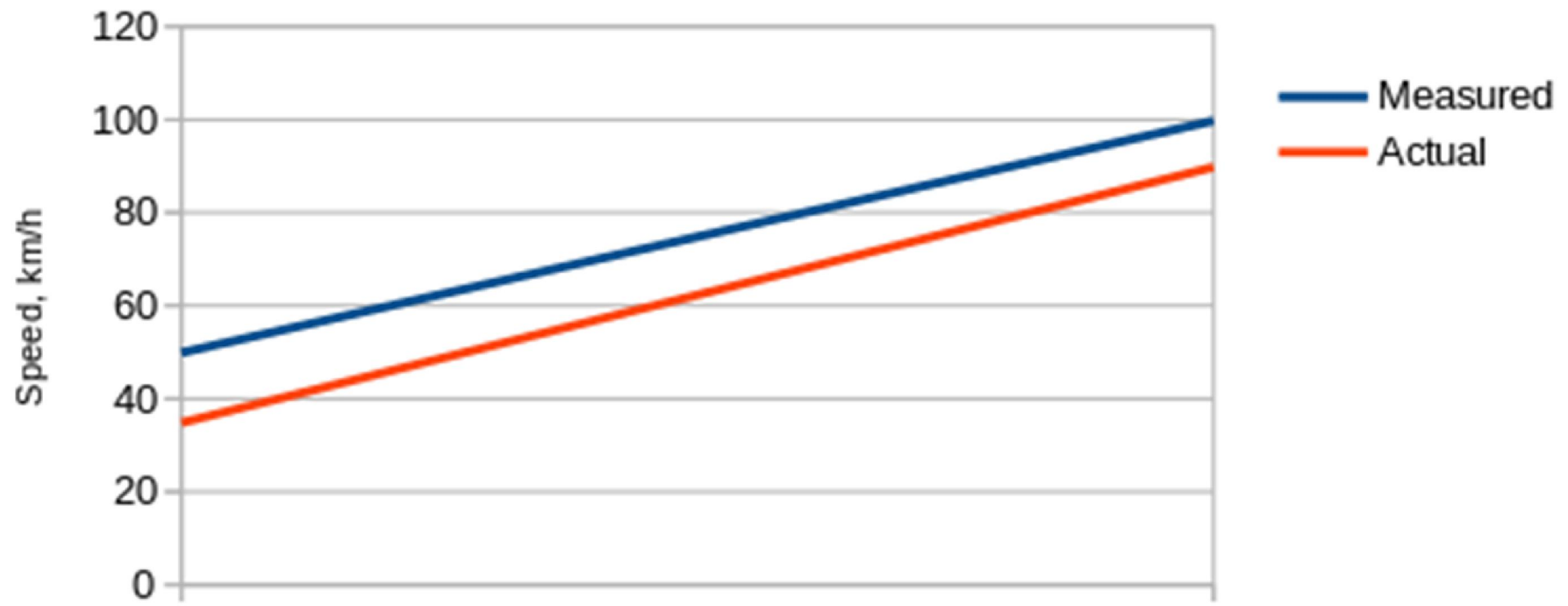
- How likely is something to happen?
 - Law change
 - Financial crisis
 - Sentiment change
 - plastic bags
 - Facebook



Facts?

Measure = Estimate

How accurate must your Speedo be?



Expert Judgment



Research

284 Experts

80,000 predictions

Some in their own area of expertise,

Some outside (as lay people)

20 Years (to see results)

Professor Philip E. Tetlock,
Wharton School,
University of Pennsylvania

Expert Judgment



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Results

“experts thought they knew
more than they knew”

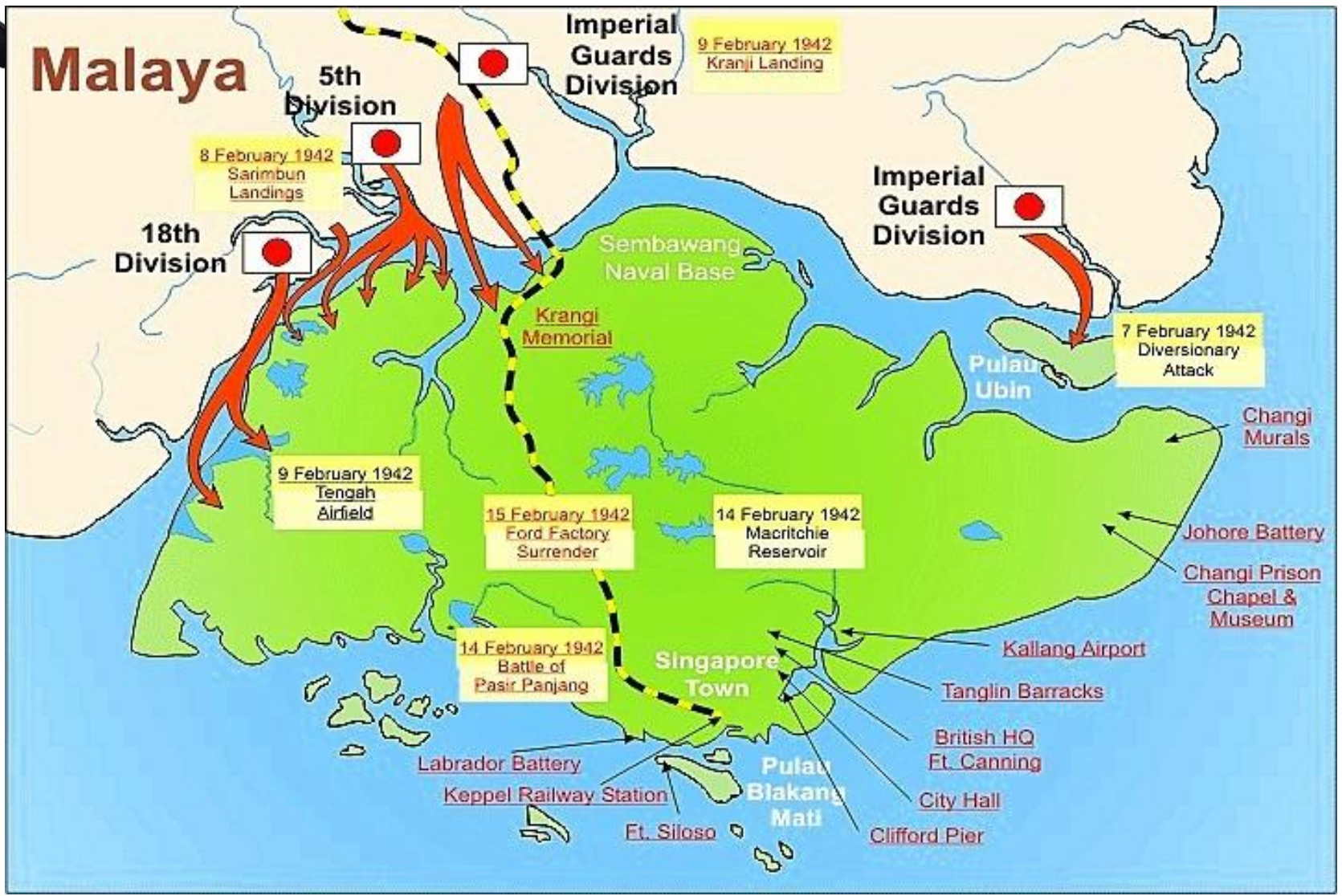
“somewhat better than ...
Berkeley undergraduates”

“a little better than ... random guessing”

“a little bit worse than ... extrapolation”

Performed worse
in their own expert area
than their non-expert colleagues

Malaya



In Place of Experts



- **Probabilistic Elicitation**

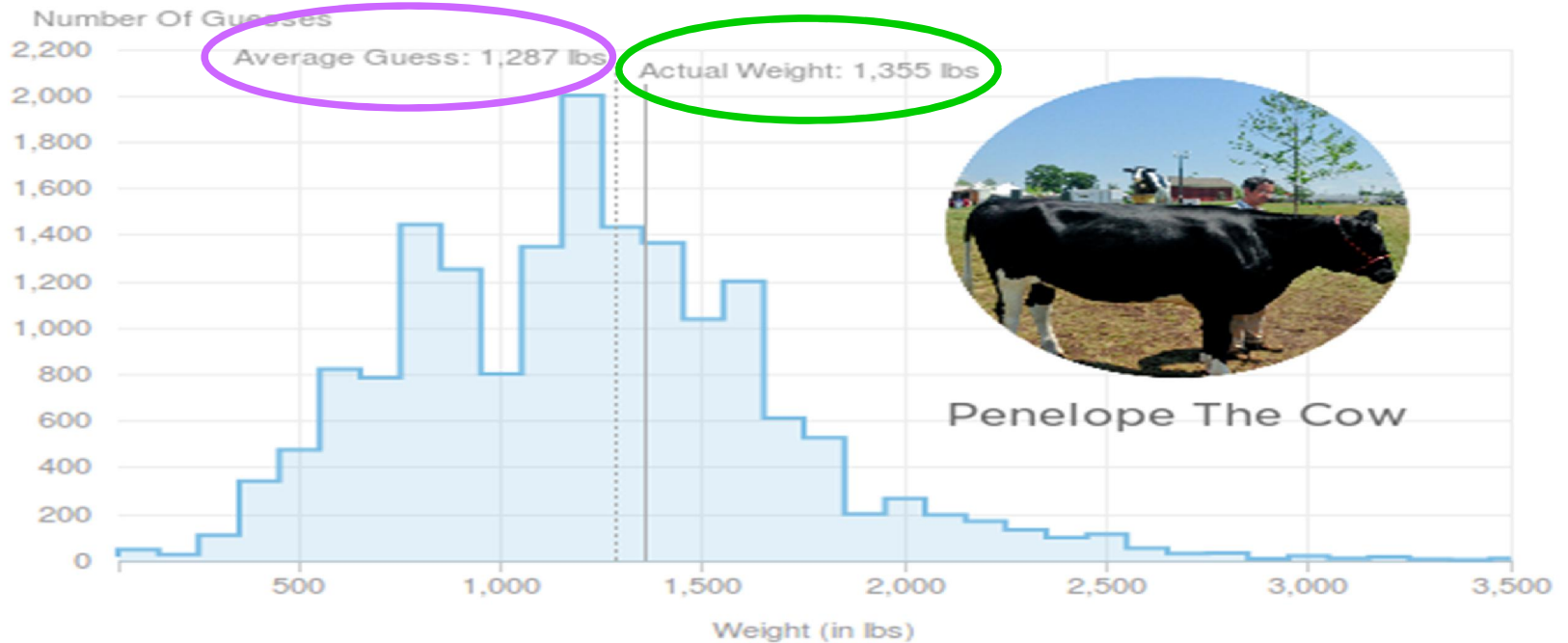
- Crowd Wisdom
 - Many Independent Views
- Aggregating Estimates
 - Statistically

17205 respondents at NPR.org



How Much Does This Cow Weigh?

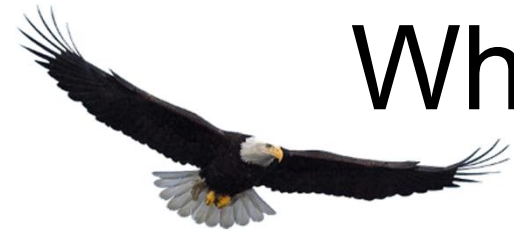
(All People)



Source: The Internet.

Credit: Quoc Trung Bui/NPR

Why is a Crowd better?



- Everyone has prior beliefs
 - Some are **Facts**
 - Some are **Myths**
 - As individuals, **Facts** and **Myths** are hard to tell apart
- **Facts** are believed by more people,
 - So statistically, belief in **Facts** tends to **reinforce**
- Each **Myth** is believed by fewer people
 - Opposing **Myths cancel** each other out

Independant Views

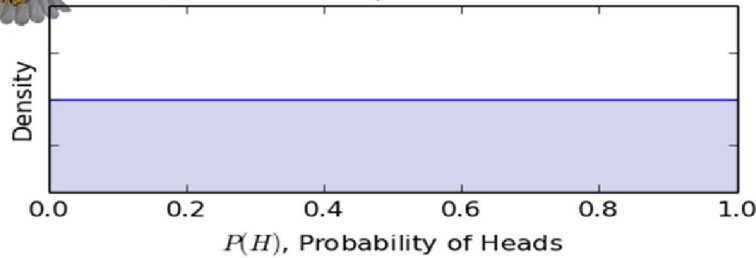


- Value Diversity
- Avoid group effects
 - Group sense-making to define terms etc
 - Provide historical data as context
 - But gather estimates in private
- Control for Biases
 - Neutral proxies for contentious items

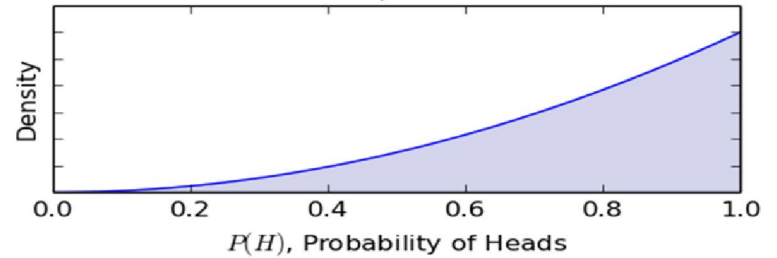
Combining Estimates



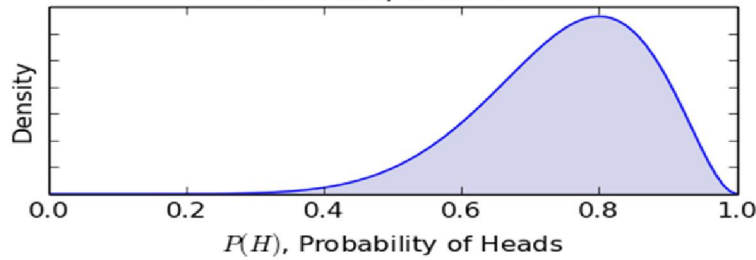
0 trials, 0 heads



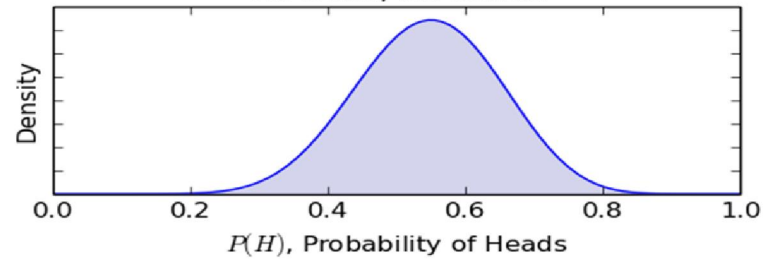
2 trials, 2 heads



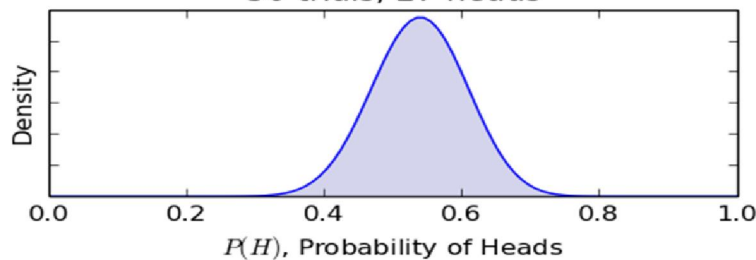
10 trials, 8 heads



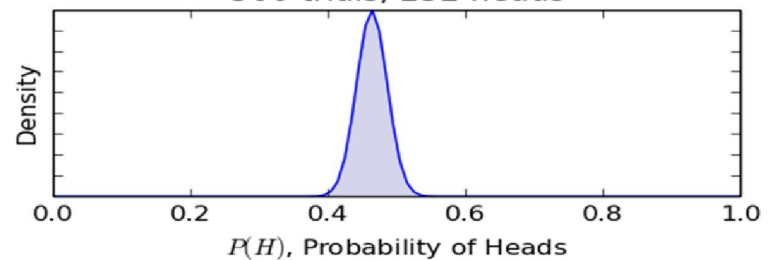
20 trials, 11 heads



50 trials, 27 heads

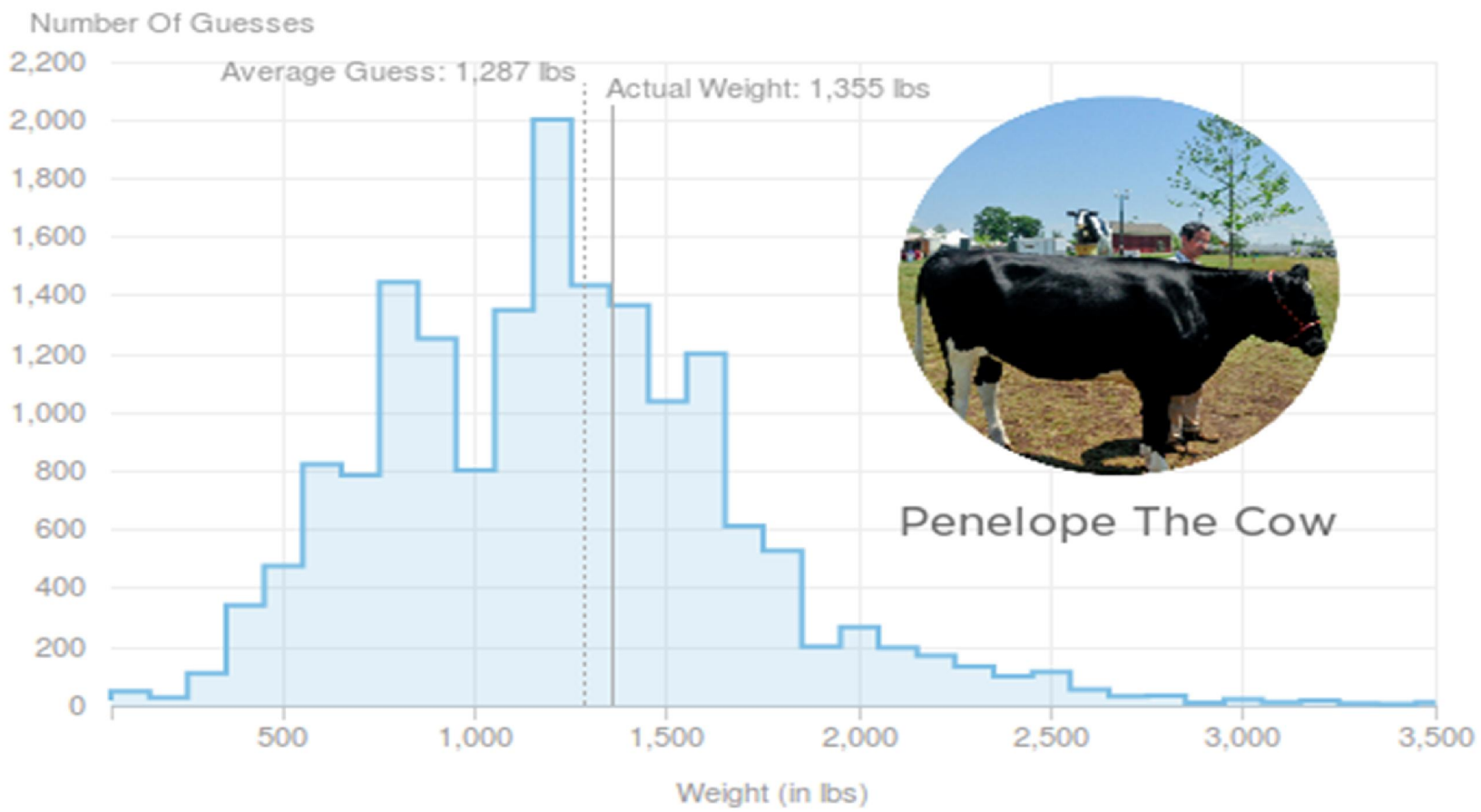


500 trials, 232 heads





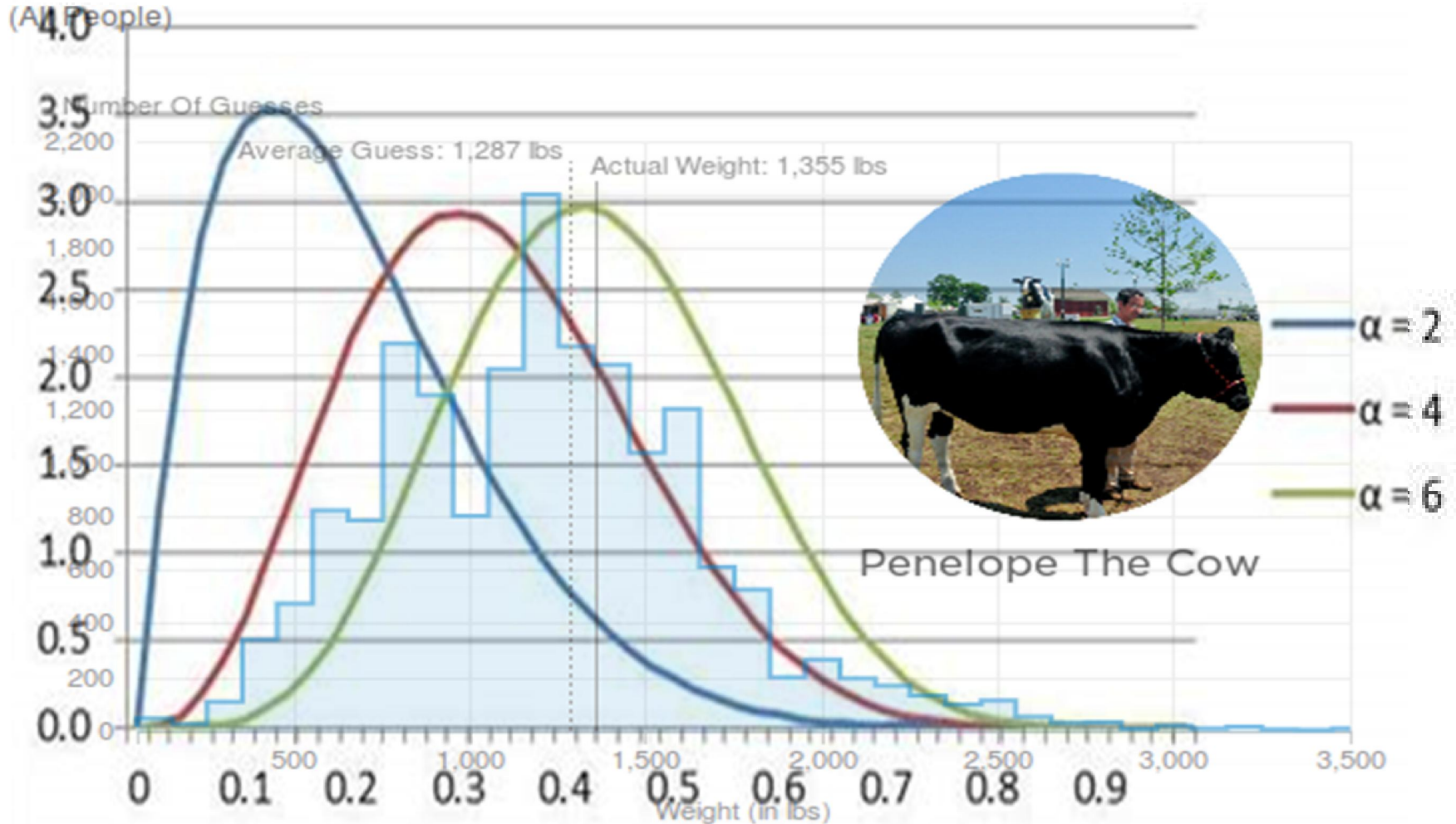
(All People)



Source: The Internet.

Credit: Quoc Trung Bui/NPR

Beta Distribution $\beta = 8$



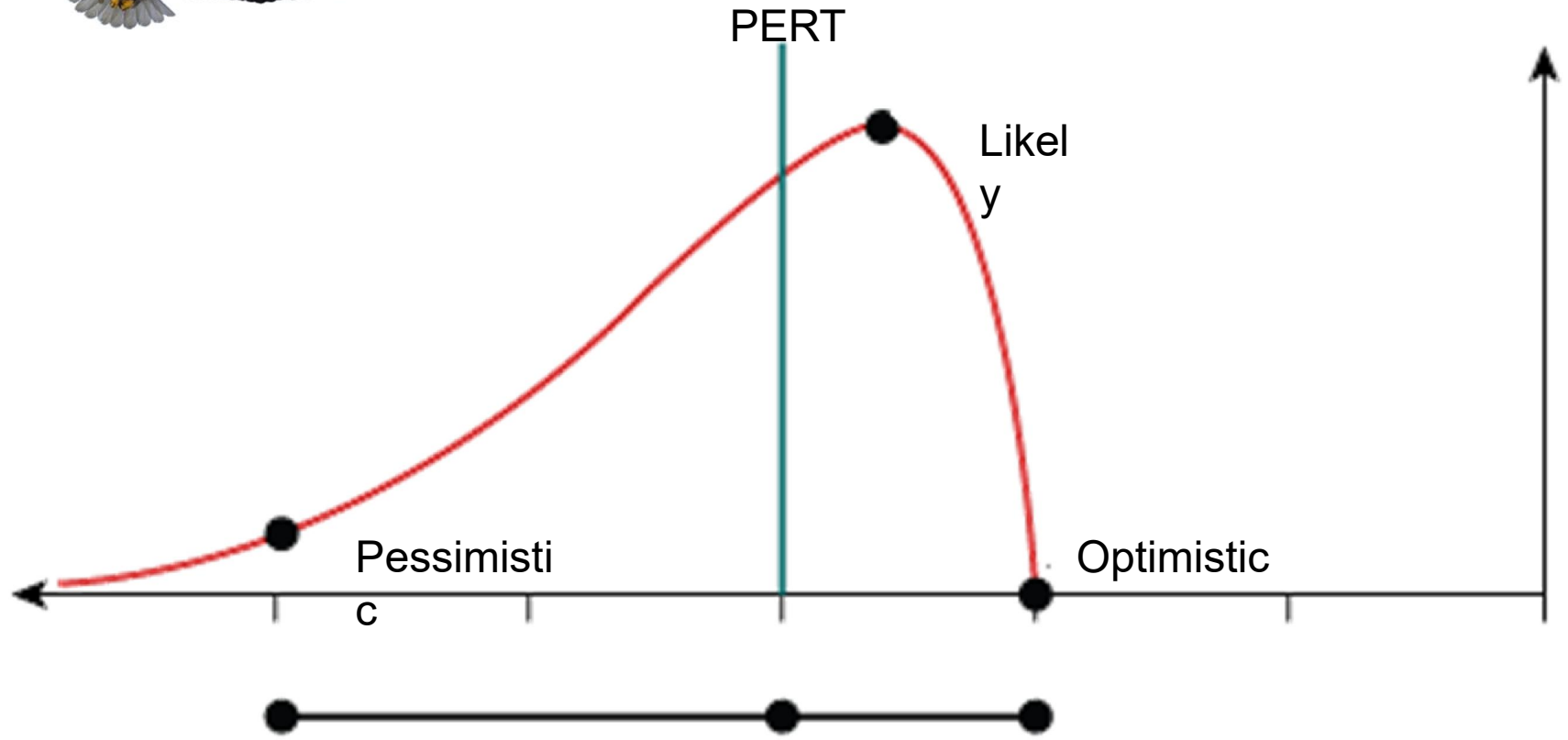
Source: The Internet.

Credit: Quoc Trung Bui/NPR

PMI 3-point Cost Estimate



Benefits as a Distribution



In a single cell...



AZ10 fx =BETA.INV(A5, AI10, AJ10, 0, 1)

	AG	AH	AI	AJ	AK	AL	AM	AZ	BA	BB	BC
6	Chance				Impact			Monte Carlo			
7	PERT		Beta Dist'n		(\$/Multiplier)			Input	Input	Output	
8	Mean μ	Variance σ^2	σ	β	Minimum	Likely	Maximum	Chance	Impact	Chance \times Impact	
10	30%	0%	63	146	0.01	0.05	0.10			0.01	Current Risk
12	40%	0%	96	143	0.01	0.05	0.10			0.02	Risk 1 year later if no action taken
14										0.24	Proposed action to mitigate risk
16	99%	0%	9	0	0.18	0.25	0.35			0.00	Risk after mitigation
17	5%	0%	2	44	0.01	0.05	0.10			-0.23	Net value of mitigation
18	Risk Trend							Increase	35%	year on year	
20	2-year risk								0.03		
22	Value vs 2-year risk								-0.21		
24	3-year risk								0.05		
26	Value vs 3-year risk								-0.19		

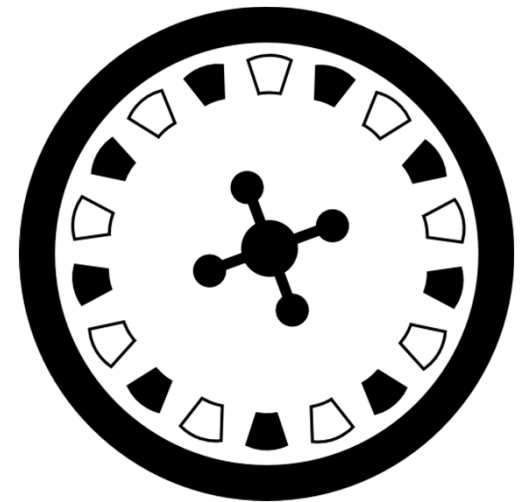
Estimate Probability



- We Estimate Probability every day
 - But we don't usually specify it
- We just need some tricks
 - To make it accessible



I'll Put
Money
On It



Equivalent Bet



- Would you prefer
 - To win or lose \$100 if the answer is within your 90% Confidence Interval range
- OR
 - To spin the wheel with a bet on 1-12 AND column 1

		0	00		
EVEN	1 to 12	1	2	3	1 to 18
		4	5	6	
		7	8	9	
RED	13 to 24	10	11	12	19 to 36
		13	14	15	
		16	17	18	
BLACK	25 to 36	19	20	21	2 to 1
		22	23	24	
		25	26	27	
ODD		28	29	30	2 to 1
		31	32	33	
		34	35	36	
		2 to 1	2 to 1	2 to 1	

Visualise...

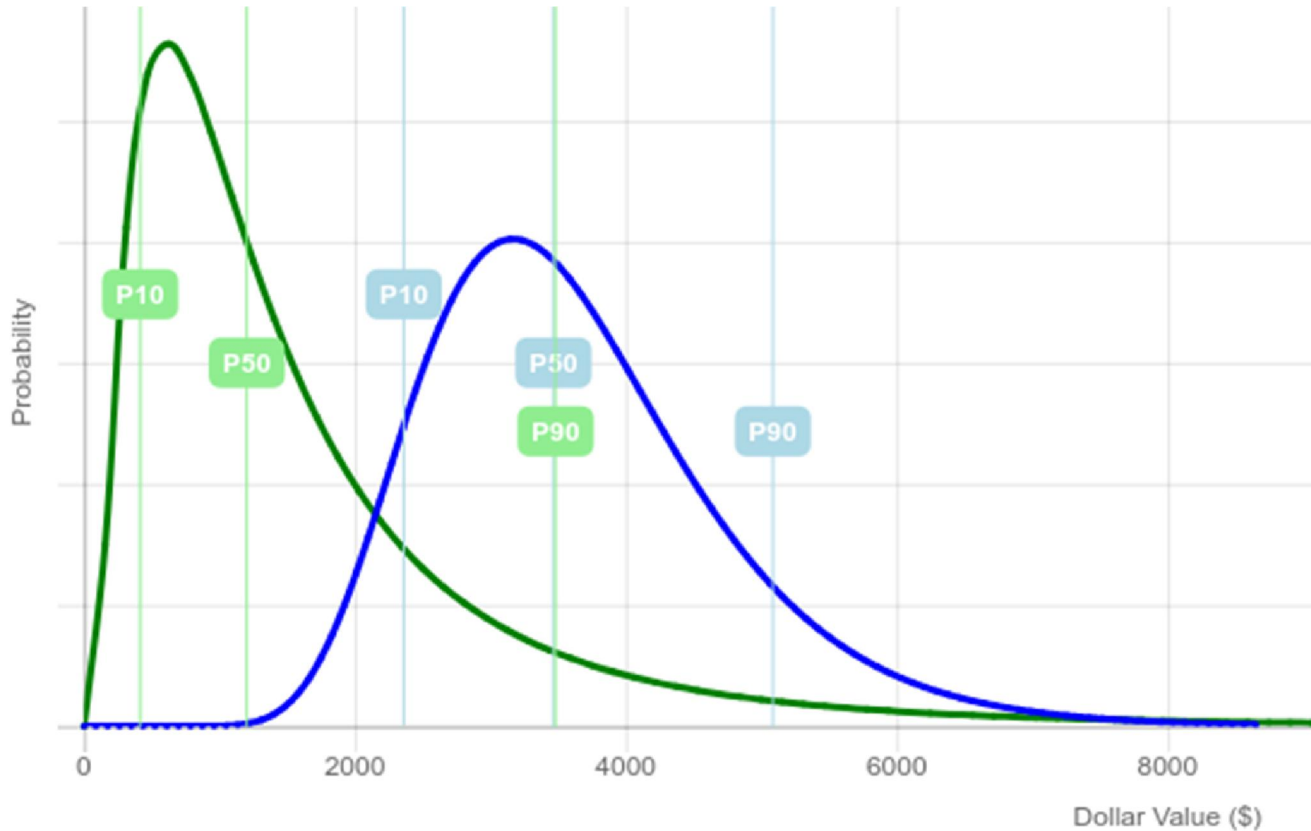
A Format-based Approach



- 50% as likely:
 - Red or Odd numbers
- 33% as likely:
 - 1-12, or in any column
- 17% as likely
 - Red AND in a column
- 11% as likely
 - 1-12 AND in a column
 - ~the 90% Confidence Interval
- 5% as likely
 - 1-12 AND in a column AND Red

		0	00		
EVEN	1 TO 12	1	2	3	1 TO 18
		4	5	6	
		7	8	9	
RED	13 TO 24	10	11	12	19 TO 24
		13	14	15	
		16	17	18	
BLACK	25 TO 36	19	20	21	25 TO 36
		22	23	24	
		25	26	27	
ODD	28	29	30	31 TO 36	
	31	32	33		
	34	35	36		
		2 TO 1	2 TO 1	2 TO 1	

Represent your Forecast



Questions?

<http://AcuteIP.com>

for copies of slides,
and supporting material

Graham.Harris@AcuteIP.com

for advice, workshops etc



How Good is an Estimator?



- Brier Score originated with Weather Forecasters- looking back at their history
- Where we have no history to go on, we can use proxy questions
- So how good are you?

Brier Score



- Across many past estimates, looks at
 - Whether you were right, and
 - How confident you were that you were right
- 0 is a perfect score
 - Always right, always confident
- 1.0 is the worst
 - 100% confident but 100% wrong
- Impossible to “cheat”





Estimating Benefits

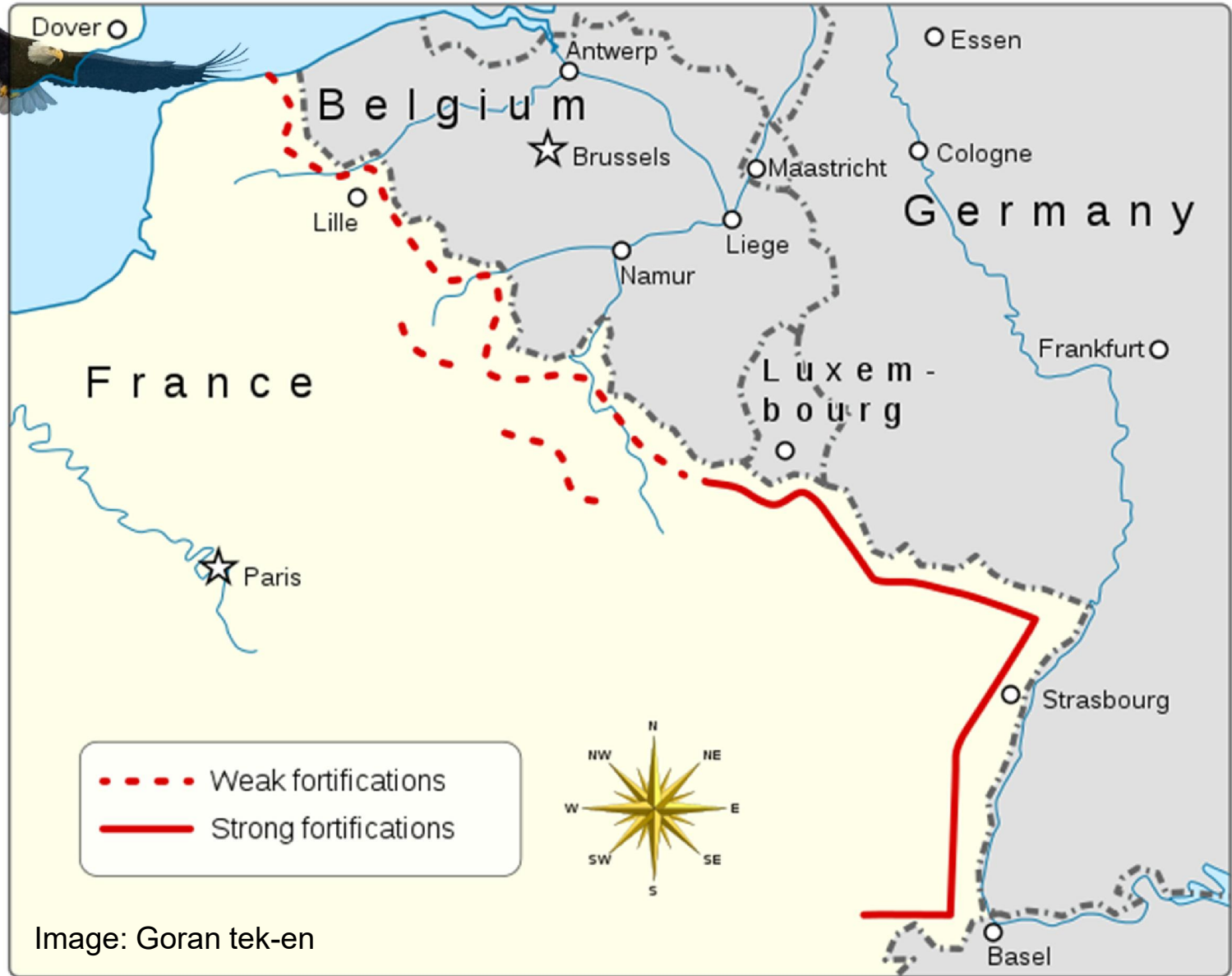


Failure
is often just

Failure
of Estimation

Image courtesy of Freepik.com





• Image: Goran tek-en