The Ludic Fallacy

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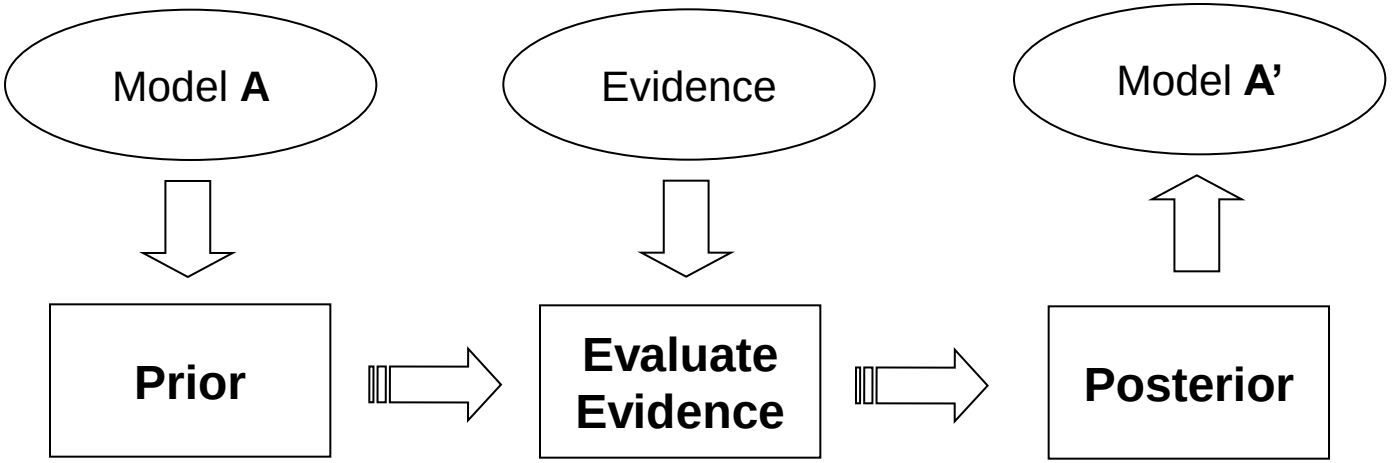
“The attributes of uncertainty we face in real life have little connection to the sterilized ones we encounter in exams and games.”

— Nassim Taleb

Summary

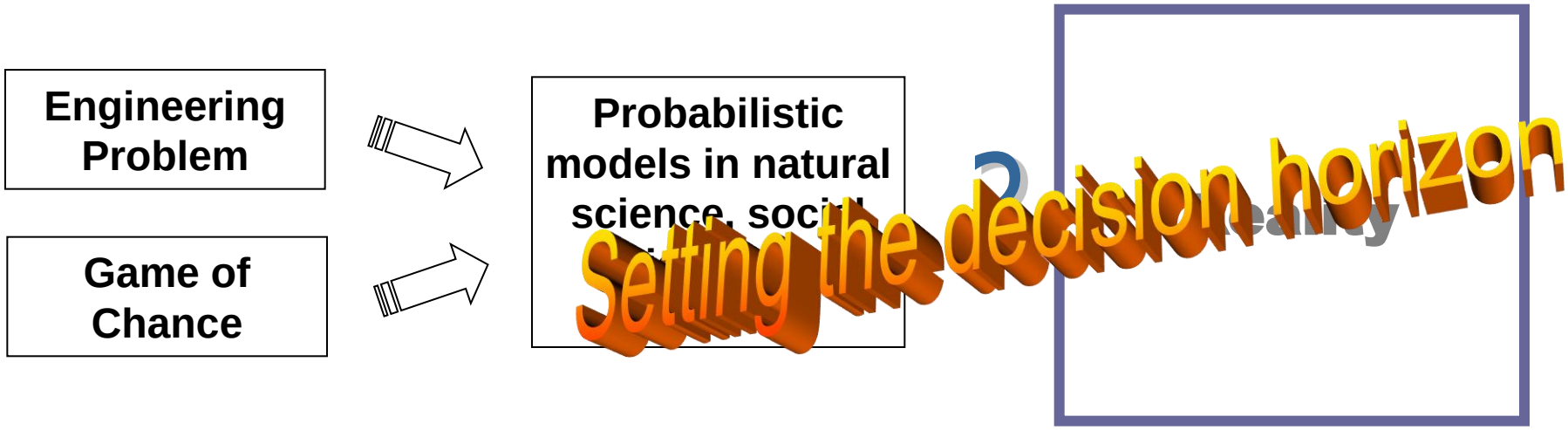
Real problems are not just games of chance

- Re-frame probability and rationality
- "TaleBayesianism"



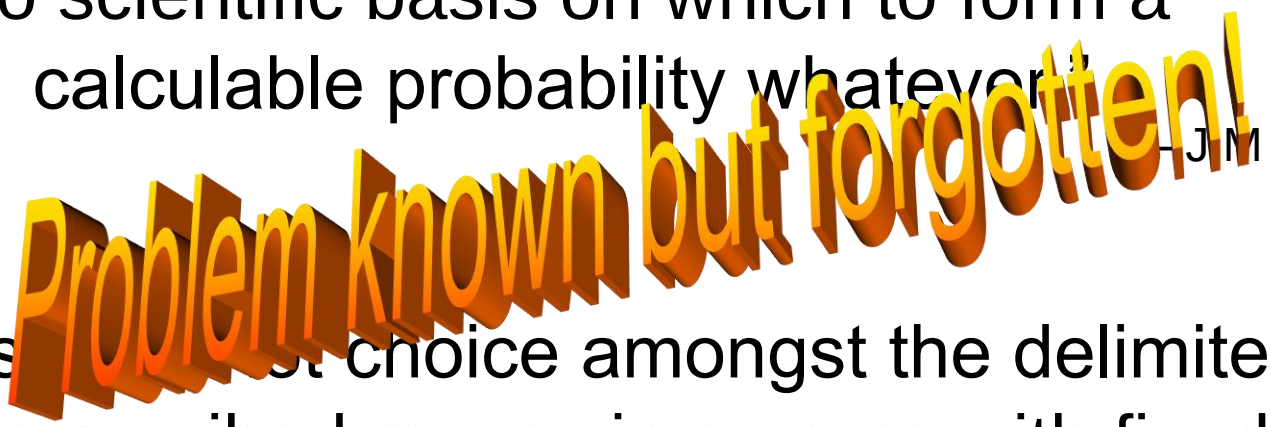
The Ludic Fallacy

- Nassim Taleb argues that problems in real life are not necessarily represented as games of chance
  - We don't know the space of possibilities
  - We can't calculate the numbers



“The game of roulette is not subject … to uncertainty. The sense in which I am using the term [uncertain] is that in which … there is no scientific basis on which to form a calculable probability whatever.”

— J M Keynes



“Decis choice amongst the delimited and prescribed moves in a game with fixed rules and a known list of outcomes of any move or sequence of moves.”

— G L S Shackle

Does it matter?

Yes, because otherwise:

- We think we understand the world better than we really do
- We use inappropriate models
- This exposes us to future unknown risk

Structure

- Probability
- Uncertainty
- Rationality
- Omniscience?
- Taleb’s demon

Probability

What is Probability?

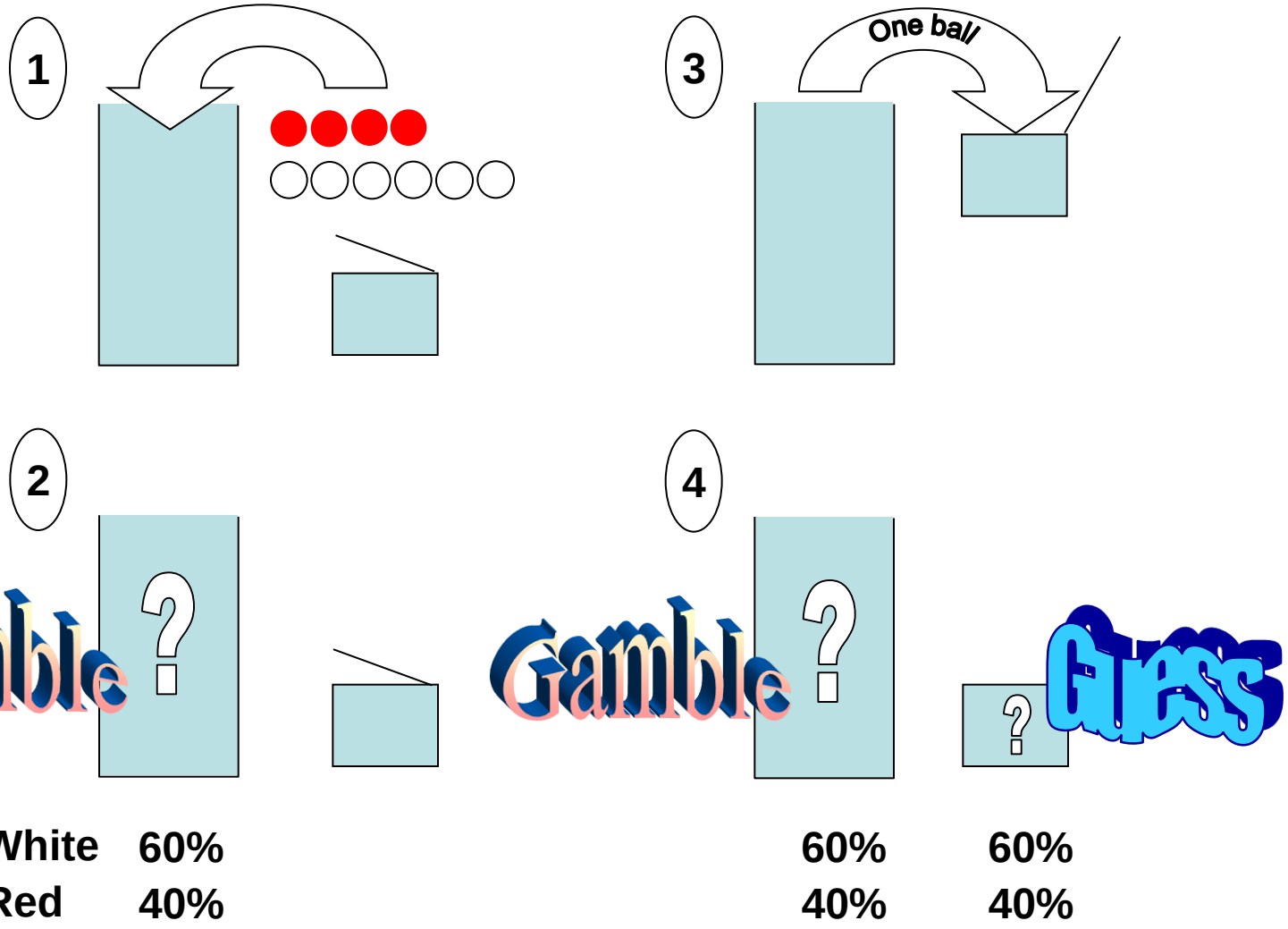
- The definition I will use is that probability consists of:
  - A set of individual possibilities (outcomes or events or worlds)
  - Individuals and combinations form a “space” of possibilities
  - A measure on this space to the interval [0,1]
- This is Kolmogorov’s starting point

Interpretations of Probability

- Frequentist
  - Hypothetical ensemble of outcomes of a repeatable experiment
  - The probability measure represents relative frequency
- Subjective
  - Space of possible worlds
  - The probability measure represents “subjective” degree of belief
  - “Subjective” has to be rational in a defined sense of decisions and utility (e.g. Savage axioms)
  - These include the “Sure Thing Principle”

Uncertainty

Aleatory and Epistemic Uncertainty

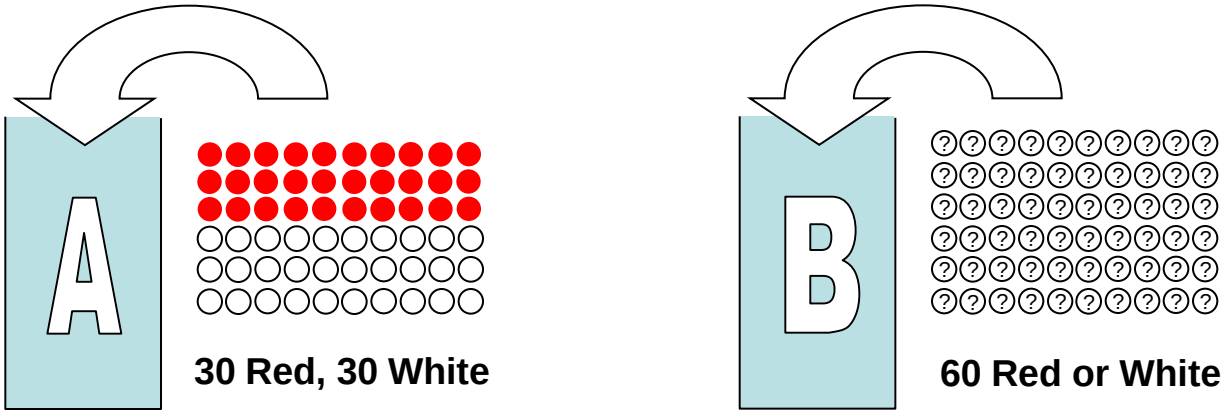


White	60%	60%	60%
Red	40%	40%	40%

Aleatory and Epistemic Uncertainty

- Aleatory Uncertainty
  - Like a game of chance (2) – we can make a choice from a space of possibilities
- Epistemic Uncertainty
  - From lack of knowledge (4) – there is only one ball, we just don't know which one
  - In the absence of any other information assume equally likely (equiprobabilities)
- Yet we do not view these two types of uncertainty with the same confidence …

Ellsberg Paradox



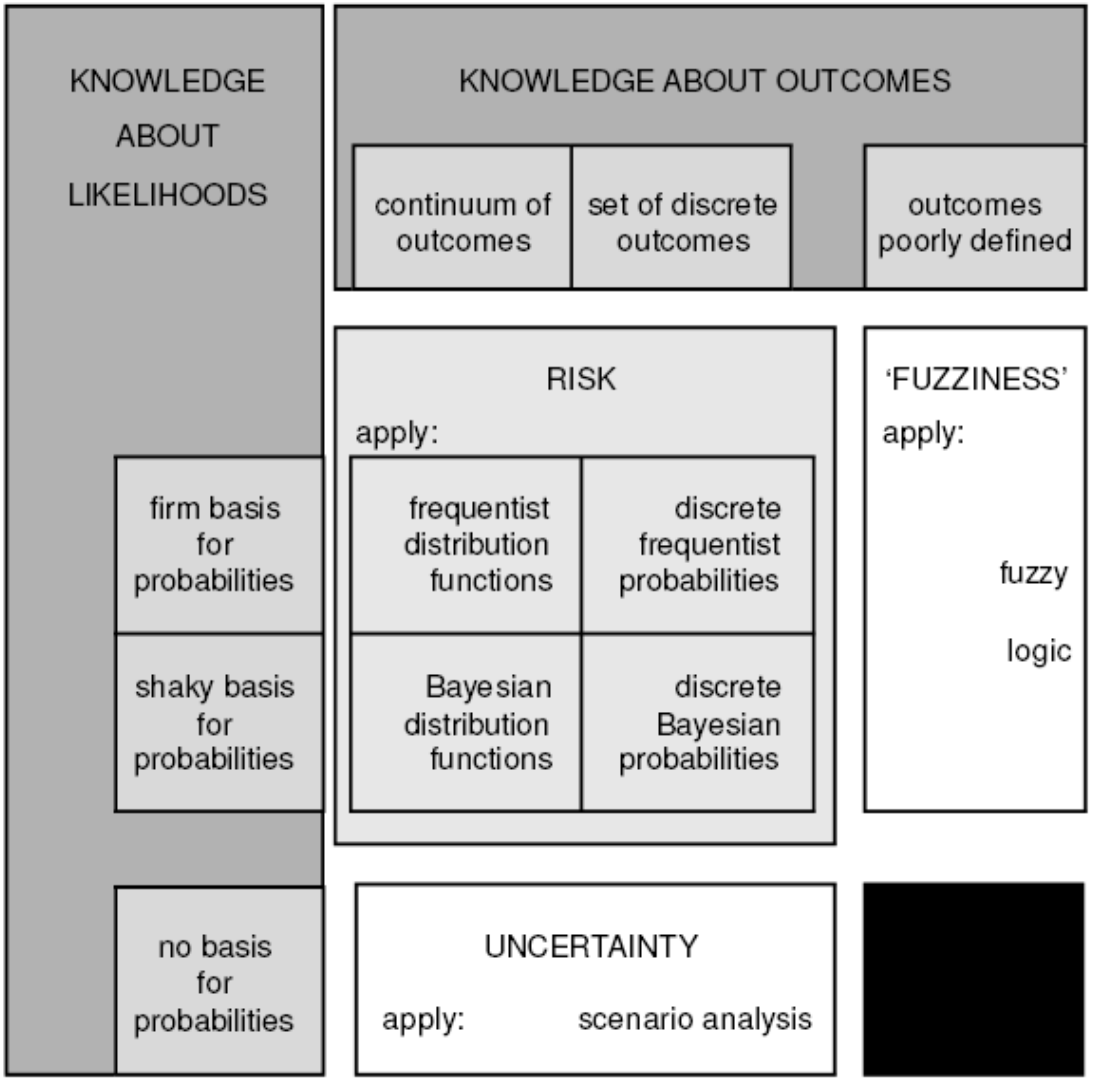
You win £100 if you pick a white ball				You win £100 if you pick a red ball			
Urn A		Urn B		Urn A		Urn B	
Winnings	Choice	Winnings	Choice	Winnings	Choice	Winnings	Choice
£100	50%	£100	?%	-	50%	-	?%
-	50%	£100	100-?%	£100	50%	£100	100-?%

People mostly choose the Urn with the **aleatory** not **epistemic** risk
Even switching colour, still choose aleatory Urn !

The Jargon of Uncertainty

Intrinsic to system (e.g. prior to an event)	Aleatory / Type A / Stochastic / Natural Variability / Irreducible
Knowledge of system (e.g. after an event)	Epistemic / Type B / Subjective / Reducible
Within Model of system	Parameter
Across Models of system	Model

Risk, Uncertainty, and Ignorance



from Stirling, A. (1998) Risk at a Turning Point?, Journal of Risk Research 1 (2) 102

Rationality

Sure Thing Principle

A. 2 tickets to football; £100 if it rains

or

B. 2 tickets to rugby; £100 if it rains

A. 2 tickets to football; £0 if it rains

or

B. 2 tickets to rugby; £0 if it rains

Do you make the same decision?

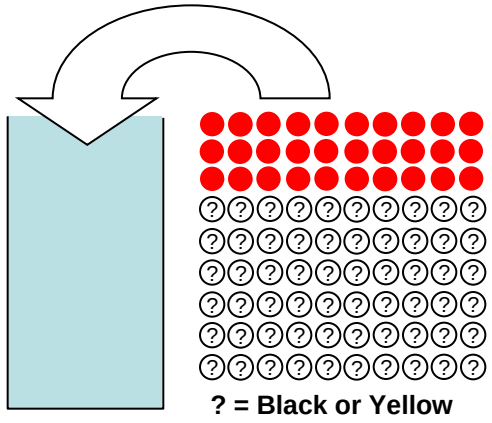
If so, the decision is a "sure thing" independent of events that offer the same payoff (in this case the payment if it rain)

Adapted from Weber, M. (1998) The Resilience of the Allais Paradox, Ethics 109 94 – 118

Invariance

- What if the Sure Thing Principle WAS valid?
  - Elements of the outcomes that are identical (e.g. the payment in case of the rain) would not affect the decision or gamble or probability
- What if it WASN’T valid?
  - It would mean that decisions (or gambles or probabilities) would depend on common circumstances or consequence
- The latter does sound vaguely plausible for real life

Ellsberg Paradox IIa



30 Red

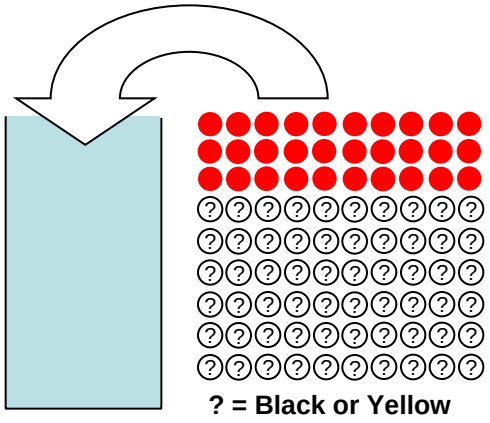
60 Black or Yellow

Experiment 1				Experiment 2			
Gamble A		**Gamble B**		**Gamble C**		**Gamble D**	
Winnings	**Choice**	**Winnings**	**Choice**	**Winnings**	**Choice**	**Winnings**	**Choice**
£200	Red	£200	Black	£100	Red or Yellow	£100	Black or Yellow

Red is an **aleatory** gamble
Black is an **epistemic** gamble

Black or Yellow is an **aleatory** gamble
Red or Yellow is an **epistemic** gamble

Ellsberg Paradox - IIb



30 Red

60 Black or Yellow

Experiment 1				Experiment 2			
Gamble A		**Gamble B**		**Gamble C**		**Gamble D**	
Winnings	**Choice**	**Winnings**	**Choice**	**Winnings**	**Choice**	**Winnings**	**Choice**
£200	Red	£200	Black	£100	Red	£100	Black
					or Yellow		or Yellow

The second Experiment differs only in that it includes Yellow.
People prefer the “sure thing” which confounds the “Sure Thing Principle”!

Allais Problem

Experiment 1				Experiment 2			
Gamble A		**Gamble B**		**Gamble C**		**Gamble D**	
Winnings	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**
$500	1%	$0	1%	$500	1%	$0	1%
$500	10%	$2,500	10%	$500	10%	$2,500	10%
$500	89%	$500	89%	$0	89%	$0	89%

er, how did that work again?

Experiment 1				Experiment 2			
Gamble A		**Gamble B**		**Gamble C**		**Gamble D**	
Winnings	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**
$1m	100%	$5m	10%	$1m	11%	$5m	10%
		$1m	89%				
$1m		**$1.39m**		**$110k**		**$500k**	

and remind me of the point …

Experiment 1				Experiment 2			
Gamble A		**Gamble B**		**Gamble C**		**Gamble D**	
Winnings	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**
$500	1%	$0	1%	$500	1%	$0	1%
$500	10%	$2,500	10%	$500	10%	$2,500	10%
$500	89%	$500	89%	$0	89%	$0	89%

Rationality

- Are our decisions therefore irrational?
- Or do we suspect the formal model may not be a complete description of reality?
- Would it be rational to expect:
  - The context to affect decisions?
  - To play safe when there are (unstated) chances outside our expectation of (downside) risk?

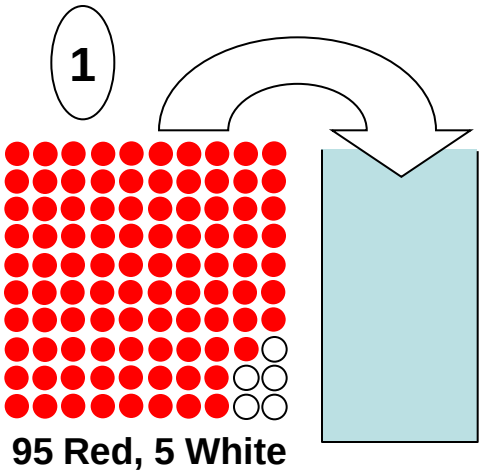
Omniscience?

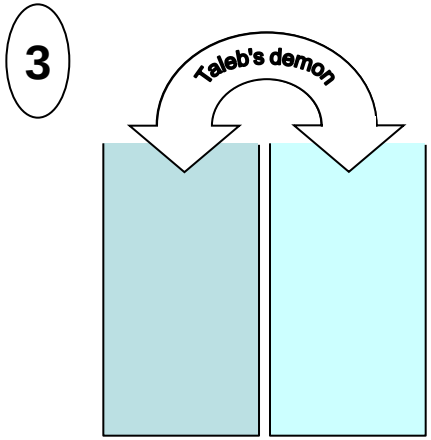
Omniscience?

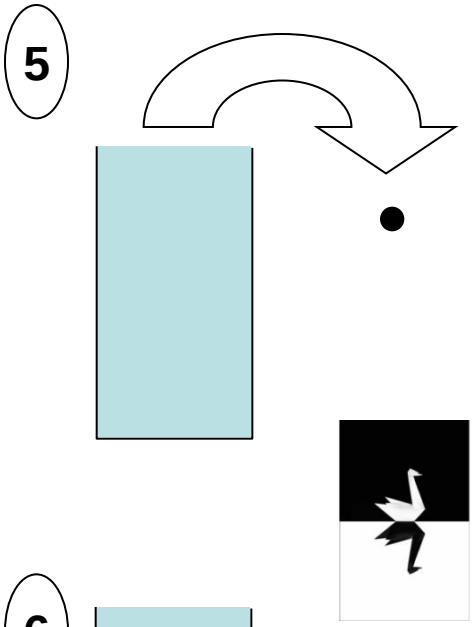
- Can we know everything?
  - In practice?
  - In principle?
- Argument
  - Suppose we could know the space of possibilities, then we can't know if there is another
- If we can't
  - We can't know the space of possibilities

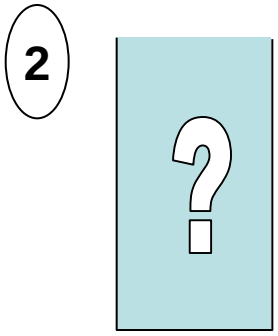
Taleb’s Demon

Talebian Uncertainty

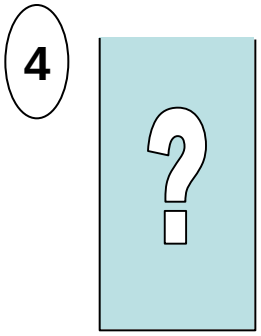




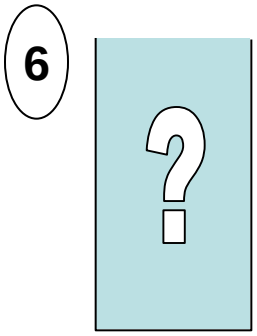




White 5%
Red 95%



Odds of a white?



Odds of a black?

Taleb's demon

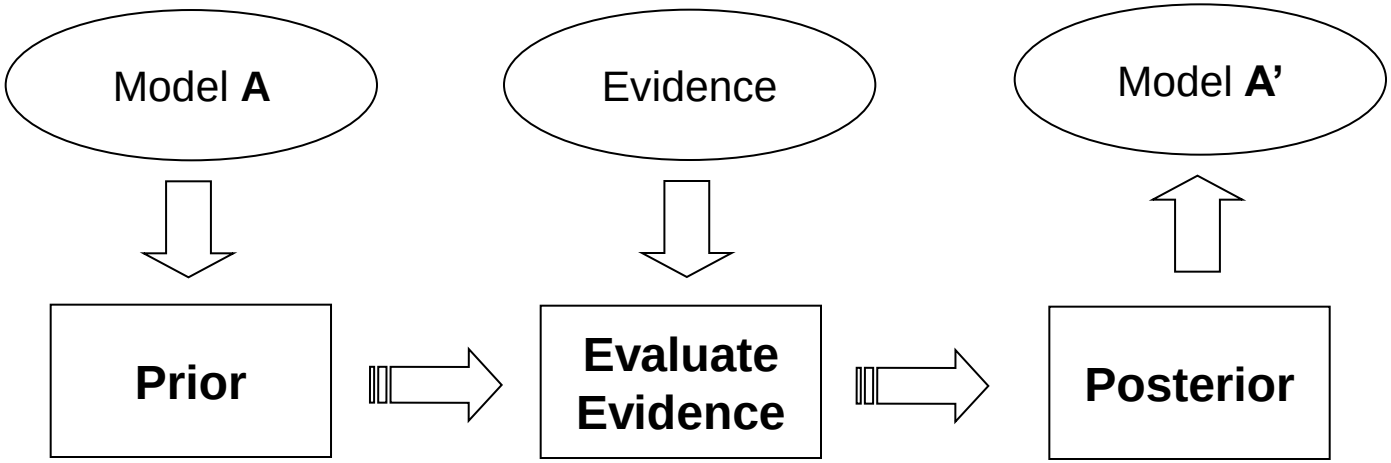
- Initially we have Aleatory Uncertainty
  - Usual probability theory applicable (2)
- A demon can change the balls
  - We no longer know the space of possibilities (3 & 4)
  - But the principle of equiprobabilities would leave the odds the same if there were no new balls introduced or balls taken away
- Then we discover a black ball
  - We know something we didn't know but not what has happened to the space of possibilities (5 & 6)

If you believe in Taleb's demon

- Epistemic uncertainty need not have the same sample space as aleatory uncertainty
  - so if you believe that epistemic uncertainty is uncomfortable you'll vote for the aleatory option
- The Sure Thing Principle need not hold
  - Taleb's demon could change the context - the space of probabilities
  - If you suspected this, your decision would depend on the context
- You would then be a "TaleBayesian"
  - Prepared to reconsider the space of possibilities **and the model** in the light of the evidence

TaleBayesian

Re-consider the model as well as the probabilities or parameters



Conclusion

- Probability models can be incomplete models of reality due to “unknown” changes in the space of possibilities
- This may provide an explanation of apparent irrationality in decision theory
- Be prepared to adopt a context-sensitive approach to uncertainty (TaleBayesian)

- Just a bit of research needed now …