Navigating Uncertainty

Strategies and Opportunties in Decision Making

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Agenda

1 **Introduction**

2 Decision Making

3 Uncertainty & Complex Systems

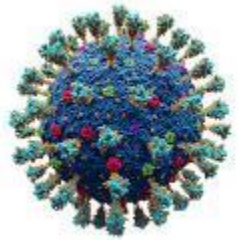
4 Decision Making under Uncertainty

Age of Uncertainty

2025

2020

2014/2021



What (not) to Expect

<< *IT'S tough to make **predictions**, especially about the **future*** >>

Yogi Berra – baseball-playing philosopher

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Would you take the bet?

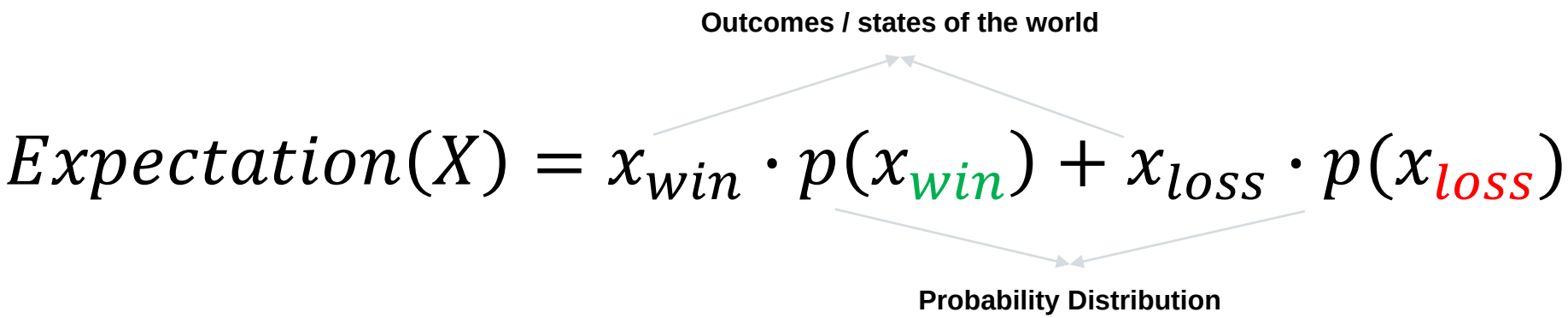
1 flip

$H = x_{win} = +12{,}000€$

$T = x_{loss} = -10{,}000€$

It is a more than a fair bet given that the expected value is +1,000€

Expected Value Theory for Risk Neutral Subjects*



Considering only expectations is not sufficient to model the behavior of most people

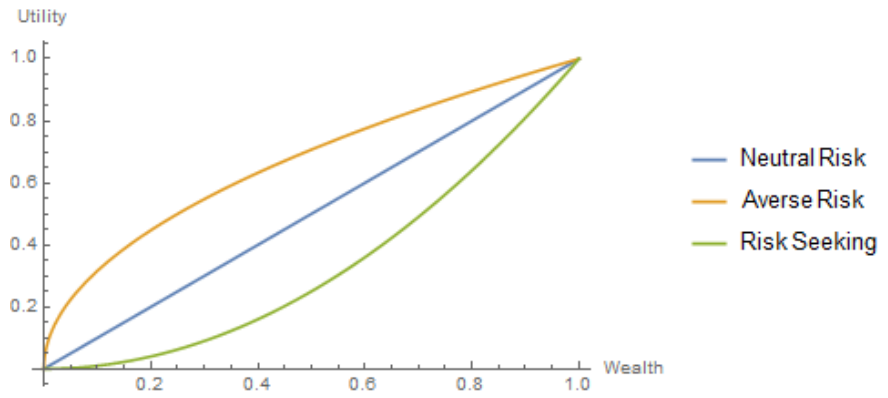
* Refer to Expected Value (Wikipedia)

Rational Subjects Want to Maximize Their Utility*

Utility of outcomes

$$Exp(U(X)) = U(x_{win}) \cdot p(x_{win}) - U(x_{loss}) \cdot p(x_{loss})$$

Probability Distribution



This categorization determines not just how you should live, but how you should invest

* Expected utility hypothesis - Wikipedia

Should You Buy This Porsche?

There are several **biases** that distort the utility function such as the emotional*, the loss aversion, the over-confident or the status-quo bias

Emotional bias - Wikipedia

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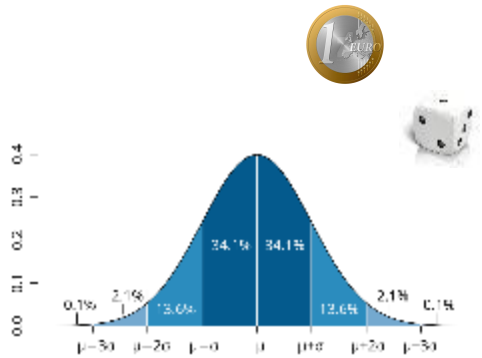
What is Uncertainty?*



Complete uncertainty

Knightian Risk

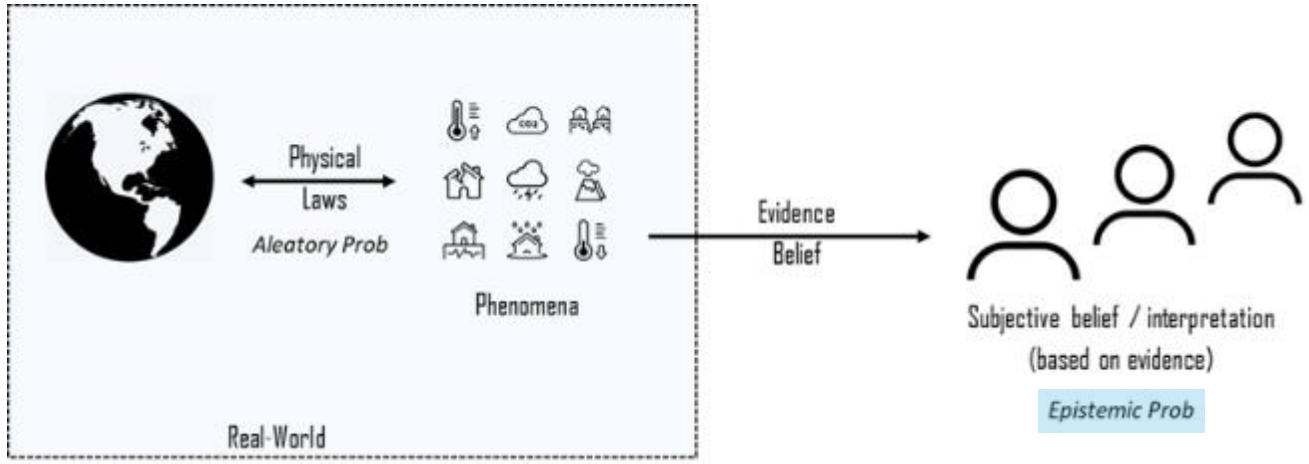
Determinism

Degree of uncertainty

High uncertainty (as well as chaotic behavior) occurs quite often in complex systems

* Please refer to F.H. Knight *Risk, Uncertainty, and Profit*. Boston. (1921)

What is Uncertainty?*



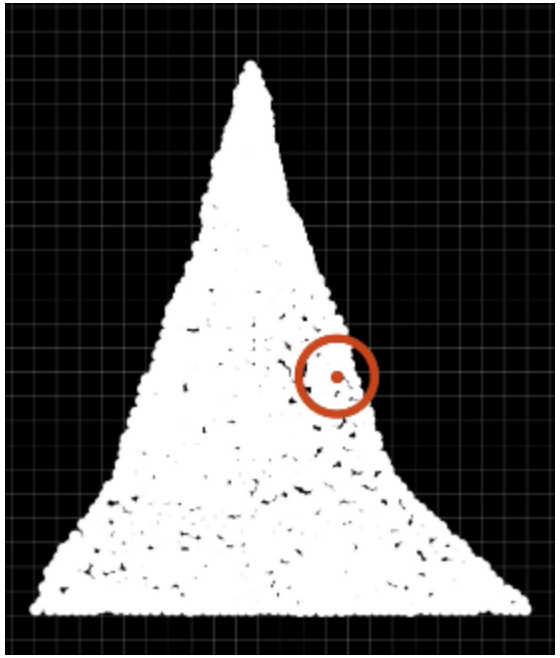
	Knowledge (knowns)	**Lack of Knowledge** (unknowns)
Awareness (known)	known knowns	known unknowns
Ignorance (unknown)	unknown knowns	unknown unknowns

Knowledge matrix

Uncertainty is inevitable since it is **part of our physical world** but also because of our own **ignorance**.

* Please refer to Aleatory and Epistemic Probability & Uncertainty by Alexander v. Felbert, April 2022

Complex World and The Edge of Chaos*

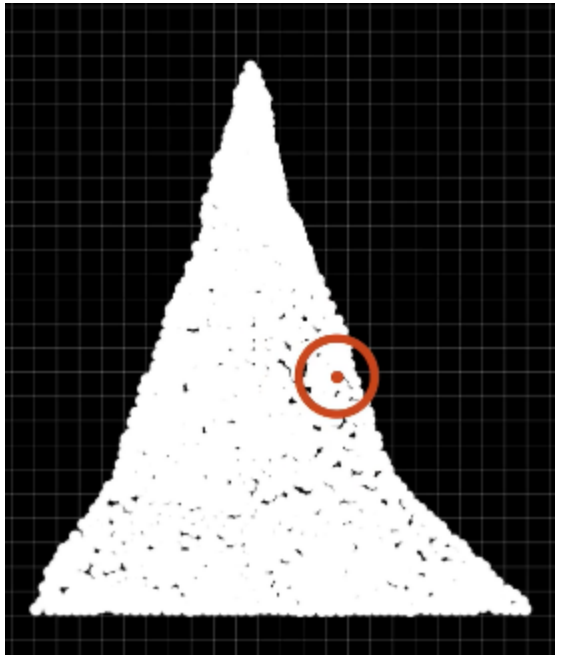


Our world is non-linear, that is, small changes can radically shift how future unfolds

* Please refer to Chaos theory - Wikipedia

How a Complex World Does NOT work

1. **Every “why” has a clear cause**
2. **Understanding parts explains the whole system**
3. **Past pattern help predict the present and future**



These assumptions are incorrect but sometimes useful

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Principles for Decision-Making Under Uncertainty

1. **Know what you know and what you don't know**
   (Rumsfeld's Knowledge Matrix)*
2. **Know the [complex] system and challenge the constraints**
3. **Express uncertainty by your subjective estimates**
   (use ranges)
4. **Update your estimates, be agile**
   (fail but fail fast, be agile)
5. **Simple models beat complex models****

* Please refer to Aleatory and Epistemic Probabilities – deep mind by A. von Felbert.
** Please refer to the Appendix as well as Uncertainty and Capacities in Finance – deep mind by A. von Felbert.

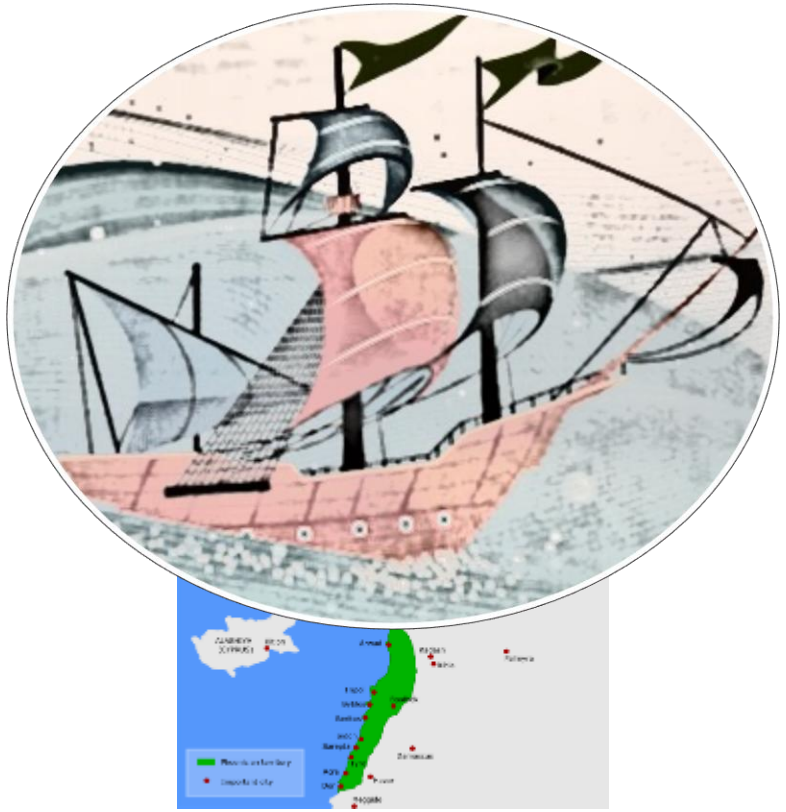
Navigating into Uncertainty*

If you **“know” the destination but you don’t know the path**, the following strategies can be applied:

1. Step by Step / Bayesian Approach
   Prince Henry the Navigator of Portugal wanted to reach India.
   He achieved his goal by navigating around Africa (1441 Mauretania, 1444 Senegal, 1455 Cape Verde , 1462 Sierra Leone, 1488 South Africa, 1498 India)

2. Big Leap
   Christopher Columbus also wanted to reach India by a big leap via the Atlantic
   His idea was to sail west to reach India in the east. Instead of India he discovered America.

3. Employ Randomness
   Some tribes use random paths to increase their success in hunting.

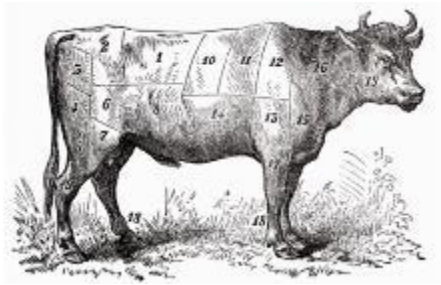


Different strategies can be helpful in overcoming uncertainty

* Think:Act 34. Die Strategie der Entdecker. Physical Copy.

Wisdom of Crowds* / Intersubjectivity

- A fat **ox** had been selected and placed on display at a country fair in 1906.
- **787 persons** have participated in a **contest to estimate the weight** of the displayed ox. Those who guessed most successfully received prizes.
- Statistician **F. Galton** observed that the **median** of the **787 independent estimates** was accurate within **1% of the true weight** of 1,198 pounds.



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

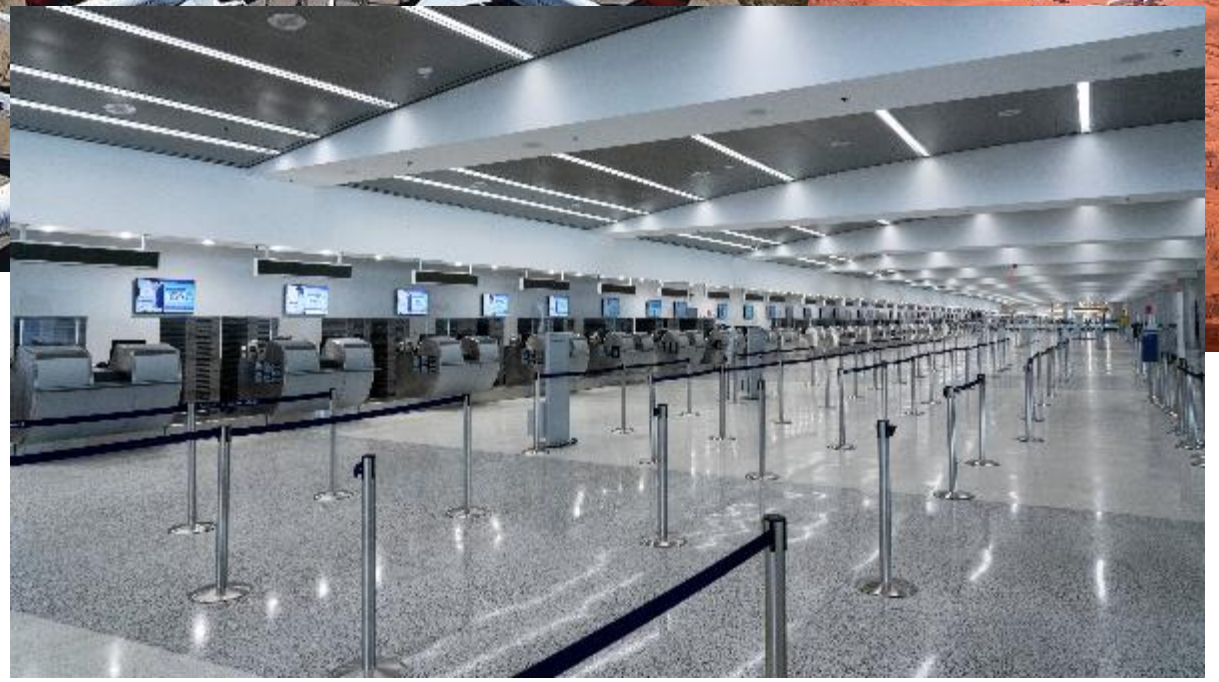
Degrees of the length of Array 0°—100°	Estimates in lbs.	Centiles: Observed deviates from 1207 lbs.	Centiles: Normal p.e =37	Excess of Observed over Normal
5	1074	−133	−90	+43
10	1109	− 98	−70	+28
15	1126	− 81	−57	+24
20	1148	− 59	−46	+13
q_1 25	1162	− 45	−37	+ 8
30	1174	− 33	−29	+ 4
35	1181	− 26	−21	+ 5
40	1188	− 19	−14	+ 5
45	1197	− 10	− 7	+ 3
m 50	1207	0	0	0
55	1214	+ 7	+ 7	0
60	1219	+ 12	+14	− 2
65	1225	+ 18	+21	− 3
70	1230	+ 23	+29	− 6
q_3 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

q_1, q_3, 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.

* Please refer to *Vox Populi* by F. Galton, 1907, Nature 75 (1949): 450-451. Retrieved via https://www.nature.com/articles/075450a0.pdf
In addition, please consider the following post https://medium.com/the-physics-of-finance/the-fragile-wisdom-of-crowds-266cbbf2e3aa since this concept does not work in each situation and is fragile to any kind of social influence.

Median values of several *independent* judgments can outperform individual expert judgments in specific situations

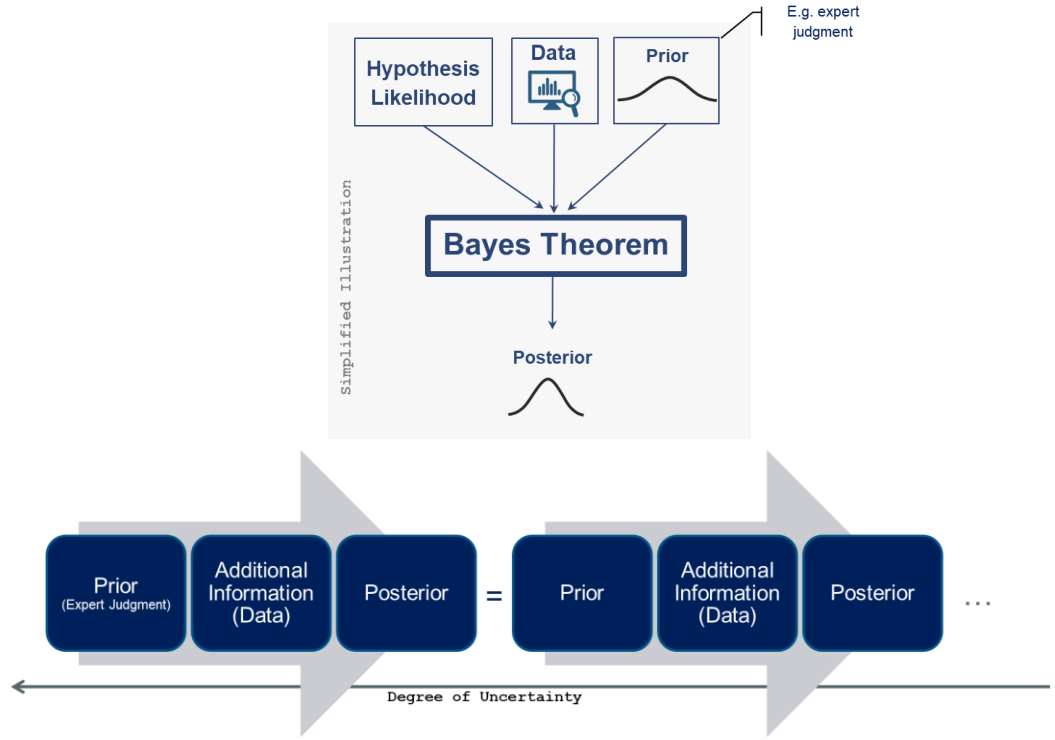
Case Study – Covid and the Impact on Aerospace Industry



Case Study – Low Default Portfolios

Own Methodology

- Start collecting data as early as possible for PD / LDG / CCF modelling
- Use external data, if possible
- Qualitative validation
  - Methodology review w.r.t. model purpose
  - Benchmarking w.r.t to peer / proxy ratings
  - Parameteric validation (e.g. central tendency)
  - Single default analysis
  - Operational & governance review
  - Expert judgment / wisdom of crowds



Third Party Methodology

- Internal pool ratings
- Use of external ratings

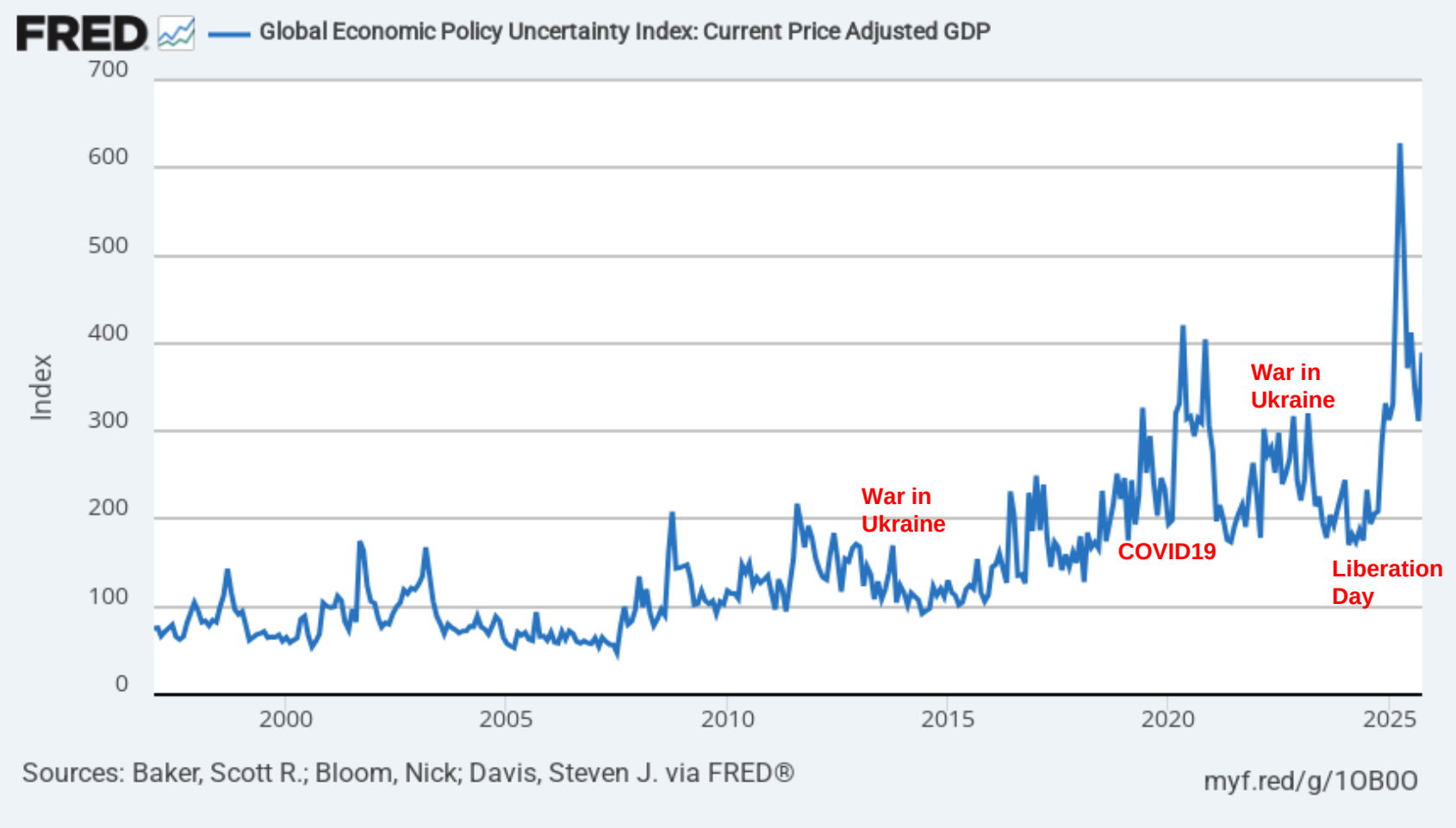
Questions?

"It is better to execute imperfect decisions than to constantly seek perfect ones that will never exist."

Charles de Gaulle

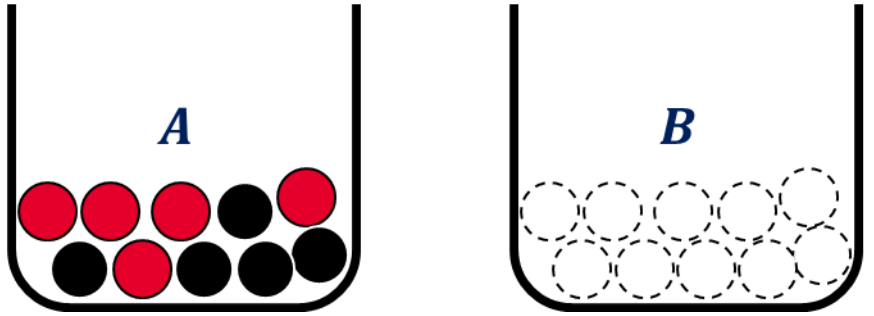
Backup

Age of Uncertainty – Measures of Uncertainty



Ellsberg's Paradox* – Notation

- Urn A and B containing **10 balls of red and/or black color**:
  - Urn A contains 5 black and 5 red balls;
  - Urn B contains 10 balls, which could all be black or red or any combinations in between;



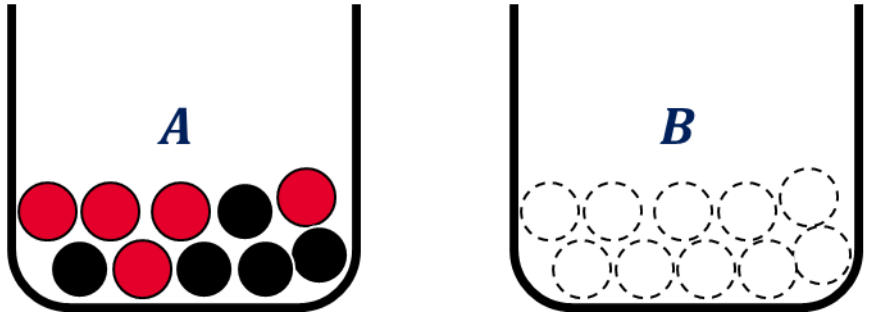
- **Drawing randomly** a red and black ball from urn A is denoted by Ar and Ab, respectively. A similar notation is used for Br and Bb;
- Corresponding probabilities of an occurrence of Ar and Ab are denoted by p_{Ar} and p_{Ab}, respectively. A similar notation is used for p_{Br} and p_{Bb};

* Daniel Ellsberg. *Risk, Ambiguity, and the Savage Axioms*. In: The Quarterly Journal of Economics 75.4 (1961), pp. 643-669.

Ellsberg's Paradox – Betting on Color

- Bet on Ar, Ab or indifferent
- Bet on Br, Bb or indifferent
- Bet on Ar, Br or indifferent
- Bet on Ab, Bb or indifferent

= options suggested by empirical observations



- It has been **empirically observed** that most subjects prefer any bet on urn A to a bet on urn B (uncertainty aversion);
- The third bet **implies** $p_{Ar} > p_{Br}$ and due to $1 = p_{Ab} + p_{Ar}$, we infer $1 - p_{Ab} > 1 - p_{Bb} \Leftrightarrow p_{Ab} > p_{Bb}$. This contradicts, however, the fourth bet and its implication $p_{Ab} < p_{Bb}$.
- This contradiction is eventually **caused by** the (σ-) **additivity** that is one of the three Kolmogorov axioms;

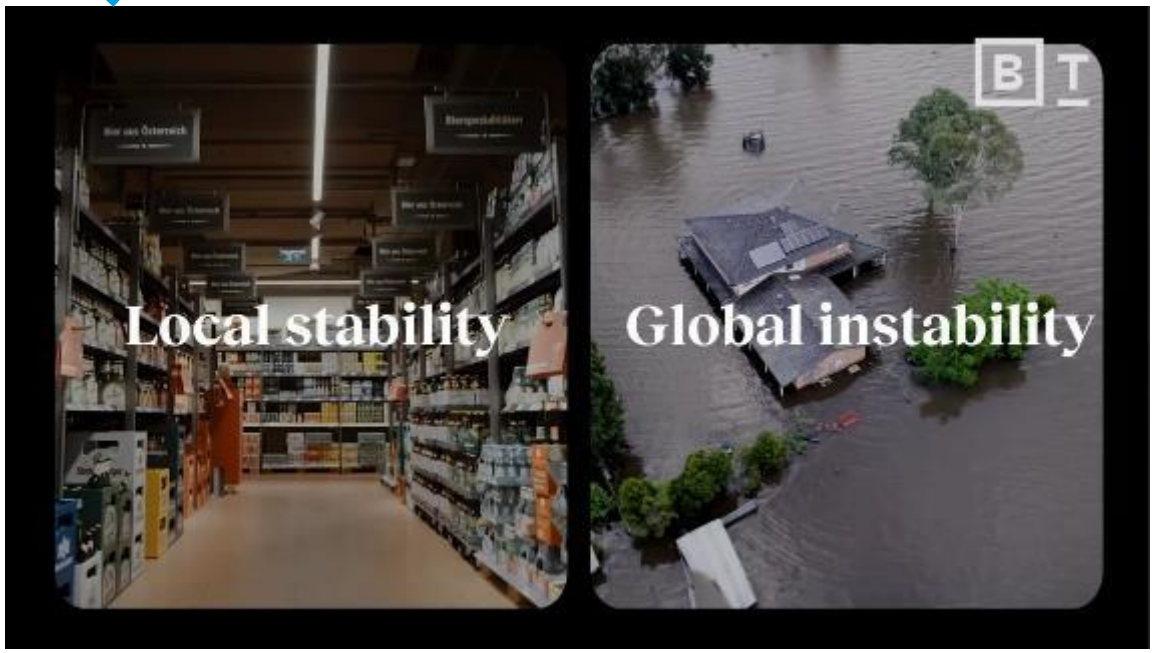
Paradox suggests that a human-centered system with a too high uncertainty might not be compatible with probability theory.

Risk Attitude of J. Kerviel Jeopardizes Société Générale

- Bank’s own risk appetite must be the driving force of all employees (not their own)

How Uncertainty Changed over Time*

Complex World**



* Please refer to “Why does it feel like the world is falling apart?” by Brian Klaas https://youtu.be/TLm6dC34gYk?si=PPVKVQza3VhVvpiW
** Please refer to Complex system - Wikipedia

Expert Judgments & Subjective Beliefs*

Expert Judgments can be used via subjective beliefs (priors) in Bayesian Statistics

* Please refer to *The Role of Expert Judgment in Statistical Inference and Evidence-Based Decision-Making* by N. C. Brownstein et al., 2019, retrieved via https://www.tandfonline.com/doi/full/10.1080/00031305.2018.1529623