Dealing with Catastrophic Harms and Uncertainty

ELPAR Talk

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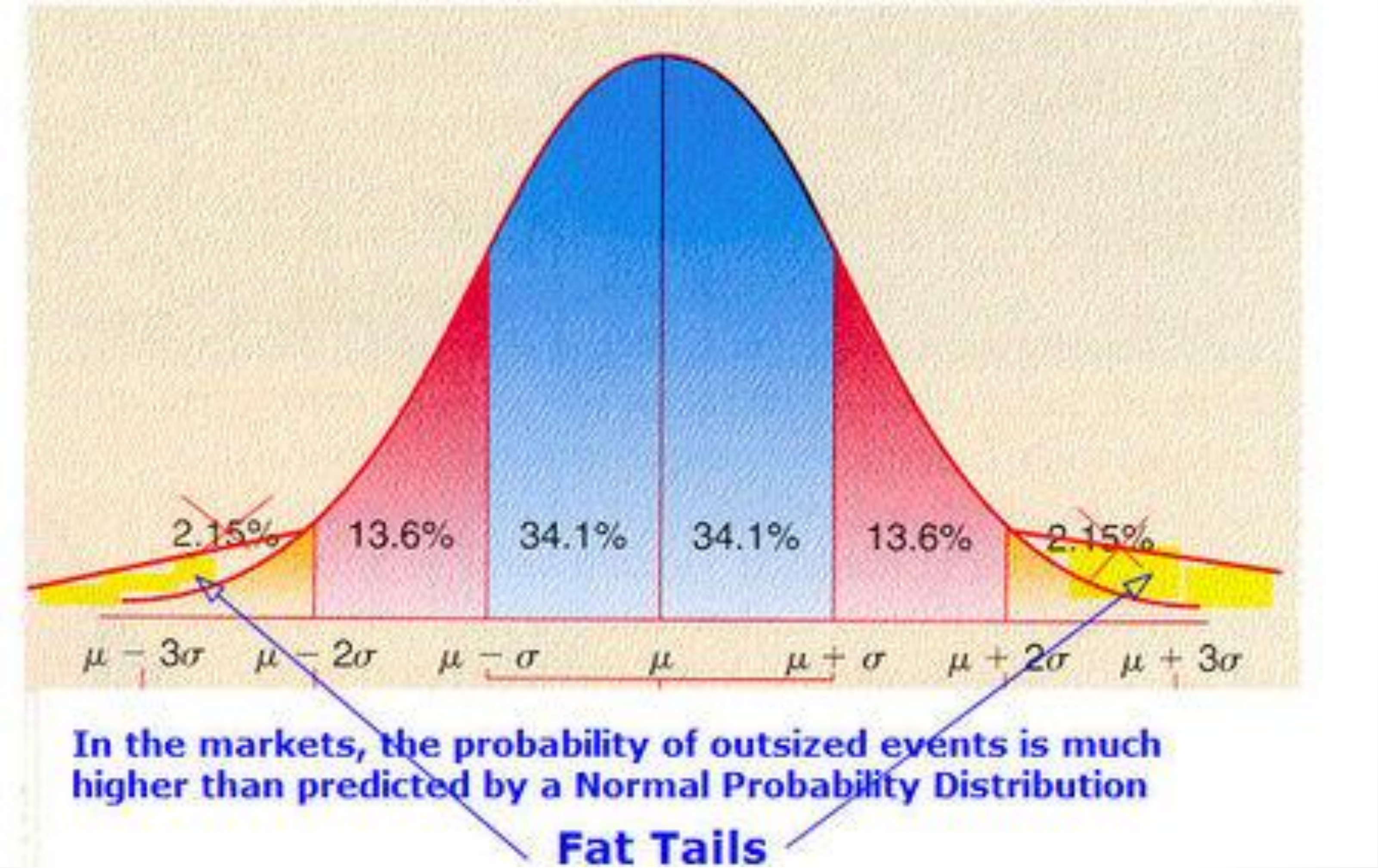
The Problem

- We know how to deal with simple problems with known probabilities.
- But often, the probabilities *aren't* known or violate the usual statistical assumptions.
- These issues are especially severe when extreme outcomes pose major risks.
- **What then?**

Probabilities Behaving Badly

FAT TAILS AND DEEP UNCERTAINTY

Situation 1: Fat-tailed Distributions



Situation 2: Deep Uncertainty

- Examples of situations where the odds are very unclear:
  - Local effects of climate change.
  - Risk of a future financial meltdown.
  - Risk of terrorist diversion of nuclear material.

How do fat tails relate to deep uncertainty?

- It's statistically difficult to pin down the exact fatness of the tail.
- We may suspect that the fat tail has a cut-off, but we don't know where it is.
- Systems may shift to a different structure rather than going to infinity—but we don't know when or how.

A Helpful Formula

- Given each policy option, let
  - **B** = best-case outcome.
  - **W** = worst-case outcome
  - α = degree of optimism (between 0 and 1).

- Evaluate each policy option by:
- $(1-\alpha)\,W + \alpha\,B$
- **In other words, take a weighted average of the best and worst cases. α measures optimism.**

Attractive Features of this Approach

- It considers both the upsides and the downsides.
- It's transparent and easily understandable.
- It asks policymakers to focus on three key factors that can be easily grasped: the best outcome, worst outcome, degree of optimism.

Climate Mitigation, Adaptation, and Nanotech

CASE STUDIES

Climate Mitigation

- Climate sensitivity could exceed 4.5 °C (but less likely than 2-3.5 °C range). (IPCC AR4)
- Weitzman: 5% chance of increase over 10° C; social welfare losses are fat-tailed.
- Long-term mitigation costs depend on future technologies, not currently known.

Conclusion: cost-benefit analysis of climate mitigation is a very dicey proposition. The uncertainties dominate the analysis.

Climate Adaptation

- Precipitation predictions -- less reliable than temperatures.
- Downsizing models is tricky.
- Sea level rise depends on poorly understood glacial dynamics.
- Future global temperature is also uncertain.
- Conclusion: adaptation should stress (1) flexible actions, and (2) robust strategies.

Advanced Nanotech

- Royal Society: “there is a lack of information of their [nanomaterials’] health, safety, and environmental impact.”
- CRS: “nanotechnology may deliver revolutionary advances with profound economic and societal implications.”
- Conclusion: big risks, big potential benefits.
- We shouldn’t be stopped by the precautionary principle, but we should try to control extent of downside.

CLOSING THOUGHTS

The Fundamental Point: The Importance of Uncertainty.

- In politics and policy disputes, people may overstate their level of certainty.
- But no prediction is perfect.
- In situations with feedback loops, fat-tail distributions are common, so extreme outcomes may be more likely than we intuitively think.

The importance of scenario planning.

- The approach discussed here is just a special case of **scenario planning**, a technique that is often used by businesses and the military.
- We tend to make policies based on predictions about a single outcome. This is often a mistake.
- In a world where extreme events matter a lot, we need to avoid the impulse to ignore the **worst-case scenarios**.

Thank you!

Applying the formula: climate change

- Suppose the **best case scenario** is that climate change does not exist.
- The **worst case scenario**: loss of 10% of GDP annually if we do nothing, or about $1 trillion.
- Assume α **=** .1. **In other words, assume we are very** that climate change does not exist.

Climate Change (2)

- Given these assumptions, applying the formula tells us that we should be willing to pay **$100 billion per year** to avoid climate change even though we think the best case scenario is *much* more likely than the worst-case scenario.

The Lesson for Climate Skeptics

- Even if you are pretty confident that the scientists are wrong and climate change does not exist, you should still support significant regulation.
- In short, don't just focus on the outcome you consider most likely. You could be wrong.

Applying the formula: nanotech

- Same worst case scenario: a loss of $1 trillion.
- Best case scenario: a technological revolution, a $1 trillion gain.
- Assume our pessimism and optimism are evenly balanced. Then α **= .5**
- Applying the formula gives a value of 0 – much better than the huge loss in the last example.