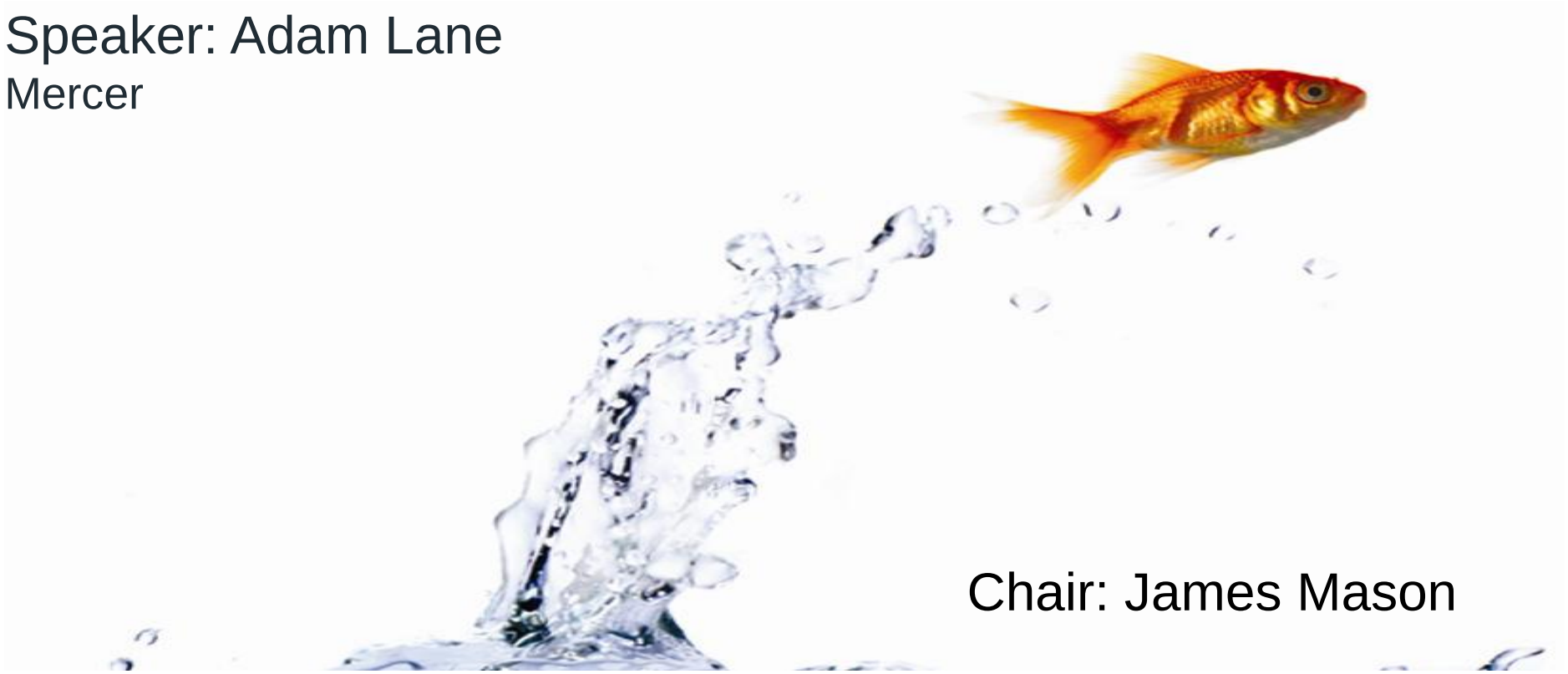
The Actuarial Profession
making financial sense of the future

C5: The failure of modern portfolio theory and implications for pensions actuaries

Speaker: Adam Lane
Mercer



Chair: James Mason

What is a Black Swan?
Courtesy of Nassim Nicholas Taleb

A “Black Swan” is an unpredictable outcome of high impact…

…that appears “obvious” after the fact.

Examples of Black Swans

How many can you think of?

Harry Potter

Google™

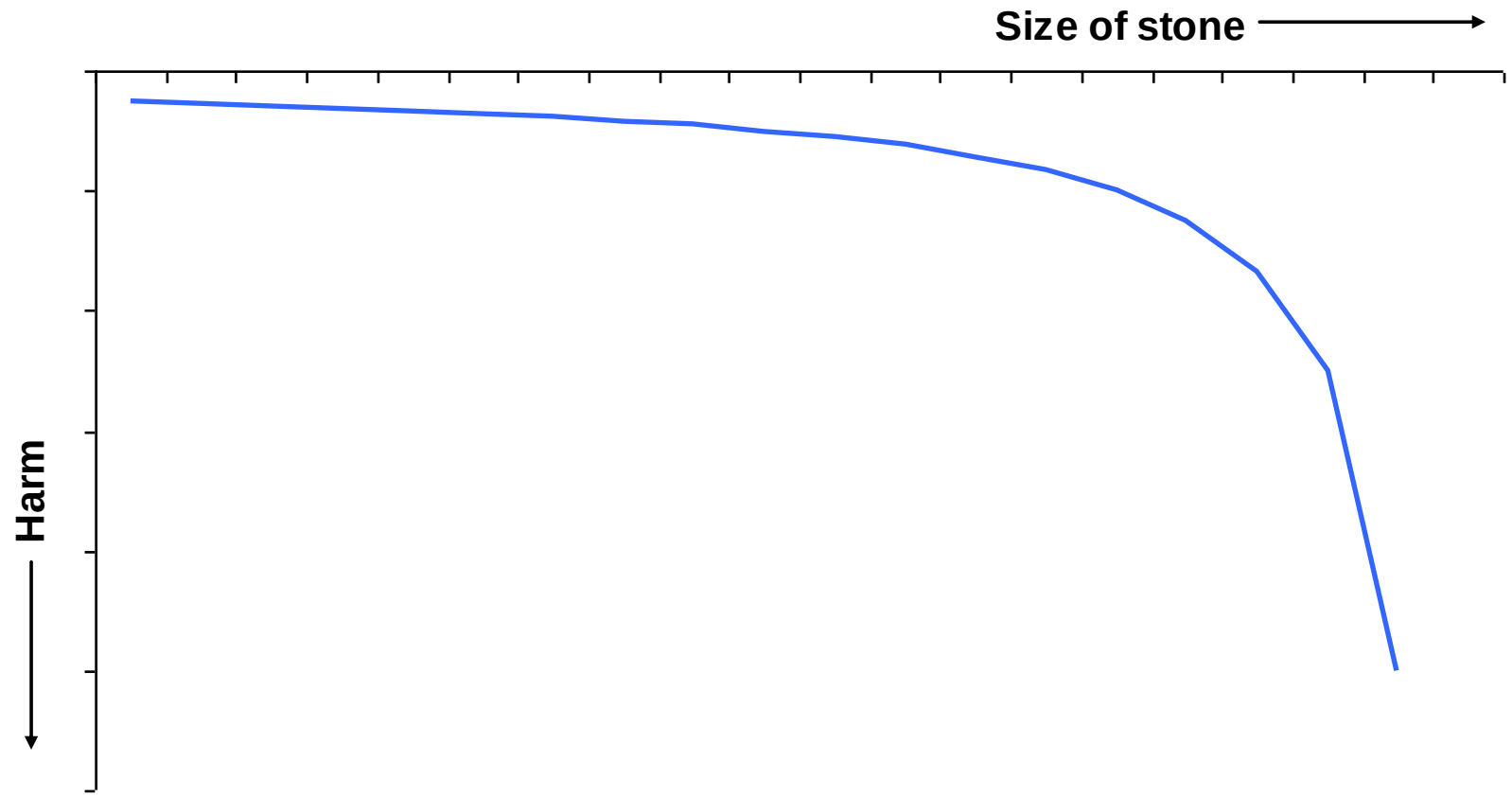
9/11

Understanding what causes Black Swans

A quick story

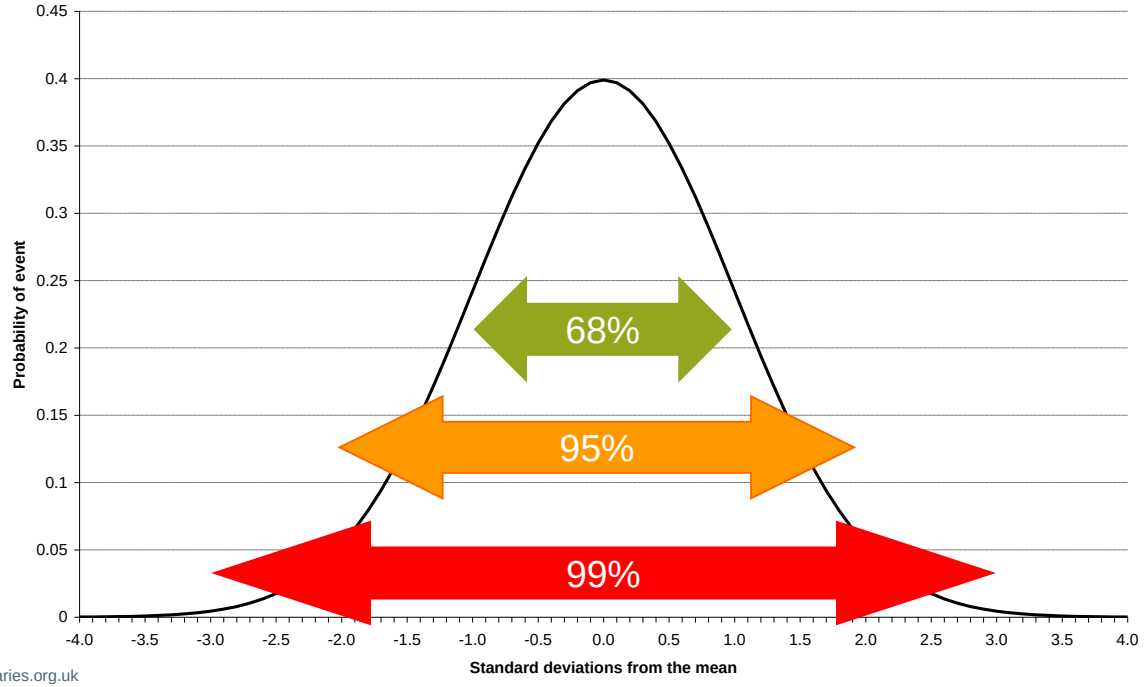
Understanding what causes Black Swans

A quick story



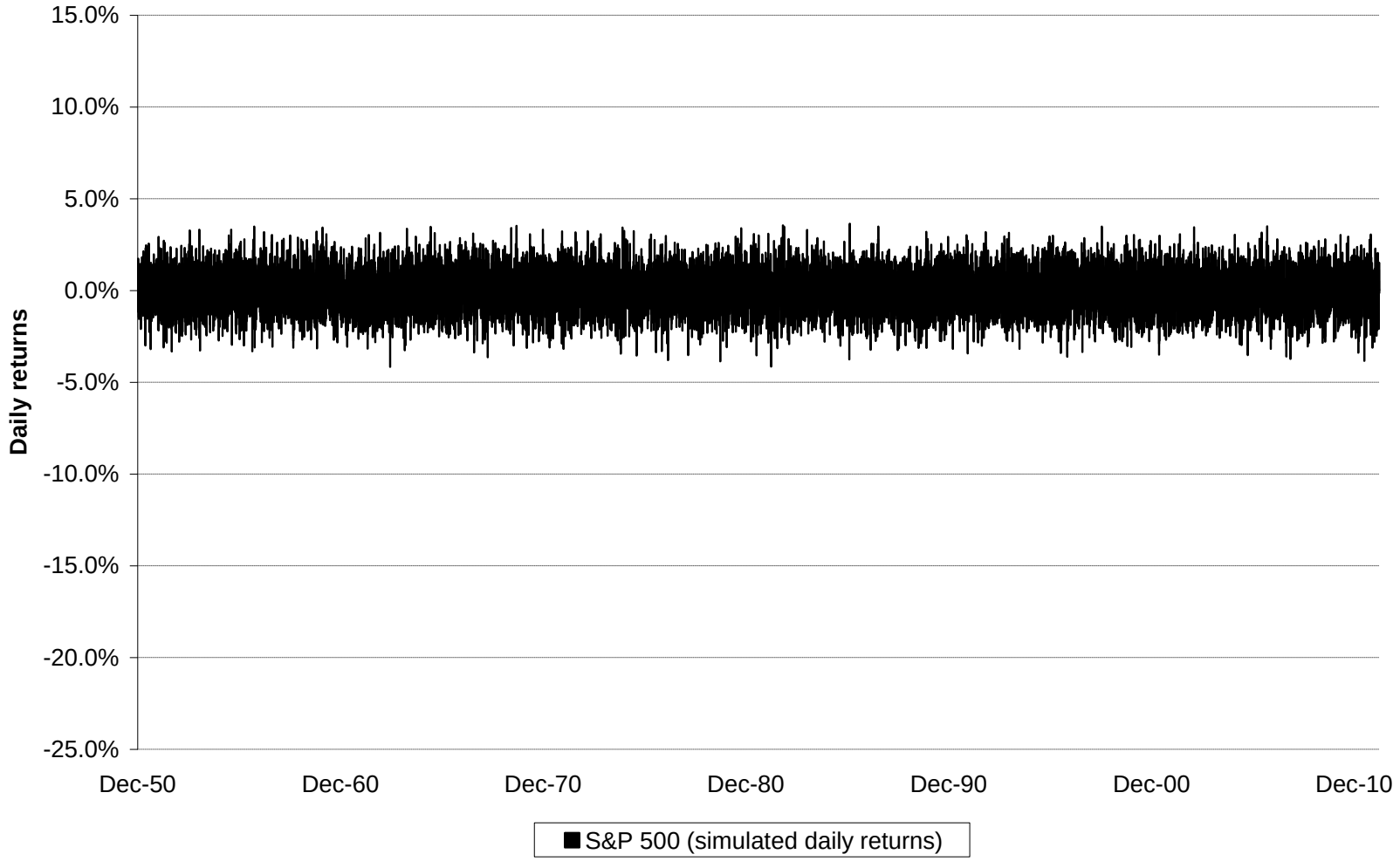
Modern financial theory
The main assumptions underpinning the theory

1. People are rational, risk averse and only aim to maximise their “utility”
2. Price change is practically continuous
3. Price changes follow a “Brownian Motion” (random walk)
   - *i. Price changes are independent (one day doesn’t affect the next)*
   - *ii. Price changes follow a “normal distribution”*
   - *iii. Mean and standard deviation of normal distribution do not change.*



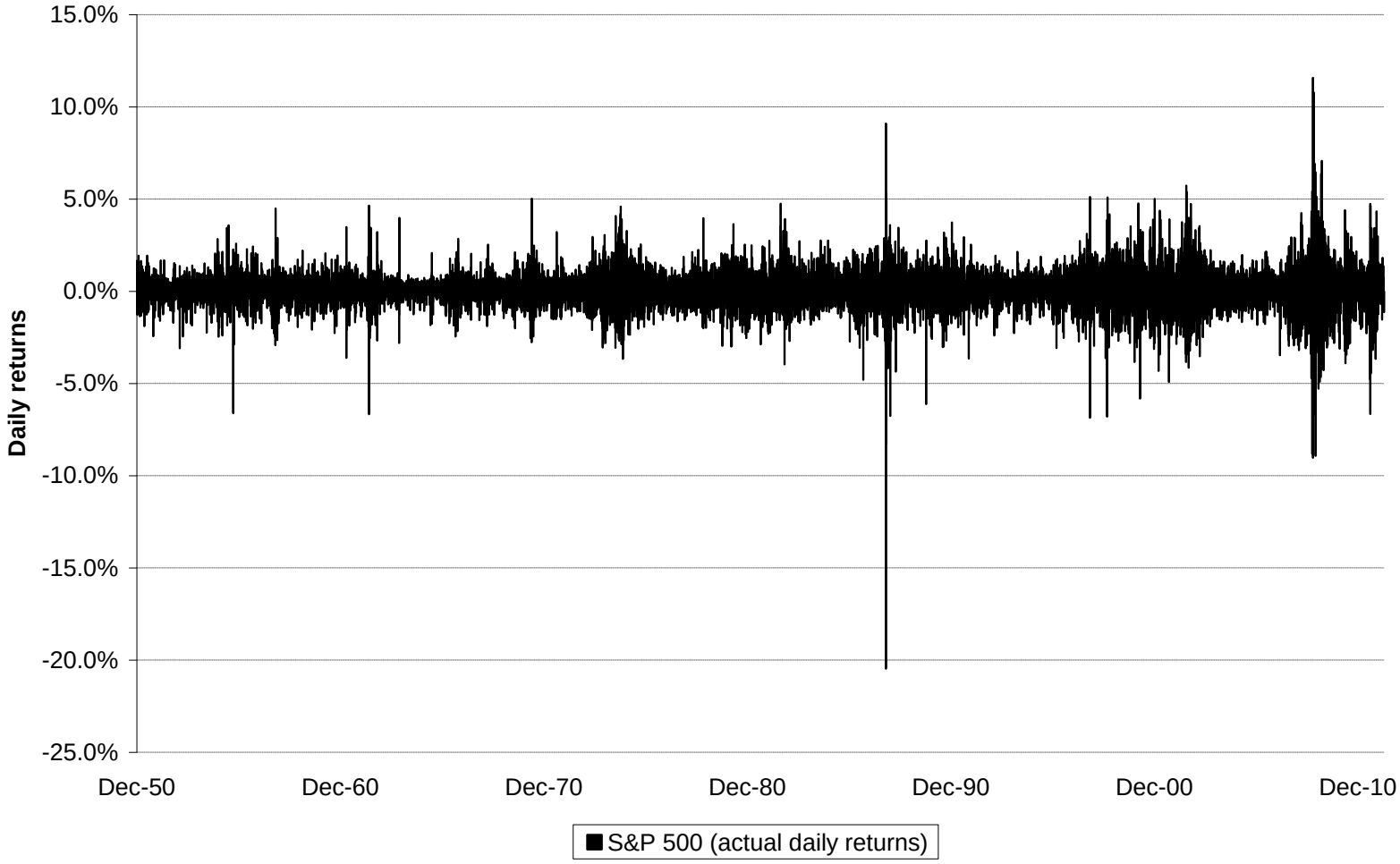
Simulated daily returns since 1950

What the “normal” model assumes the world is like



S&P 500 daily returns since 1950

What the world is really like…

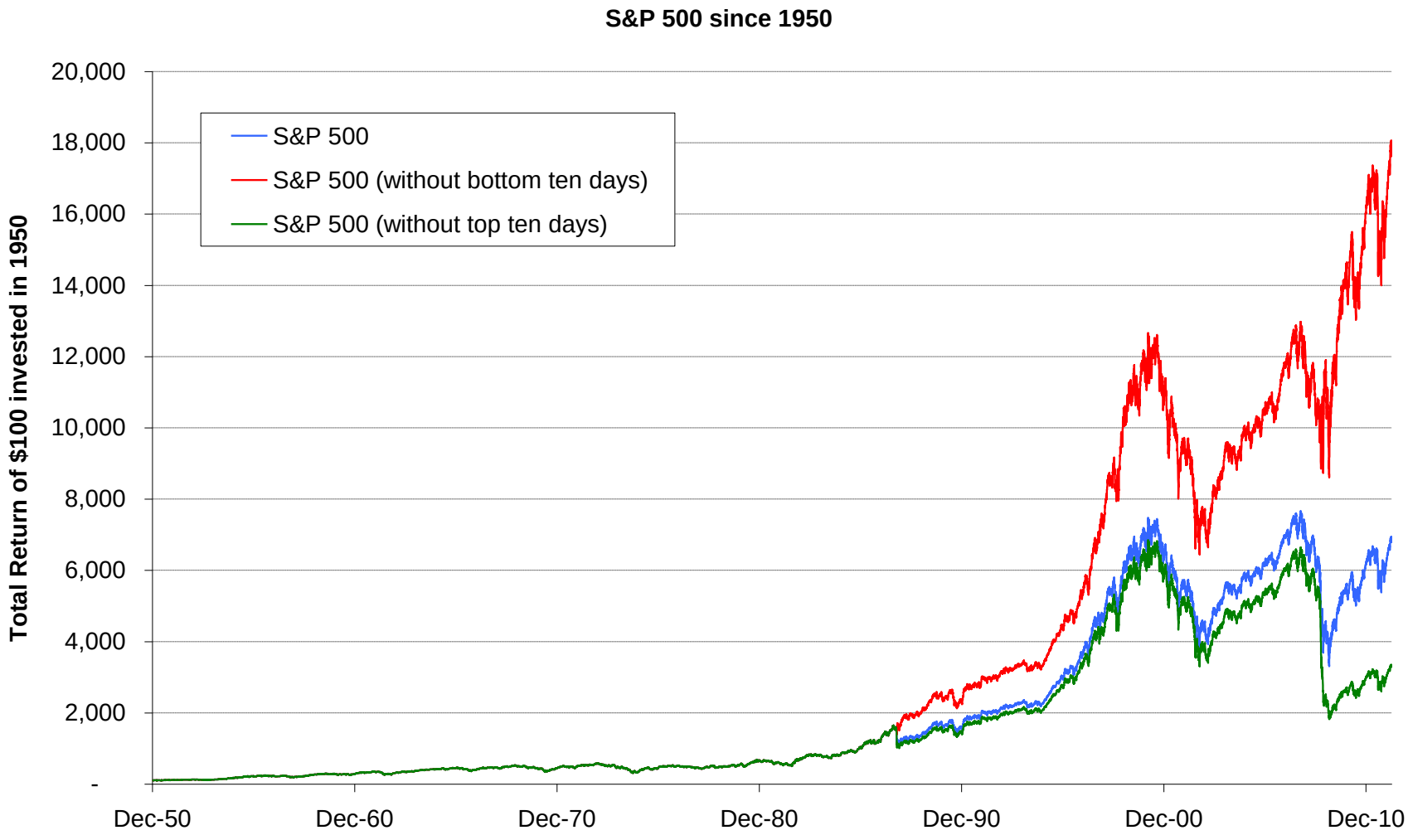


S&P 500
10 most extreme days

Date	Return	Once in every...*
19 October 1987	-20.5%	9 x 10^{89} years
13 October 2008	+11.6%	7,700 trillion, trillion years
28 October 2008	+10.8%	1 trillion, trillion years
21 October 1987	+9.1%	44,000 trillion years
15 October 2008	-9.0%	24,000 trillion years
1 December 2008	-8.9%	930 trillion years
29 September 2008	-8.8%	310 trillion years
26 October 1987	-8.3%	32 trillion years
9 October 2008	-7.6%	150 billion years
23 March 2009	+7.1%	3 billion years

* Assuming a normal distribution and typical assumptions for expected return and standard deviation.

S&P 500
One-off events have a disproportionate impact



Some conclusions
Extreme events

- Traditional financial theories are based on false assumptions
- One off events matter and this has profound implications for decision making and risk management
- Extreme events happen more often than you would expect from a market's normal level of volatility
- Extreme events tend to "cluster"

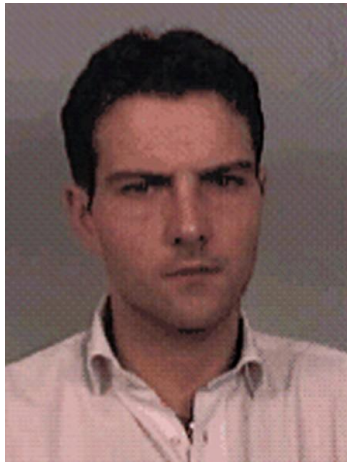
We are future “blind”
We should stop using hindsight as foresight

The perfect storm: Risk of sinking is not proportional to distance from the shore! The risk of ruin is not proportional to volatility!

The fallacy of economies of scale

The curious case of Jérôme Kerviel and “too big to fail”

One “big” bank, one rogue trader

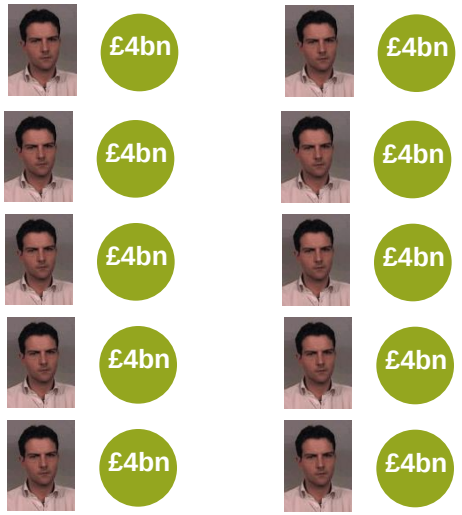


£40bn

Market impact

Liquidation costs
~ £3,200,000,000

Many “smaller” banks



Market impact

Liquidation costs
~ £000’s

Taleb again
The four quadrants of risk management

	Simple payoffs	Complex payoffs
Mild randomness ("thin tails")	Robust to Black Swans	Quite robust to Black Swans
Wild randomness ("thick tails")	Quite robust to Black Swans	**Extremely fragile to Black Swans**

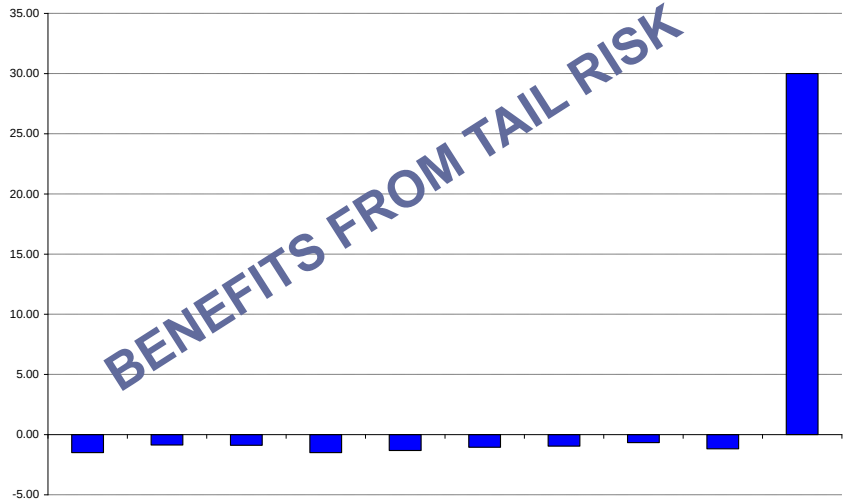
Complex payoffs
Introducing “concave” and “convex” payoffs

Concave – Betting pounds to win pennies

Examples:

- Banks
- Debt
- Selling portfolio insurance
- Convergent strategies (eg LTCM)
- Mean-variance portfolios
- Value/fundamental investment strategies

Convex – Betting pennies to win pounds



Examples:

- Private equity
- Pharmaceutical companies/Biotech
- Buying portfolio insurance
- Divergent strategies (eg managed futures)
- Portfolios containing “idle capital”
- Short positions in concave assets

Options as insurance
What can we do about extreme risks?

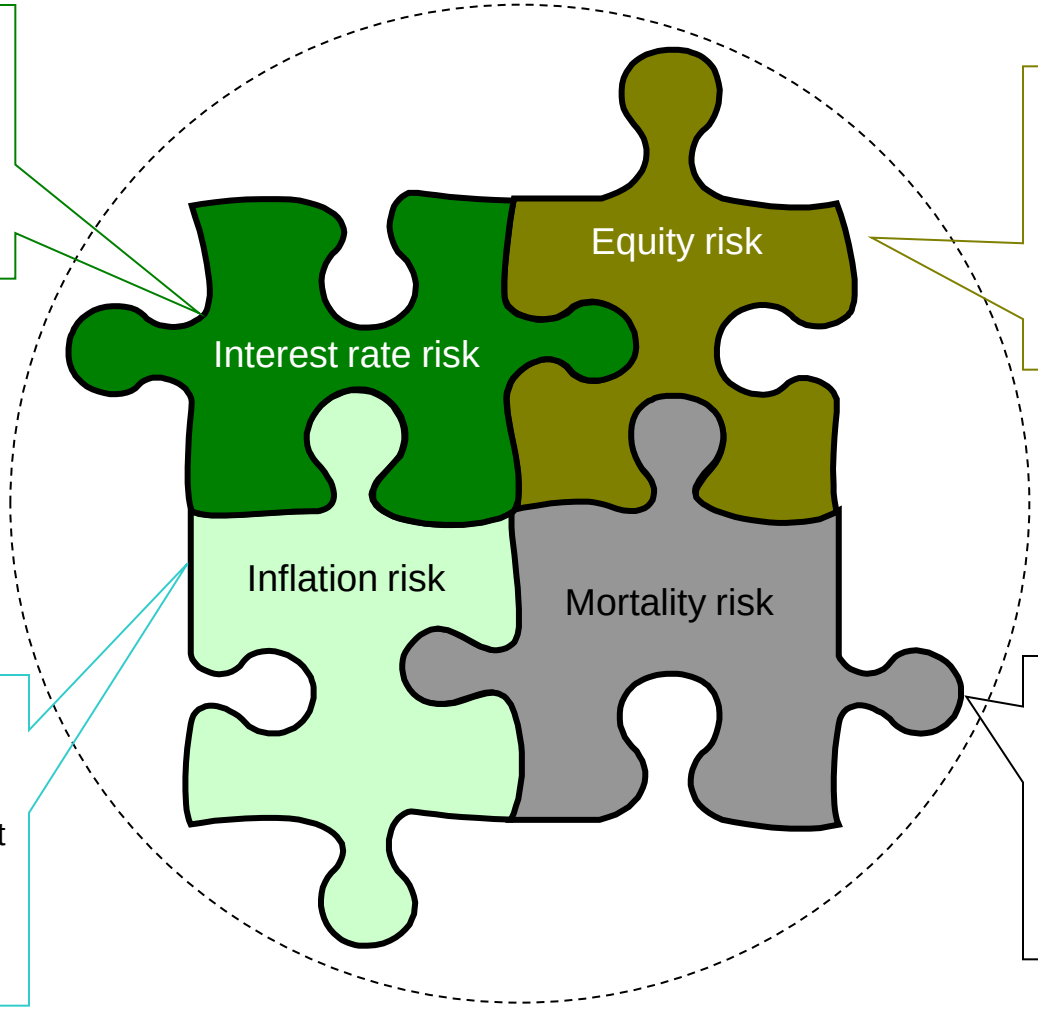
- The main risks facing pensions schemes are:
  - Interest rate risk
  - Inflation risk
  - Equity risk
  - Mortality risk
  - Sponsor covenant risk
- Key elements of any hedging strategy include the following:
  - Effectiveness of the hedging instrument
  - Cost of the hedge (the “cost of carry”)
  - Position sizing (the “hedge ratio”)
- Most institutional investment portfolios contain significant open ended risk exposures and are therefore exposed to catastrophic losses.

Consider risk reduction, cost and your overall strategy

Intelligent liability hedging

<u>Interest rate risk hedging:</u>

- Hedging already started for many schemes.
- Take an opportunistic approach to increase hedge ratio



<u>Equity risk hedging:</u>

Link into de-risking plan:

- Hedge a proportion of downside risk in exchange for a giving up returns above a certain threshold?

<u>Inflation risk hedging:</u>

- Consider how best to increase exposure to inflation – too expensive at the moment?
- Deflation is arguably one of the largest risks facing UK pension schemes.

<u>Mortality risk hedging:</u>

- Will become more important as a scheme approaches a fully funded position.
- Be prepared
- Consider an opportunistic approach

Better models…
What can we do about extreme risks?

- Much effort given to refining the old “normal” models
- These fixes still don’t deal with the fact that extreme events are largely impossible to predict – “unknown, unknowns”.
- Worse, modelling the tails is extremely prone to input error. A simple rounding error can lead to massive changes in results.
- Focus on dealing with contingencies rather than predicting rare events!
- Actuaries are uniquely placed to give this advice.

Any questions?