

The Actuarial Profession
making financial sense of the future

The failure of modern portfolio theory and implications for pensions actuaries
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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.

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Examples of Black Swans

How many can you think of?

Harry Potter



Google



9/11

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Understanding what causes Black Swans

A quick story

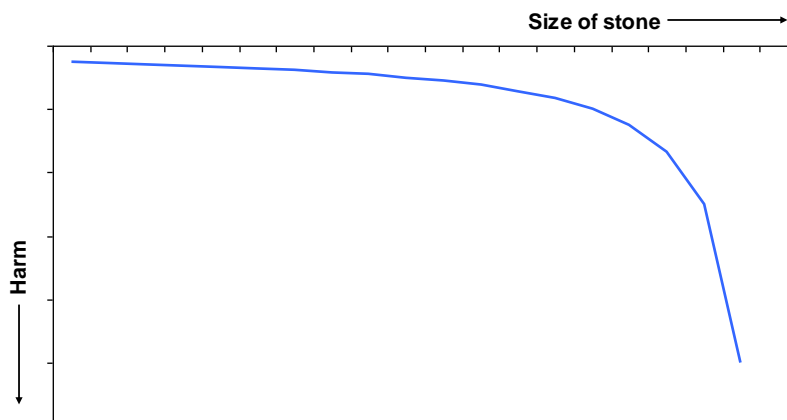


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Understanding what causes Black Swans

A quick story



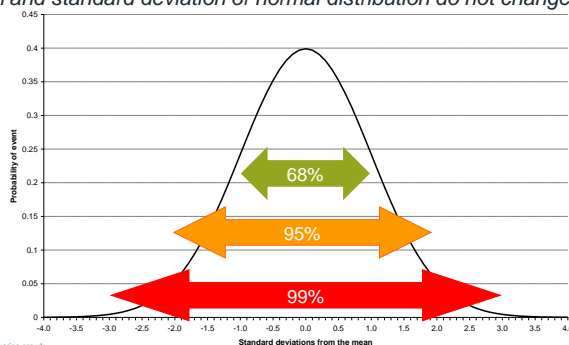
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Modern financial theory

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.

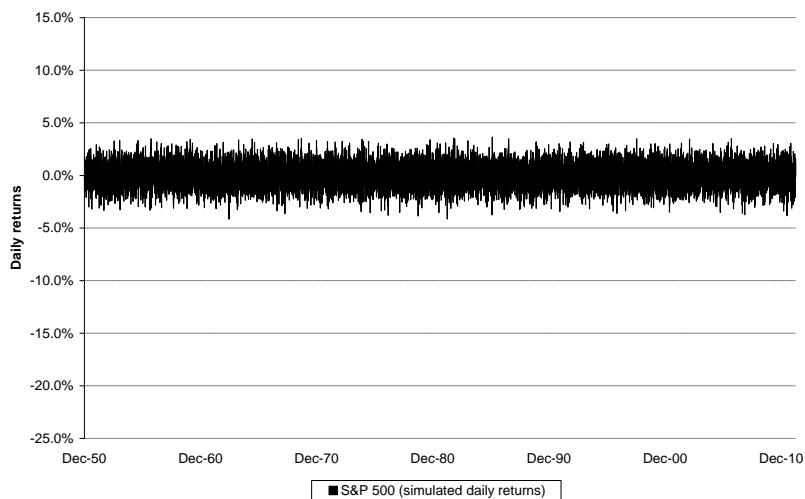


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Simulated daily returns since 1950

What the “normal” model assumes the world is like

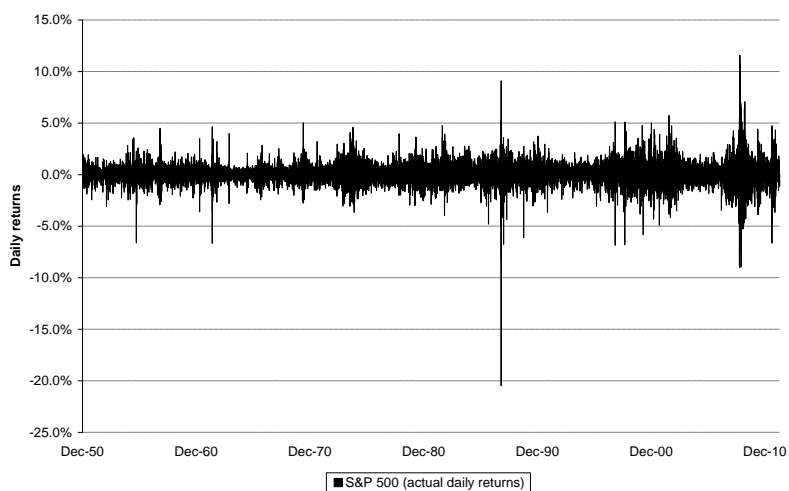


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S&P 500 daily returns since 1950

What the world is really like...



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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 |

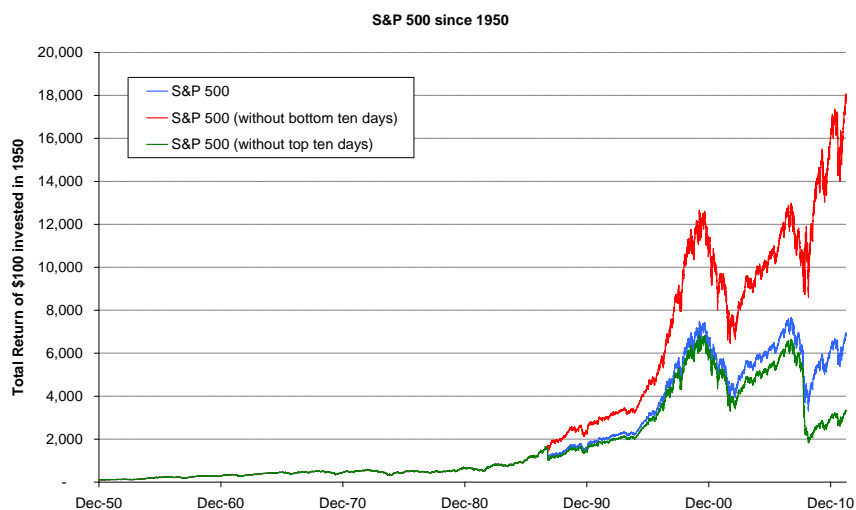
* Assuming a normal distribution and typical assumptions for expected return and standard deviation.

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S&P 500

One-off events have a disproportionate impact



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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”

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We are future “blind”

We should stop using hindsight as foresight



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



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The fallacy of economies of scale

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

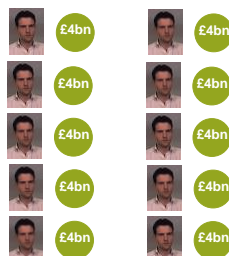
One “big” bank, one rogue trader



Market impact

Liquidation costs
~ £3,200,000,000

Many “smaller” banks



Market impact

Liquidation costs
~ £000's

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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 |

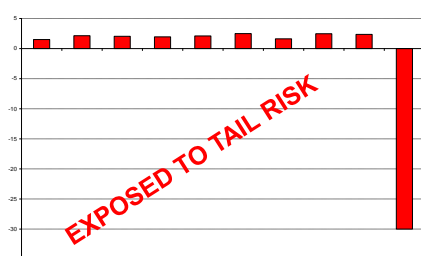
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Complex payoffs

Introducing "concave" and "convex" payoffs

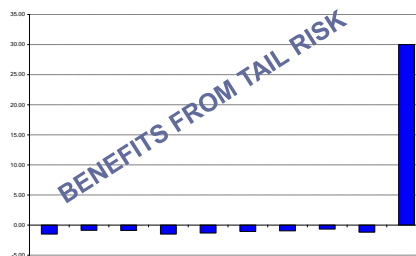
Concave – Betting pounds to win pennies



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

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Options as insurance

What can we do about extreme risks?

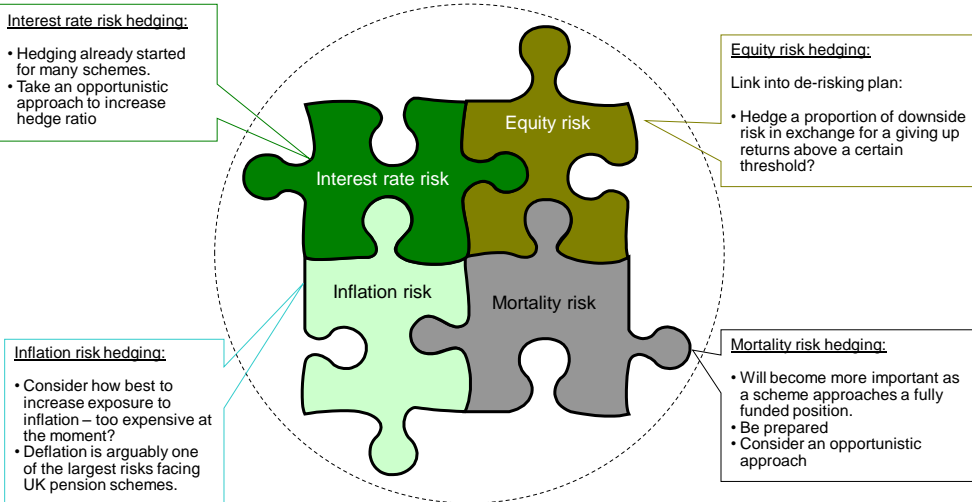
- The main risks facing pensions schemes are:
 - Interest rate risk
 - Inflation risk
 - Equity risk
 - Mortality risk
 - Sponsor covenant risk
- Key elements of any hedging strategy include the following:
 - Effectiveness of the hedging instrument
 - Cost of the hedge (the “cost of carry”)
 - Position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

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Consider risk reduction, cost and your overall strategy

Intelligent liability hedging



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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?

