



Institute
and Faculty
of Actuaries

IFoA India Conference 2024

29 November – 1 December, Andaz Hotel, New Delhi



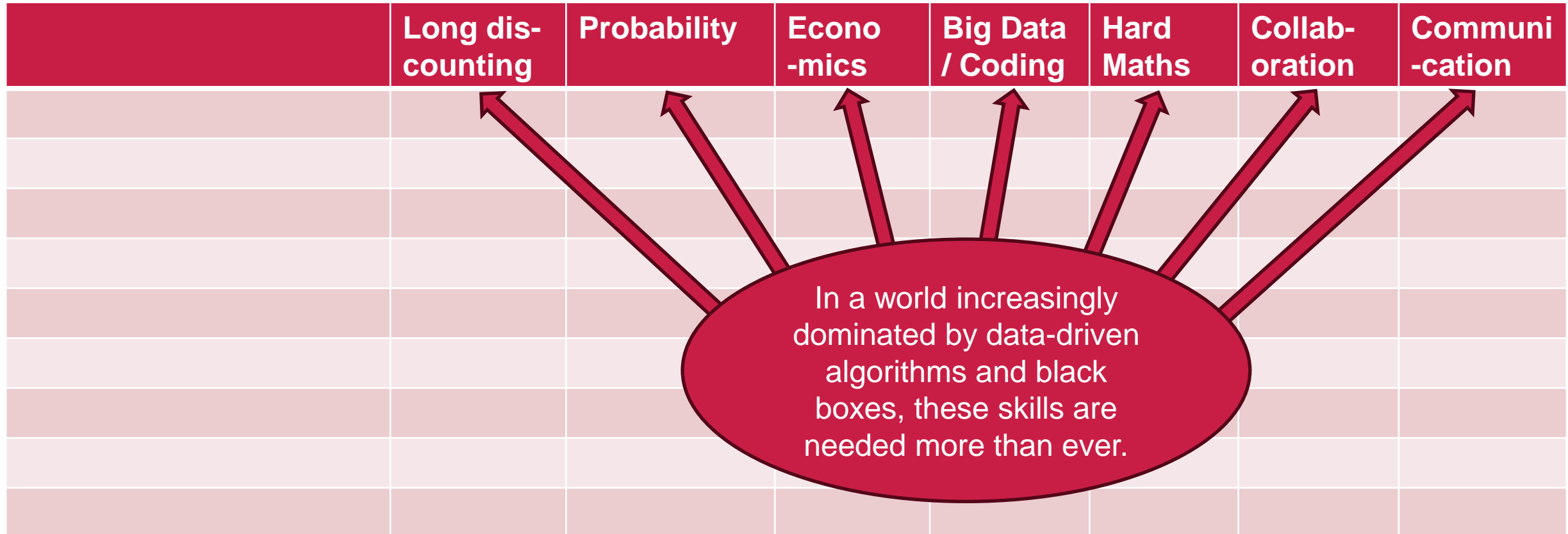
Institute
and Faculty
of Actuaries

Unconventional Actuary

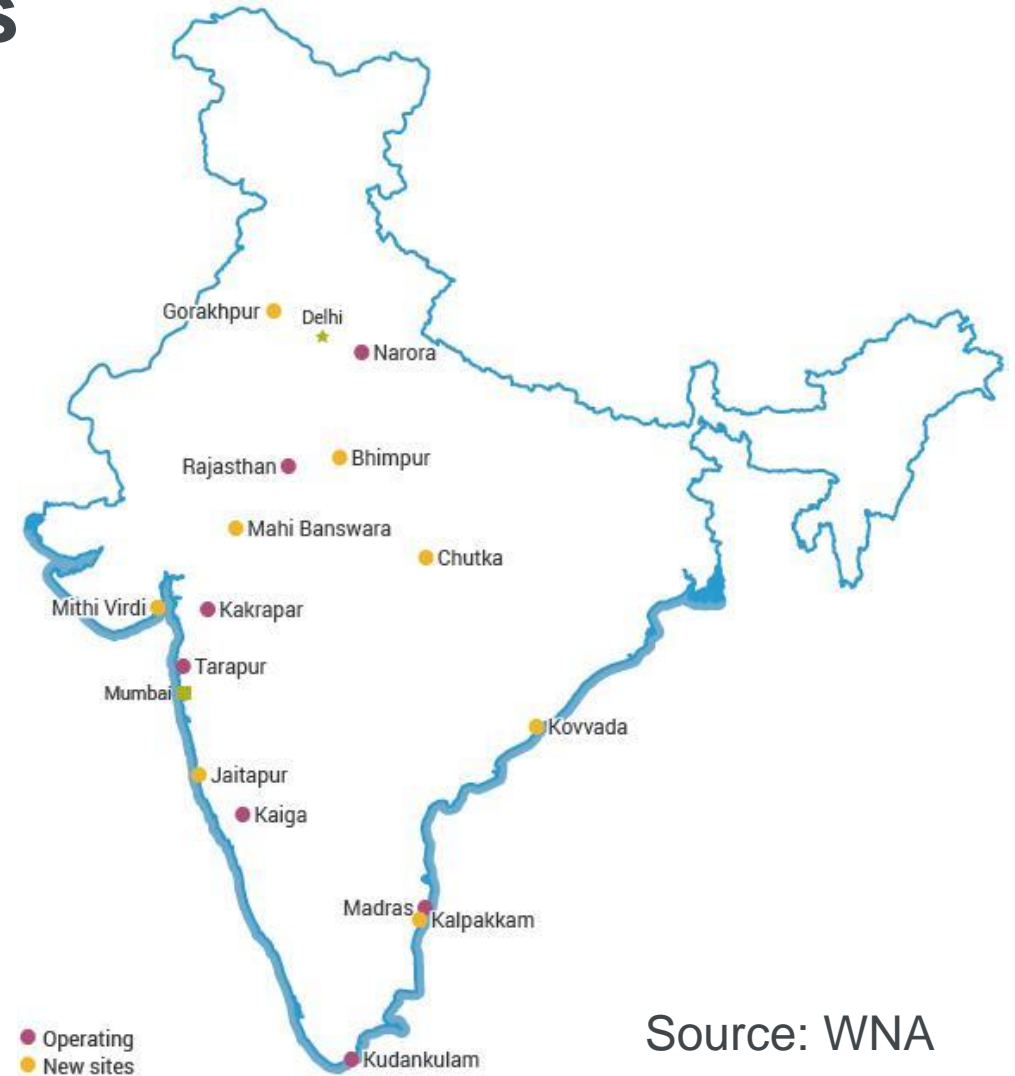
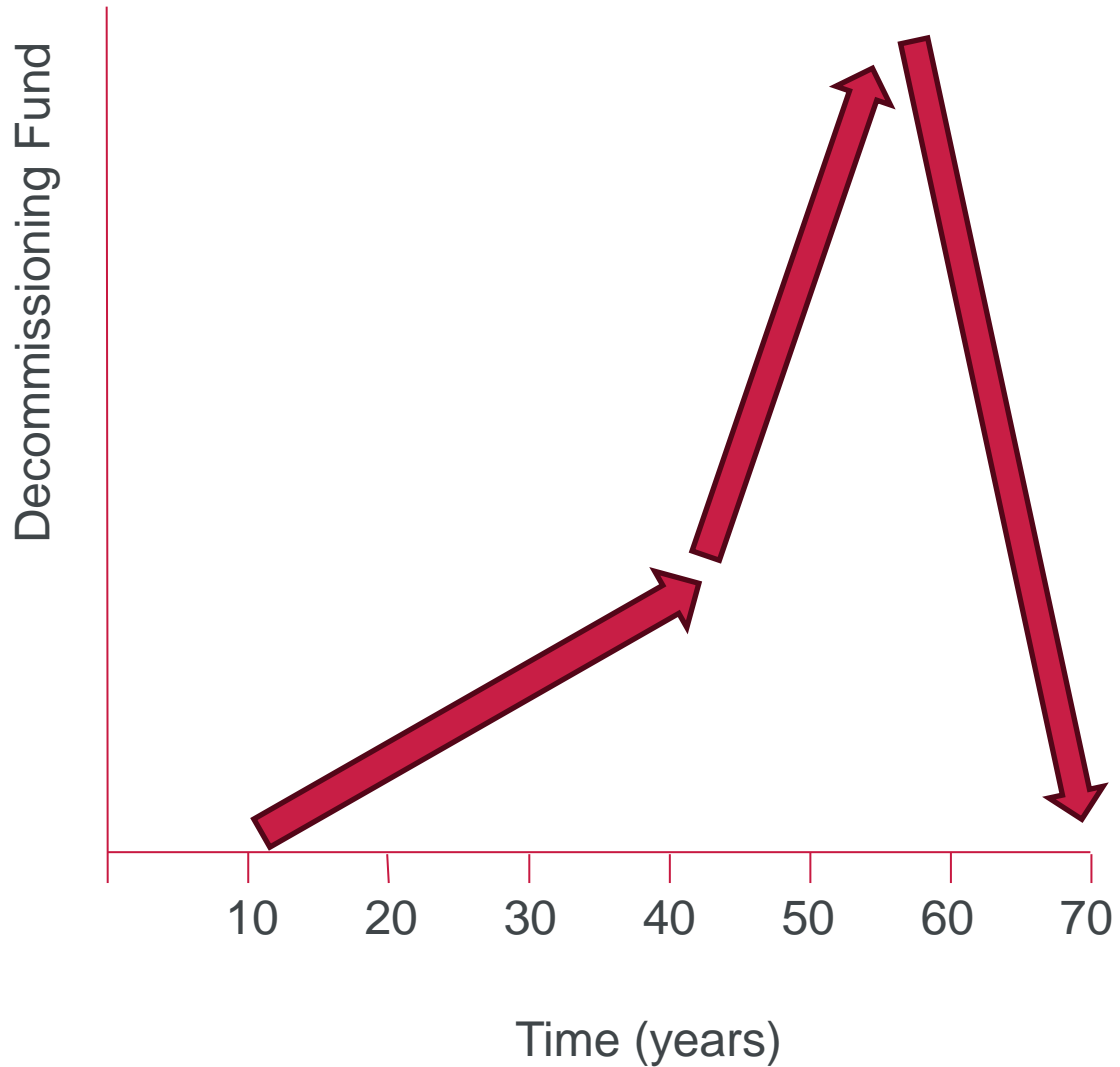
Andrew Smith PhD, Hon FIA, Hon FSA, University College Dublin.
ansmith@ucd.ie

IFoA India Conference 2024

What do I think are Actuaries are Good At?



Financing Nuclear Power Stations



Source: WNA

Credit Transition Modelling for Corporate Bonds

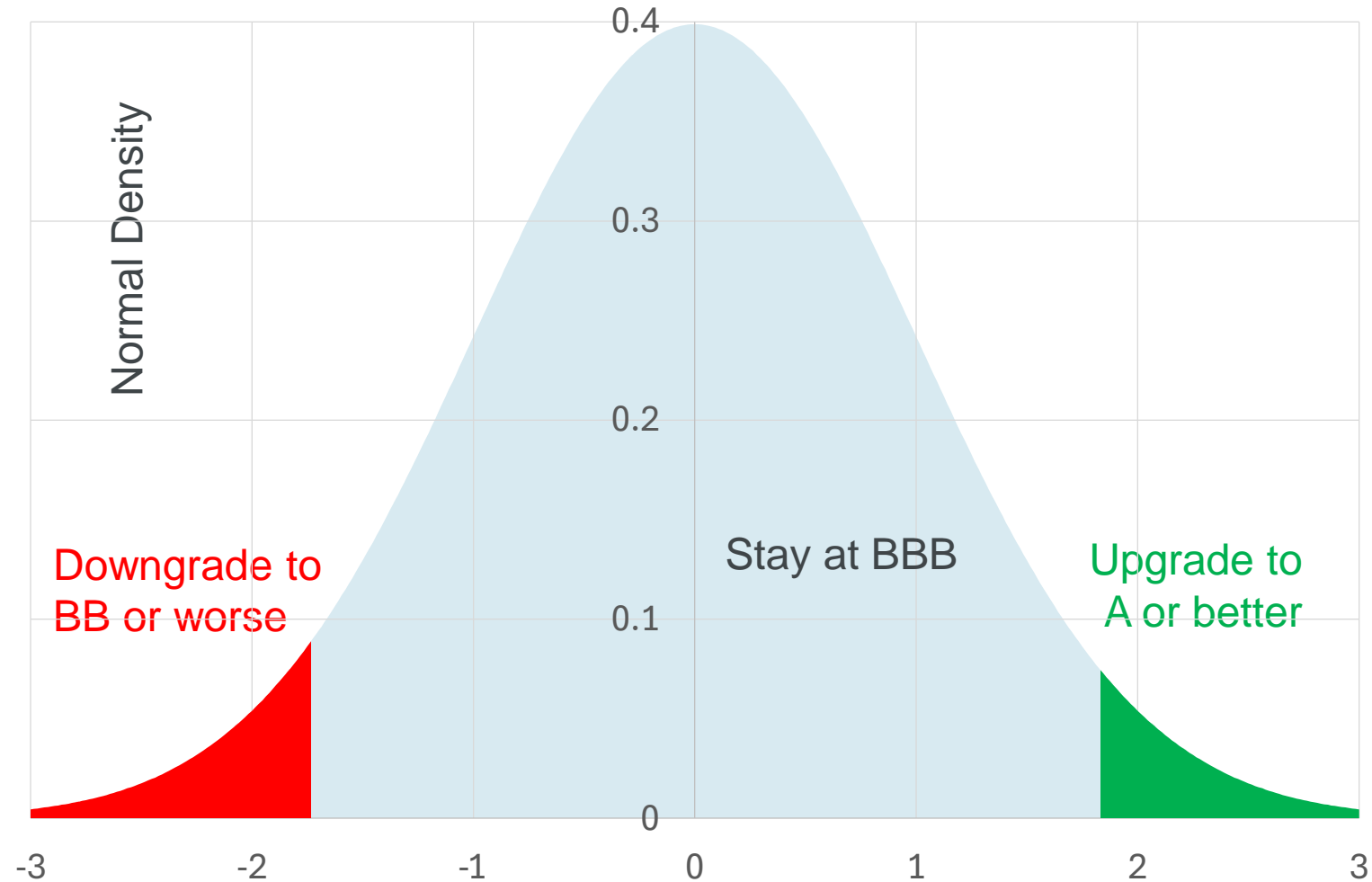
Global Corporate Average Transition Rates (1981-2023) %									
From \ to	AAA	AA	A	BBB	BB	B	CCC/C	D	Not Rated
AAA	87.26	8.94	0.51	0.03	0.10	0.03	0.05	0.00	3.08
AA	0.46	87.63	7.57	0.45	0.05	0.06	0.02	0.02	3.76
A	0.02	1.50	89.21	4.72	0.24	0.10	0.01	0.05	4.14
BBB	0.00	0.07	3.08	87.13	3.28	0.41	0.09	0.14	5.80
BB	0.01	0.02	0.10	4.46	78.59	6.40	0.51	0.57	9.33
B	0.00	0.02	0.06	0.15	4.46	75.03	4.85	2.98	12.46
CCC/C	0.00	0.00	0.08	0.14	0.43	13.34	44.95	25.98	15.08

Source: S&P 2023 Annual Global Corporate Default and Rating Transition Study

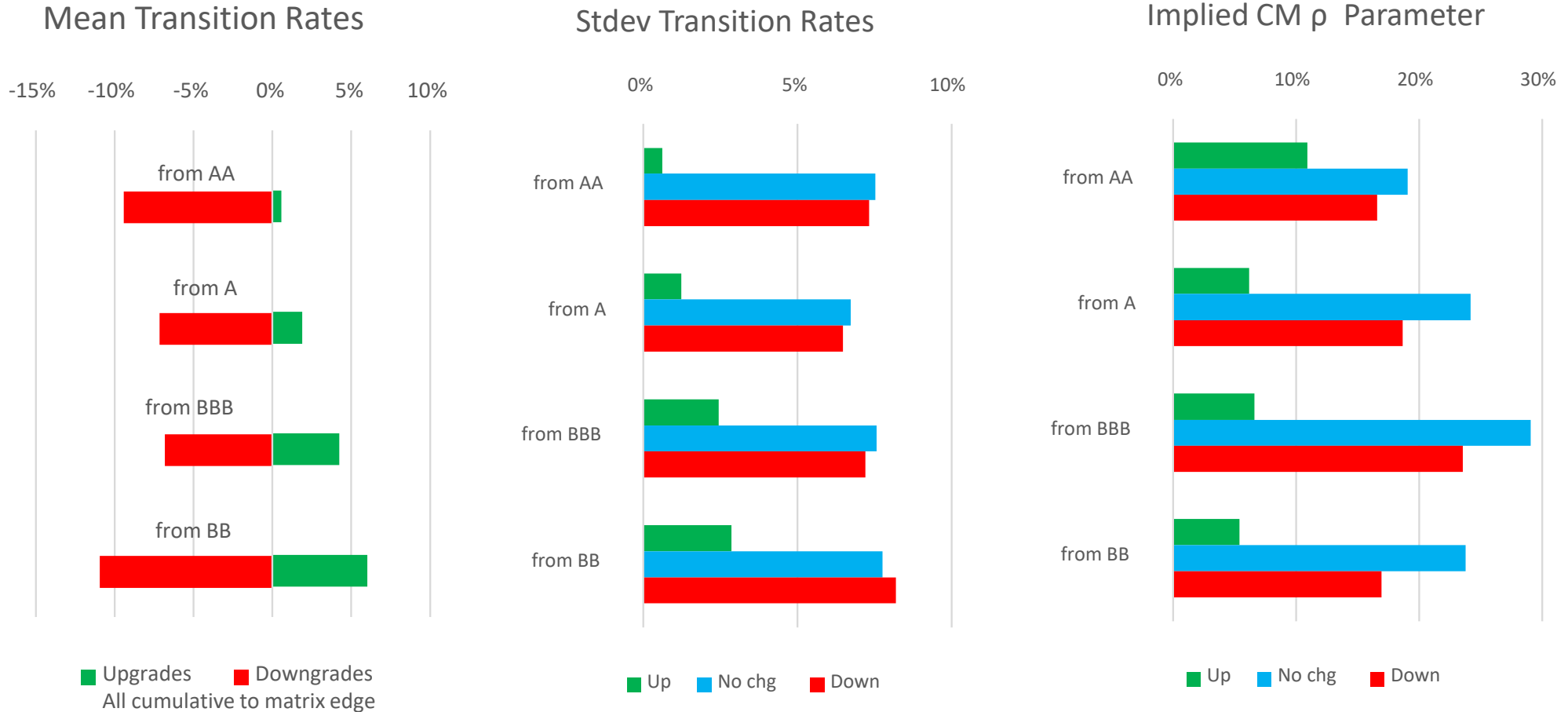
Question: Given \$100m of bonds currently BBB, what is the distribution of downgraded bond values next year?

Credit Metrics Model Approach (Basis of Basel Formula)

- Every name has its own (unobserved) normal variate.
- Triggers (observed) upgrades or downgrades according to the diagram.
- Expressed as $Z = \rho^{1/2}X + (1-\rho^2)^{1/2}Y$
- Systematic normal factor X varies by year and not by name.
- Specific normal factor Y varies by year and by name.
- Two Z 's for different names in the same year have correlation ρ .



Credit Downgrades are Lumpier than Upgrades



Machine-Learning (K-means) algorithm need to capture asymmetry.

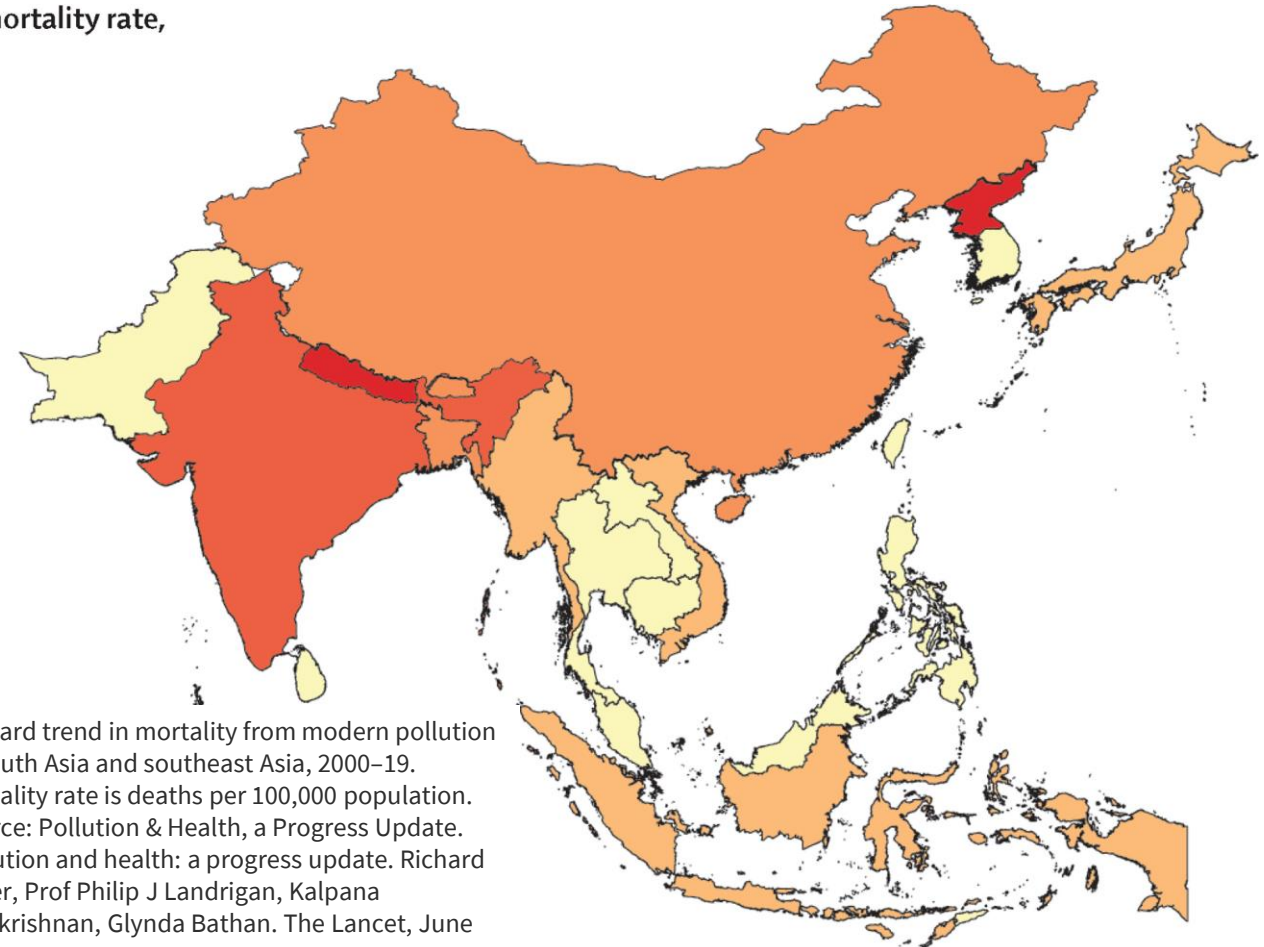
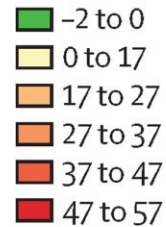
Source: Transition Risks For Rating-Based Assets.

Alan Reed & Andrew Smith, Society of Actuaries in Ireland, 2021.

Air Pollution Effect on Local Mortality

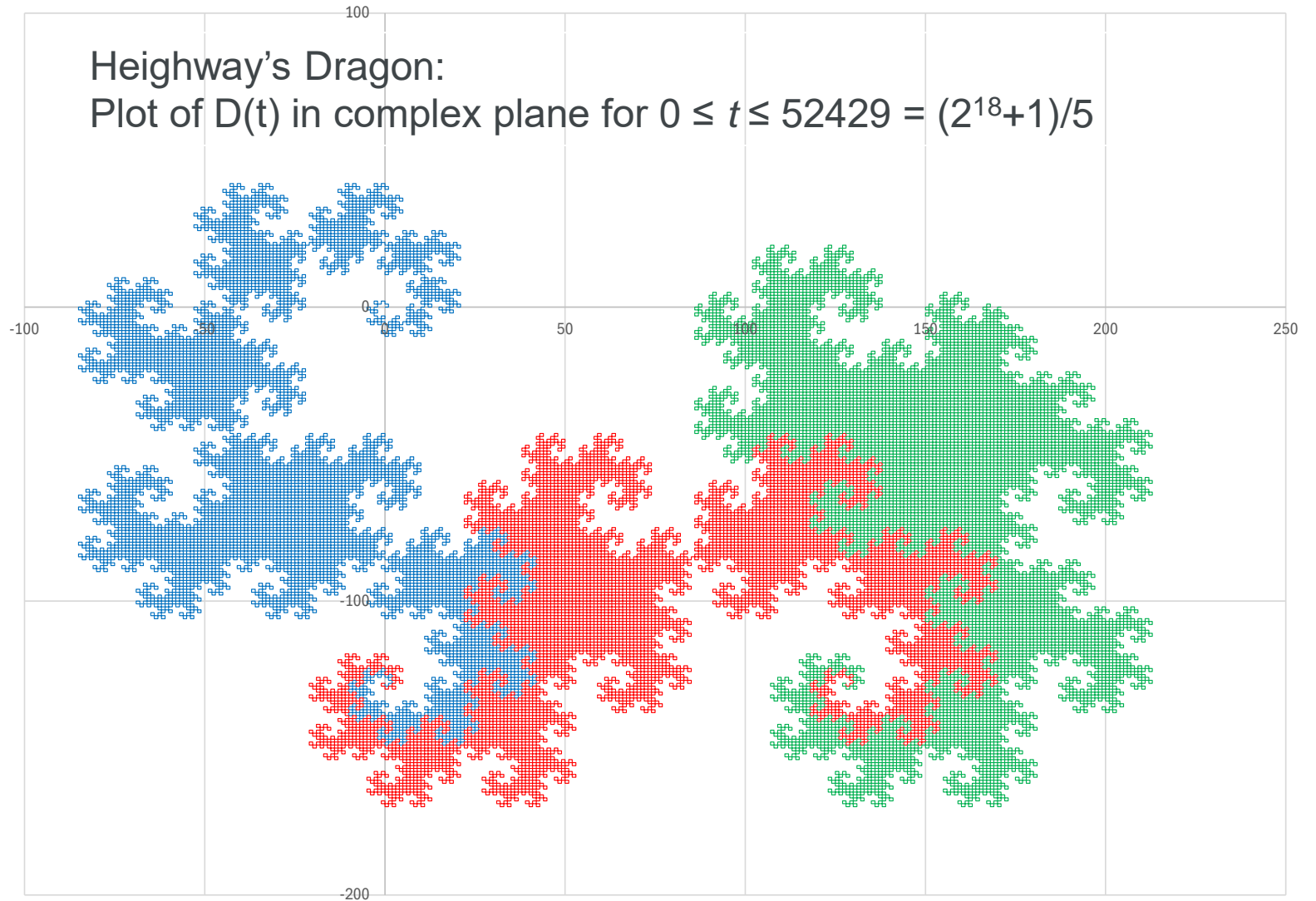
- Air pollution is a cause of many excess deaths (estimated 2.3 million per year in India alone).
- Some pollutants have no direct impact on mortality (eg CO₂)
- Others cause respiratory diseases but are spread over a wide area (eg NO₂, SO₂)
- PM2.5's associated with heart and respiratory diseases, cancers, and dementia are localised, being 1m or 3m from a main road matters.

Difference in mortality rate,
2000-19



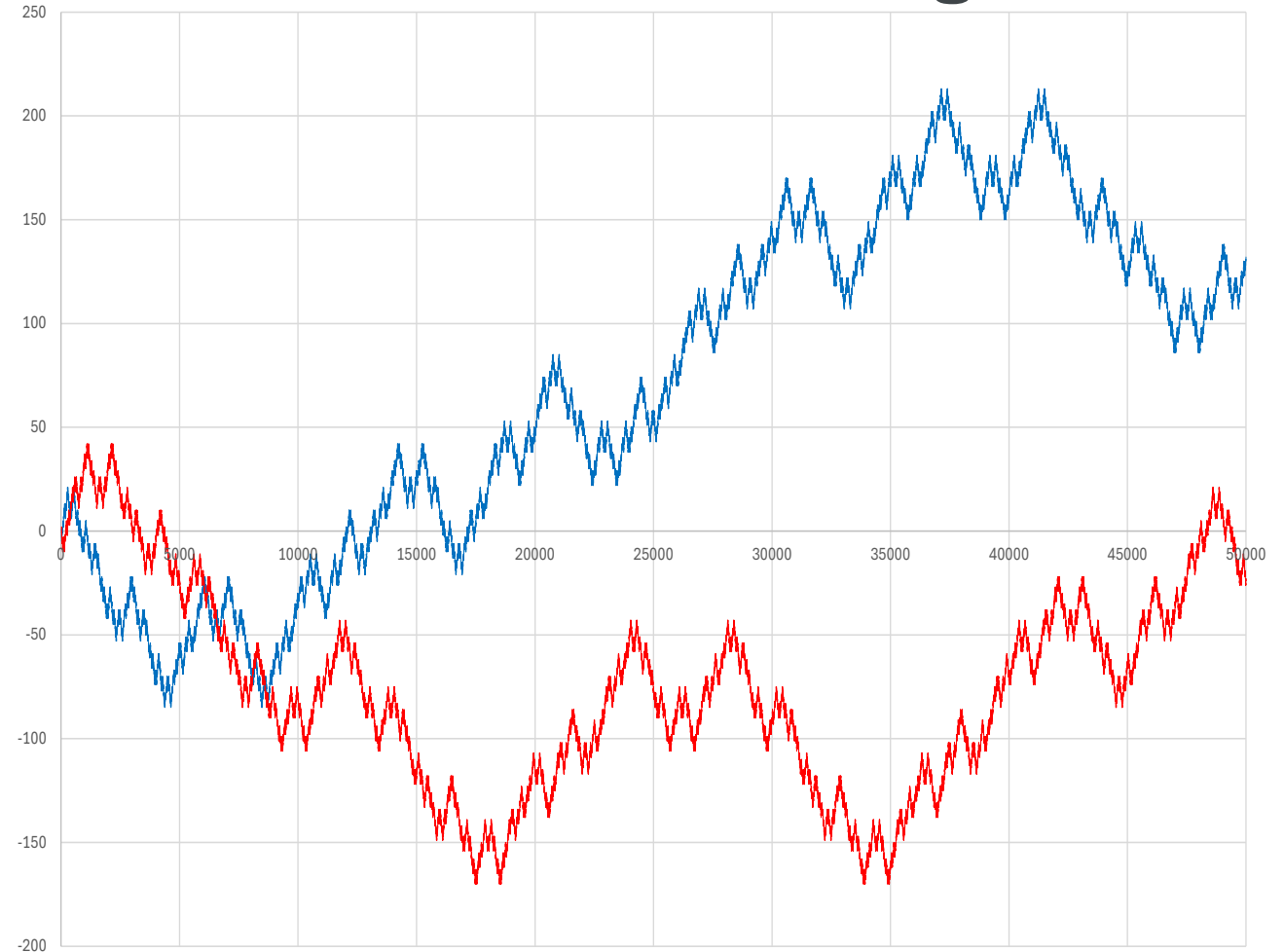
Ireland Fractal

- $D(0) = 0$
- $D(1) = 1$
- If $0 < t \leq \frac{1}{2}$ then
$$D(t) = (1 - i) D(2t) / 2$$
- If $\frac{1}{2} < t < 1$ then
$$D(t) = 1 - i D(1-t)$$
- If $t > 1$ then
$$D(t) + (1+i) D(t/2)$$
- Circular references in theory (eg $t = \frac{1}{3}$) but not in practice on a binary computer.



Deterministic Brownian Motion for Stress Testing

- Stress tests for banks and insurers often specified as an end-point with a 1-year horizon.
- For some activities, such as hedging of financial options, the path taken matters more than the end-point.
- Stressed paths should be deterministic but of realistic or stressed intra-year volatility.
- And reproducible!
- Real and imaginary parts of Heighway's dragon fit the criteria.



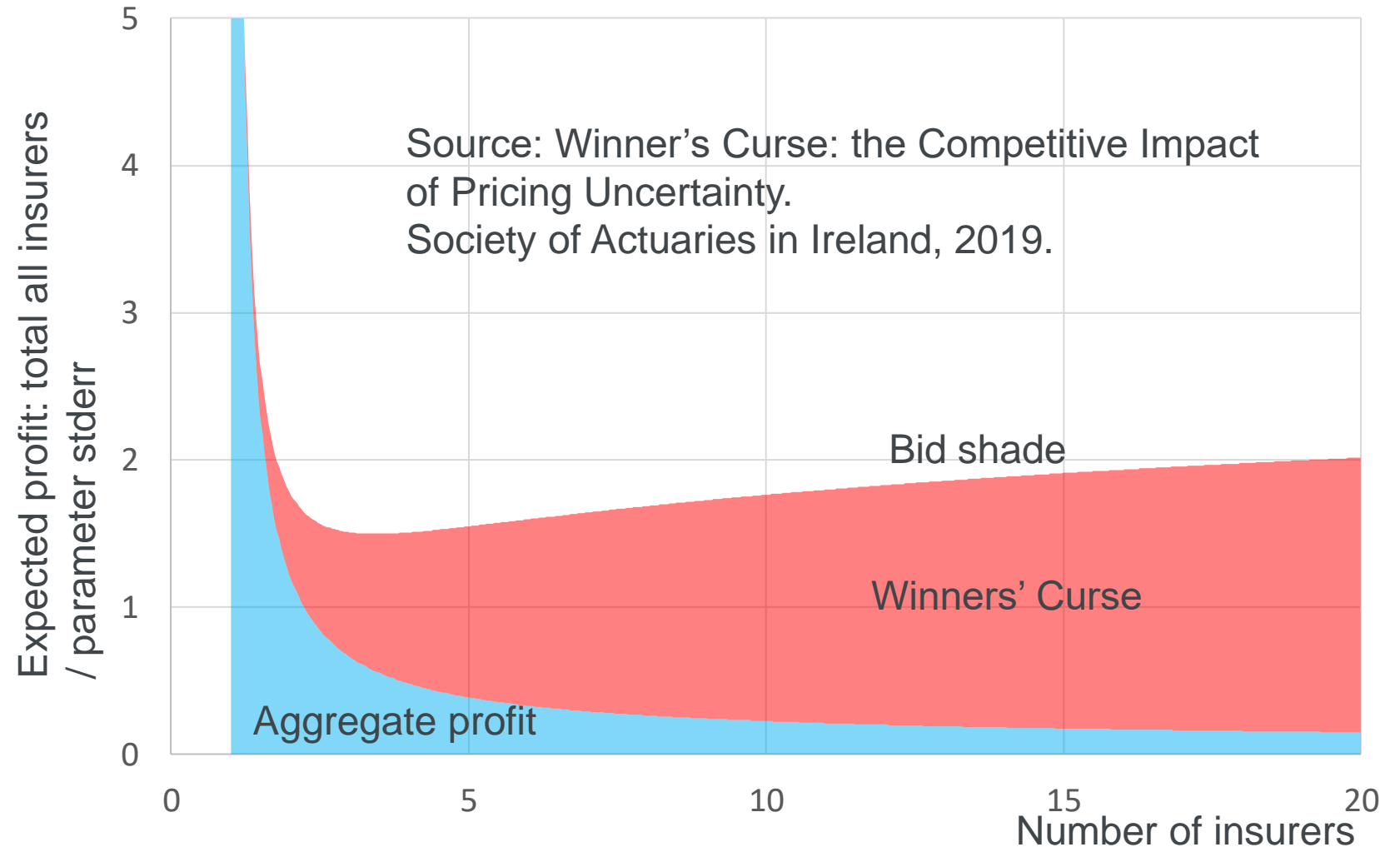
Source: Taking shape: the Brownian blancmange' fractal and how it can be used in hedging. The Actuary. Feb 2022.

Economics of FX Spread-Betting Firms

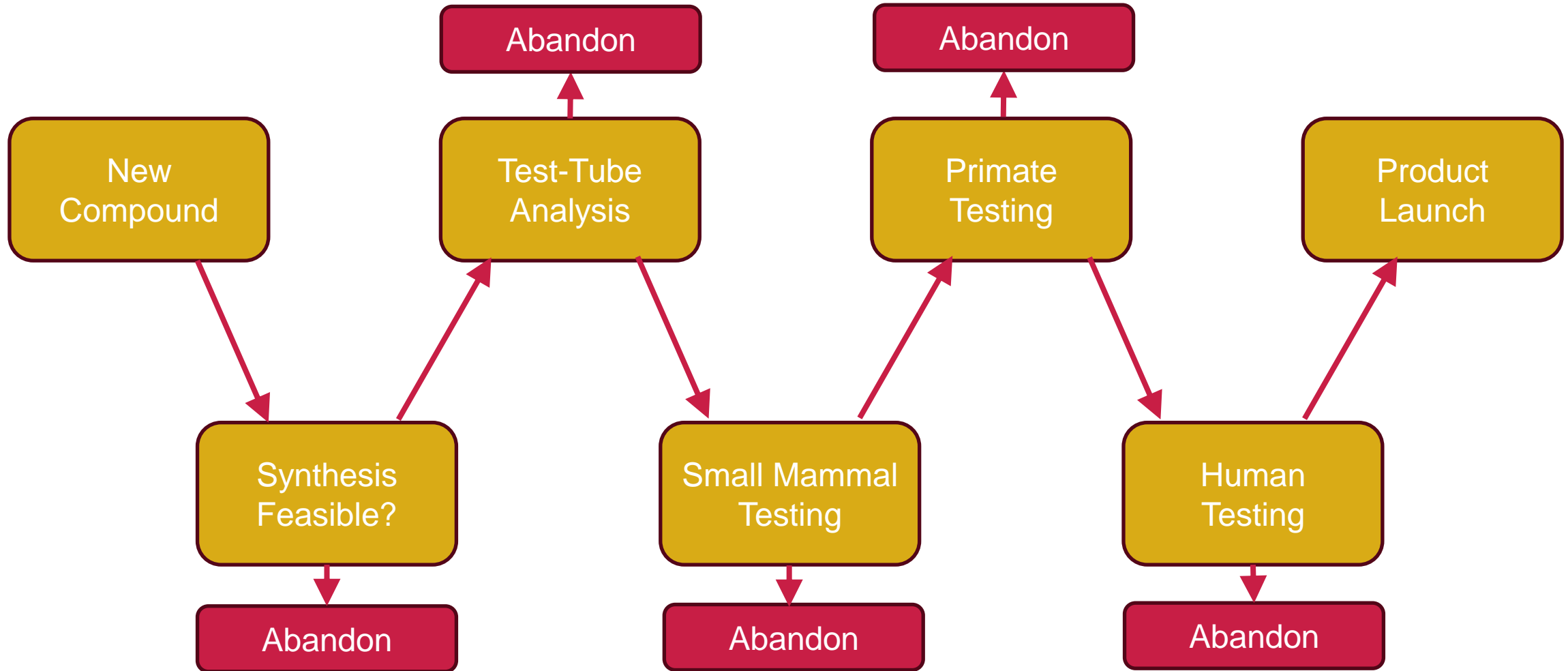
Negative Information Ratio	Zero Information Ratio	Positive Information Ratio
Gambler more often wrong than right	Gambler is randomly right or wrong.	Gambler is more often right than wrong.
	If FX markets are efficient then all gamblers have zero information ratio.	
?	Betting services can collect fees and diversify bets.	Betting firms can collect fees, some of which is spent on hedging transactions.

Insurance Pricing, Competition and Nash Equilibrium

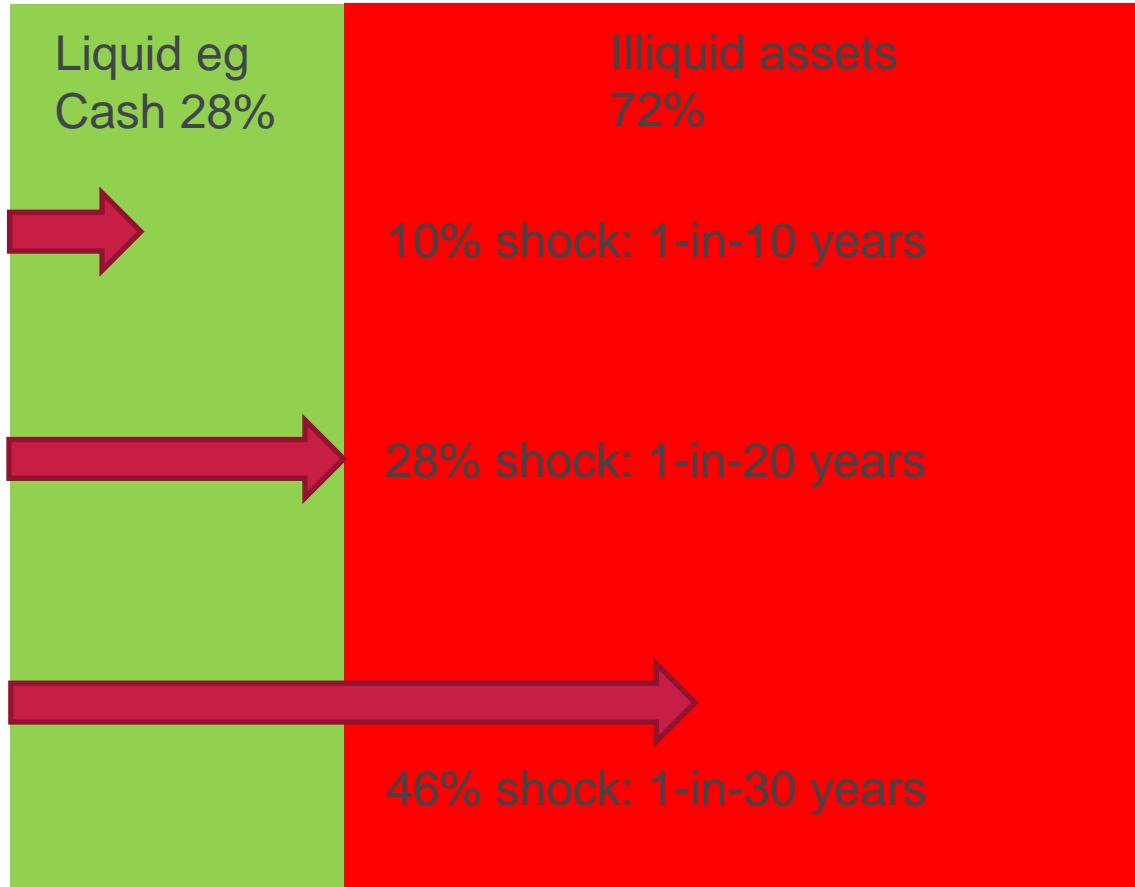
- Parameter uncertainty: claims estimate may be too high or too low.
- Winner's curse: most likely to win business where claims cost is underestimated.
- Profit margin conditional on winning business is worse than you think.
- Compensate by "bid shading" in auction theory.



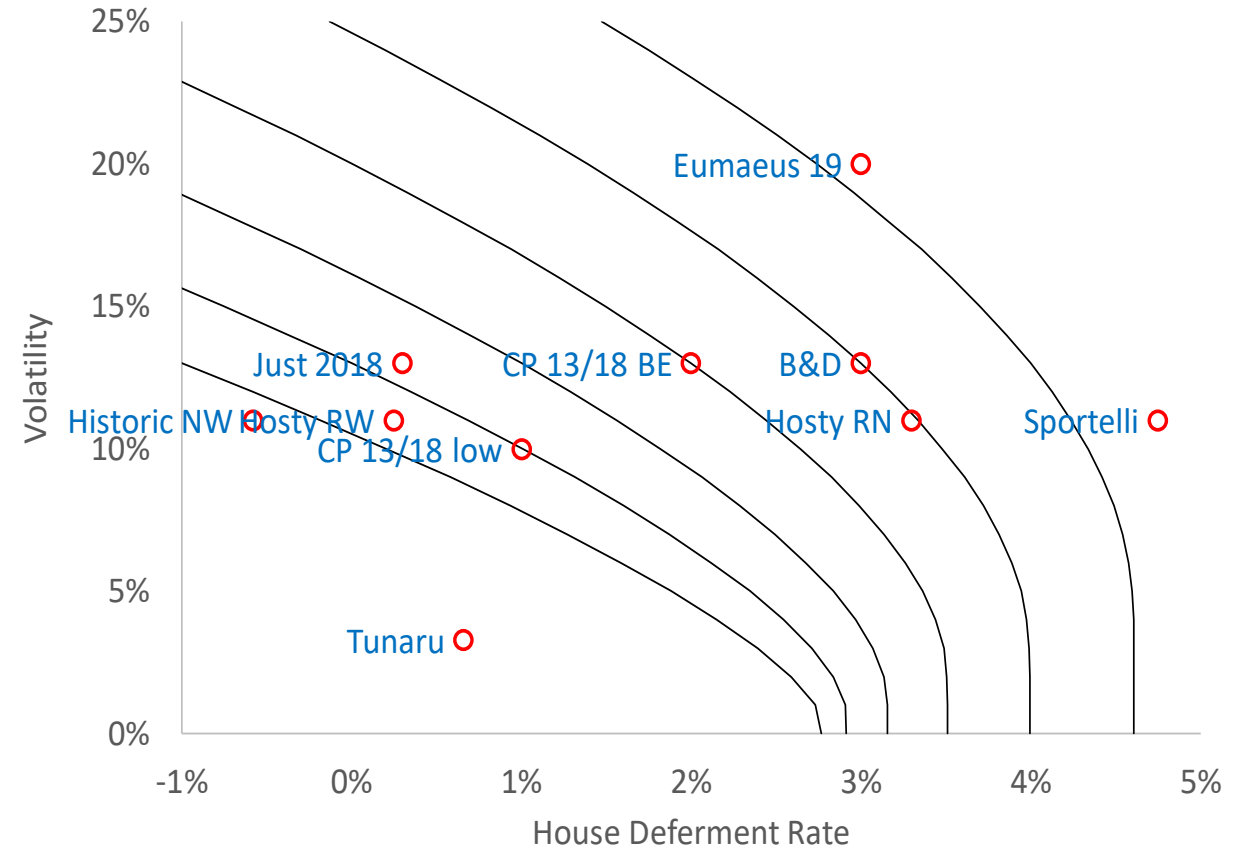
Real Options in New Medicine Development



Equity Release Mortgages and Illiquidity Premiums

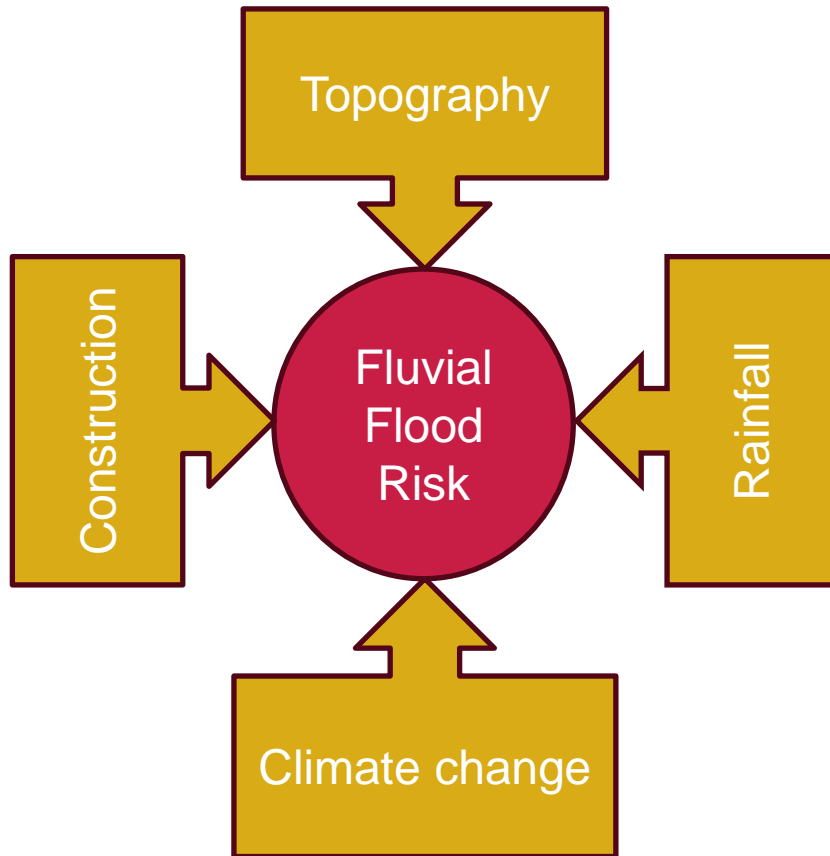


Source: The Value of Liquidity Sacrifice Options
Swiss Actuarial Association, August 2020.



Source: Equity Release Mortgages: Irish & UK Experience.
Jeffery & Smith, SoAI, 2019.

Fluvial Flood Risk Modelling



Actuarial Skills Required for Unusual Applications

	Long dis- counting	Probability	Econo- -mics	Big Data / Coding	Hard Maths	Collab- oration	Communi- -cation
Power stations	√	√				√	√
Credit transitions		√			√		√
Pollution / mortality				√		√	√
Ireland Fractal				√	√		√
Spread Betting		√	√				√
Insurance Game Theory		√	√		√		√
Medicine Development		√				√	√
Equity release mortgage	√	√	√		√		√
Flood models		√		√		√	√

Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



Institute
and Faculty
of Actuaries

Unconventional Actuary

Andrew Smith PhD, Hon FIA, Hon FSA, University College Dublin
ansmith@ucd.ie

IFoA India Conference 2024