UFM Escuela de Negocios

22 de marzo, 2018

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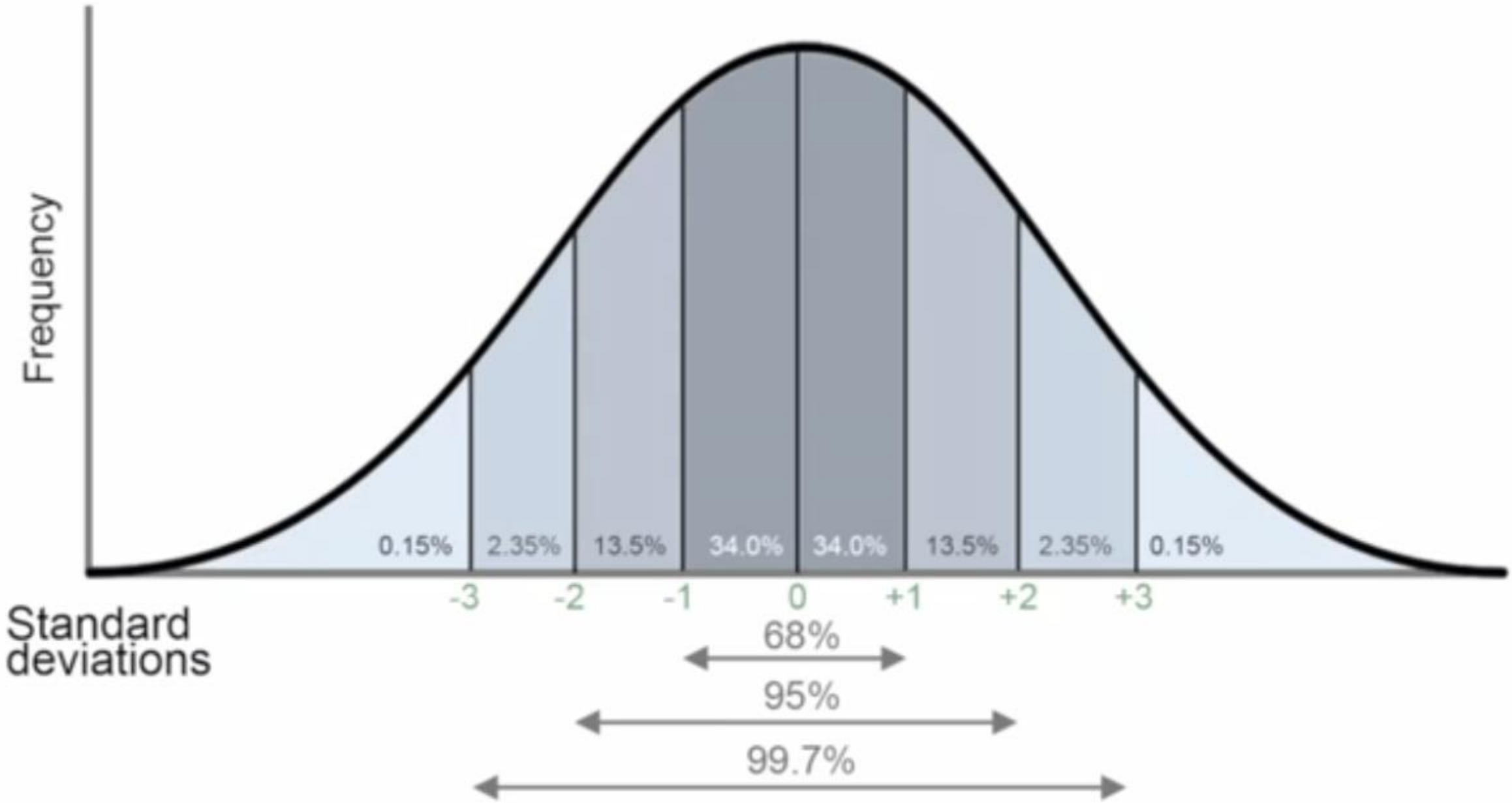

Frequency
0.15%
2.35%
13.5%
34.0%
34.0%
13.5%
2.35%
0.15%
-3
-2
-1
0
+1
+2
+3
Standard deviations
68%
95%
99.7%

Dos bancos:

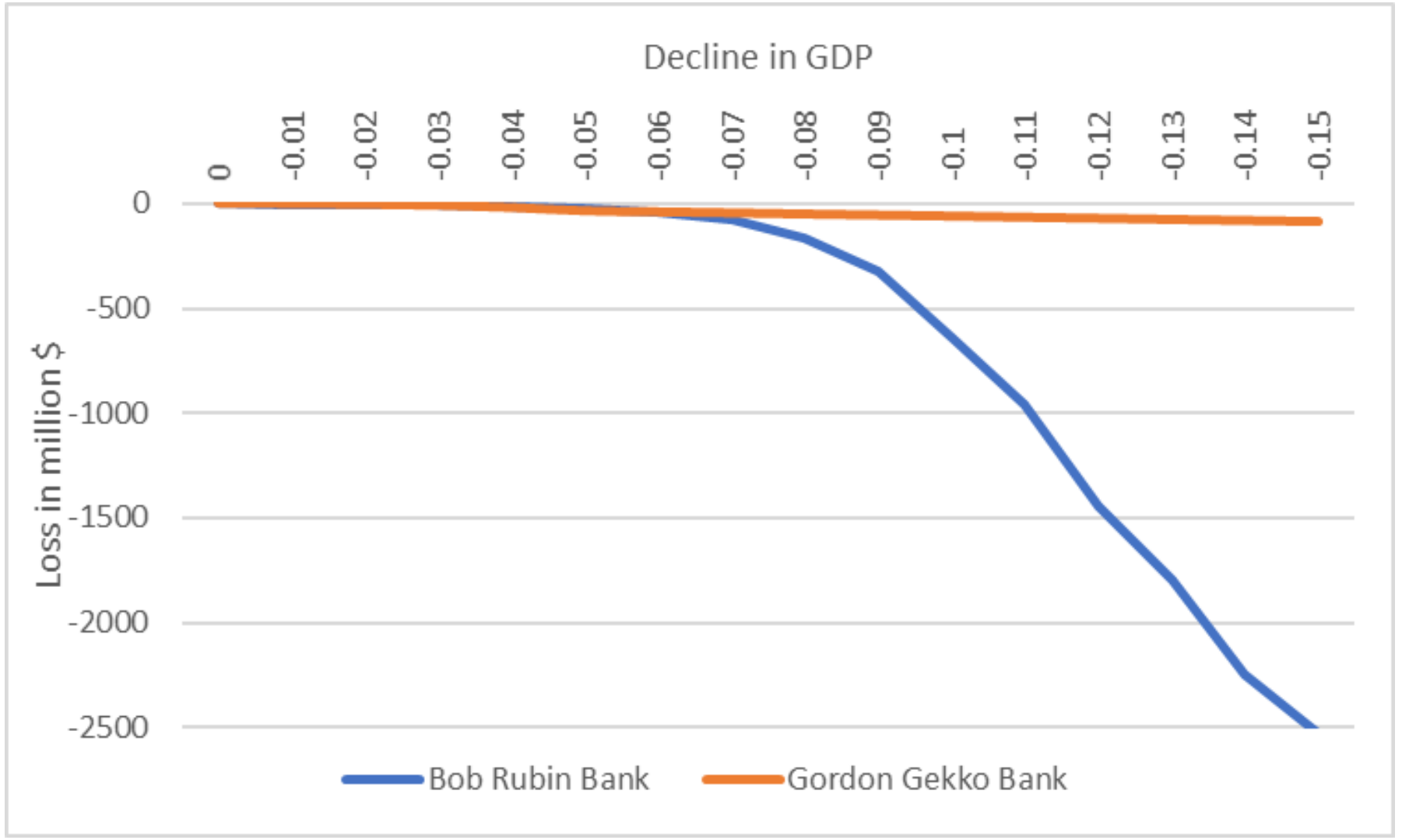
- The Bob Rubin Bank and the Gordon Gekko Bank

- Stress test:
  - Scenario: caída de 5% en el producto interno bruto (PIB) y unos otros variables
  - Bob Rubin Bank: $30 million in losses, 50% decline in (regulatory) capital
  - Gordon Gekko Bank: $35 million in losses, 60% decline in (regulatory) capital

- Which bank is better?

Respuesta:

We don´t know! (at least, not with just our “stress test” or “scenario”)



The Bob Rubin Bank has **FATTER TAILS**, that is, higher negative convexity to extreme events

Bob Rubin Bank is **MORE FRAGILE**

Negative convexity (concavity):

-5%:	Bob Rubin Bank:	-$20 million, -33.34% capital
	Gordon Gekko Bank:	-$35 million, -60% capital
-6%:	Bob Rubin Bank:	-$40 million, -66.67% capital
	Gordon Gekko Bank:	-$40 million, -68% capital
-7%:	Bob Rubin Bank:	-$80 million, **-133.33%** capital
	Gordon Gekko Bank:	-$45 million, -77% capital
-8%:	Bob Rubin Bank:	-$160 million, **-266.67%** capital
	Gordon Gekko Bank:	-$50 million, -85.8% capital
-9%:	Bob Rubin Bank:	-$320 million, **-533.33%** capital
	Gordon Gekko Bank:	-$55 million, -94% capital

Pregunta:

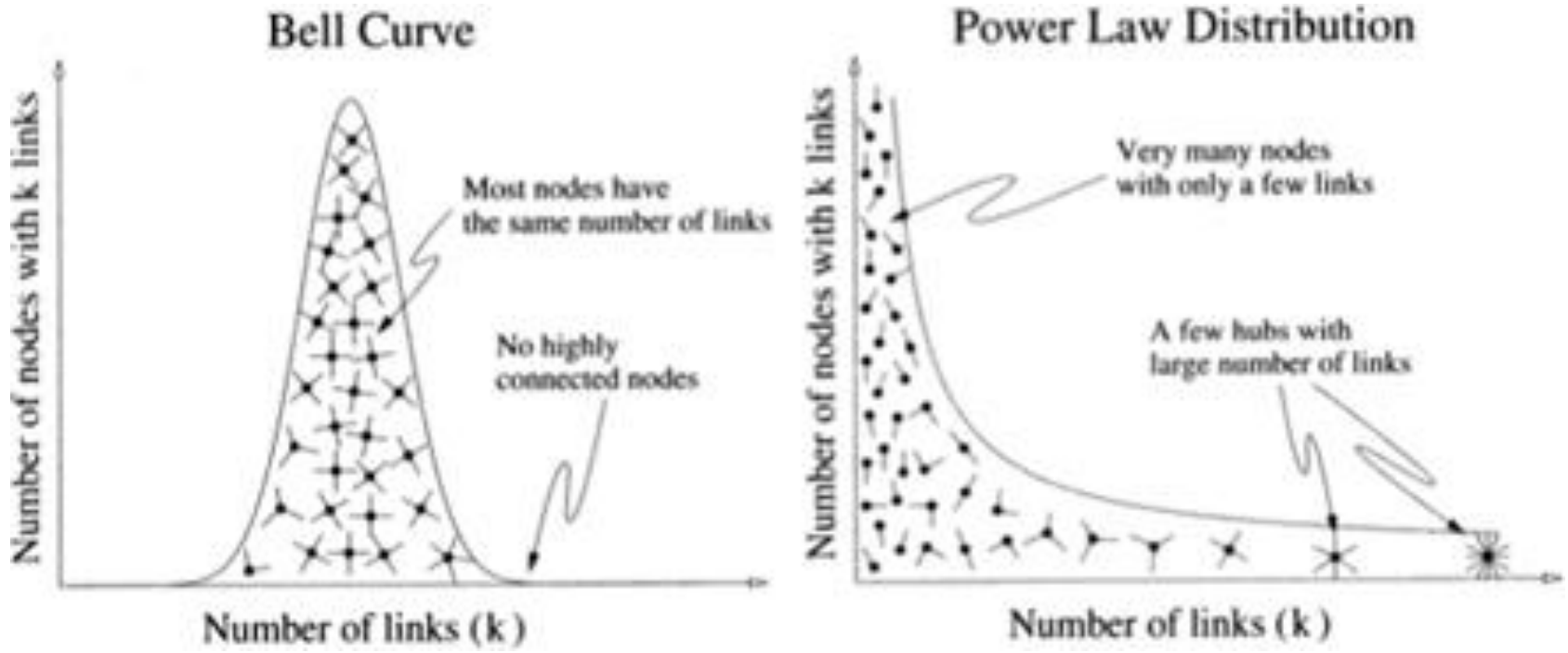
At 8%, which of the two banks went broke (**ruin**)?

Risk of ruin = the probability that one loses all of its capital (i.e., goes out of business) and the recovery of loss is not possible.

Dice throwing > risk of ruin? Forced to bet $10,000: probability 50/50

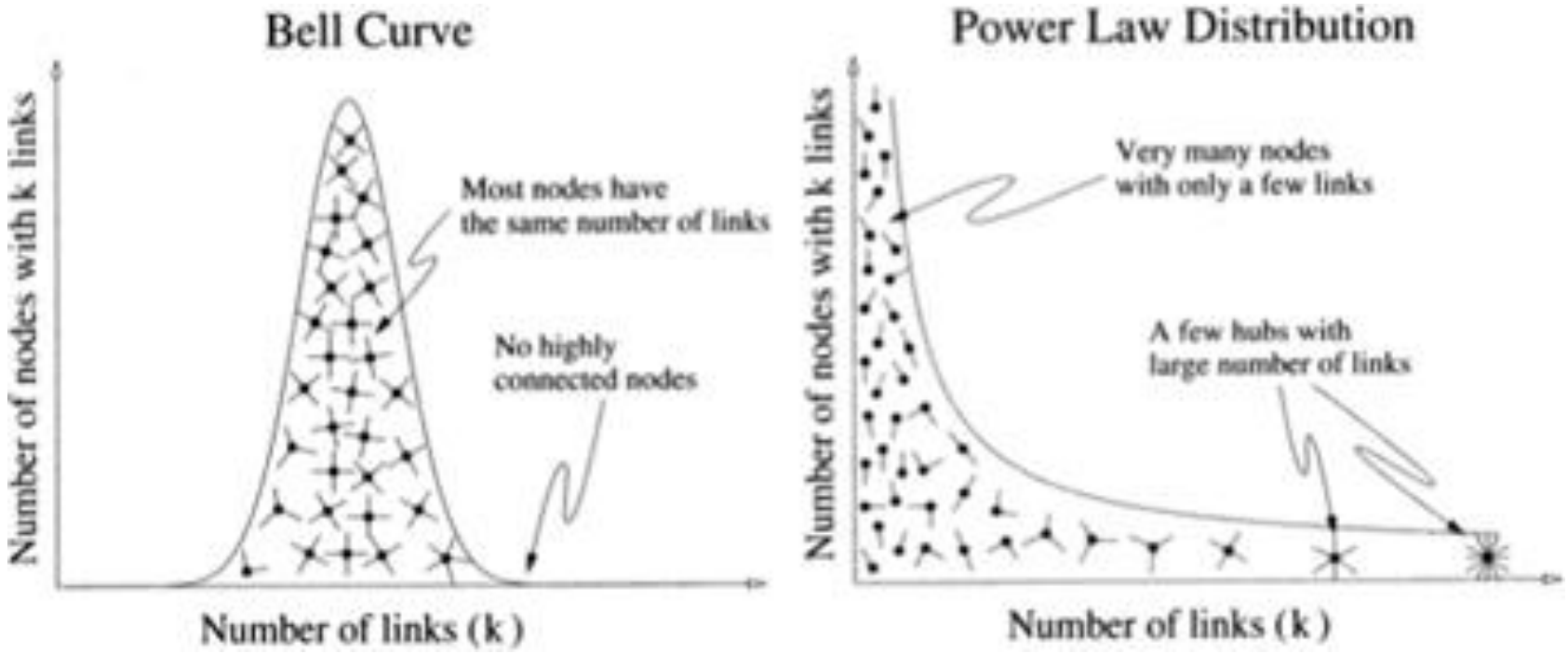
“Power laws” (Mandelbrot/Pareto)

How long is the coastline of Great-Britain?



“Power laws” (Mandelbrot/Pareto)

Median wealth US = $44,900



“Power laws” (Pareto)

Example: wealth of the super rich (power law applies to the tail)

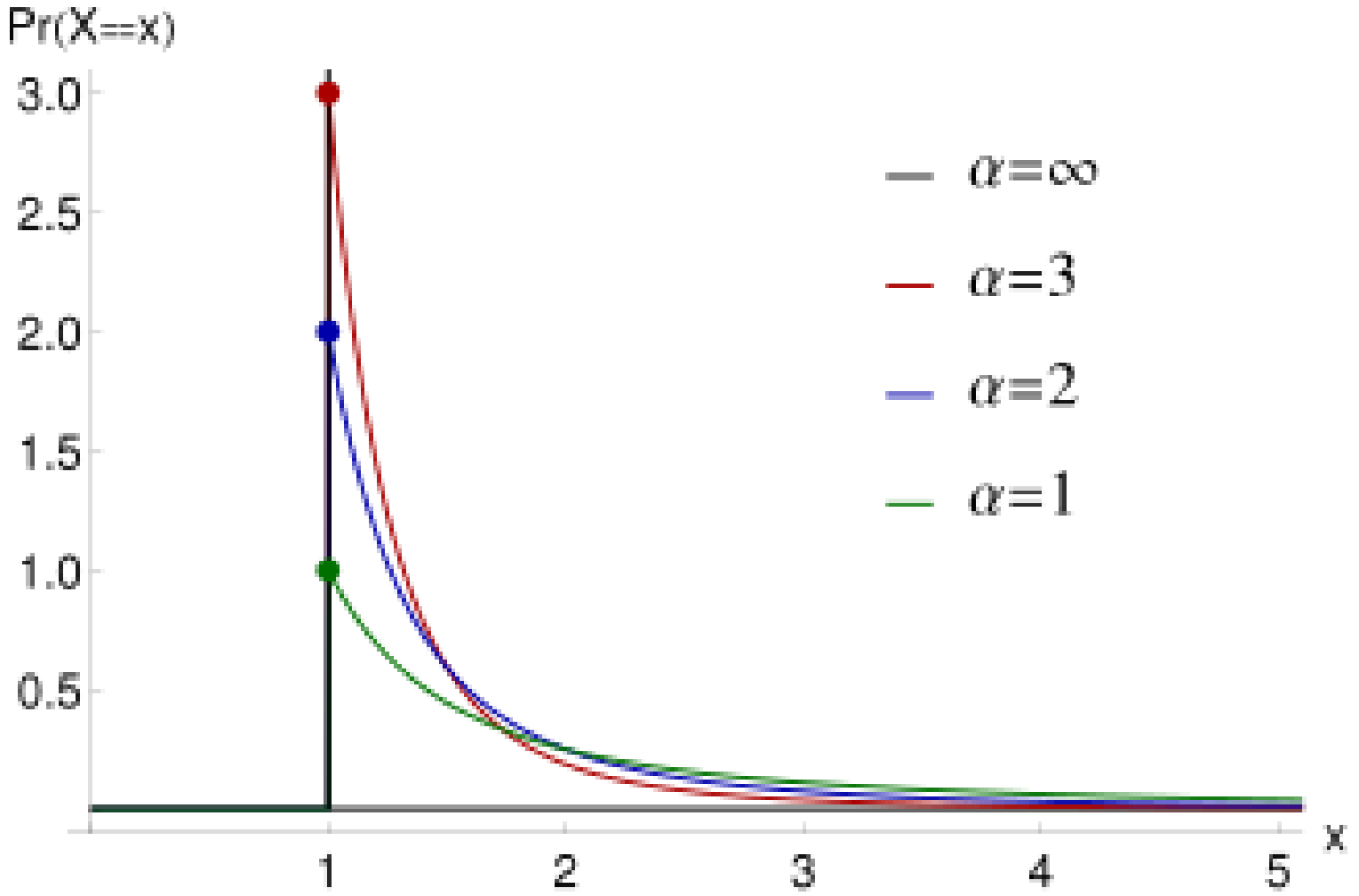
Power value = α (alpha)

The lower α, the fatter the tail

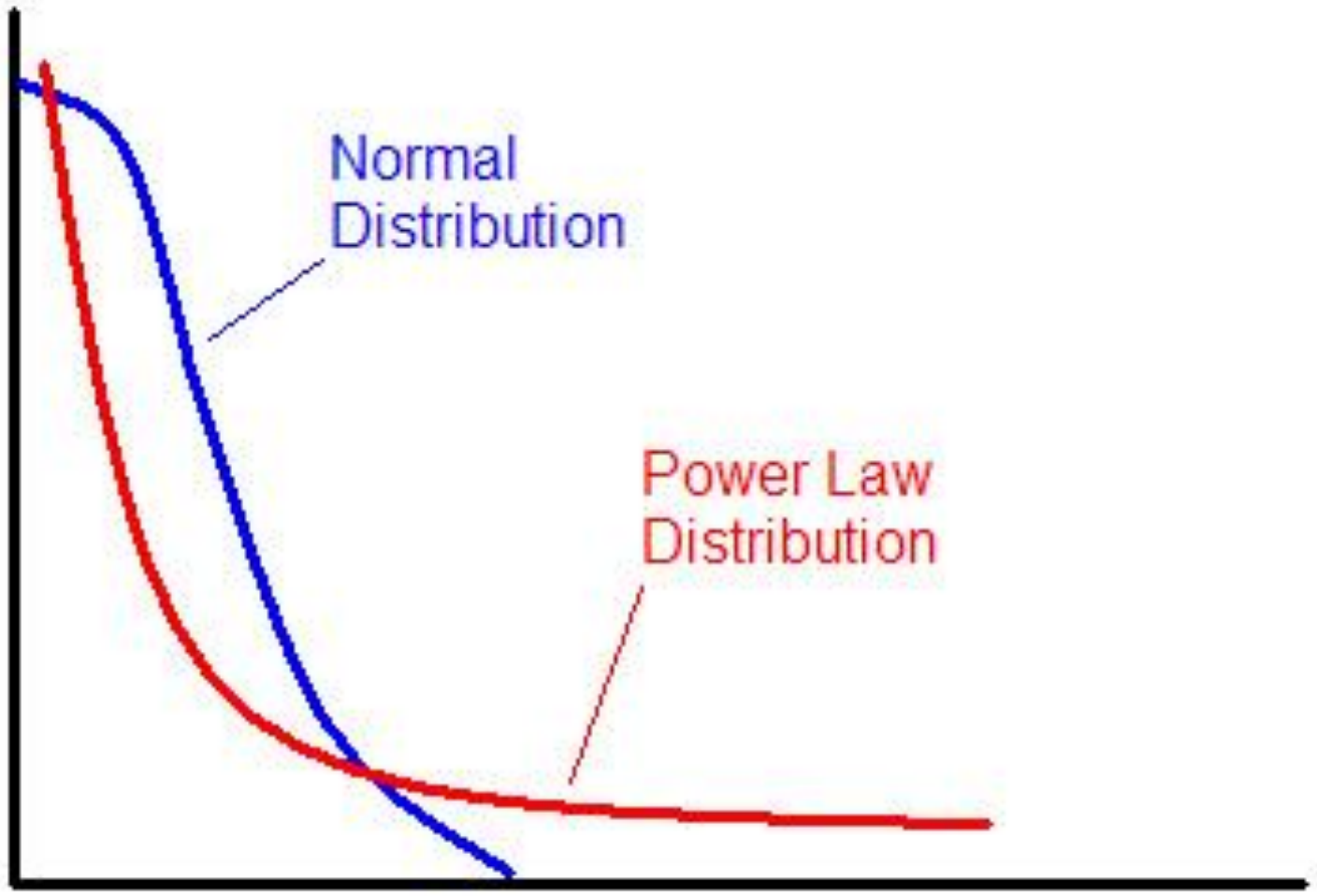
Richer than 1 million: 1 in 62.5
Richer than 2 million: 1 in 125
Richer than 4 million: 1 in 250
Richer than 8 million: 1 in 500
Richer than 16 million: 1 in 1,000
Richer than 32 million: 1 in ?

Alpha = 1

Tails & alpha (power laws)



Power law versus normal distribution



“Power laws” (Mandelbrot)

How long is the coastline of Great-Britain?

Answer: **infinite**

Coastline paradox

With 100 km unit:

2,800 km

With 50 km unit:

3,400 km

Otros fenomenos con “power law” o “fat tail” *distributions* y sus alphas

Intensity of wars	**1.80**
Solar flare intensity	1.83
Frequency of use of words	2.20^{5}
Population of U.S. cities	2.30
Magnitude of earthquakes	3.04
Protein interaction degree	3.1
Email address book size	3.5
Sales of books	3.7
Papers authored	**4.3**

Otros fenomenos con “power law” o “fat tail” *distributions* y sus alphas

Return multiples, fund size <$100m	1.68
Total Value to Paid In, Small Funds ($50m-$250m), 1981-2003	1.75
PSED Study, revenue growth yr 2 to 5	1.76
Total Value to Paid In, Large Funds (>$250m), 1981-2003	1.78
Kauffman Study, revenue growth yr 2 to 5	1.8
North American angel investment returns	1.8
Return multiples, fund size $250m-$500m	1.84
Return multiples, fund size $100m-$250m	1.85
Inc 500, revenue growth year 2 to 5	1.86
Derived from Correlation Ventures data	1.88
Return multiples, fund size > $1b	1.89
All VC-backed startups, per Horsley-Keogh	1.9
All VC-backed startups, per Venture Economics	1.97
British angel investment returns	1.97
Unicorn valuations	2.13
Return multiples, fund size $500m-$1b	2.27

Otros fenomenos con “power law” o “fat tail” *distributions* y sus alphas

Value of patents	1.3
U.S. Patents	1.43
Value of patents	1.45-1.67
Harvard Patents	1.71
German Patents	1.87
Size of all U.S. Firms	2.06
Corporate R&D (simulation from sparse data)	2.21
Pharmaceutical development-1970s	2.22
Size of Largest 500 US Firms	2.25
Pharmaceutical development-1980s	2.36
Movies with stars	2.72
Movie income	2.91
Movies without stars	3.26

Rule of thumb en economía

Cuando no sabes si un fenómeno es “fat tailed” o no, asume que sí!

Cuando existen “power laws” (fat tails), los modelos de riesgo convencionales fallan

- Estos modelos típicos están basados en “distribuciones normales de probabilidad”. Problemas:
  - Subestiman la frecuencia de los “extremos”
    - Ejemplos:
      - Black-Scholes option formula (algunas opciones están más baratas de lo que deberían)
      - La crisis y crash del 2008 y la Gran Depresión no eran “outliers” estadisticas
  - “Fat tail” distribuciones no tienen “standard deviation” (o variance = infinite) con **alpha < 3** y no tienen media con **alpha < 2**
  - La media es mucho mas inestable y no se estabiliza fácilmente agregando nuevas observaciones
    - Ejemplos:
      - Muestra de alturas (que tanto puede llegar a afectar una nueva observación la media)
      - Muestra de riqueza en Omaha

Peor año para Guatemala:

- PIB 1982: -3.5%
- PIB 1983: -2.5%

- Para qué nos preparamos?

- **Comentario**: volatilidad tiende a concentrarse en periodos cortos

Sharpe Ratio

- **Sharpe** = Average (excess) return / standard deviation (portfolio or asset)

  Equals: “Return (above market)” / “Risk”

Beta: standard deviation of investment versus index (2.4x: means fund will move 2.4 times more than index)

Variance: square of mean absolute deviation (eliminate signs +-)

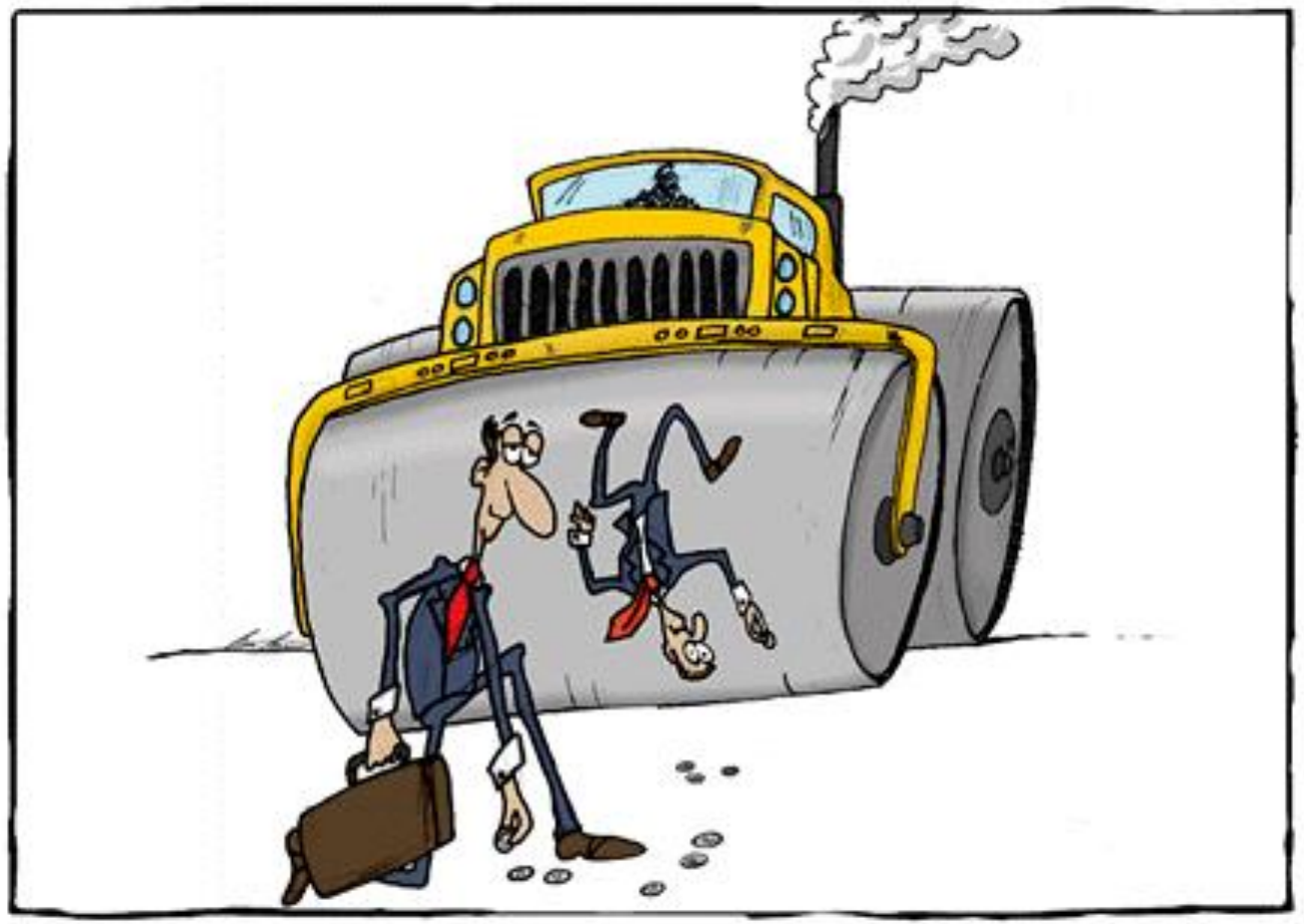
Standard deviation: square root of variance

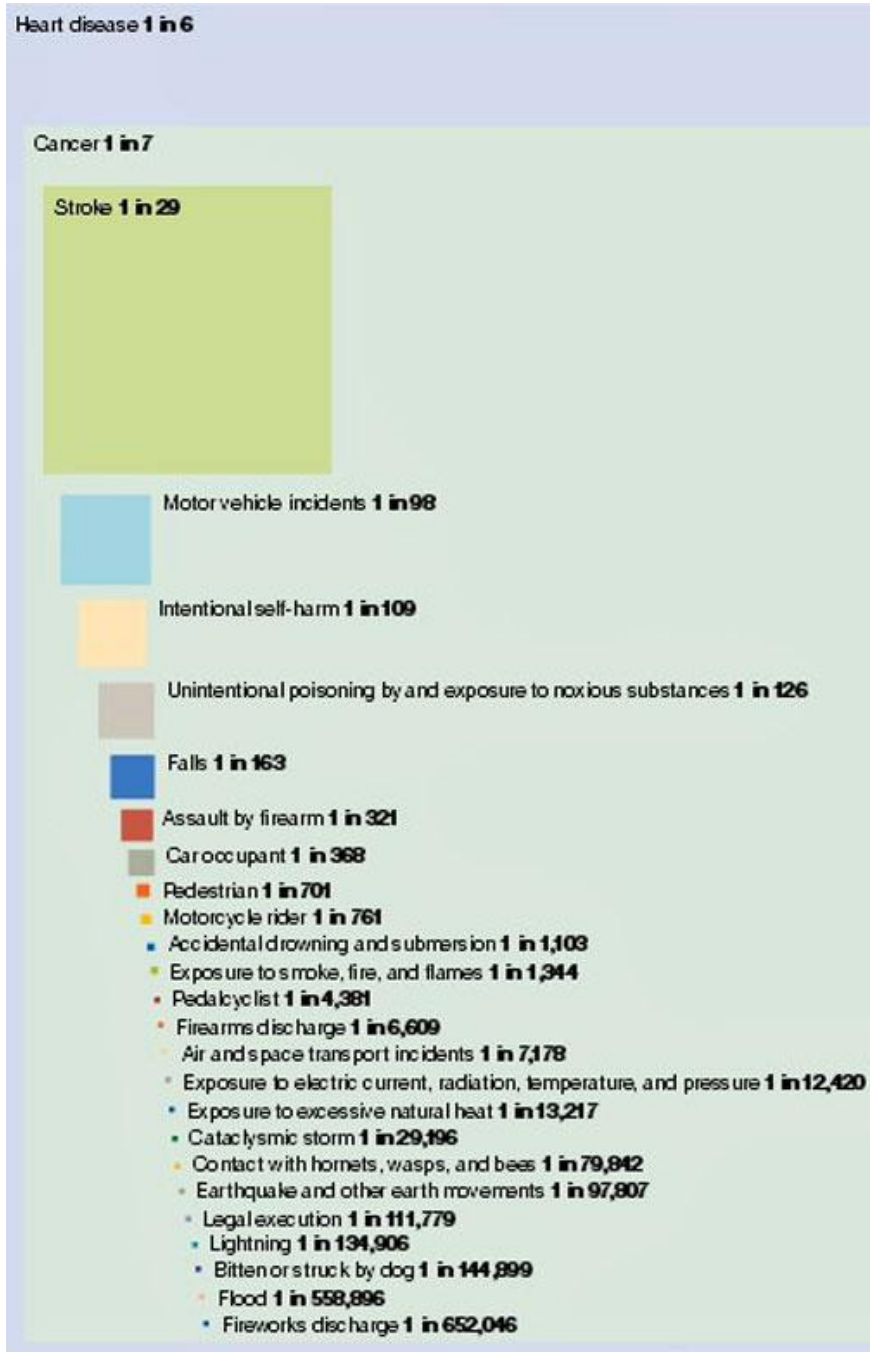
Fat tails? Mean absolute deviation is LOWER than standard deviation, *especially* under fat tails. This means that 4, 5, 6 sigma events (4x SD) are much more common than practitioners think.

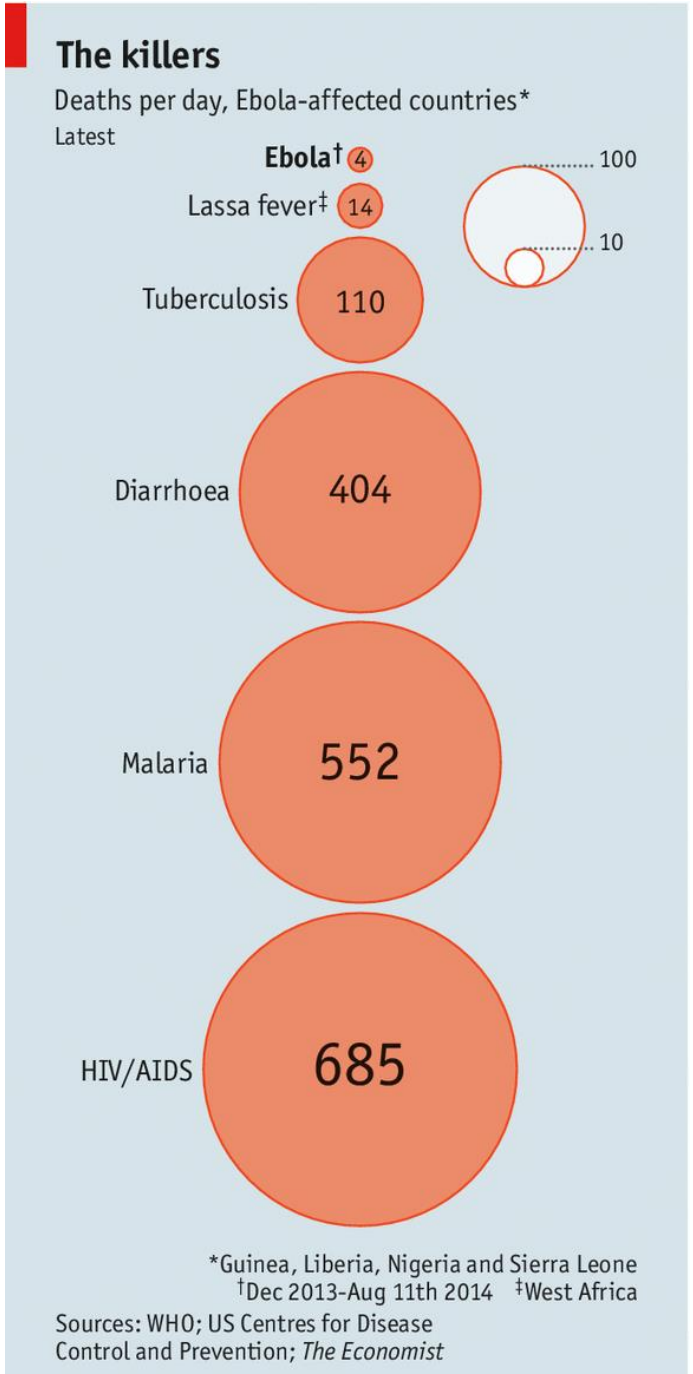
Ejercicio

1. Piensa en tres fenómenos que demuestra la misma tendencia que los ejemplos mostrados (“power laws”)
2. Determina si eres “convex” (**antifragile**) o “concave / negatively convex” (**fragile**) al fenómeno: a qué lado de la mesa estás?
3. Si eres “concave” (la volatilidad te afecta **mucho** peor que mejor), determina una o varias estrategias para reducir el downside al fenómeno identificado

“Picking pennies…?” Beneficios no compensan riesgo




Heart disease 1 in 6
Cancer 1 in 7
Stroke 1 in 29
Motor vehicle incidents 1 in 98
Intentional self-harm 1 in 109
Unintentional poisoning by and exposure to noxious substances 1 in 126
Falls 1 in 163
Assault by firearm 1 in 321
Car occupant 1 in 368
Pedestrian 1 in 701
Motorcycle rider 1 in 761
Accidental drowning and submersion 1 in 1,103
Exposure to smoke, fire, and flames 1 in 1,344
Pedalcyclist 1 in 4,381
Firearms discharge 1 in 6,609
Air and space transport incidents 1 in 7,178
Exposure to electric current, radiation, temperature, and pressure 1 in 12,420
Exposure to excessive natural heat 1 in 13,217
Cataclysmic storm 1 in 29,196
Contact with hornets, wasps, and bees 1 in 79,842
Earthquake and other earth movements 1 in 97,807
Legal execution 1 in 111,779
Lightning 1 in 134,906
Bitten or struck by dog 1 in 144,899
Flood 1 in 558,896
Fireworks discharge 1 in 652,046


The killers
Deaths per day, Ebola-affected countries*
Latest
Ebola† 4
Lassa fever‡ 14
Tuberculosis 110
Diarrhoea 404
Malaria 552
HIV/AIDS 685
100
10
*Guinea, Liberia, Nigeria and Sierra Leone
†Dec 2013-Aug 11th 2014 ‡West Africa
Sources: WHO; US Centres for Disease Control and Prevention; The Economist

No es **riesgo**, es **riesgo + payoff**

NEW YORK TIMES BESTSELLING AUTHOR OF

THE BLACK SWAN

SKIN IN THE GAME

Hidden Asymmetries in Daily Life

NASSIM NICHOLAS TALEB

COMPARATIVE LIFE EXPECTANCY	*DOMAIN*	*PROBABILITY DISTRIBUTION*
The young is expected to live longer than the old.	Perishable: life of humans and other animals	Gaussian (or close, from same type of family)
Both the young and the old have equivalent life expectancy.	Non-perishable informational: lifetime of species	Exponential
LINDY EFFECT. The old is expected to stay longer than the young in proportion to their age.	Non-perishable informational: life of intellectual production, lifetime of genera	Power law

	Evidentiary Risk Management	Analytical Risk Management	
	Statistical/Actuarial Based	Model Based	**Fragility Based**
	Relies on past	Relies on theoretical model (with statistical backup/backtesting)	**Relies on present attributes of object**
Probabilistic?	Probabilistic	Probabilistic	Nonprobabilistic
Typical Methods	Times series statistics, etc.	Use of estimated probability distribution	Detection of nonlinearity through heuristics
Expression	Variance Value at Risk	Variance, Value at Risk Tail exposure (Shortfall)	Fragility Indicator
Characteristic	Dependence on both past sample and parameters	Dependence on parameters	Dependence on detection of second order effects
Performance	Erratic, Unreliable for tails	Erratic, Unreliable for tails	Robust