

# The Prism of Uncertainty and Big Data

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In-Depth Seminars – D23

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**CRISC**

**CGEIT**

**CISM**

**CISA**

2013 Fall Conference – “Sail to Success”

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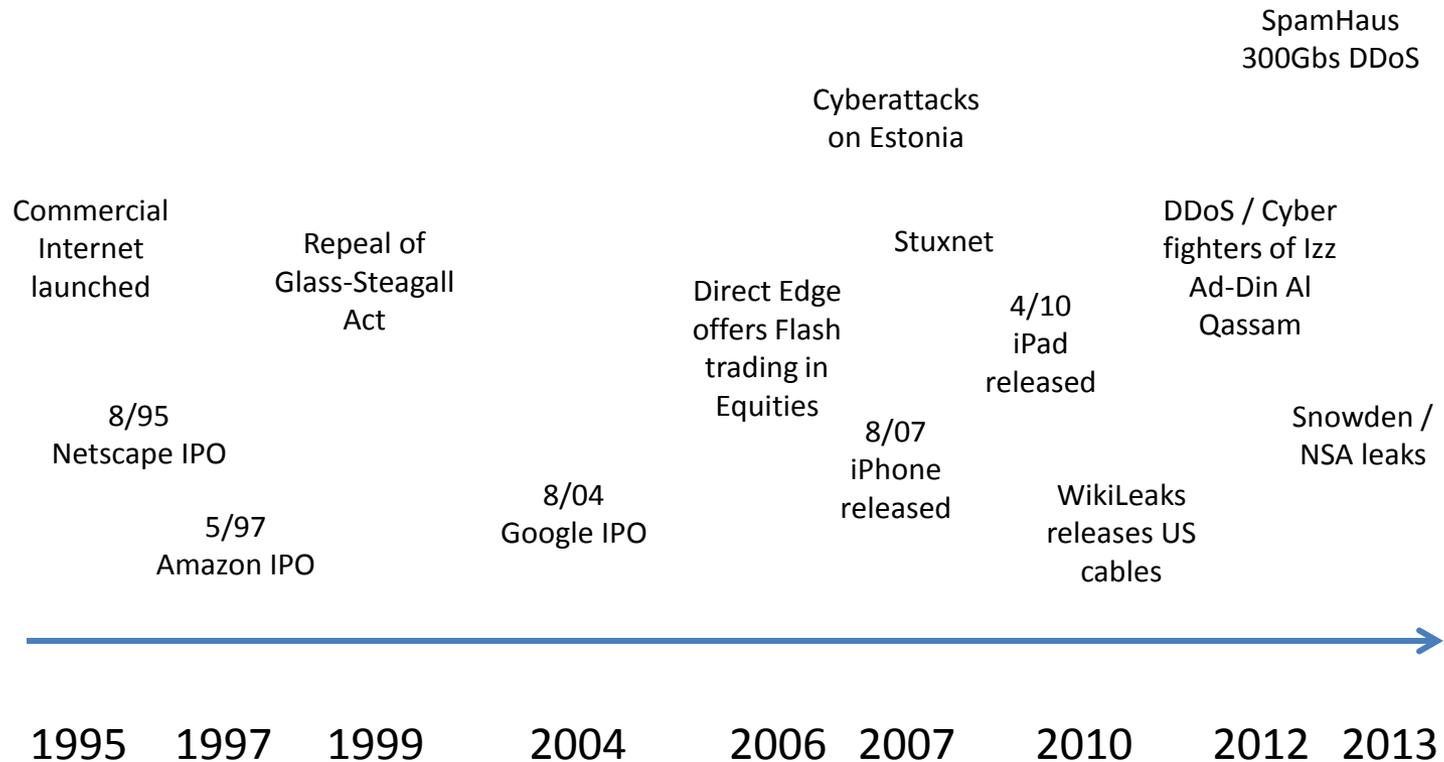
# A 7<sup>th</sup> Inning Stretch...



# I thought Yogi Berra said it...

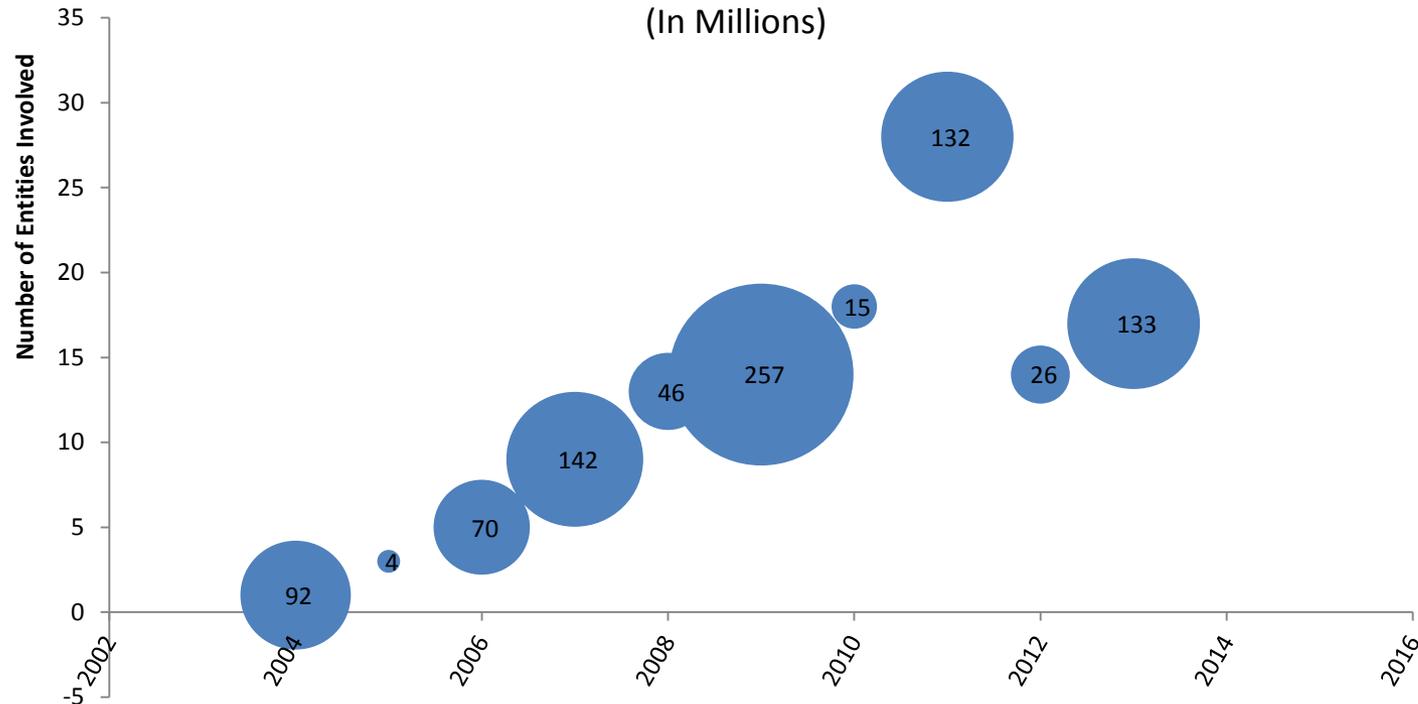


# A new normal



# World's Biggest Data Breaches\*

**Total Number of Records Lost due to Data Breach**  
(In Millions)



**Rise in data breaches drives interest in cyber insurance (Computerworld, August 16, 2013)\*\***

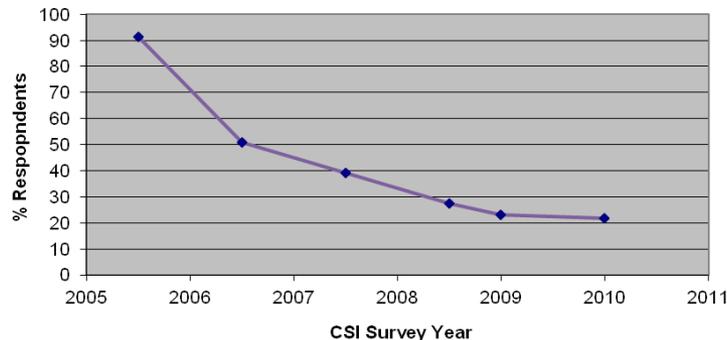
Researchers found that the average cost of the security incidents affecting the companies participating in the study to be \$9.3 million. When asked to predict what the average cost would be to them in the future, respondents estimated \$163 million.

\*Source: <http://www.informationisbeautiful.net/visualizations/worlds-biggest-data-breaches-hacks/>

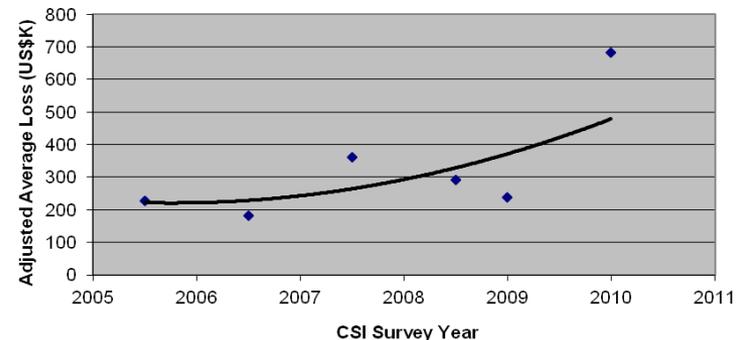
\*\*Source: <http://www.computerworld.com.sg/tech/security/rise-in-data-breaches-drives-interest-in-cyber-insurance/>

# The “Inverse CSI Effect”

The up-front and on-going investment costs required to implement and maintain the advanced methodologies and techniques associated with the concealment, stealth and obfuscation strategies will necessitate a proportionate increase in the expected returns, in order to maintain a stable cost-benefit ratio for the cyber-criminals’ enterprise.



Incidence



Impact

See, [http://www.dcs.kcl.ac.uk/staff/richard/CyFor\\_2012\\_LNCS.pdf](http://www.dcs.kcl.ac.uk/staff/richard/CyFor_2012_LNCS.pdf)

# A new vocabulary

- Self-organized criticality
- Speed of error propagation
- Asymmetric errors
- Nonlinear impacts
- Discontinuous failure
- Spill over effects / contagion

# A new concept

“Mathematically chaos is associated with a nonlinear relationship between inputs and outputs. Software is worse than chaotic; the output is not just nonlinear, it can actually be a discontinuous function because it is built on logic gates.”

# Observed: Catastrophic failure?



**Knight Capital 'has 48 hours' to save itself after IT glitch causes \$440m loss**

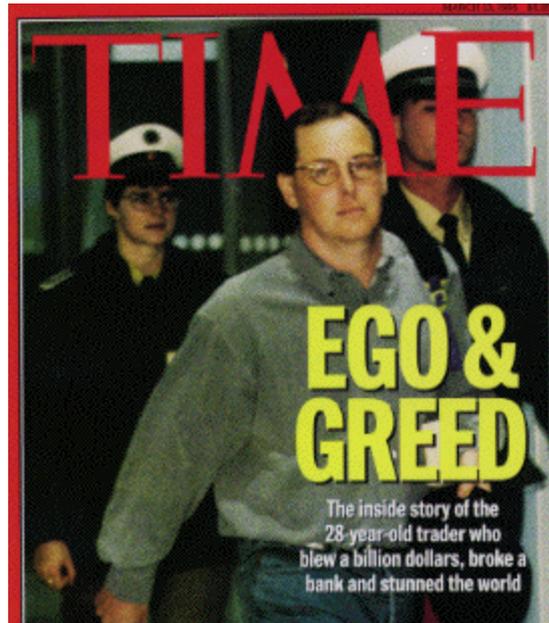


**The tech problems at the RBS banking group that left millions of people unable to access money for four days last week were caused by a failure in a piece of batch scheduling software**



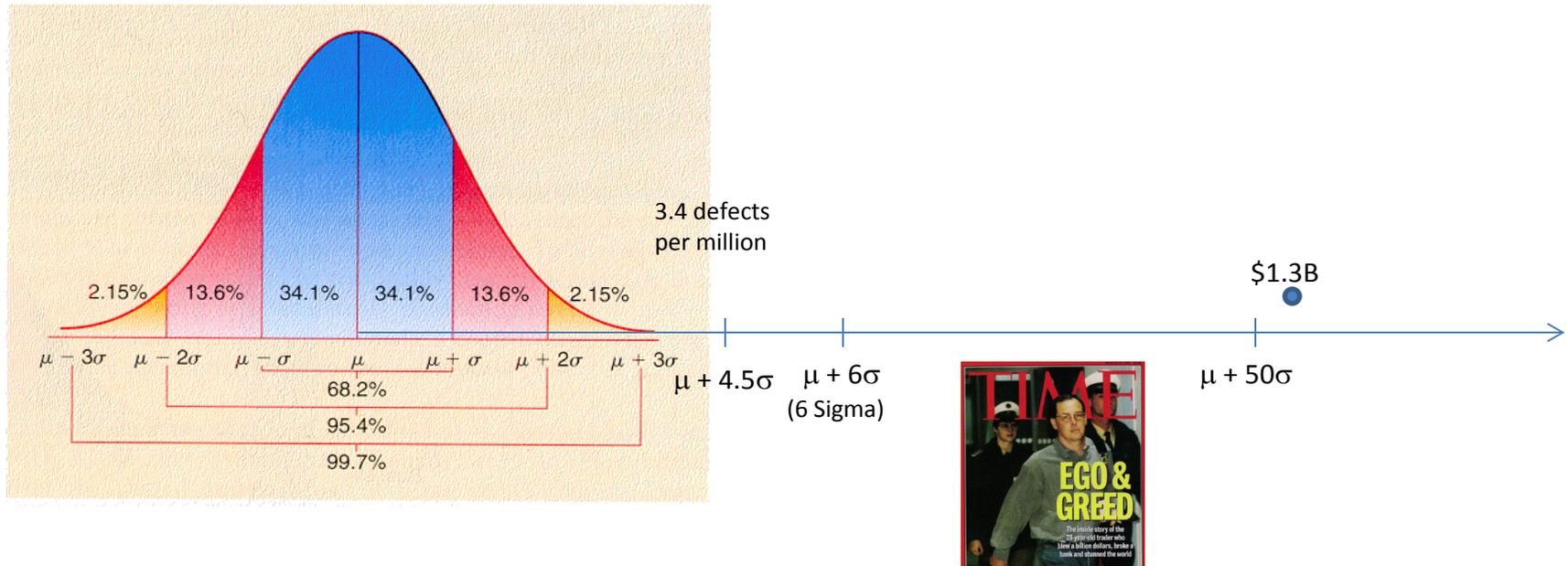
**Why the Facebook IPO failed**

# A watershed event that focused an industry



Nick Leeson lost \$1.3bn betting on risky trades in 1995, causing Barings Bank to collapse after 233 years in business. Its clients included Queen Elizabeth.

# Needed: a new way to understand a new risk?



# Basel II & the 56-Box Model

## Mapping of Business Lines

Level 1	Level 2	Activity Groups
Corporate Finance	Corporate Finance	Mergers and acquisitions, underwriting, privatisations, securitisation, research, debt (government, high yield), equi syndications, IPO, secondary private placements
	Municipal/Government Finance	
	Merchant Banking	
	Advisory Services	
Trading & Sales	Sales	Fixed income, equity, foreign exchanges, commodities, crf funding, own position securities, lending and repos, broker debt, prime brokerage
	Market Making	
	Proprietary Positions	
	Treasury	
Retail Banking	Retail Banking	Retail lending and deposits, banking services, trust and es
	Private Banking	Private lending and deposits, banking services, trust and estates, investment advice
	Card Services	Merchant/commercial/corporate cards, private labels and retail
Commercial Banking	Commercial Banking	Project finance, real estate, export finance, trade finance, factoring, leasing, lending, guarantees, bills of exchange
Payment and Settlement <sup>1</sup>	External Clients	Payments and collections, funds transfer, clearing and settlement
Agency Services	Custody	Escrow, depository receipts, securities lending (customers) corporate actions
	Corporate Agency	Issuer and paying agents
	Corporate Trust	
Asset Management	Discretionary Fund Management	Pooled, segregated, retail, institutional, closed, open, private equity
	Non-Discretionary Fund Management	Pooled, segregated, retail, institutional, closed, open
Retail Brokerage	Retail Brokerage	Execution and full service

## Detailed Loss Event Type Classification

Event-Type Category (Level 1)	Definition	Categories (Level 2)	Activity Examples (Level 3)
Internal fraud	Losses due to acts of a type intended to defraud, misappropriate property or circumvent regulations, the law or company policy, excluding diversity/ discrimination events, which involves at least one internal party	Unauthorised Activity	Transactions not reported (intentional) Transaction type unauthorised (w/monetary loss) Mismarking of position (intentional)
		Theft and Fraud	Fraud / credit fraud / worthless deposits Theft / extortion / embezzlement / robbery Misappropriation of assets Malicious destruction of assets Forgery Check kiting Smuggling Account take-over / impersonation / etc. Tax non-compliance / evasion (willful) Bribes / kickbacks Insider trading (not on firm's account)
External fraud	Losses due to acts of a type intended to defraud, misappropriate property or circumvent the law, by a third party	Theft and Fraud	Theft/Robbery Forgery Check kiting
		Systems Security	Hacking damage Theft of information (w/monetary loss)
Employment Practices and Workplace Safety	Losses arising from acts inconsistent with employment, health or safety laws or agreements, from payment of personal injury claims, or from diversity / discrimination events	Employee Relations	Compensation, benefit, termination issues Organised labour activity
		Safe Environment	General liability (slip and fall, etc.) Employee health & safety rules events Workers compensation
		Diversity & Discrimination	All discrimination types
Clients, Products & Business Practices	Losses arising from an unintentional or negligent failure to meet a professional obligation to specific clients (including fiduciary and suitability requirements), or from the nature or design of a product.	Suitability, Disclosure & Fiduciary	Fiduciary breaches / guideline violations Suitability / disclosure issues (KYC, etc.) Retail customer disclosure violations Breach of privacy Aggressive sales Account churning Misuse of confidential information Lender liability
Improper Business or Market Practices			Anti-trust Improper trade / market practices Market manipulation Insider trading (on firm's account) Unlicensed activity Money laundering
		Product Flaws	Product defects (unauthorised, etc.) Model errors
		Selection, Sponsorship & Exposure	Failure to investigate client per guidelines Exceeding client exposure limits
		Advisory Activities	Disputes over performance of advisory activities
Disasters and other events			Natural disaster losses Human losses from external sources (terrorism, vandalism)
Business disruption and system failures	Losses arising from disruption of business or system failures	Systems	Hardware Software Telecommunications Utility outage / disruptions
Execution, Delivery & Process Management	Losses from failed transaction processing or process management, from relations with trade counterparties and vendors	Transaction Capture, Execution & Maintenance	Miscommunication Data entry, maintenance or loading error Missed deadline or responsibility Model / system misoperation Accounting error / entity attribution error Other task misperformance Delivery failure Collateral management failure Reference Data Maintenance
		Monitoring and Reporting	Failed mandatory reporting obligation Inaccurate external report (loss incurred)
Customer Intake and Documentation			Client permissions / disclaimers missing Legal documents missing / incomplete
		Customer / Client Account Management	Unapproved access given to accounts Incorrect client records (loss incurred) Negligent loss or damage of client assets
Trade Counterparties			Non-client counterparty misperformance Misc. non-client counterparty disputes
Vendors & Suppliers			Outsourcing Vendor disputes

# Big Data & Banking

## The Operational Riskdata eXchange Association (ORX)

- Founded in 2002 with the primary objective of creating a platform for the secure and anonymised exchange of high-quality operational risk loss data.
- Today ORX operates the world's leading operational risk loss data consortium for the financial services industry
- An association of 64 leading banks from 19 countries
- The largest banks in the world are members, including:
  - ABN AMRO {Netherlands}
  - American Express Company {USA}
  - Bank of America {USA}
  - Barclays Bank {UK}
  - BBVA {Spain}
  - BNP Paribas {France}
  - BNY Mellon {USA}
  - Credit Suisse {UK}
  - DBS Bank Ltd {Singapore}
  - Deutsche Bank AG {Germany}
  - Grupo Santander {Spain}
  - HSBC Holdings plc {UK}
  - ING Group {Netherlands}
  - Intesa SanPaolo {Italy}
  - Itau Unibanco S.A. {Brazil}
  - JPMorgan Chase & Co. {USA}
  - Morgan Stanley {USA}
  - Nordea Bank AB {Sweden}
  - PNC Bank {USA}
  - Rabobank Nederland {Netherlands}
  - Royal Bank of Scotland Group {UK}
  - Société Générale {France}
  - Standard Bank Group {South Africa}
  - Standard Chartered Bank {Singapore}
  - Wells Fargo & Co {USA}

# A database of 300K losses totaling €152bn

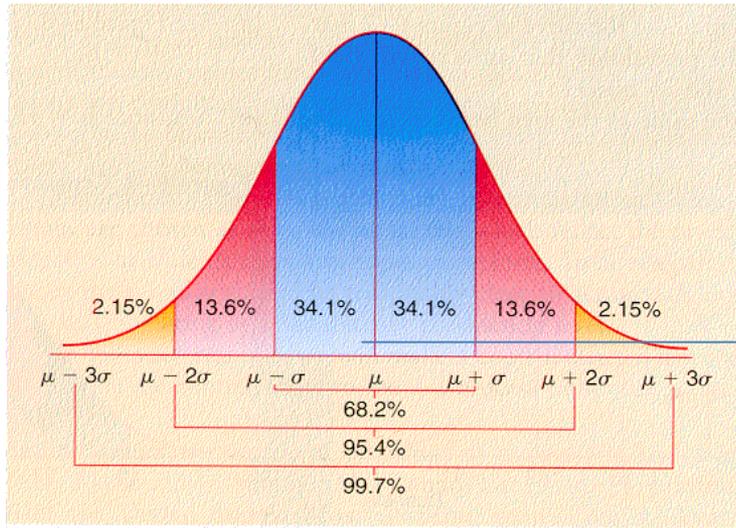
## 2007 Illustrative: Total Gross Loss by Event Type by Business Line\*

	Internal Fraud	External Fraud	Employment Practices	Clients, Products & Business Practices	Disasters & Public Safety	Technology & Infrastructure	Execution Delivery & Process Management	Malicious Damage	Total % by Business Line
Corporate Finance	0.08%	0.42%	0.18%	24.79%	0.00%	0.00%	1.24%	0.00%	26.71%
Trading & Sales	1.34%	0.69%	0.30%	4.74%	0.00%	0.28%	7.00%	0.00%	14.35%
Retail Banking	1.97%	7.13%	2.12%	8.51%	0.33%	0.61%	7.46%	0.02%	28.17%
Commercial Banking	1.04%	2.10%	0.28%	3.35%	0.01%	0.09%	5.08%	0.00%	11.97%
Clearing	0.11%	0.26%	0.03%	0.31%	0.00%	0.08%	0.63%	0.00%	1.42%
Agency Services	0.02%	0.03%	0.04%	2.03%	0.00%	0.02%	0.69%	0.00%	2.84%
Asset Management	0.06%	0.05%	0.17%	3.11%	0.00%	0.02%	0.89%	0.00%	4.30%
Retail Brokerage	0.14%	0.09%	0.26%	1.57%	0.01%	0.01%	0.30%	0.00%	2.38%
Private Banking	0.55%	0.20%	0.11%	2.44%	0.00%	0.01%	0.65%	0.00%	3.96%
Corporate Items	0.10%	0.07%	0.33%	1.28%	1.12%	0.03%	0.97%	0.01%	3.90%
<b>Total % by Event Type</b>	5.42%	11.04%	3.84%	52.14%	1.48%	1.15%	24.90%	0.03%	100.00%

Key > 1% - 5% 5% - 10% >10%

\*To request current, see <http://www.orx.org/request.report.php>

# Question: Does Big Data enable us to manage to an average outcome?



**Can UBS Bounce Back from the Rogue-Trader Scandal?**  
 September 2011: UBS announced it lost over \$2bn as a result of unauthorized trading by Kweku Adoboli, a director of the bank's Global Synthetic Equities Trading team in London



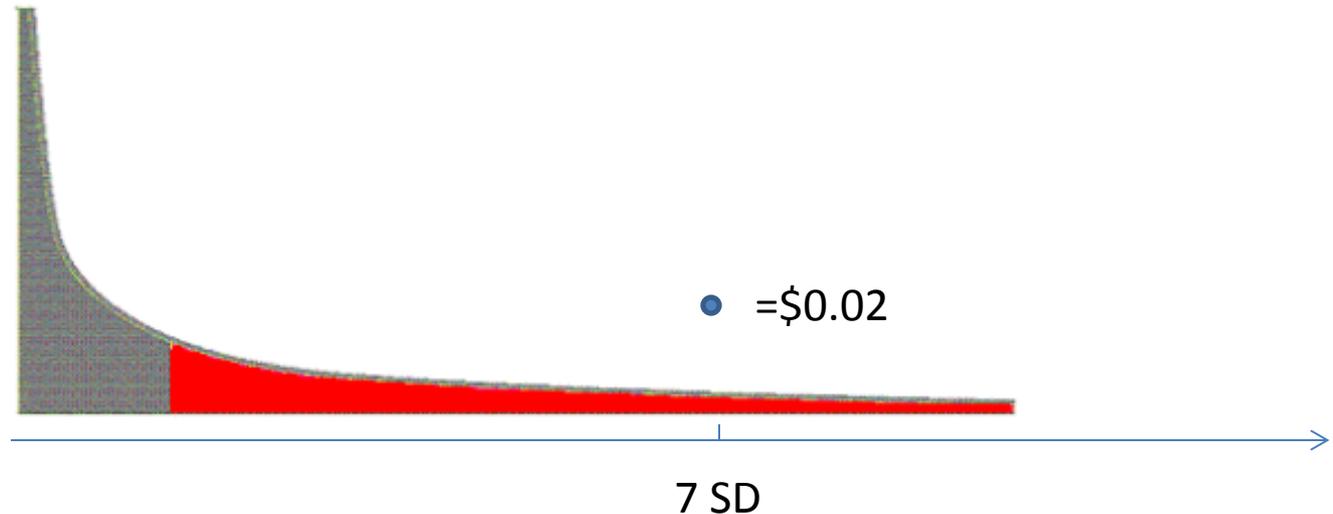
**Societe Generale rogue trader Kerviel loses appeal**  
 The ex-trader lost the bank almost \$6.5bn in 2008 and was convicted in 2010



**Ex-JPMorgan employees charged in \$6B loss**  
 Two former traders Wednesday hit with criminal charges in the \$6.2 billion "London whale" investigation of derivatives losses.



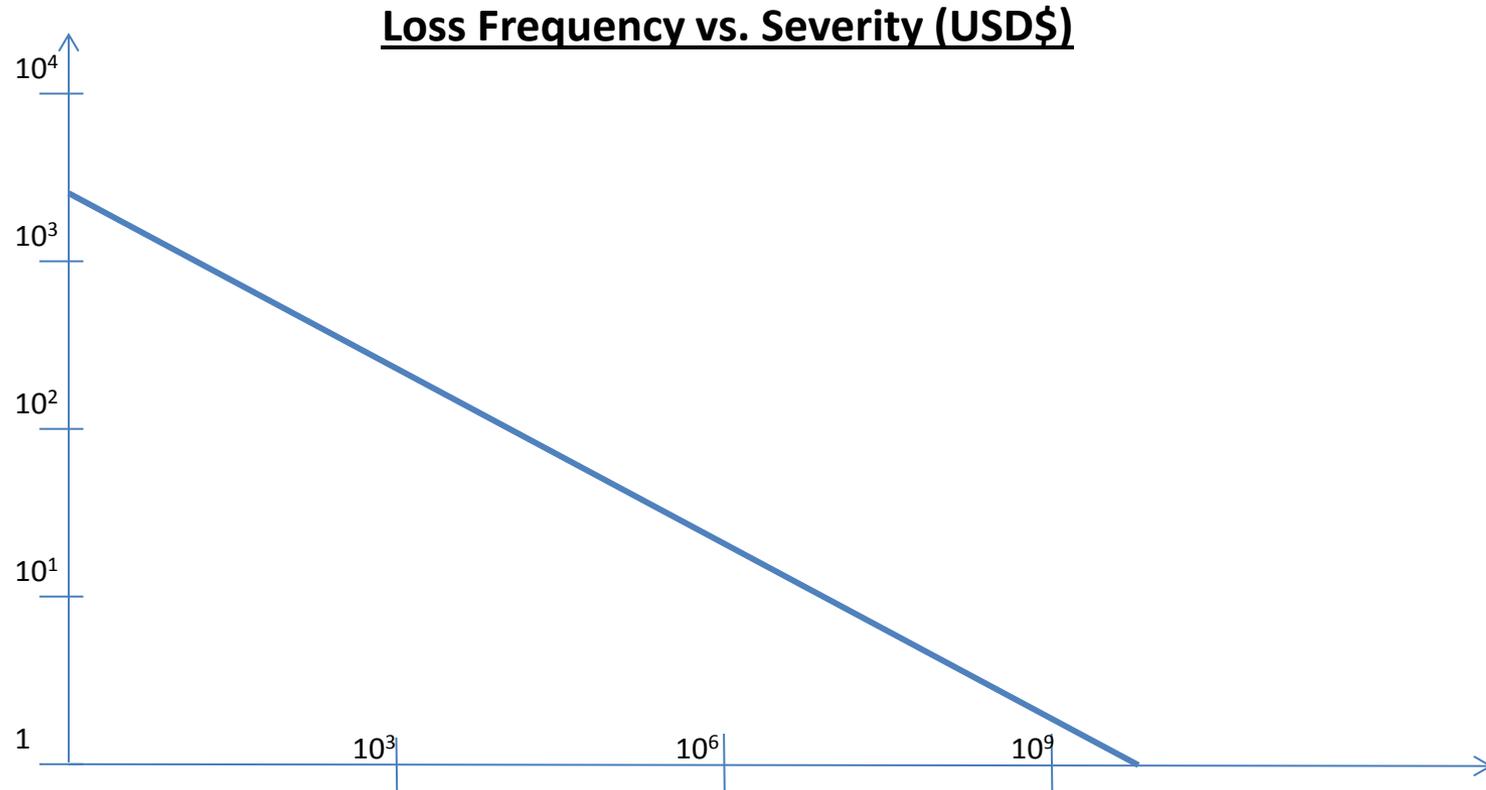
# Question: Does Big Data enable us to accurately predict events?



## **Societe Generale rogue trader Kerviel loses appeal**

The ex-trader lost the bank almost 5bn euros (\$6.5bn; £4bn) in 2008, and was convicted in 2010

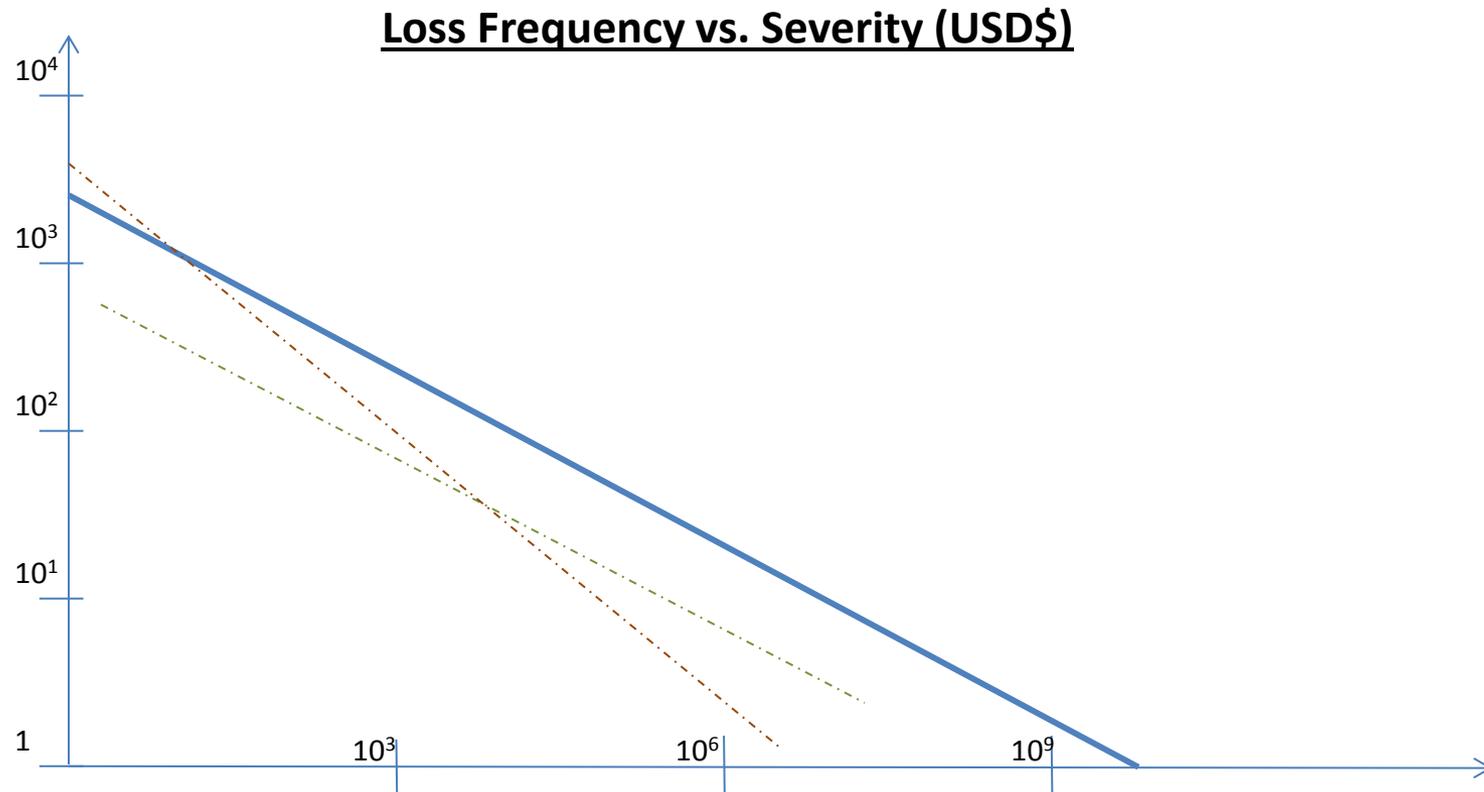
# Question: Does Big Data provide a new perspective on risk and uncertainty?



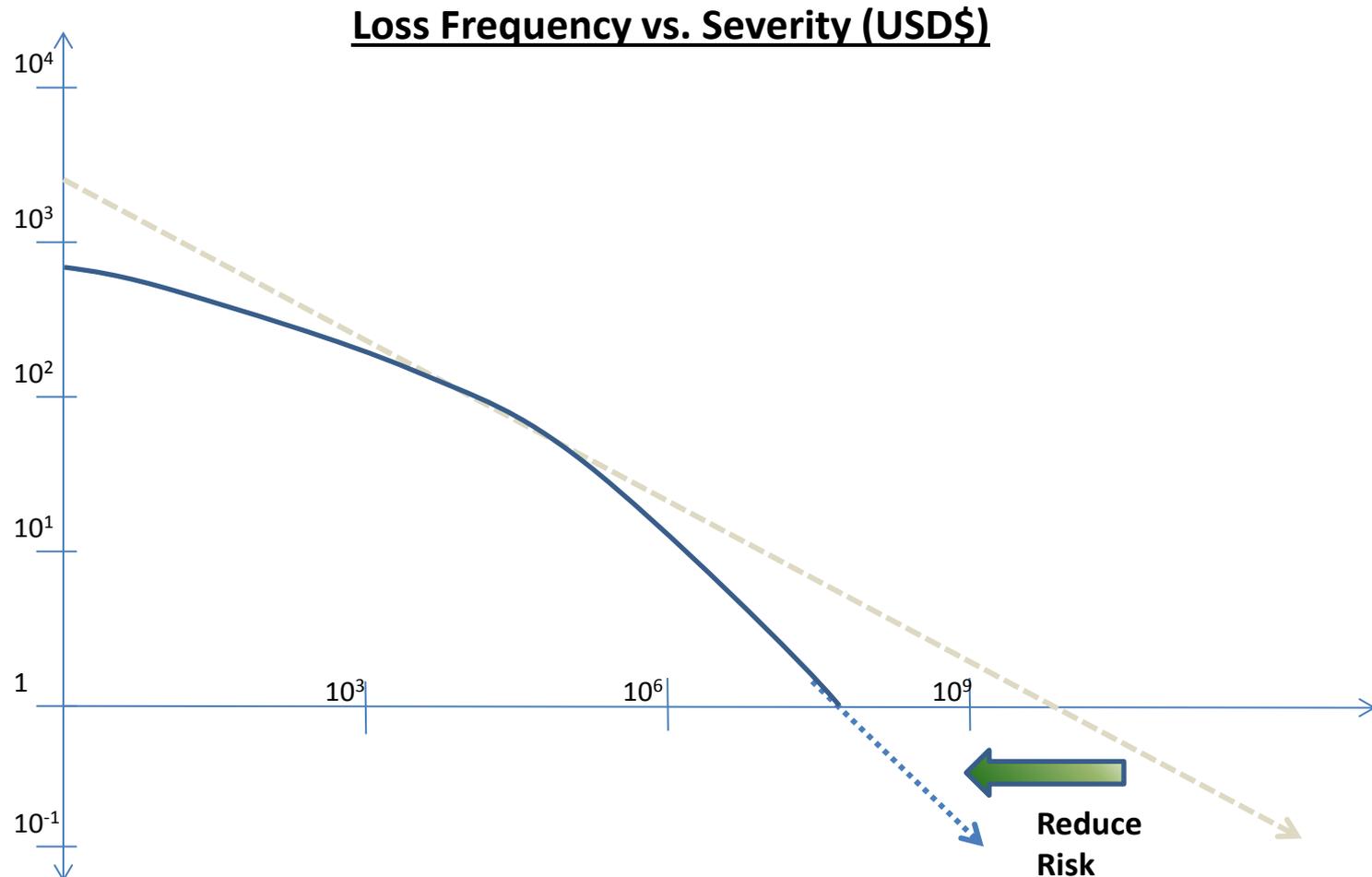
# Noted: The Power Law signature

- Provide signatures of order for seemingly ubiquitous subjects
  - from terrorist events to order flow in financial markets
- Key characteristic is “scale invariance”
  - Implies that individual financial firms will have patterns of losses similar to those experienced in the overall industry
  - Advanced risk control methods can be formulated in line with industry data and effectively applied at the firm level
- **Indicates that extreme values are an integral and meaningful part of the data that need to be understood and controlled**

# Question: Is this a (your) risk curve?



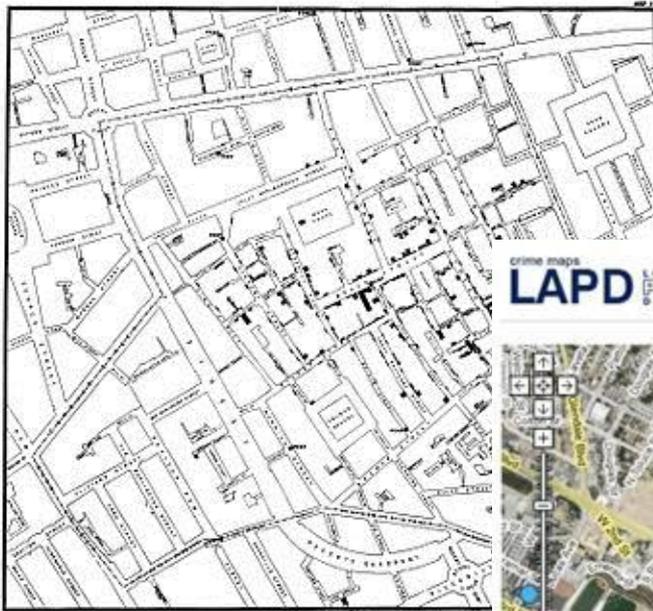
# If so, how would you manage to an efficient frontier?



# Can you address the challenge at different levels of resolution?

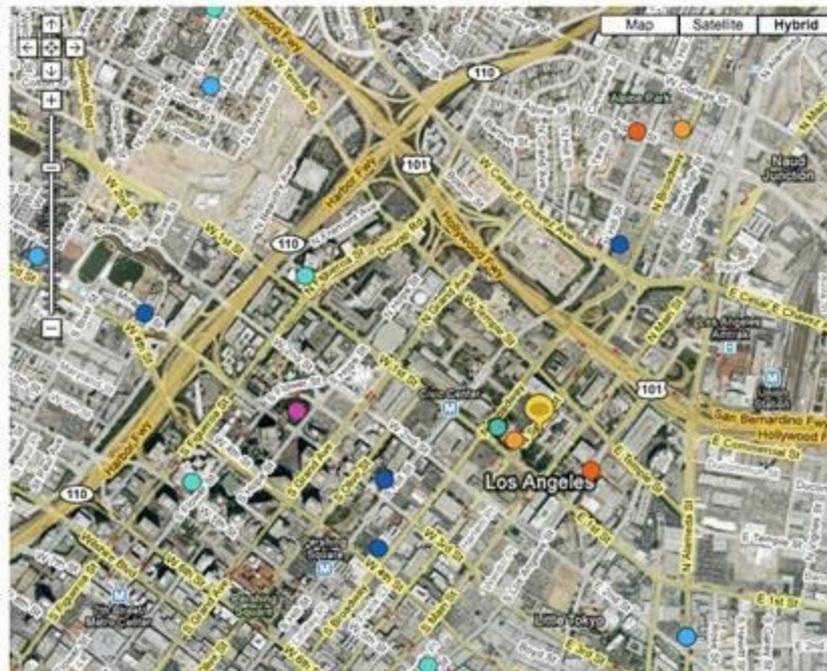
- Scenario analysis
  - Forecast magnitude of potential extreme events
  - Build model scenarios
  - Control analysis
  - Guard against bias
- Routine losses
  - Scrutinize losses / near misses for indicators of vulnerability
    - Root cause analysis
  - Data /sensor fusion

# Big Data – an evolution



crime maps  
**LAPD** LOS ANGELES  
POLICE DEPARTMENT

Drag large map to move. > Sign Up for LAPD e-Policing



200 N Spring St  
Los Angeles, CA 90012  
Central Division

Date Range Show:  
10/03/2008 to 10/05/2008  
Radius: 5 mile(s)

#### CRIME INFO SEARCH

200 North Spring Street  
Enter an address or double click the map for regional crime statistics

#### CHOOSE A DATE RANGE:

end date: (click icon below)

10/05/2008

3 days

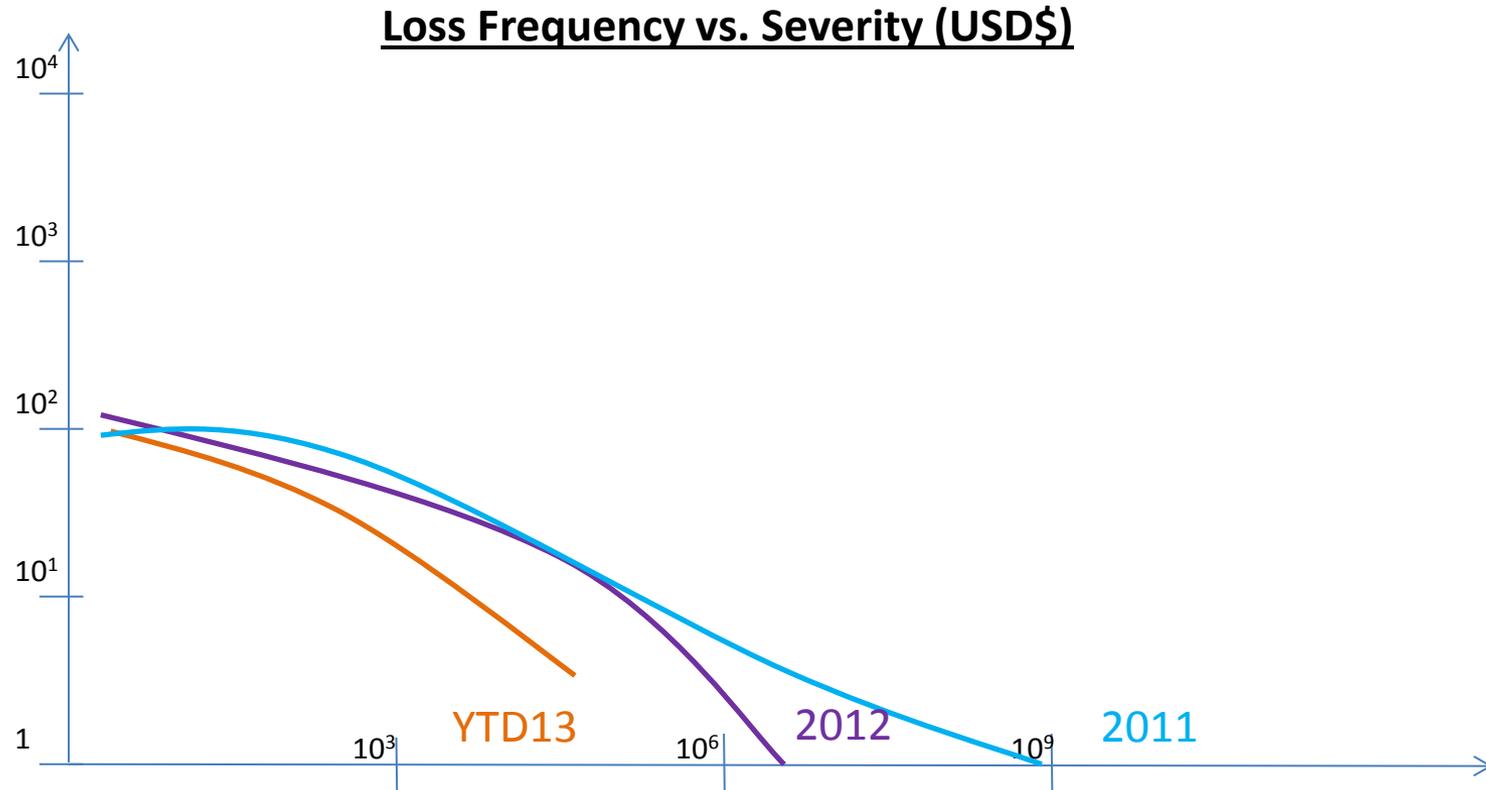
5 miles

(7 day range may load slowly)

#### CHOOSE CRIMES

- Burglary (Property)
- Grand Theft Auto
- Theft from Vehicle
- Personal/Other Theft
- Robbery (Violent)
- Aggravated Assault
- Rape

# An effective way to visualize results?



# A footnote

*W. Heisenberg, uncertainty principle paper (1927)*

- *“In the strict formulation of the law of causality—‘if we know the present exactly, we can calculate the future’—it is not the conclusion that is wrong but the premise.”*

Frank Knight, Risk Uncertainty and Profit (1921)

- Situations with **risk** were those where the outcomes were unknown but governed by **probability distributions known at the outset**.
- These situations differ in a deep way from "**uncertain**" ones, where the outcomes were likewise random, but governed by an **unknown probability model**.



\* *Cartoon by John Richardson for Physics World, March 1998*

# Questions?