Models in Risk Management
Wrong but useful

Inaugural lecture

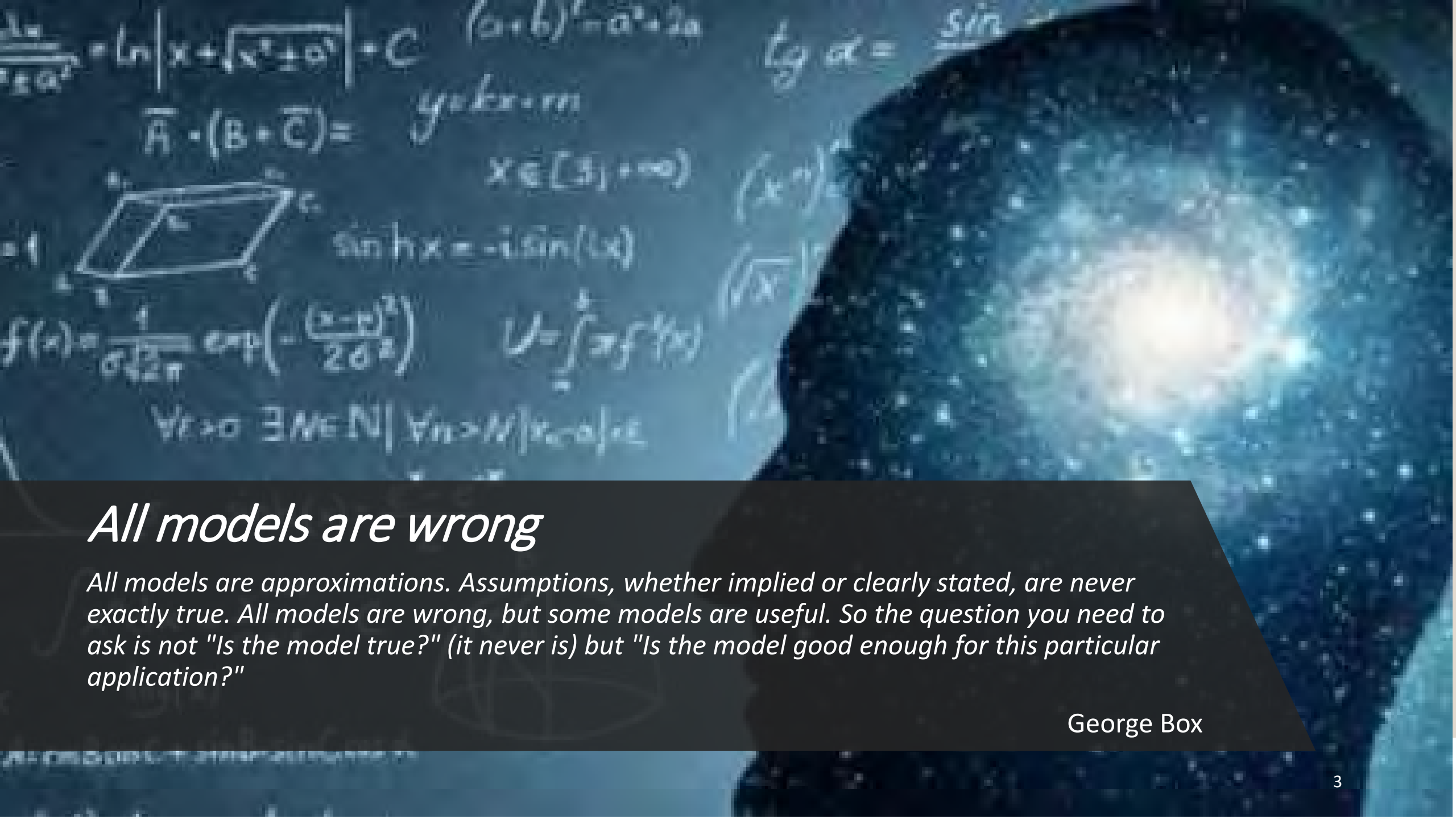
Helgard Raubenheimer – 22 November 2021

Risk

"any event or action that may adversely affect an organisation's ability to achieve its objectives and execute its strategies" or "the quantifiable likelihood of loss or less-than-expected returns"

McNeil et al. (2015)

2



All models are wrong

All models are approximations. Assumptions, whether implied or clearly stated, are never exactly true. All models are wrong, but some models are useful. So the question you need to ask is not "Is the model true?" (it never is) but "Is the model good enough for this particular application?"

George Box

Agenda

- Financial institutions
- Role players
- Examples
- Quantitative risk management
- Models: Wrong or useful?
- Some final notes

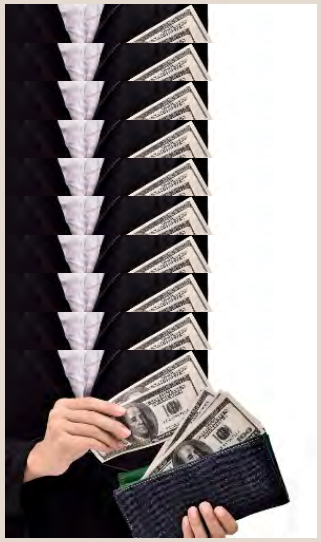
Financial institutions

- Banking
- Insurance
- Investment
- Brokerage, etc..

Financial institutions

Banking

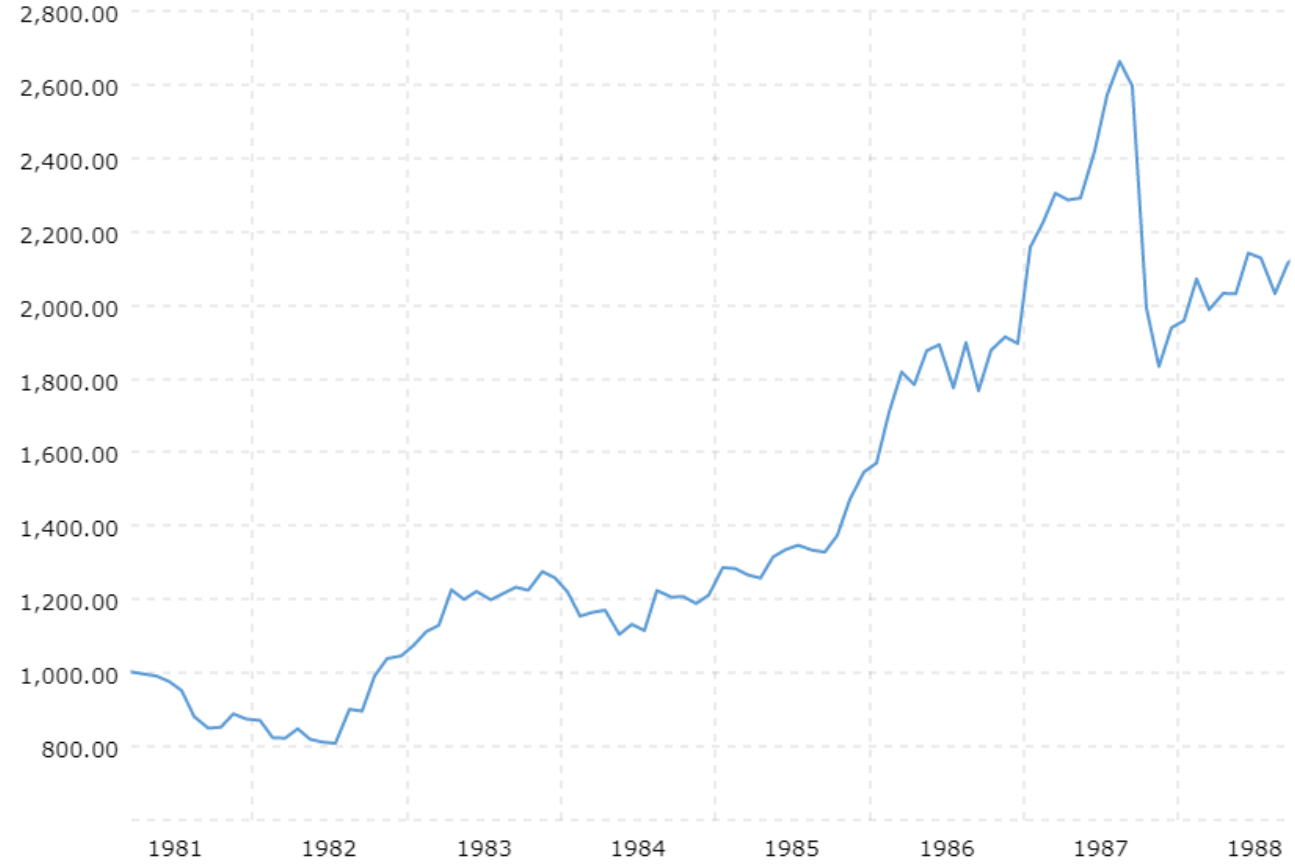
Insurance



Role players

Examples

#1: Black Monday (1987)



Examples

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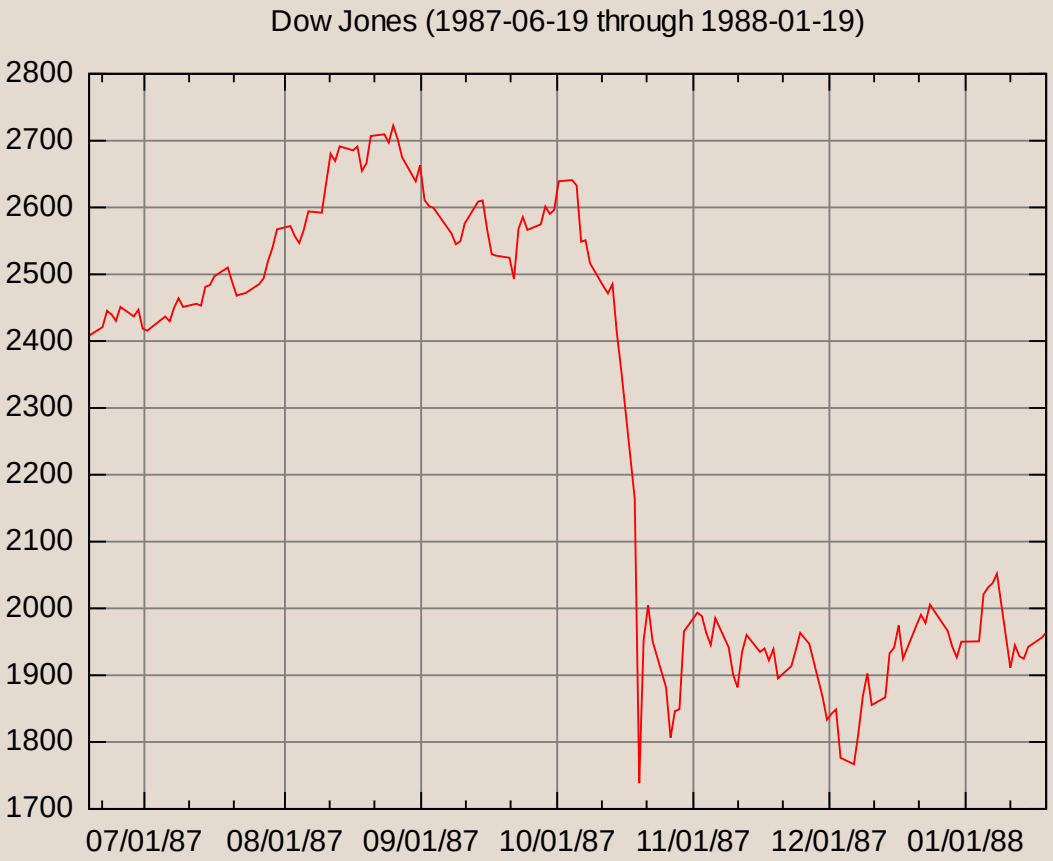
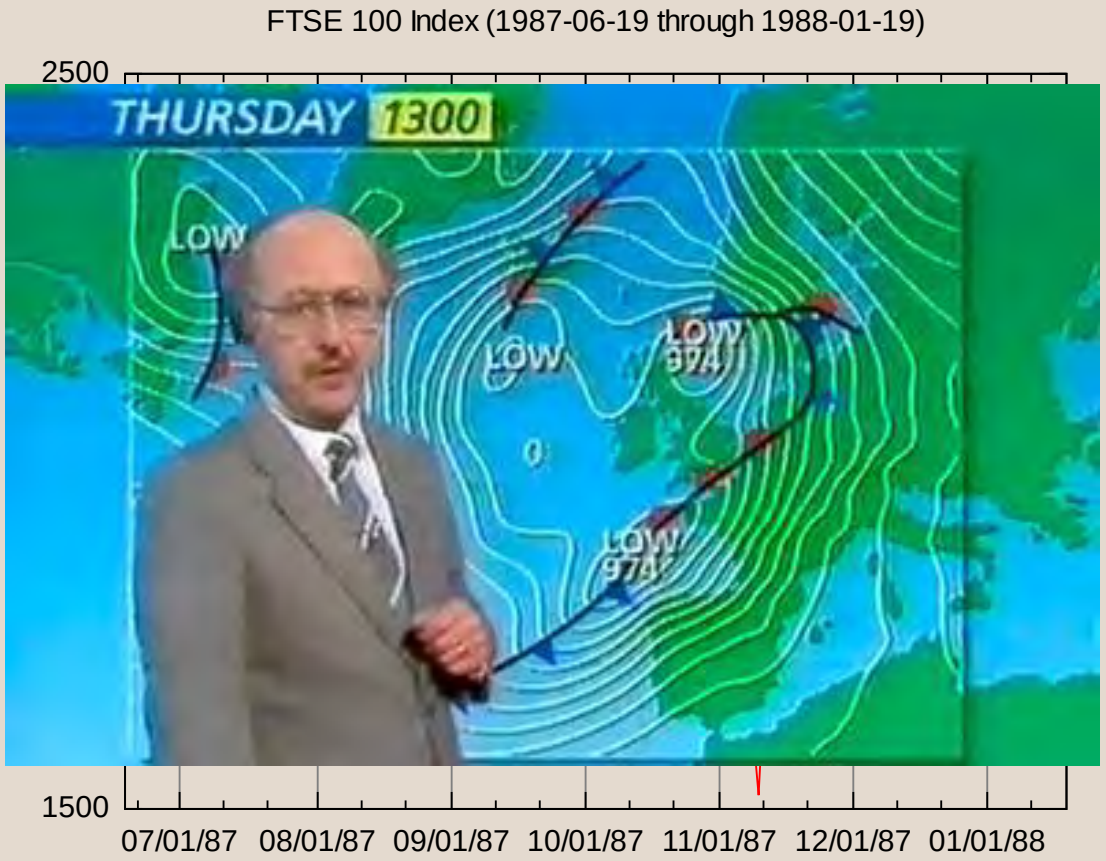
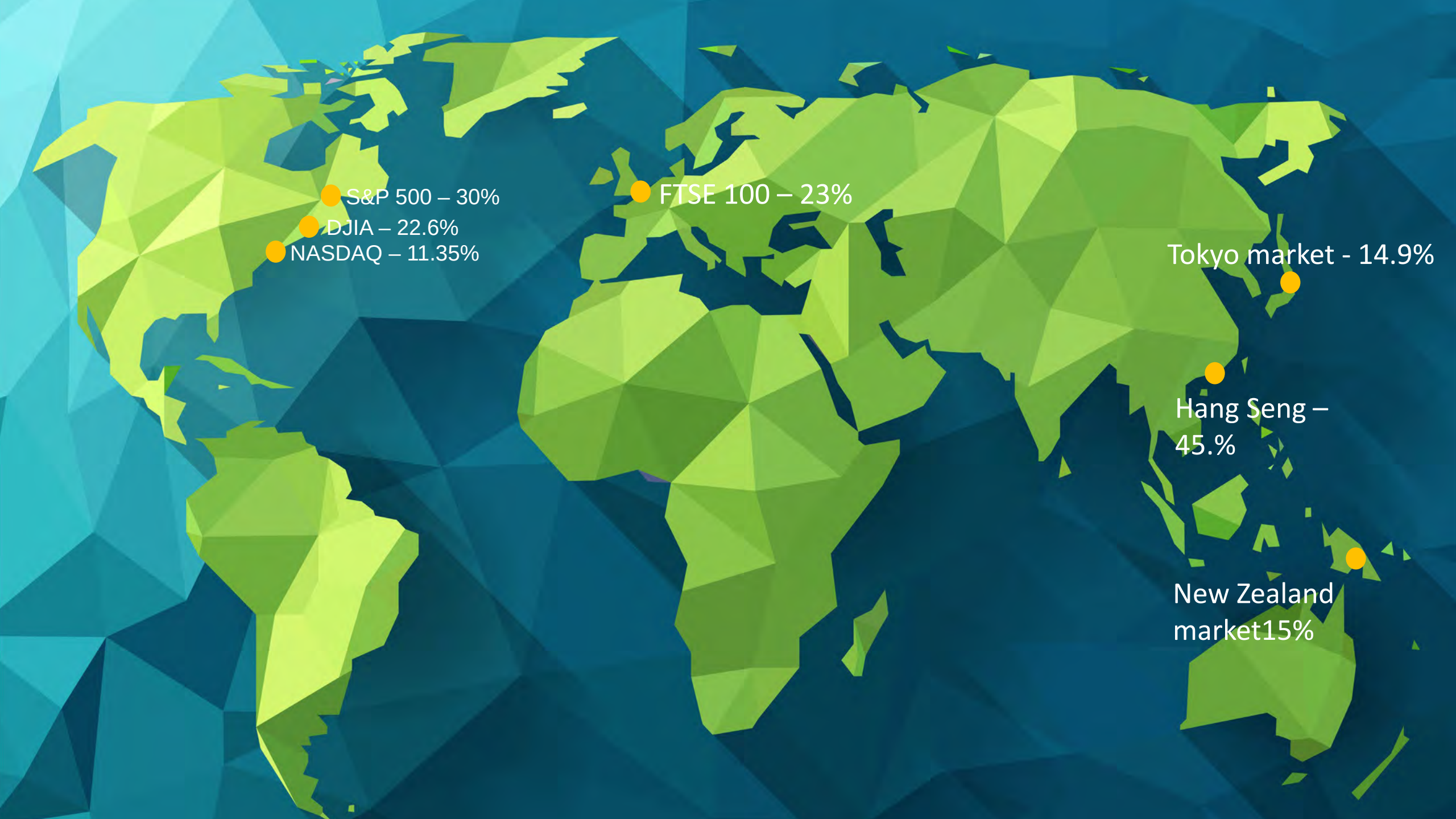





S&P 500 – 30%
DJIA – 22.6%
NASDAQ – 11.35%
FTSE 100 – 23%
Tokyo market - 14.9%
Hang Seng – 45.%
New Zealand market15%

Examples

#2: Barings Bank (February 1995)

Nick Leeson was a 28-year-old derivatives trader at Barings.

He was very successful in making speculative trades, which resulted in huge profits for Barings.

Examples

#2: Barings Bank (February 1995)

BARINGS

One of the largest and most stable banks in the world

Trading futures on the Nikkai 225 for clients and should have been a cash neutral business.

Given the responsibility of double-checking his own trades, rather than reporting them to a superior

£10 million- 10% of Barings annual profit in 1992)

To recover lost money, he began taking increasingly bigger odds.

Losses were kept in a secret account

1993: £20 million, 1994: £208 million

Examples

#2: Barings Bank (February 1995)

January 16, 1995, he placed a short straddle on the Singapore and Tokyo stock exchanges,

January 17, 1995, the Great Hanshin earthquake hit, Japan caused a sharp drop in the Asian markets

Attempted to offset losses with a series of increasingly risky trades

Leeson fled Singapore on February 23, 1995. In the end, his losses accounted for £827 million

Examples

#3: September 11 Attacks

Examples

#3: September 11 Attacks

At 8:46 am the first plane was flown into the North Tower of the World Trade Center complex.

At 9:03 am, the World Trade Center's South Tower was hit by a second plane.

Both 110-story towers collapsed within an hour and forty-two minutes

Sharp plunge in the stock market

- $1.4 trillion loss in market value

Business interruption

- $11.0 billion

Property

- $9.6 billion

Liability

- $7.5 billion

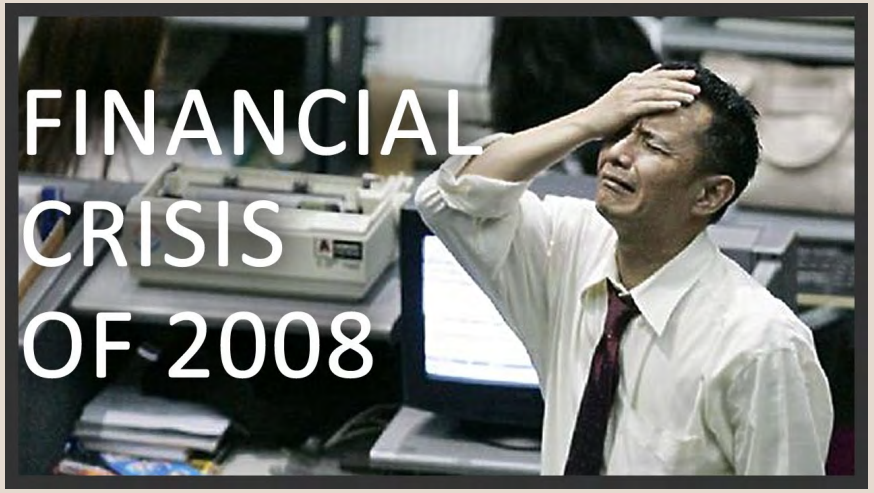
Worker's compensation

- $1.8 billion

Examples

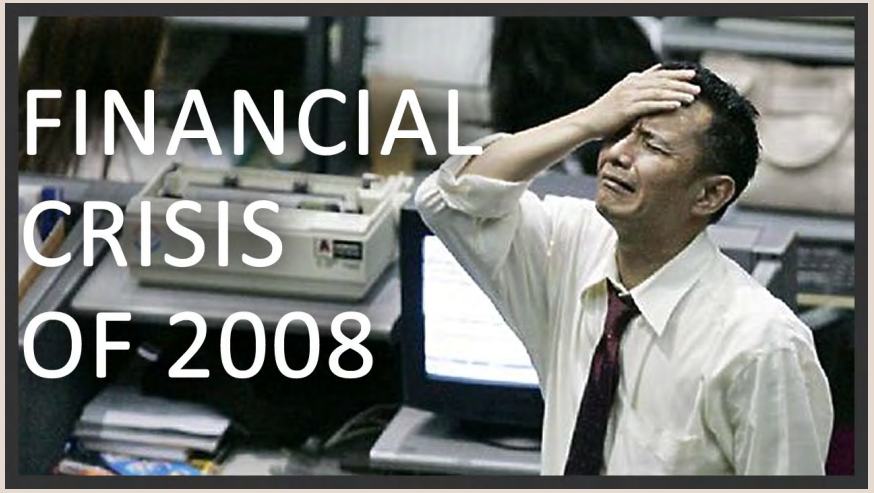
#4: Credit crisis of 2008

Examples

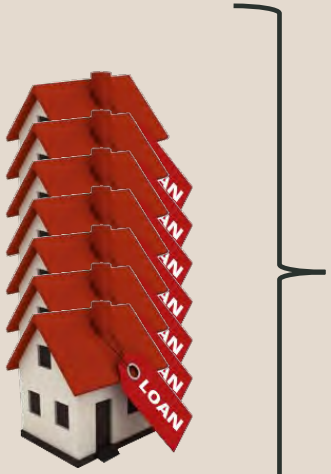


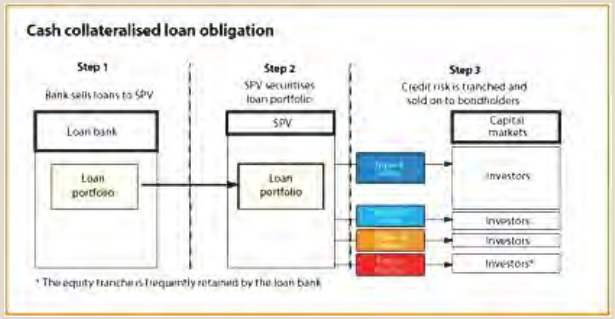
#4: Credit crisis of 2008

Examples

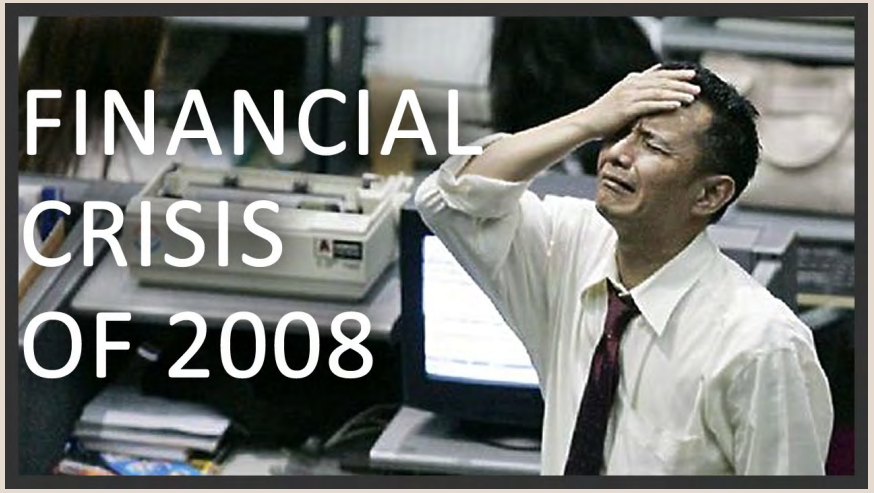


#4: Credit crisis of 2008





Examples



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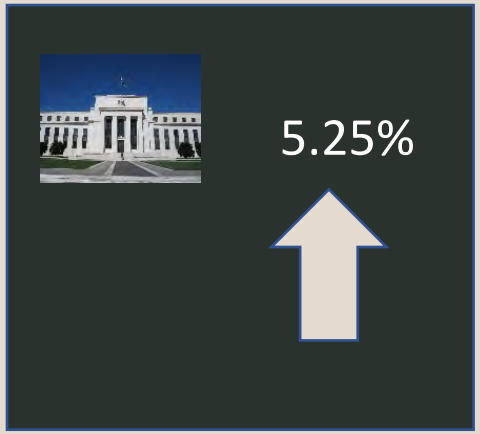
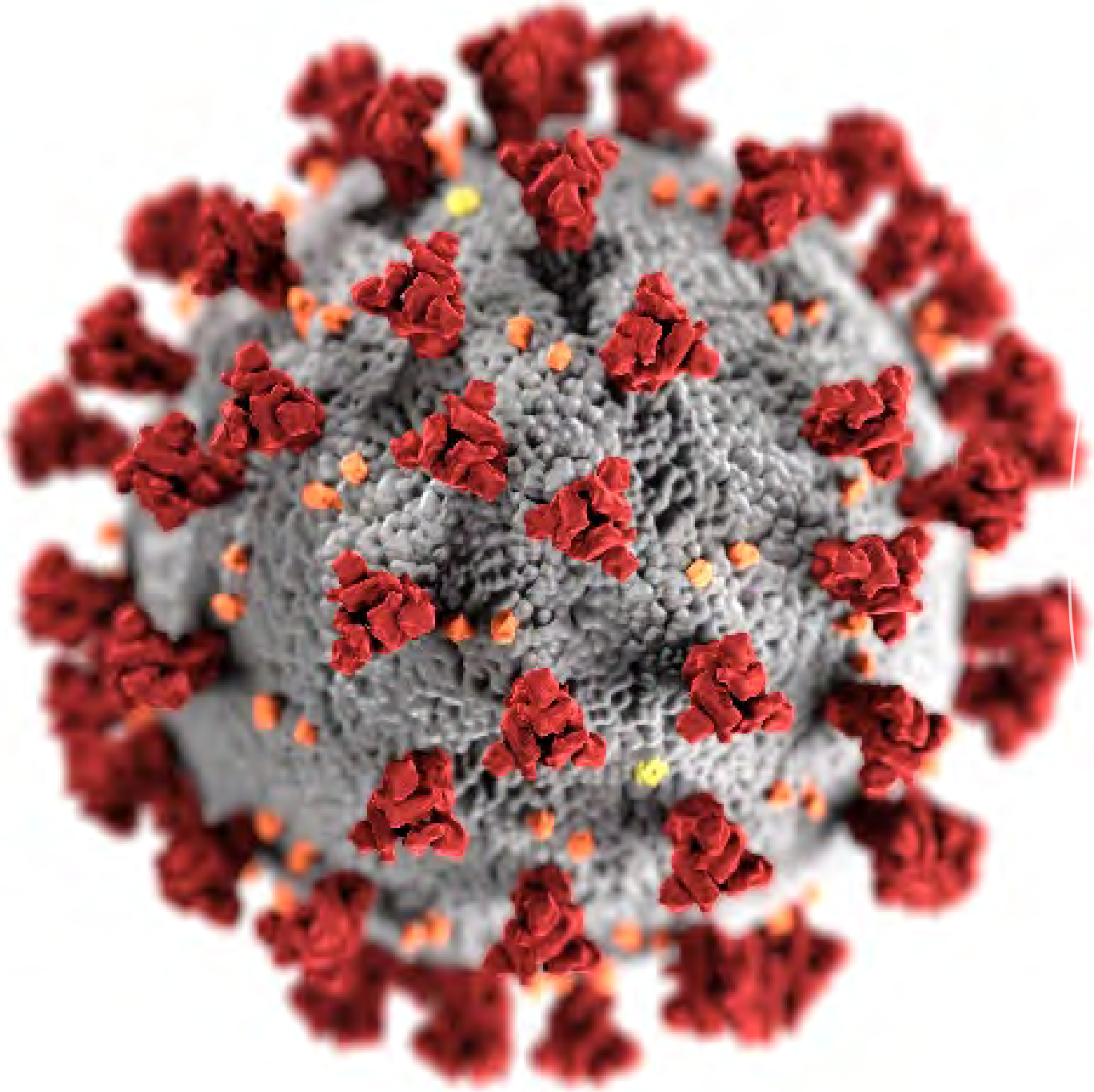


Examples

#4: Credit crisis of 2008

The International Monetary Fund estimated that large US and European banks lost more than $1 trillion on toxic assets



Examples

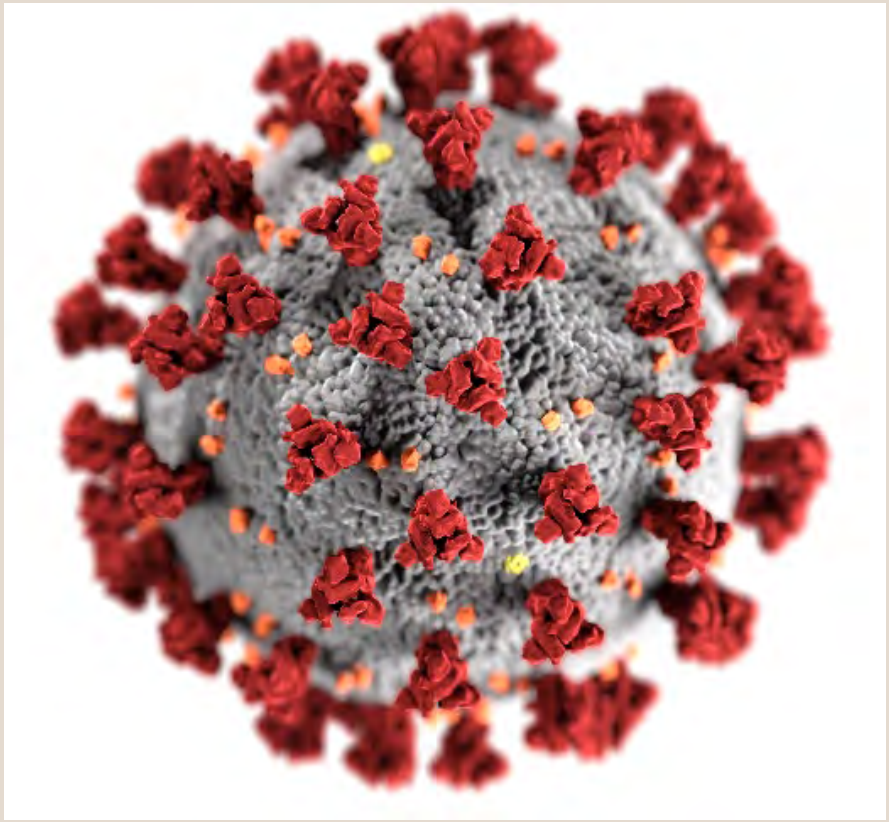
#5: Covid 19 pandemic

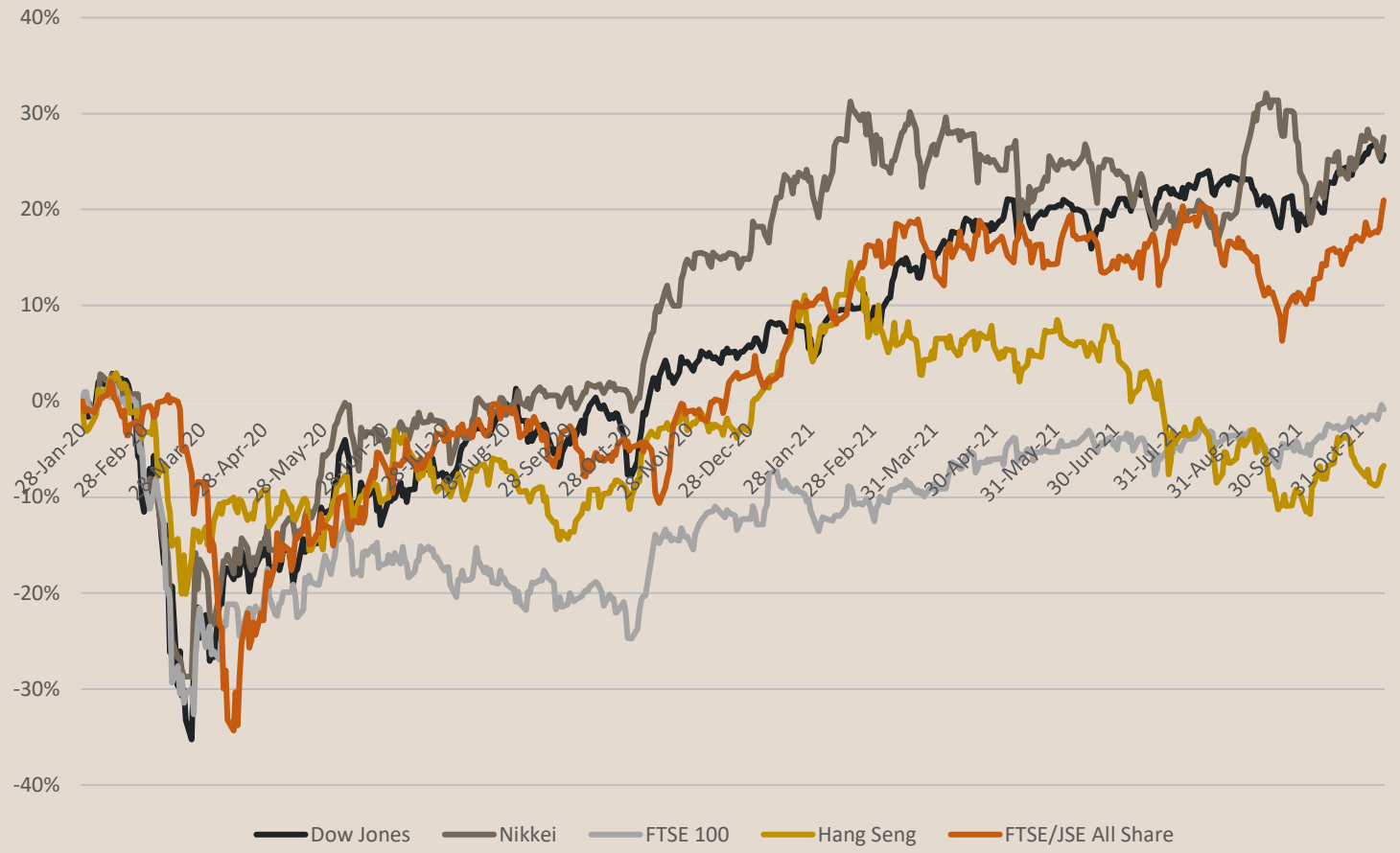
“They're funny things,
Accidents. You never have them
till you're having them.”

— A.A. Milne, The House at Pooh Corner

Examples

#5: Covid 19 pandemic

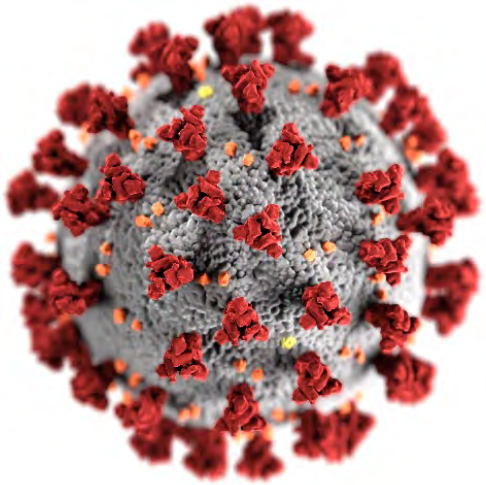


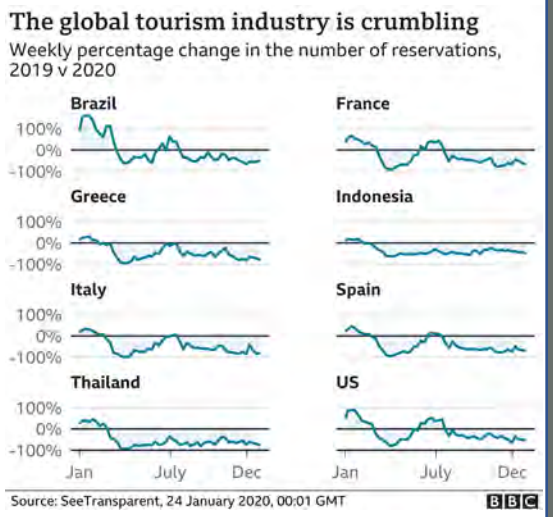


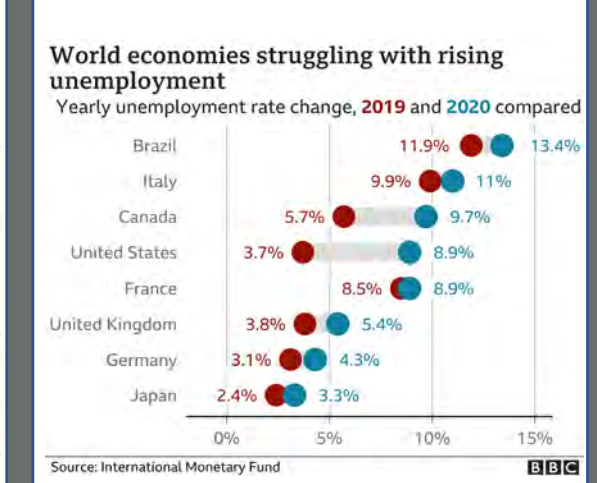
Examples

"Could be worse. Not sure how, but it could be."
—Eeyore

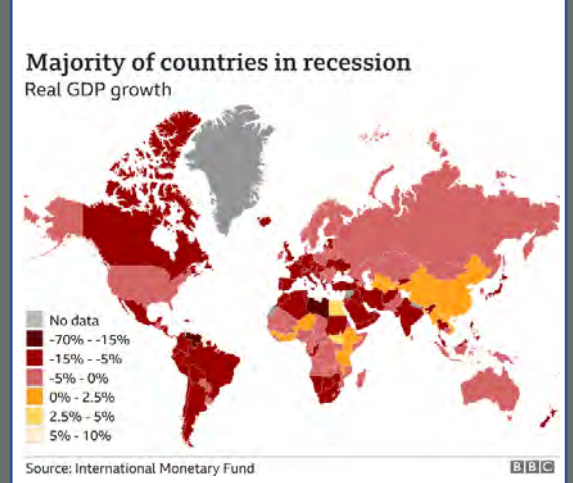
#5: Covid 19 pandemic







*SA 28.47(2019); 28.74%(2020); 33.4% (2021)

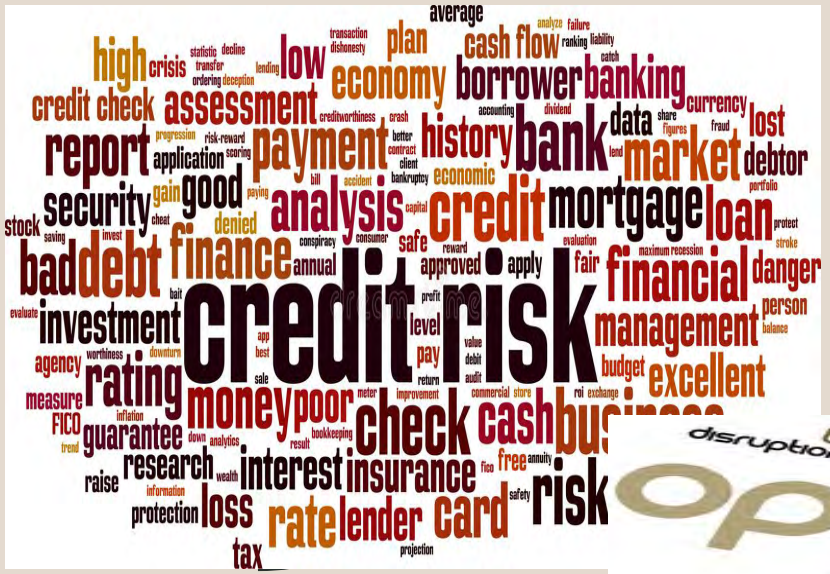


Quantitative risk management

Financial Risks

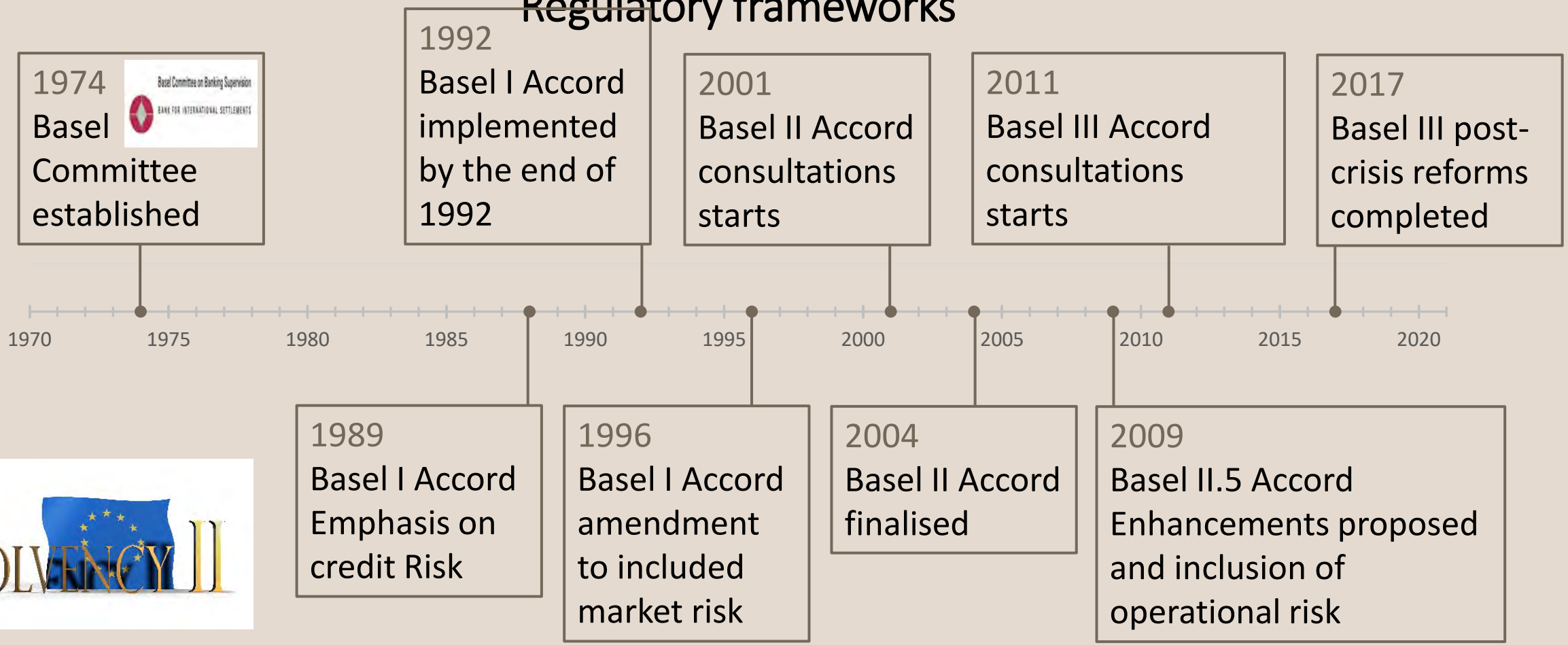
Banking

Insurance



Quantitative risk management

Regulatory frameworks



Quantitative risk management

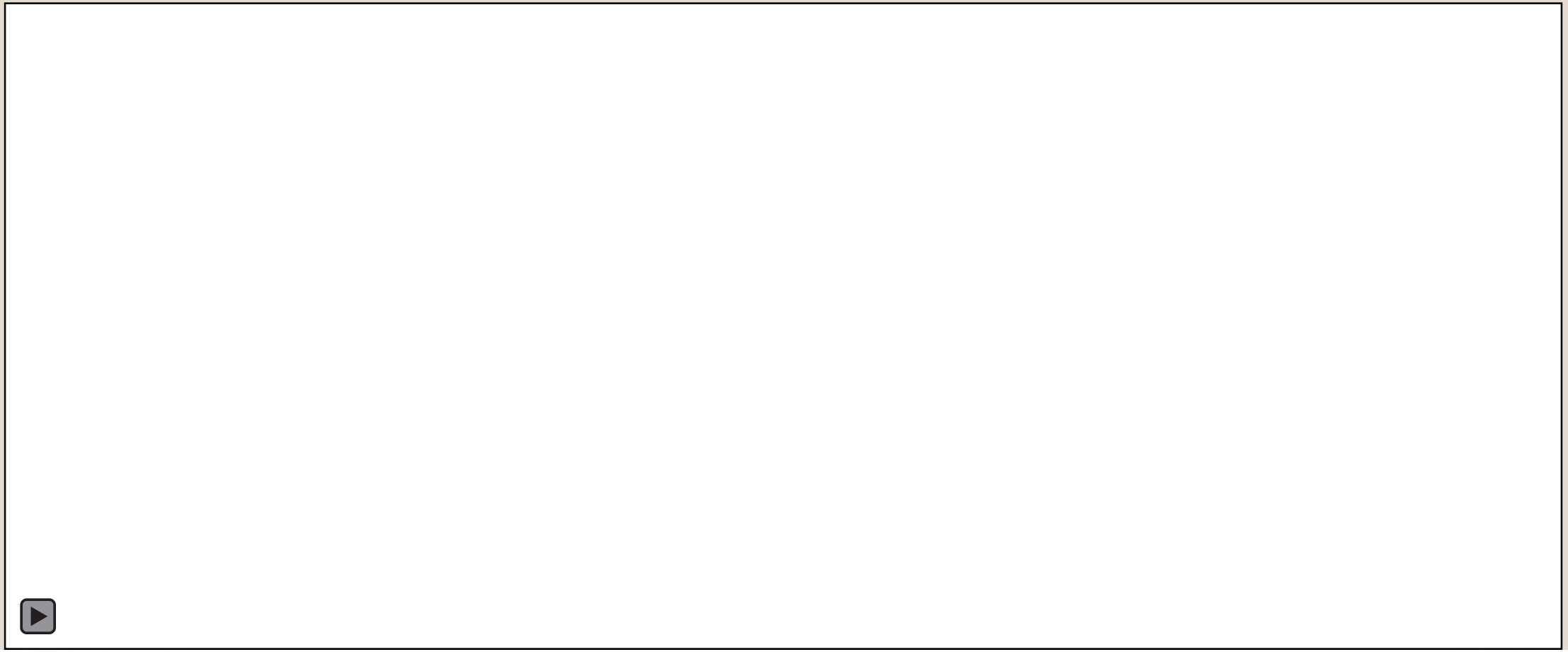
Risk measurement

Risk measures are functions with certain properties.

These functions are the amount of capital that should be added to a risky position to make it acceptable to the regulator

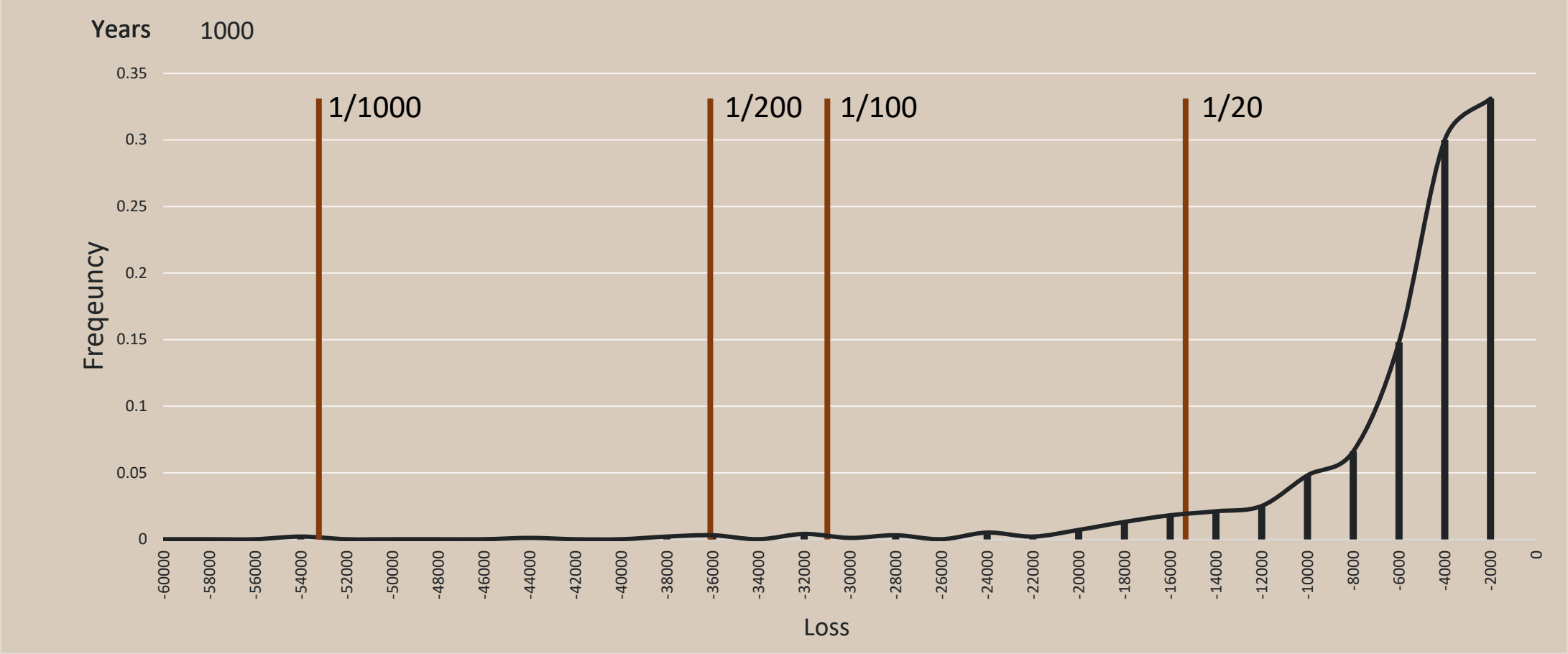
Quantitative risk management

Risk measurement

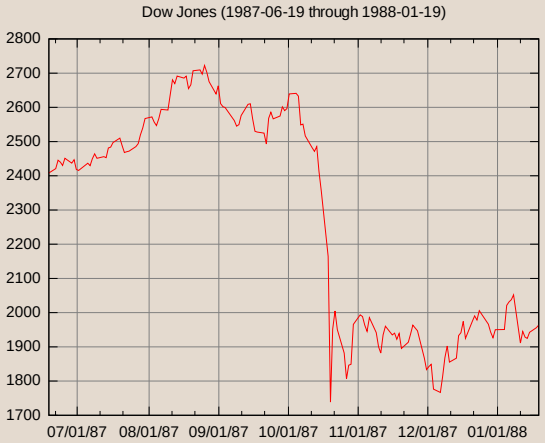


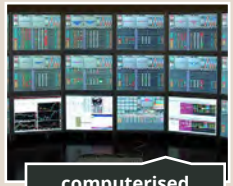
Quantitative risk management

Risk measurement



Models: Wrong or useful?





computerised trading

portfolio insurance trading strategies

selling short S&P 500 Index futures

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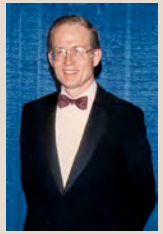
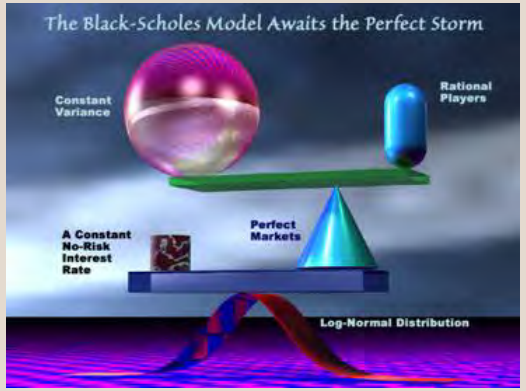




All models have faults - that doesn't mean you can't use them as tools for making decisions.

Myron Scholes

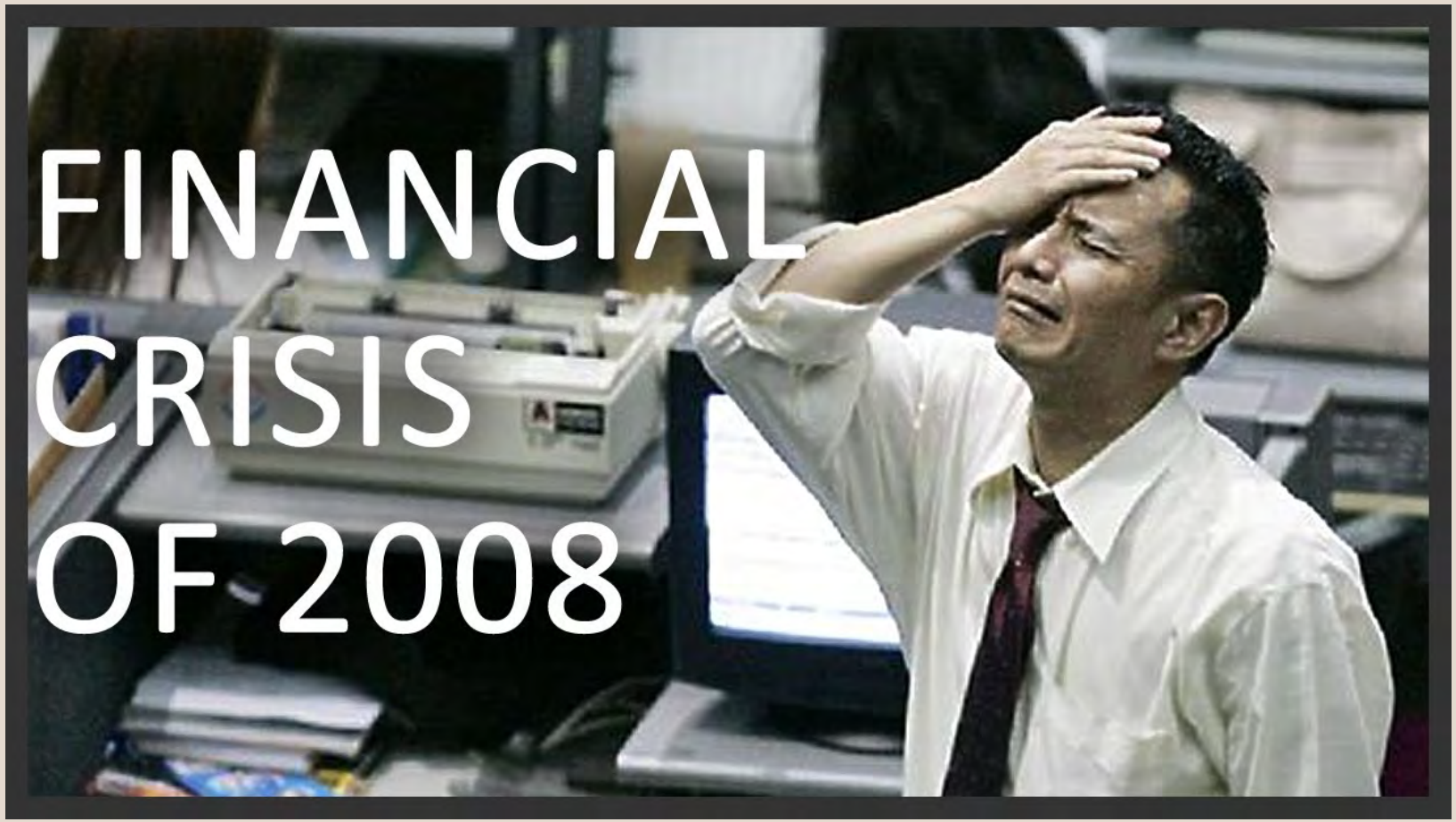
A Perfect Storm – Long Term Capital Management lost $4.6 billion in 1998
Scholes and Merton were co-founders of the fund

Metallgesellschaft in 1993 – $1.3 billion
Orange County in 1994 – $1.64 billion

"All I can say is, beware of geeks bearing formulas,"
Warren Buffett

Models: Wrong or useful?

Example 4: Credit crisis of 2008



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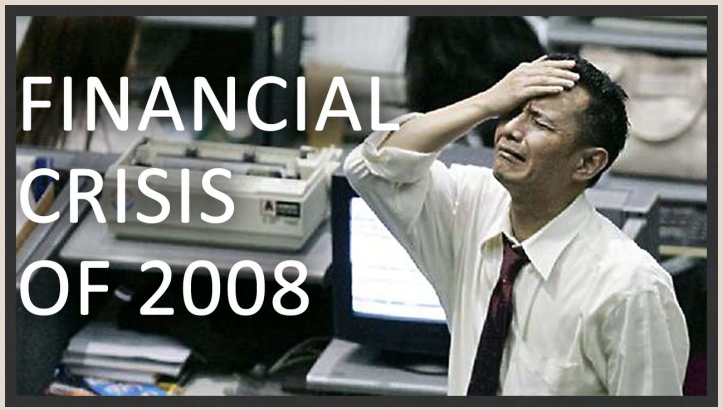

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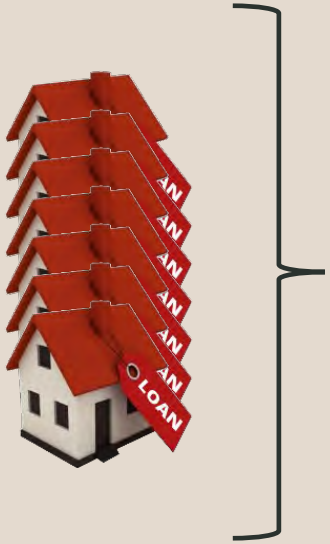

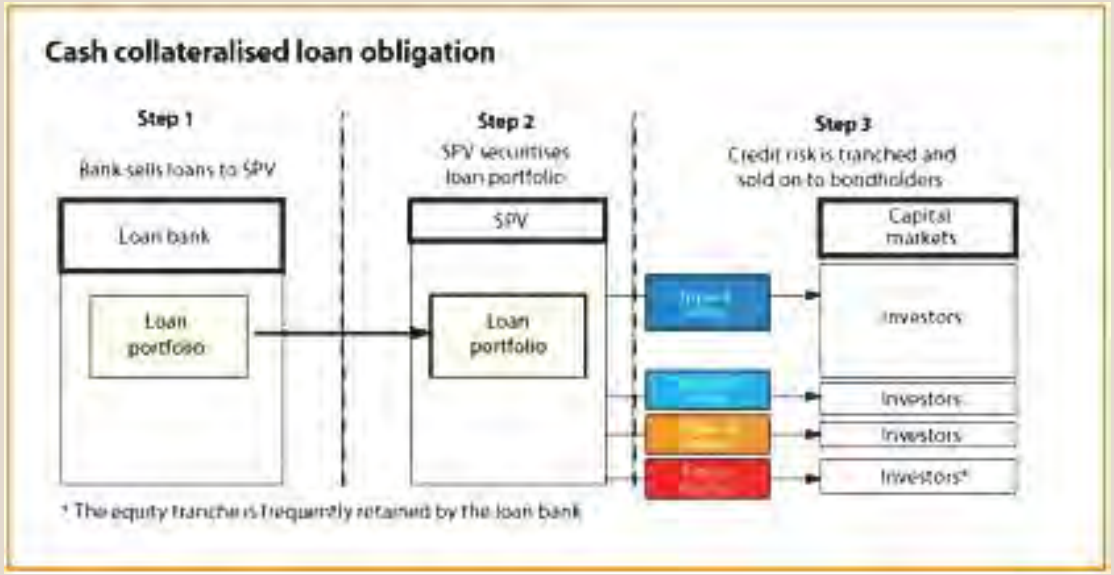

Recipe for Disaster: The Formula That Killed Wall Street By Felix Salmon 23 February, 2009 Wired Magazine

$$Pr[T_A<1, T_B<1] = \phi_2(\phi^{-1}(F_A(1)), \phi^{-1}(F_B(1)), \gamma)$$

"The formula that killed so many pension plans: David X. Li's Gaussian copula, as first published in 2000. Investors exploited it as a quick – and fatally flawed – way to assess risk."

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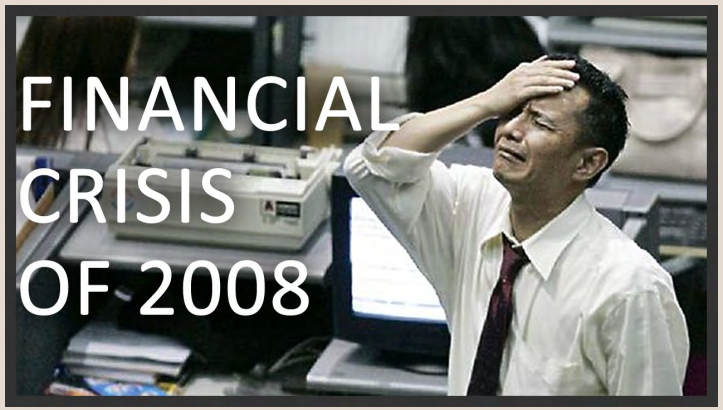

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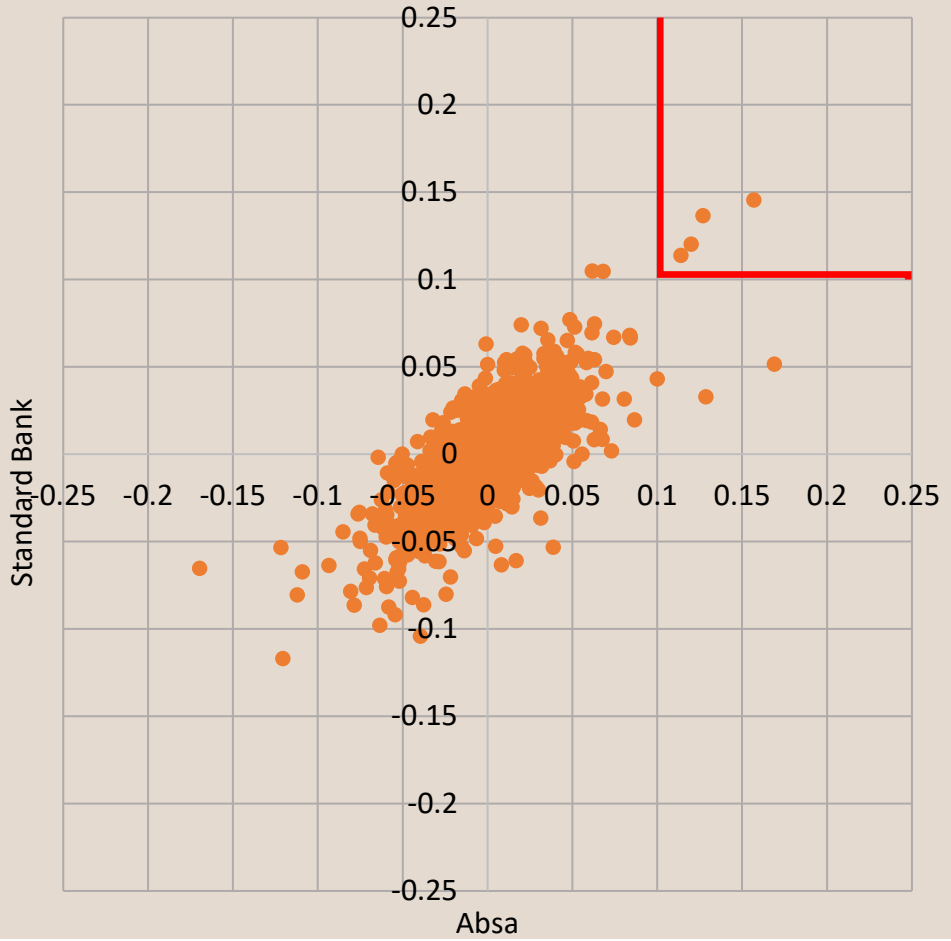

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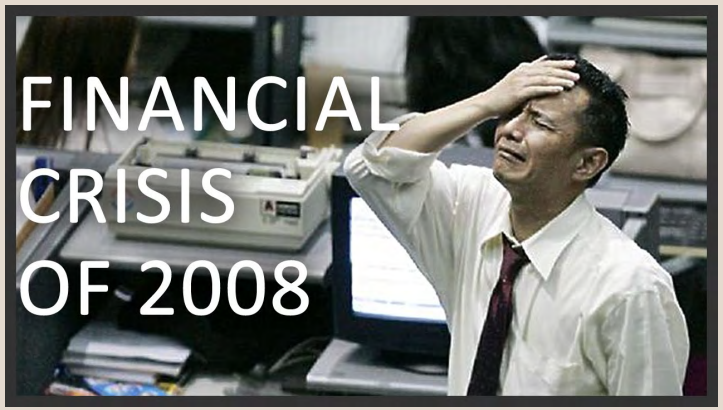

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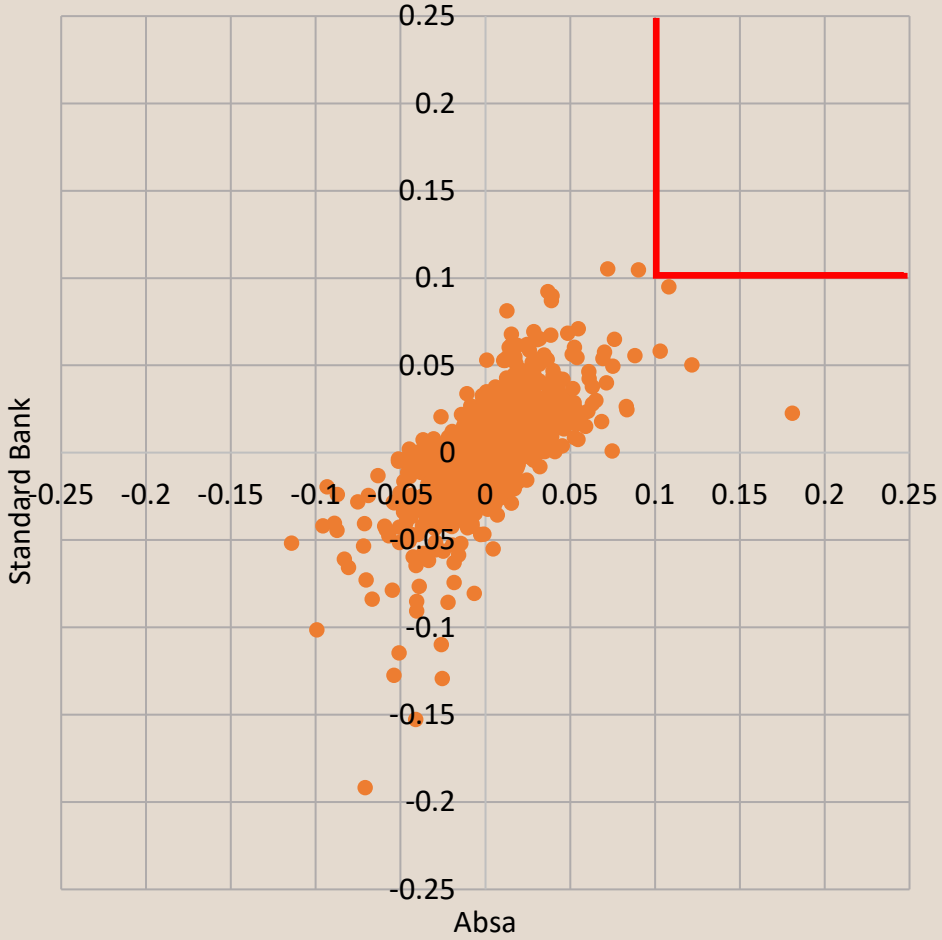

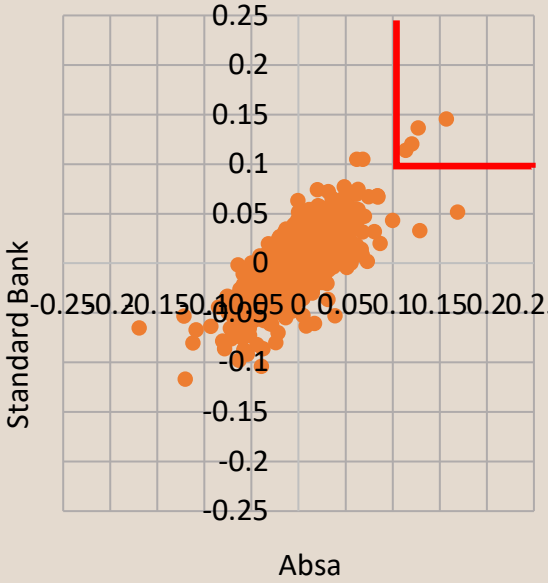

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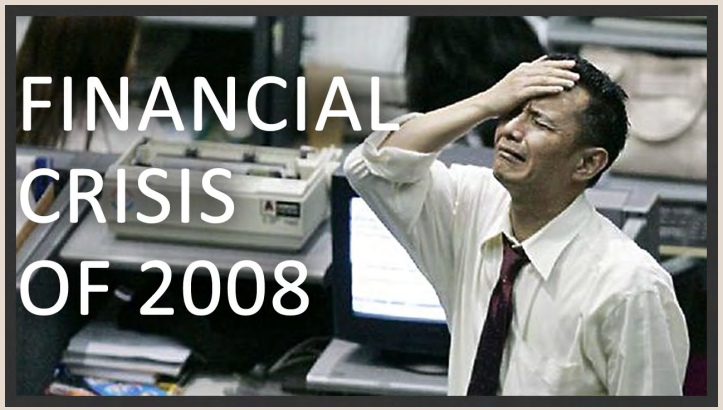

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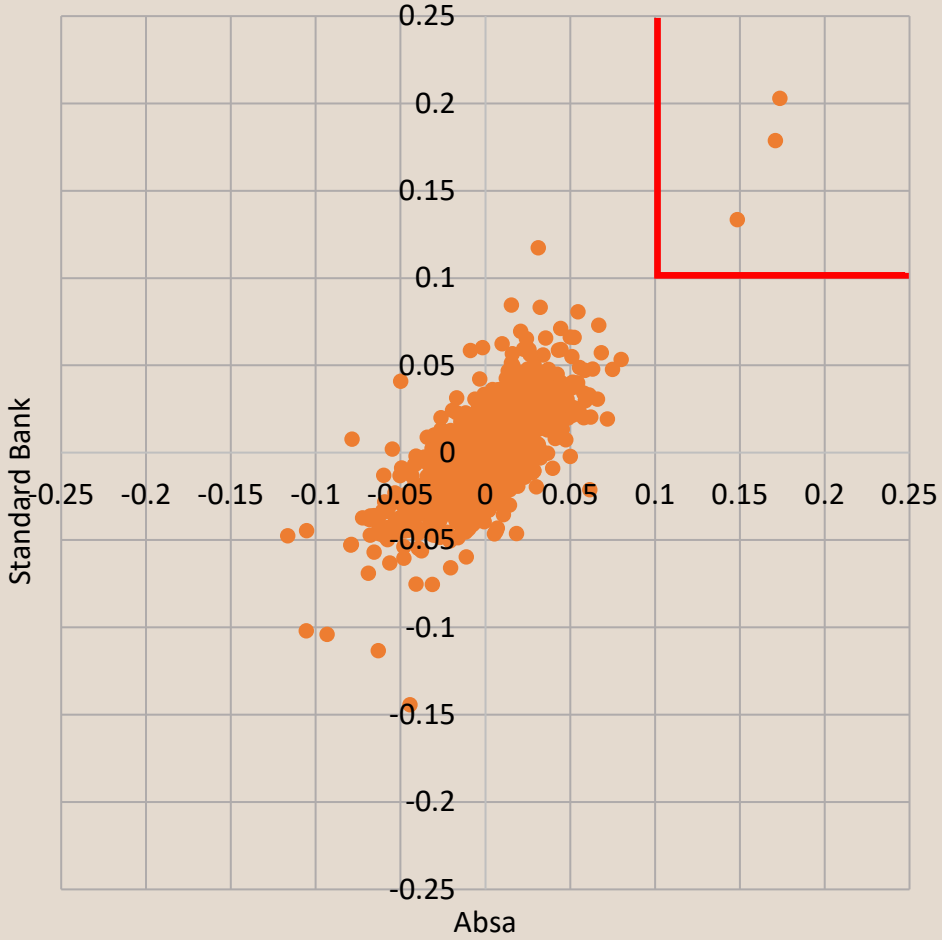

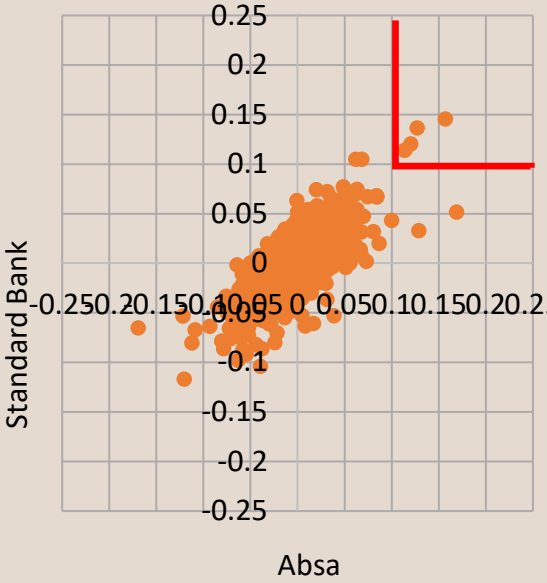

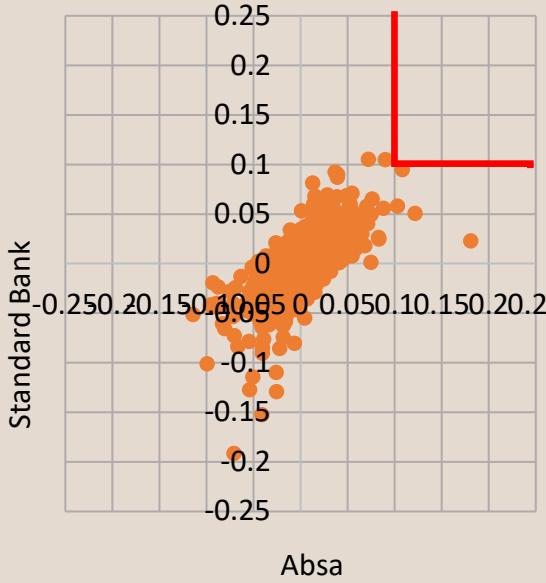

Models: Wrong or useful?

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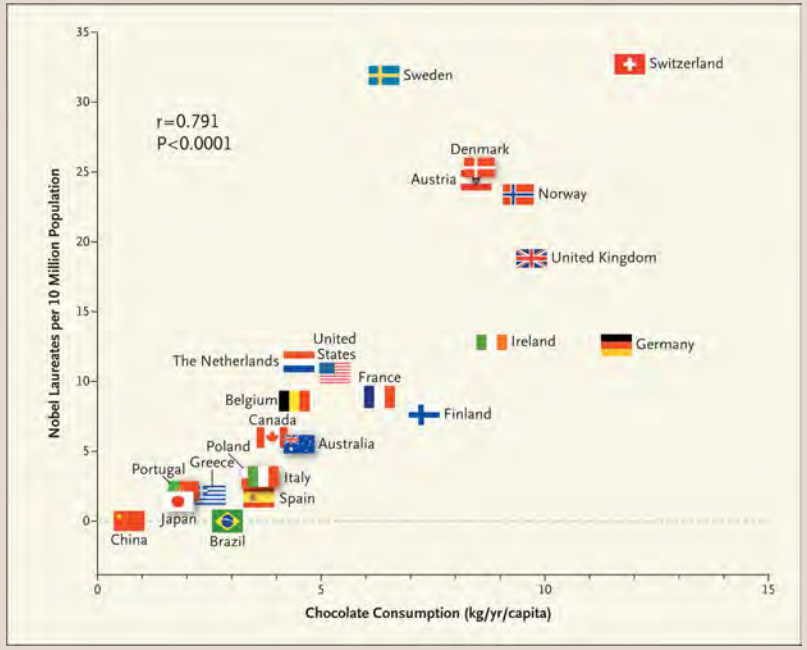
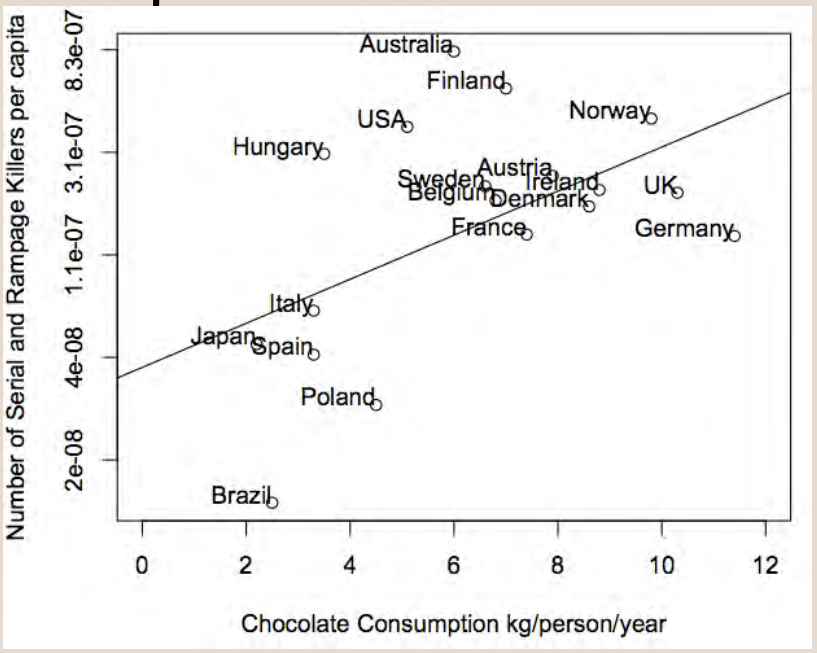
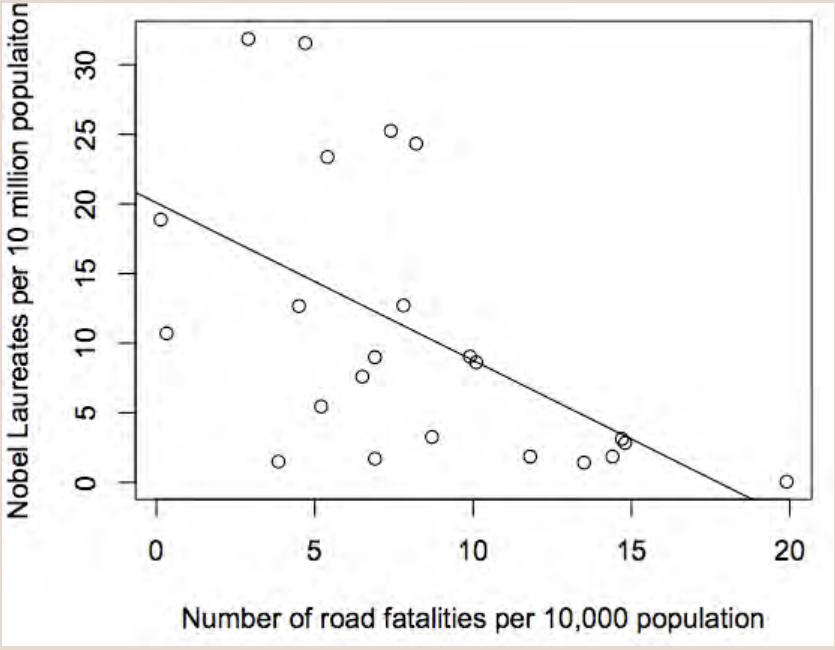






https://www.nejm.org/doi/full/10.1056/NEJMon1211064 - Chocolate Consumption, Cognitive Function, and Nobel Laureates

http://replicatedtypo.com/wp-content/uploads/2012/11/ChocolateSerialKillers_WintersRoberts.pdf

"Very few people understand the essence of the model"
David X. Li

"Anything that relies on correlation is charlatanism"
Nassim Taleb

BMI

Models: Wrong or useful?

Examples 2 & 3

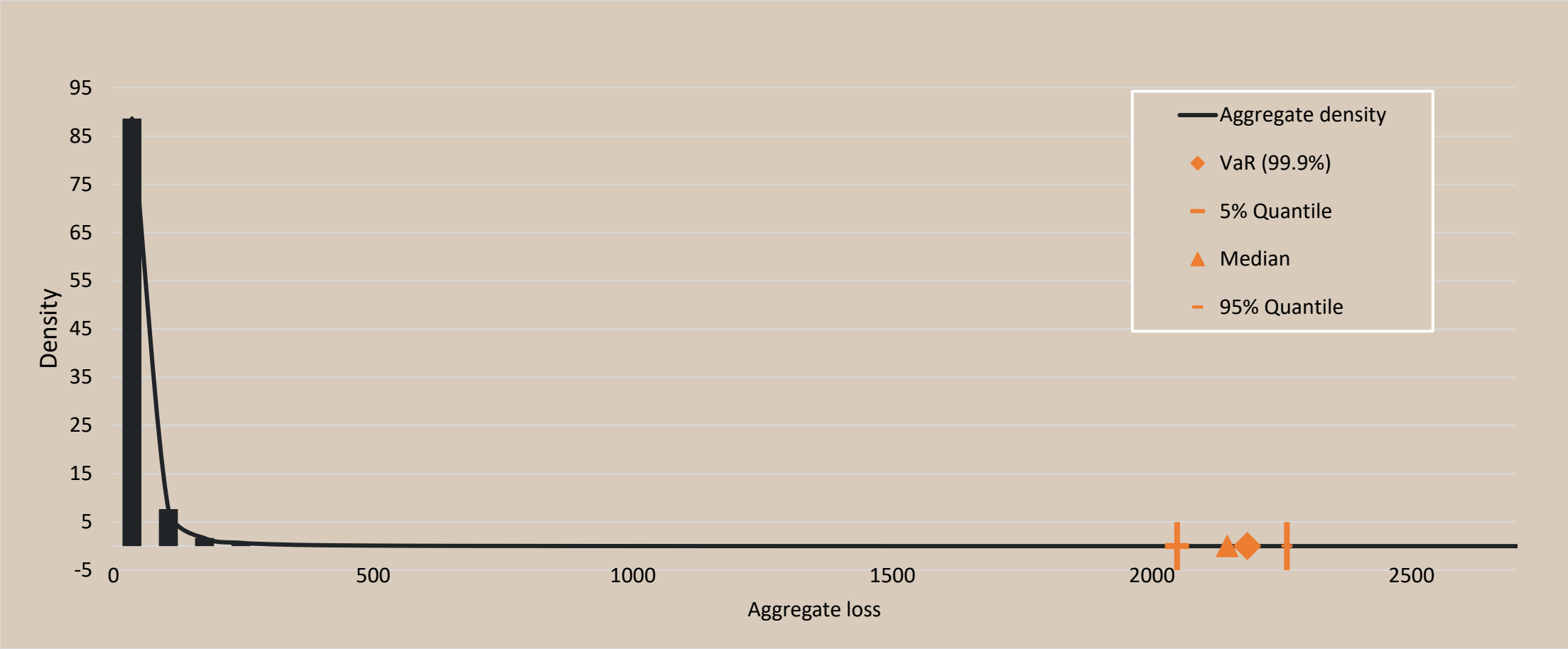
– extremes

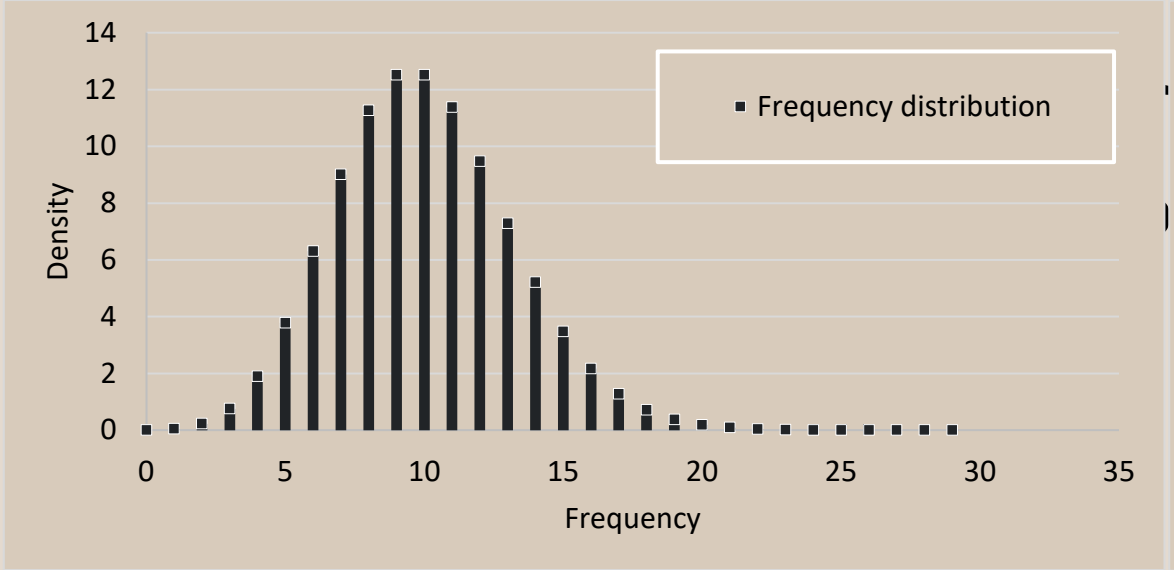
– tail events

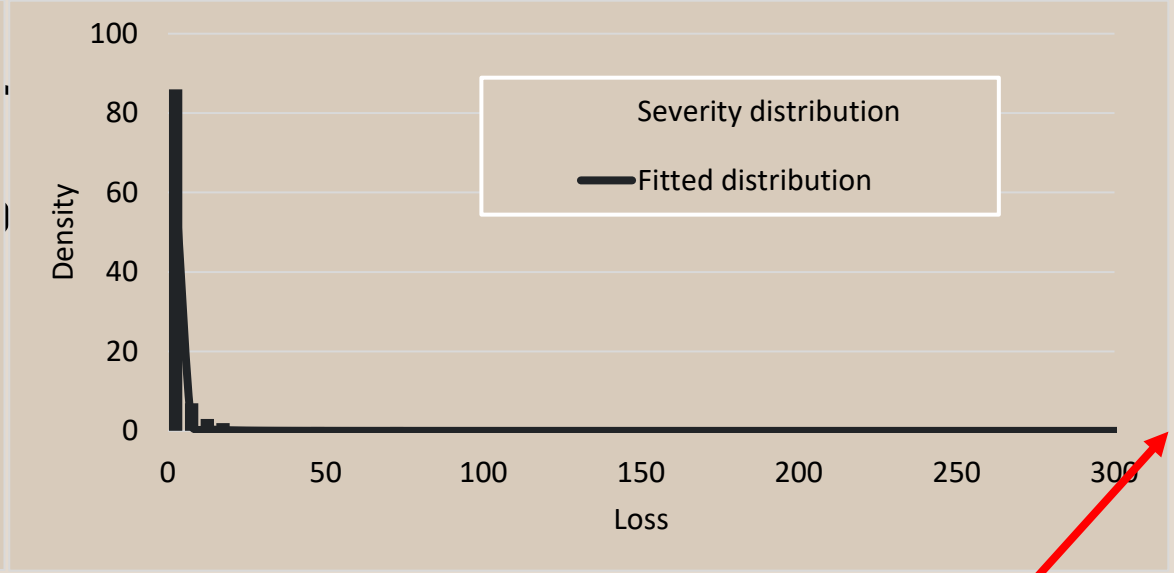
– black swans

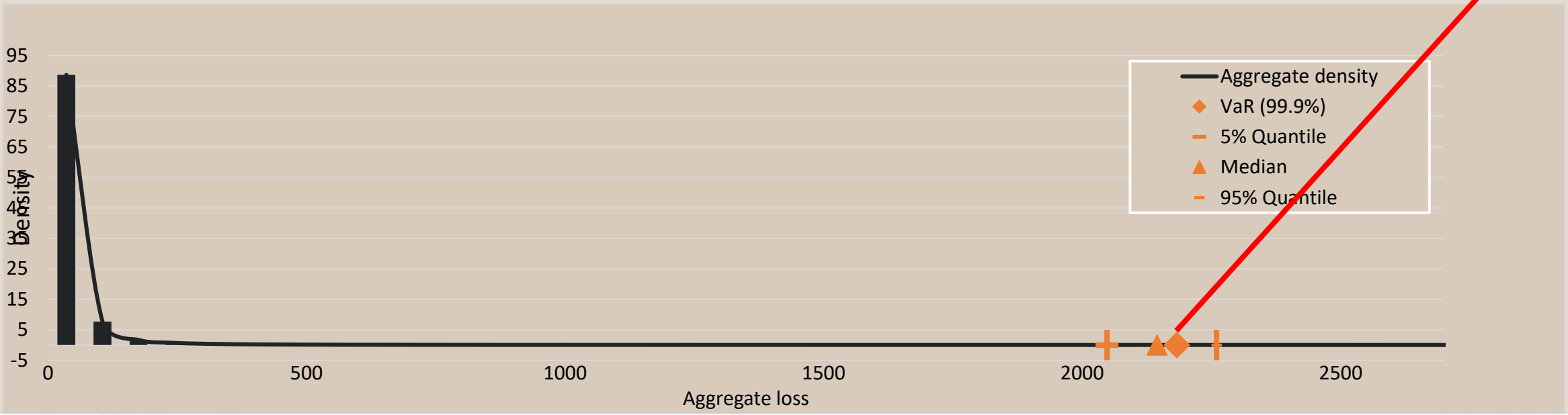
Models: Wrong or useful?

Examples 2 & 3



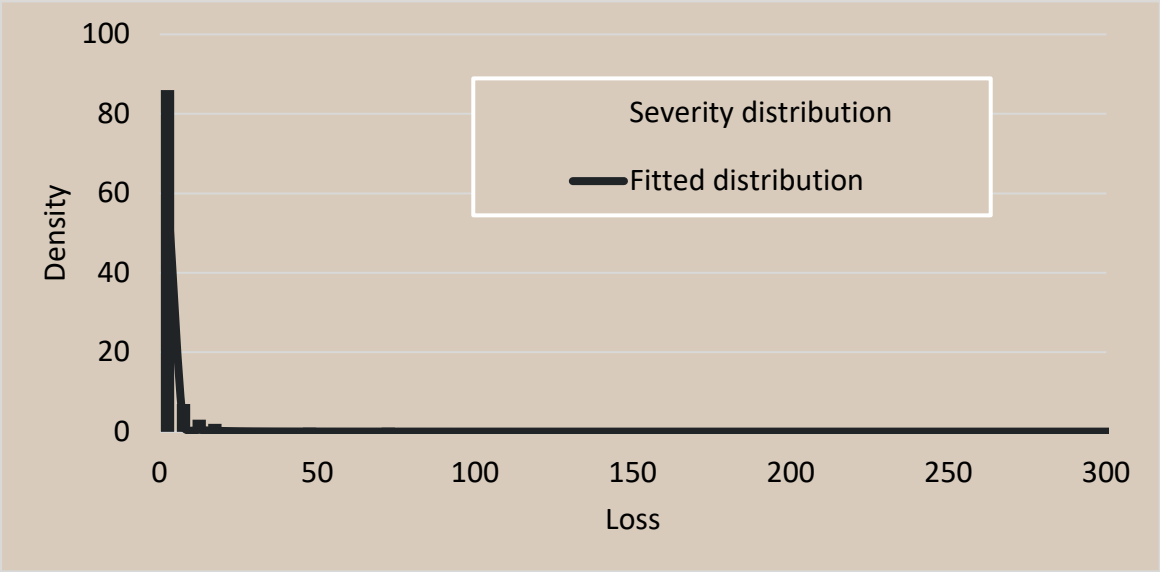

Frequency distribution
Density
Frequency
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30
35

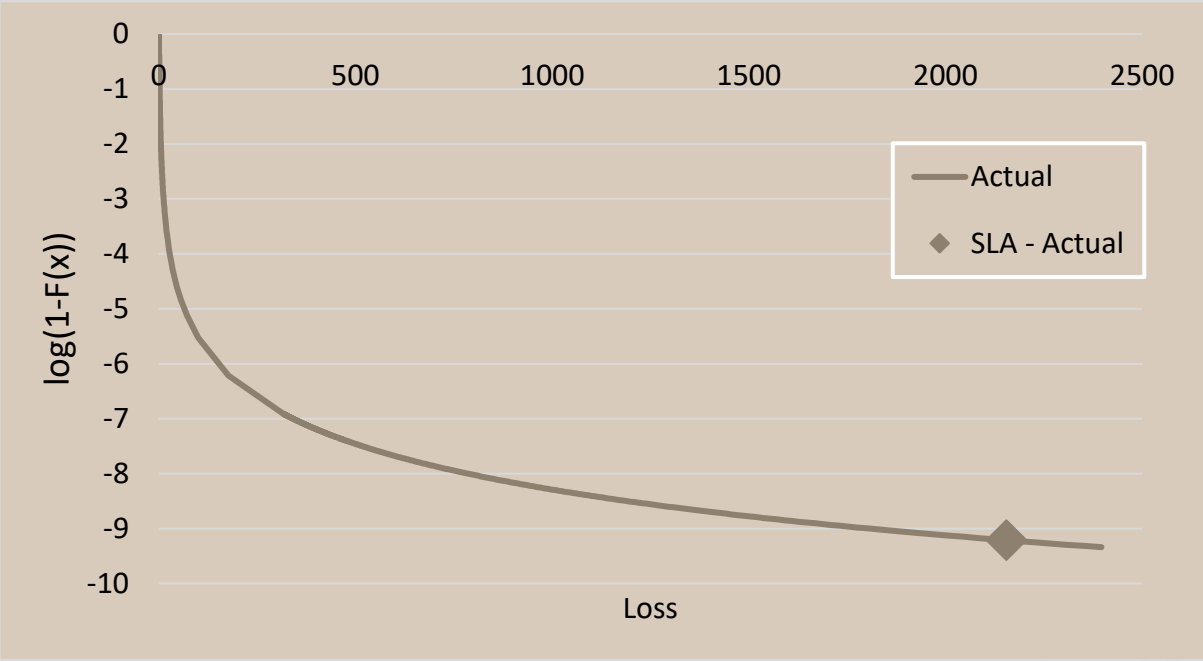

Severity distribution
Fitted distribution
Density
Loss
0
20
40
60
80
100
0
50
100
150
200
250
300


Aggregate density
VaR (99.9%)
5% Quantile
Median
95% Quantile
Density
Aggregate loss
-5
5
15
25
35
45
55
65
75
85
95
0
500
1000
1500
2000
2500

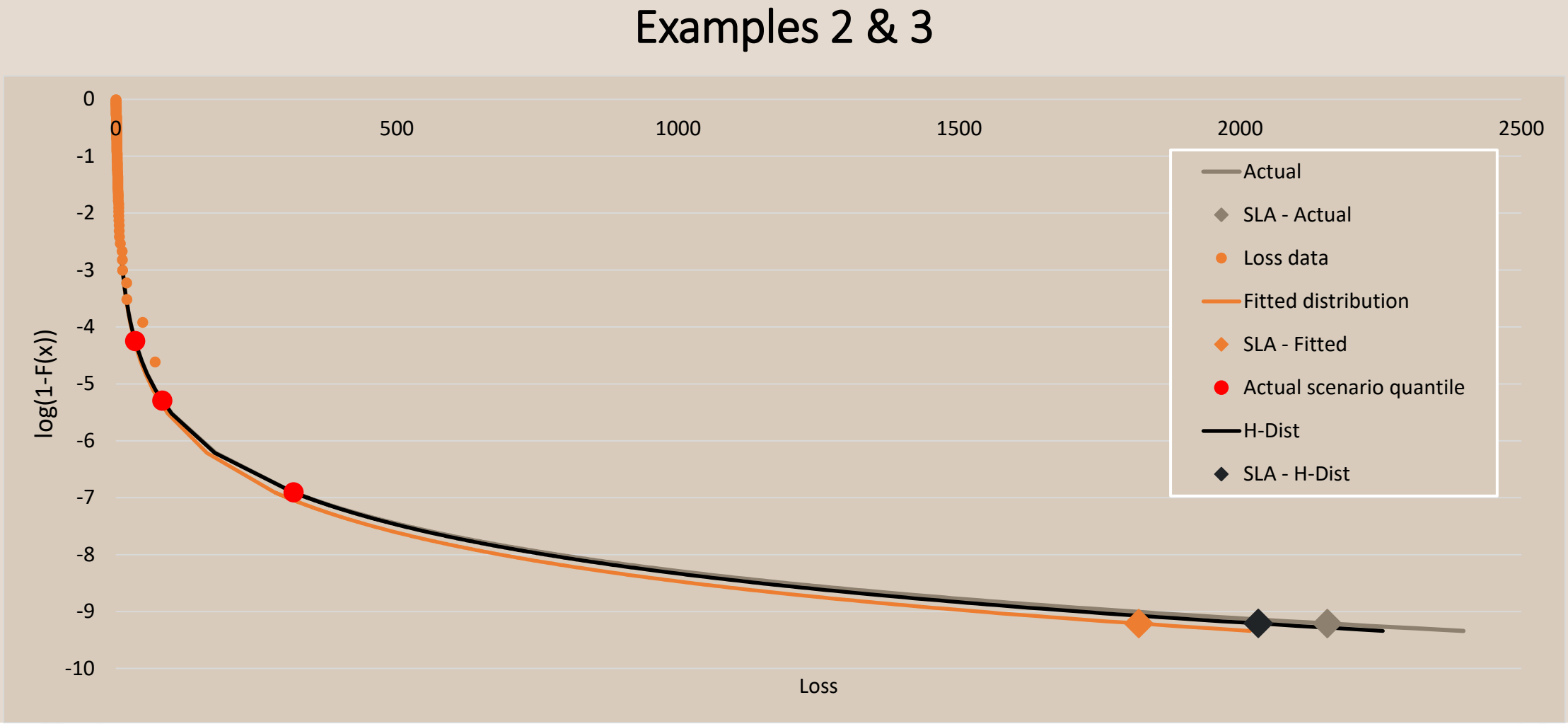
Models: Wrong or useful?

nples 2 & 3



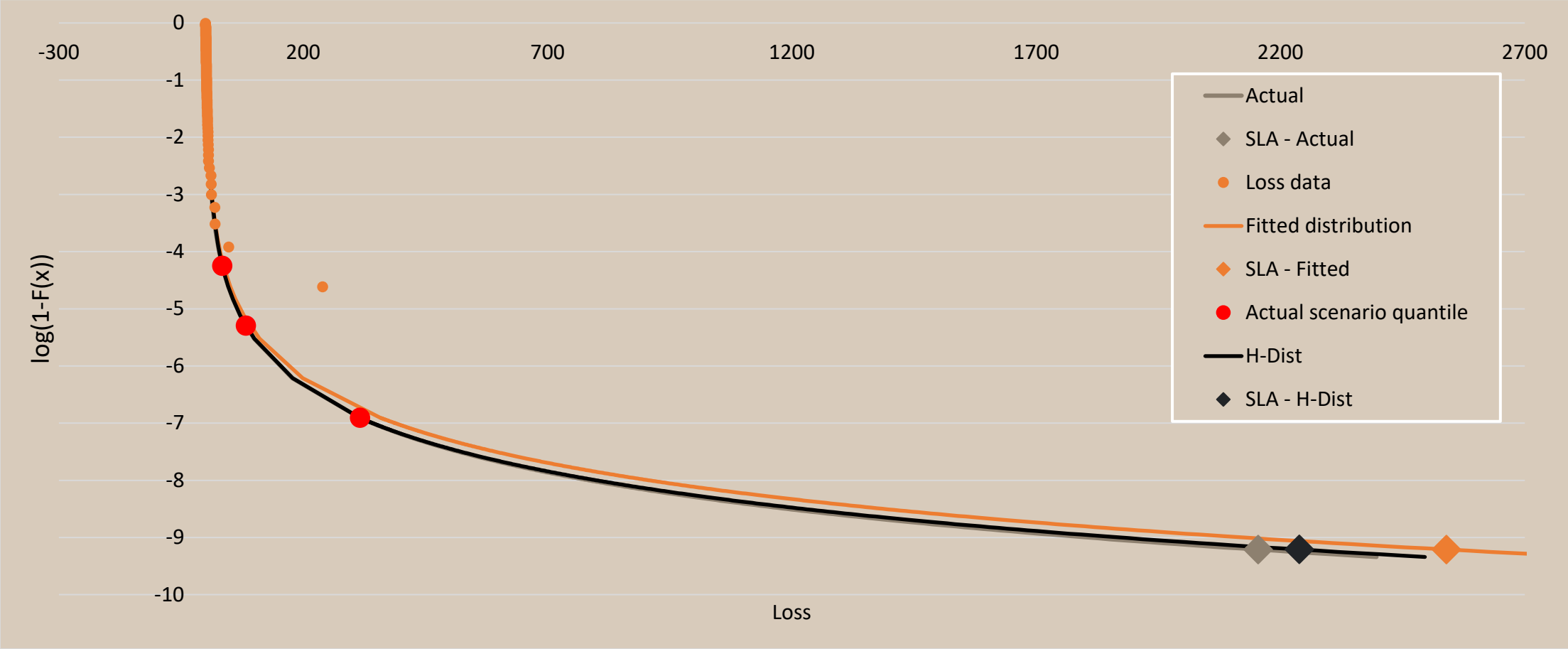


Models: Wrong or useful?



Models: Wrong or useful?

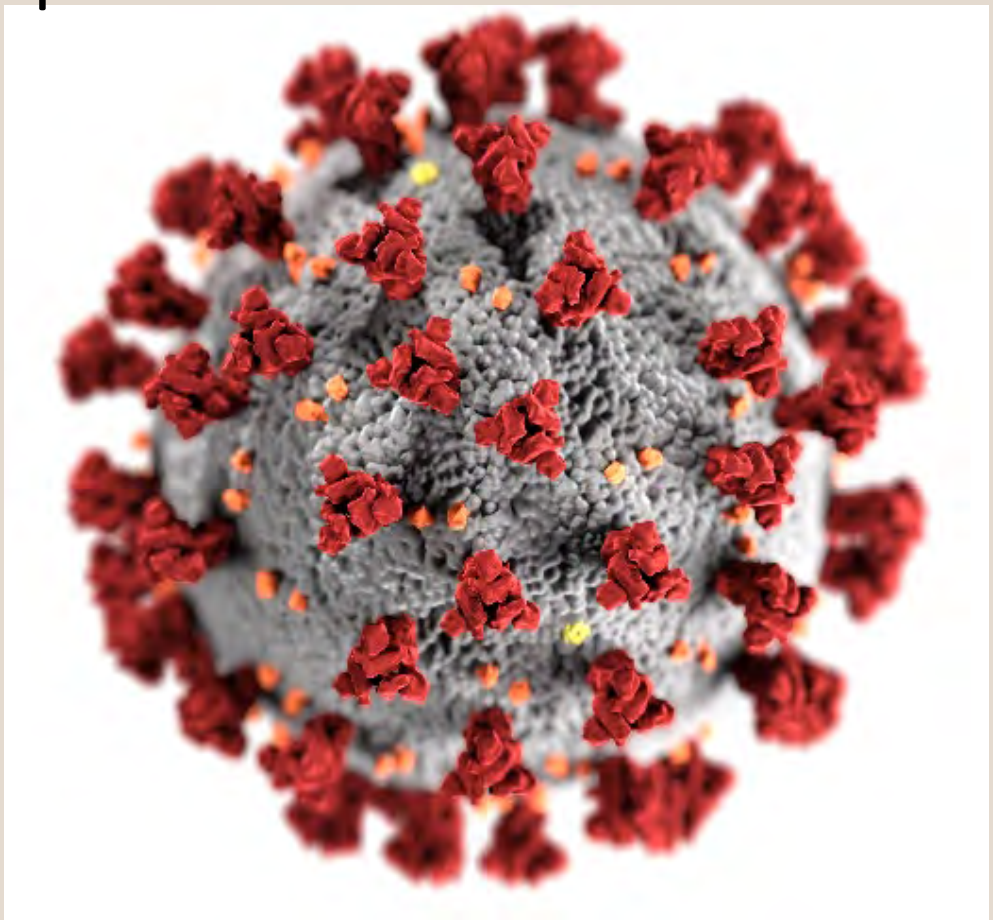
Examples 2 & 3



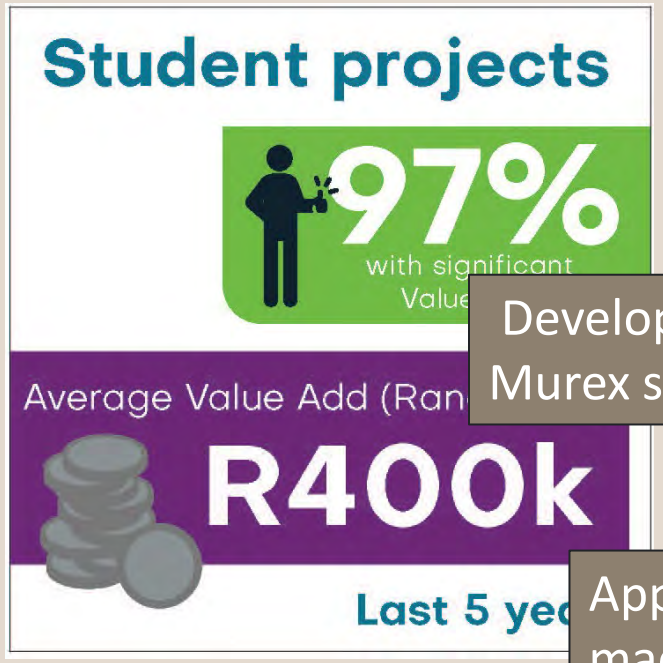
Models: Wrong or useful?

Example 5: Covid 19 pandemic

- Things don't react as they used to
- Influence of payment holidays on credit loss models
- The reaction to macro economic indicated changed



Models: Wrong or useful?



Developing a dynamic model for IFRS 9 stage impairment classification (2020)

case study in

Building a challenger model on credit bureau data to better explain the claims experience of vehicle insurance contracts (2020)

Develop

Investigation into the use of machine learning based approaches to support the estimation of claims reserves

Develop independ

Murex system (

Development of a customer churn prediction model in retail banking (2019)

Development of a transactional fraud model for store

Approaches to incorporate forward-looking macroeconomic information into probability of default models for corporate credit risk (2019)

growth in a

home loans portfolio and non-performing loans in order to manage risk appetite (2018)

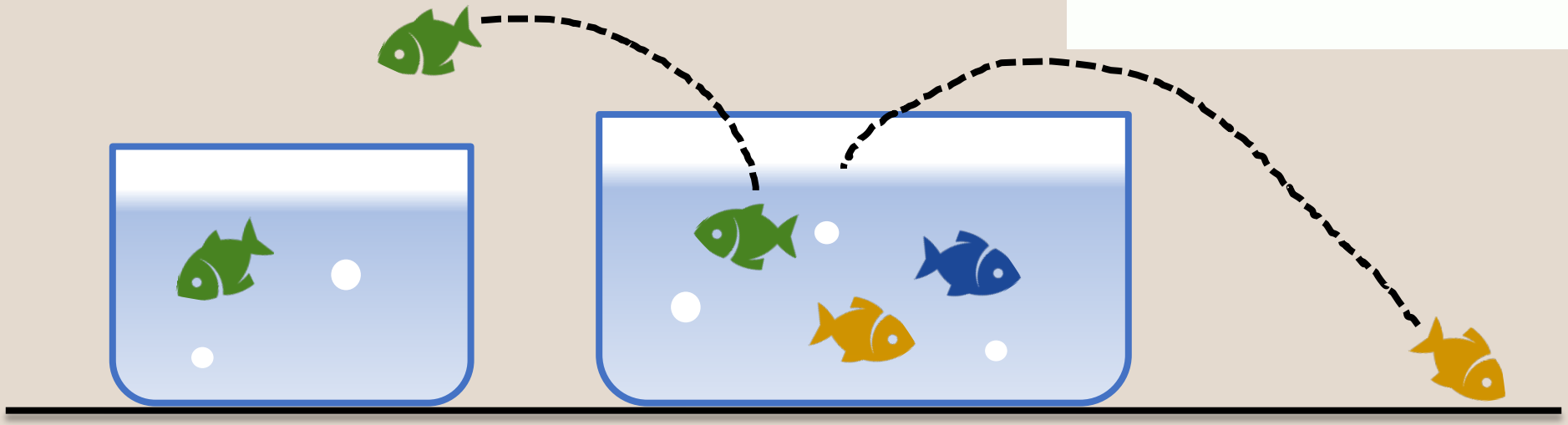
Development of an IFRS 9 cash flow model based on the expected credit loss methodology (2019)

Models: Wrong or useful?

100s more examples

Development of a customer churn prediction model in retail banking (2019)

Capricorn Group



Some final notes

Entrepreneurial approach / Industry engaged

- **2009** Absa IDRP: Forward looking Risk Analysis utilising Loss data to assist Budgeting for expected losses and to optimise growth assumptions in Operational Risk Capital
- **2011** Standard Bank - Operational risk capital model validation
- **2012** Absa IDRP: Operational risk capital model validation
- **2014** Student Project: Development of a challenger methodology for integrating historical data with scenario assessments in Operational Risk capital modelling (2014)
- **2015** Combining scenario and historical data in the loss distribution approach: a new procedure that incorporates measures of agreement between scenarios and historical data
- **2016** Won 3 national and international accolades and included in the "Good Practice Guide to Setting Inputs for Operational Risk Models" of the Institute and Faculty of Actuaries (UK).
- **2017** Implemented at Absa
- **2019** Investec - Operational risk capital model validation
- **2020** Implemented at Investec, SA & UK

Thank you

NWU Management

Prof Riaan de Jongh

Prof Machiel Kruger

BMI – Colleagues