EDHEC BUSINESS SCHOOL

FEN_842 Risk Measurement

Lecture 1
Risk Management intro

Winfried G. Hallerbach PhD

March 17, 2025

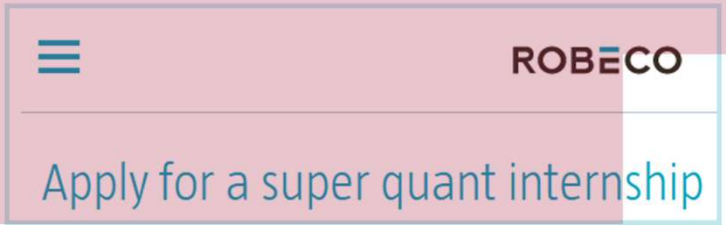
Make an impact

Personal introduction

- professor of finance :

- coordinating faculty member :

- director Quant Fixed Income :



- Financial Strategies Group :

Risk Measurement

This course is about what ?

what is **risk** ?

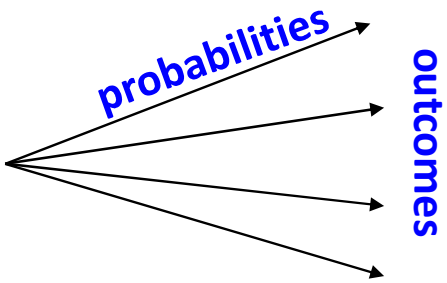
what is **uncertainty** ?

what is **ignorance** ?

Risk

What do / can we know of the future ?

now **“later”**



ex-ante, prospective

several possible outcomes

risk	uncertainty
uncertainty	ignorance

known / not known

outcomes

known / not known

probabilities

- Knight [1921] made distinction between uncertainty and risk (“measurable uncertainty”)
- compare with “known knowns, known unknowns, and unknown unknowns”
- people tend to fill in the blanks → story telling, overconfidence

Course information

Lecture outline including grading weights

1. risk management intro
2. risk measures
3. risk measure estimation
4. risk measure evaluation
5. estimation risk & model risk
6. looking further

	PGE :	non-PGE :
group case assignment :	**100%**	**50%**

groups of 3 students

skills, competences

knowledge

individual final exam : **N/A** **50%**
open + MC Qs, closed book

Lecture material

See my announcement mail from last Tuesday (March 11)

- slides (-notes) & lectures are compulsory for final exam → only for non-PGE
  of course, it also helps for making the assignment

- slides are quite "full" → self-contained, reduces own note taking
  → take notes / annotate slides **by hand** instead of typing on laptop :

- posted on BlackBoard : pdf's of slides with notes sections
- notes sections contain additional comments and references to literature & URLs

- readings are only complementary : suggested & background

- **NO Excel sheets / code snippets available** → replicate results yourself, "learning by doing"

Grading of group assignment (1)

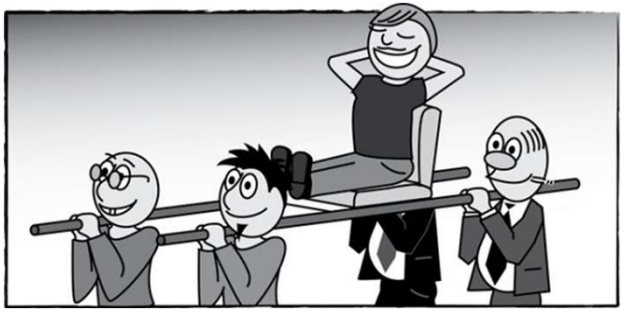
Knowledge ↔ skills & competencies

- based on content AND form → exercise in writing actual research report
  → the **final report** is graded → time planning !

- I encourage you to contact me with Qs about research set-up, report outline etc before / during / after lectures, via email

- potential problems in group work :

free riders



equal participation
equal contribution

dominators

Grading of group assignment (2)

Peer evaluation & collaboration criteria

- from group grade to individual grade : → adjust for individual contribution
  → use **peer evaluation**

- each group member grades the other group members on a 5-point scale

criteria :

- **form & interpersonal skills :** communication and collaboration with other group members :
  . attendance and well-prepared constructive participation in meetings
  . cooperative and supportive attitude, ability to manage conflict
  . clear communication with group members
  . focus on completion of assigned tasks in a timely manner
  . reliable & responsible group member
- **content contribution :** amount & quality :
  . participation in idea generation, calculations, results discussion, writing the research report
  . ability to contribute quality work at the standard required for the assignment

Grading of group assignment (3)

Calculation of individual grade from group grade (group = 3)

- calculate your average score from the grades [1:5] given by the other group members :

$$score_i = \frac{1}{2} \sum_{j \neq i, j=1}^{2} grade_{from\ j\ for\ i}$$

- divide by avge score to obtain Peer Adjustment Factor :

$$PAF_i = \frac{score_i}{\frac{1}{2} \sum_{j=1,2} score_j}$$

- trim PAF to min 0.9 and max 1.1 :

$$PAF_i^* = \max\left[0.9, \min\left[1.1, PAF_i\right]\right]$$

- $individual\ grade_i = group\ grade \cdot PAF_i^*$

  capped at 20

example :

	evaluated by :					
student :	A	B	C	score	PAF	**PAF***
A		5	5	5.00	1.15	**1.10**
B	4		3	3.50	0.81	**0.90**
C	5	4		4.50	1.04	**1.04**
avge :				4.33		

student :	group grade	PAF*	**indiv grade**
A	16	1.10	17.60
B	16	0.90	14.40
C	16	1.04	16.62

What this course offers (1)

- you have mixed background,
  different prior finance / statistics / econometrics knowledge → I have to find a middle ground

- **theory** : opportunity to explore new ideas & learn new concepts … but also :

  - **practical relevance** + **implementation** + **communication**

- real life is not an exam question !

  → "learning by doing"
  → competences & skills
  → case assignment

  → research report

What this course offers (2)

- instead of providing you with many separate concepts ….

- this course presents foundation concepts and their relation, highlighting practical relevance & application

- this foundation tree of theoretical & practical knowledge provides a firm basis for further embellishments

Theory : still confused ….

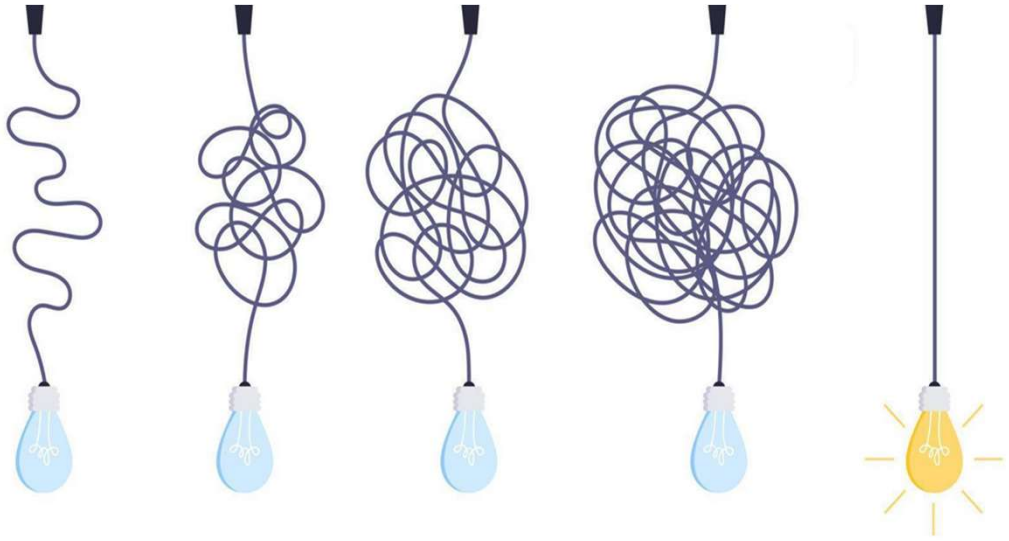
… but at a higher level

Finance is an **“emergent” discipline** :

understanding does not tend to grow gradually over time,

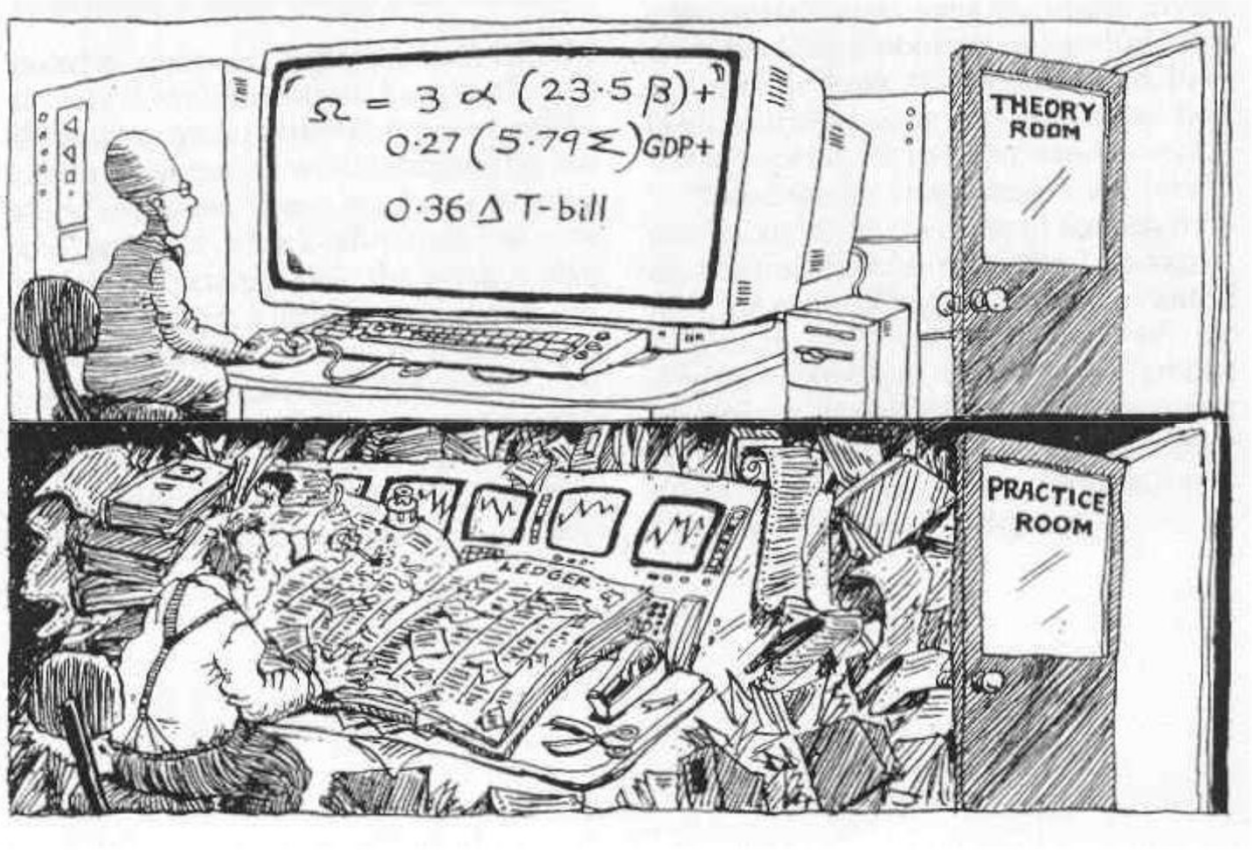
but in a **“click fashion”**

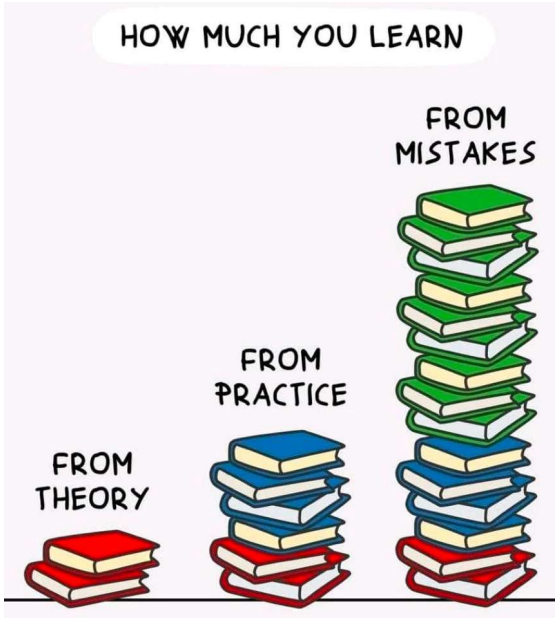
- questions
- confusion
- …
- confusion, but at a higher level
- …
- understanding



so do not panic !

Theory versus practice …





“Low fat modeling”

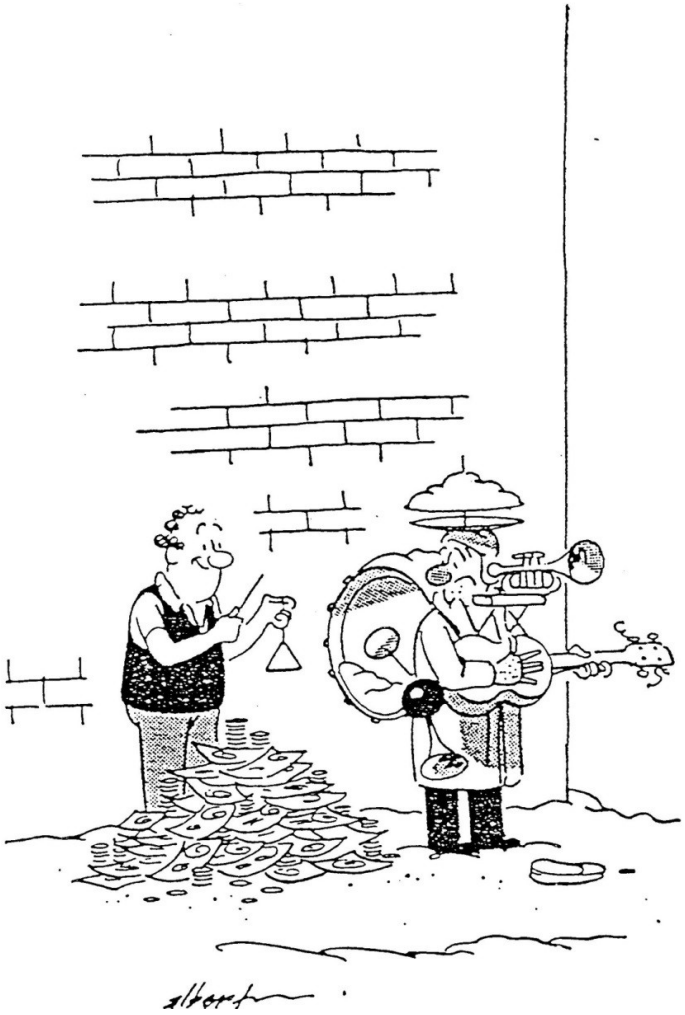
… to enhance robustness

- no complex hypotheses,
  but shave with **Occam’s razor** :

  principle of parsimony

- “Make everything as simple as possible,
  but not simpler” (Albert Einstein)

- need **expertise** to place assumptions
  that make problem tractable,
  but do not “hurt” too much
  in straying from reality



Outline of lecture 1

Introduction risk management

- Bird's eye view : the risk management process
- Behavioral considerations : heuristics & biases
- Financial debacles : overview & Archegos

Risk Management

Risk measurement is part of **risk management** process

Q : ***what*** *is risk management ?*

not : ...
but : ...

Q : ***why*** *risk management ?*

...
...
...

"The bad news is our fund lost millions. The good news is none of it was our own money."

Risk Management

Risk measurement is part of **risk management** process

risk management framework :

1. analysis
2. policy
3. implementation
4. monitor, evaluate & report

→ identification & measurement :
frequency & severity / exposure

→ plan : . diversification
. hedging
. insurance
. no action

→ feedback loop

Risk Management (1)

Step 1 : Analysis – risk typology, according to sources

market risks : unexpected fluctuations in :
- equity prices
- interest rates
- exchange rates
- commodity prices

credit risks : deterioration of credit quality / default of counterparty

liquidity risks : market/asset : impossibility to trade against fair market prices
funding : financial buffers exhausted, marking-to-market requirements

operational risks : BIS : “risks other than credit and market risk”
“The risk of direct or indirect loss resulting from inadequate or failed internal processes, people & systems or from external events.”

reputational risks : failure to comply with regulatory or legal obligations
failure to deliver minimum standards of service & product quality
unethical practices (exposed)
→ loss of good name, “risk of risks”

Risk Management (1)

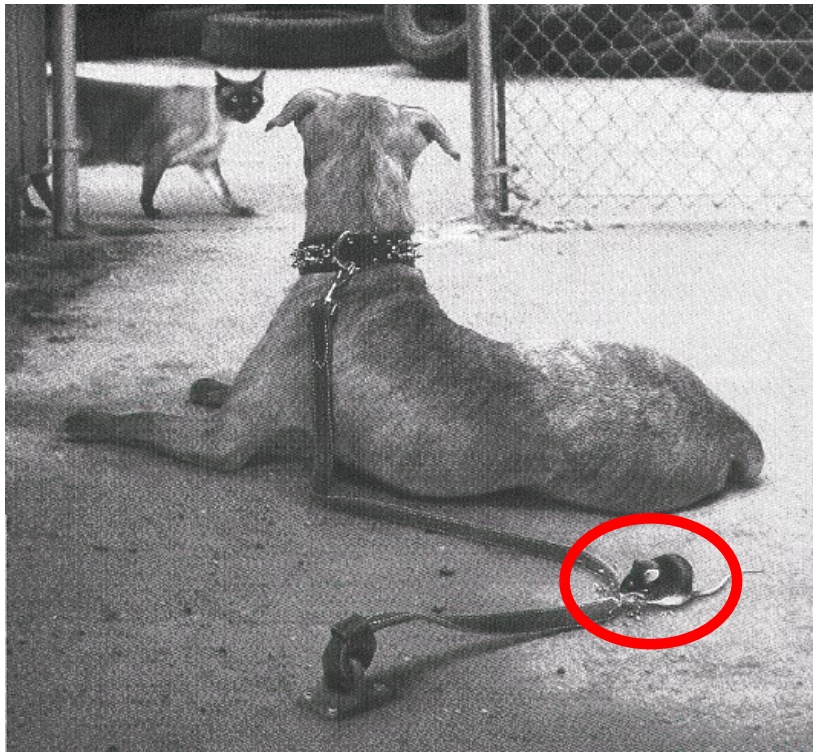
Step 1 : Analysis – exposure awareness

the dog, the cat ...

Risk Management (1)

Step 1 : Analysis – exposure awareness

... and the mouse



be inventive to imagine the “impossible” : remember Murphy ?

Risk Management (1)

Step 1 : Analysis – probabilities

risk analysis : what can happen ?
with what probability ?
how will it affect me ? → exposure

subjective probability concept : "gut feeling"
importance of collecting information
to update vague notion to more precise estimate
"learning"

problems with **risk perception :** behavioral biases (see later)

objective probability concept :
based on relative frequency from historical data
parametric ? Gaussian ???
representative period ?
past is mirror of the future ?

Risk Management (2)

Step 2 : Plan

Q : *what is the difference between* ***hedging*** *&* ***speculation*** *?*

in practice we observe :

"selective hedging" :

depending on expectations on
future risk sources,
exposures are hedged / left unhedged

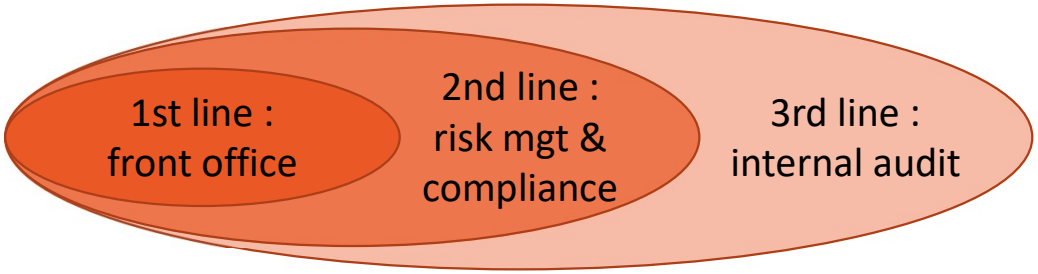
Q : *what is the role of*
expectations
in risk management ?

Risk Management (3)

Step 3 : Implementation of risk management within investment firms

hardware :

- organization : separation of functional responsibilities
  "3 lines of defense" :



① portfolio managers (PMs) : risk takers, "risk owners"

② independent oversight on PMs, monitoring & reporting
control framework for financial & operational risks

③ independent assurance of effectiveness
of 1st and 2nd line risk management

- technology

Risk Management (3)

Step 3 : Implementation

hardware

software :

procedures, information flow
controls & limits :
on (max) positions, exclusions, leverage,
on liquidity,
on counterparty exposure

internal limits : risk management dept (2nd line of defense)
external limits : clients, regulation

active breach : caused by PM, when portfolio revision does not comply with restrictions
passive breach : not due to portfolio changes,
but to market fluctuations, in-/outflows, rating changes e.g.

note : passive breach becomes active breach if not corrected within reasonable time period

Risk Management (3)

Step 3 : Implementation

hardware
software

"governance"
→ controls risk management process
→ transparency, responsibility & accountability

what could possibly go wrong ???

wetware :

"human factor"	→ behavioral biases
communication	→ Kepler
control	→ audit : abuse, misuse, fraud
	feedback : control process
learning organization	→ Darwin

Risk Management (4)

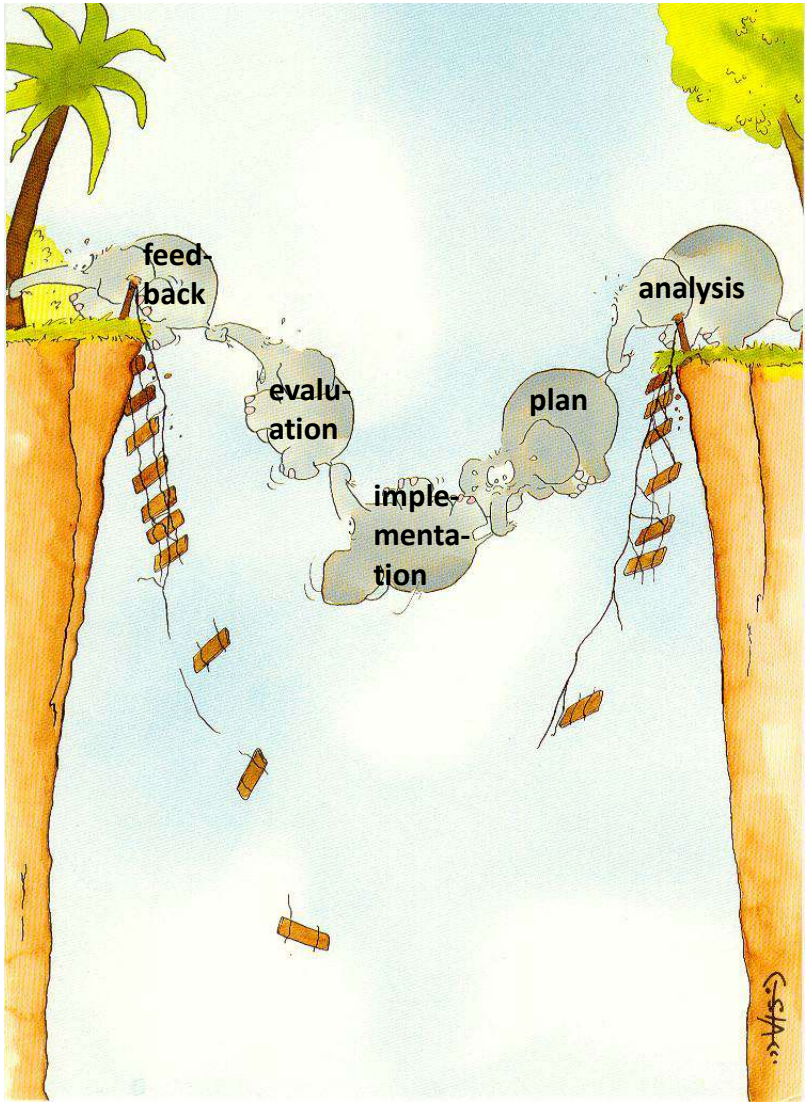
Step 4 : Communication

internally : avoid **"wizard risk"**

externally : transparency : no "lemons" → sub-prime mortgages in the 2008 GFC

A continuous process …

The weakest link …



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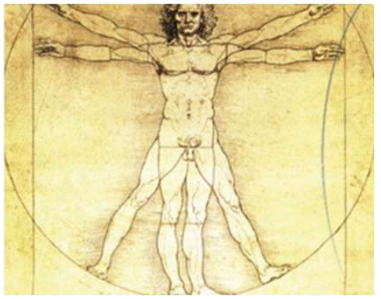
Theory versus practice …

economic theory : "homo economicus", "Rational Actor Theory" (RAT)



- fully informed
- fully rational
- optimizers ("max EU")

practice : suboptimal decisions

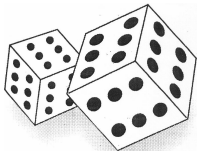
- **bounded rationality :** cognitive limitations, imperfect information, time constraint
- **heuristics :** "rules of thumb", "shortcuts"
- **behavioral biases :** predispositions toward systematic errors in processing & interpreting data
  - **emotional biases :** "not thinking" : impulses, intuition & feelings distort reasoning
  - **cognitive biases :** "errors in thinking" : basic statistical, info-processing, memory errors

“Just a normal day …

.. at the nation’s most important financial institution …”

Behavioral considerations

"Intuition is a good servant, but a bad master…"



Instead, we categorize according to :

- the **perception** of risk,
- making **predictions**, and
- the **preferences** towards risk → next slides

In a nutshell, people :

- have blind spots : illusions about their chances, probabilities
- are overconfident in their capabilities – fueled by :
  - illusion of knowledge : over-estimate how much you know / understand
  - illusion of control of the situation, with ex post rationalization of past events
  - self-serving bias : self-enhancement : success is attributed to own actions & decisions
    self-protection : failure is attributed to external factors
    → people **do not learn** from (their) mistakes …
- show strong loss aversion : do almost everything to avoid losses
- show strong regret aversion, coupled with hindsight

Perceptions (1/2)

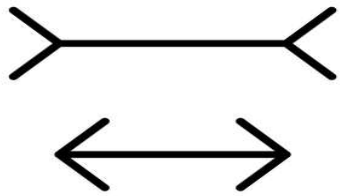
Biased observations

- pareidolia : seeking patterns that do not exist
- apophenia : perceiving meaningful connections between unrelated things, believing that random events are less random

- familiarity : preferring things that are familiar, may enhance blind spots
- availability : the ease with which occurrences can be brought to mind biases risk perception : retrievability (recent car accident); imaginability (9/11, Trump)

- representativeness : using stereotypes, prototypes or averages to form judgment
  good company → good stock

- context framing : **strong** sensitivity to the way information is presented
  Müller-Lyer illusion :
  moon illusion



Perceptions (2/2)

Biased analysis

- conjunction effect : Pr{combined event} > Pr{single event}
  sensitive to coherent (but redundant) stories
- small sample bias : drawing false conclusions from insufficient data & filling gaps with a story
- confirmation bias : looking only for information that supports existing / preferred beliefs
  "selective perception" → to avoid cognitive dissonance
- ex-post rationalization : increases probability of an event's past occurrence
- the resulting hindsight bias promotes over-confidence
  this may lead to under-estimating risk ;
  likewise, random events (noise) may be considered as coming from foolish mistakes & trigger action to correct

Making predictions (1/2)

Dealing with uncertainty

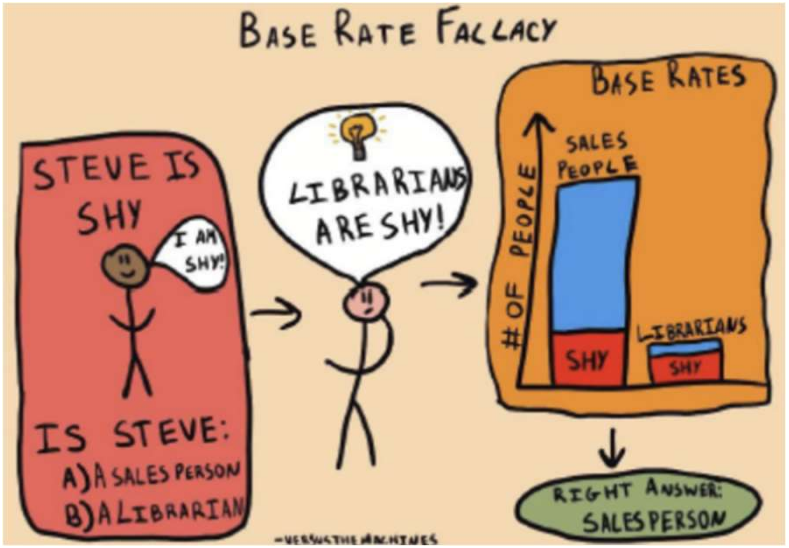
- misconception of chance : "gambler's fallacy", "that cannot be coincidence….", "hot hands", attribute causality to random sequence of events
- illusion of validity : misplaced trust in predictions based on redundant (i.e. consistent) data, over-confidence from "story telling"

Q : *for one year, either salary of € 100,000, or € 0.01 in first week, doubles every week ?*

- anchoring and insufficient adjustment :
  - → the power of compounding (exponential vs linear extrapolation)
  - → current situation (portfolio) is anchor against which profit & loss is evaluated
  - → adjustment is too small (dare to be more aggressive, but beware of over-reaction)

- herding : peer pressure, "better fail conventionally than succeed unconventionally", group think → magnifies psychological biases, polarization of opinions

Making predictions (2/2)



- neglecting base rate probabilities when making predictions

  details are likely to increase probability when in effect they decrease likelihood → conjunction bias
  story telling increases perceived probability of an event

- overweighting low probabilities, unlikely outcomes

  → preference for "lottery stocks" : low price, high volatility, high return skewness
  → (active) weight of stock for which special event is expected will be too large

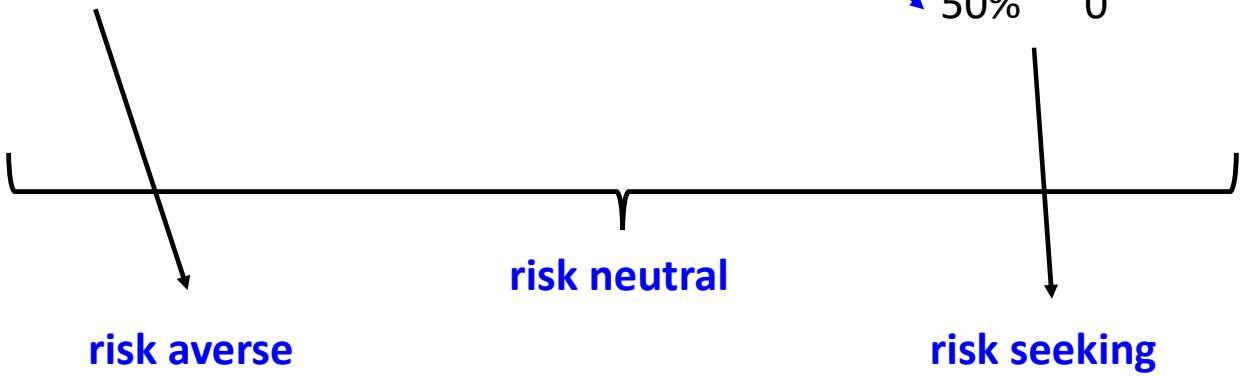
- over-confidence, optimism & blind spots :

  exaggerate your talents : 80% is "better than average person"
  illusion of control : under-estimate the role of chance,
  under-estimate likelihood of outcomes over which you have no control

Risk attitude (1/8)

Evaluating uncertain outcomes

compare a **certain** amount of 50 against a **gamble** of : 50% 100 / 50% 0 — expected monetary value = 50



- in general we observe risk aversion → insurance
- sometimes risk loving → casino, lottery
  → low stake, very low probability of high payoff

Risk attitude (2/8)

Gains / losses instead of wealth

- risk attitude seems to depend on initial situation :

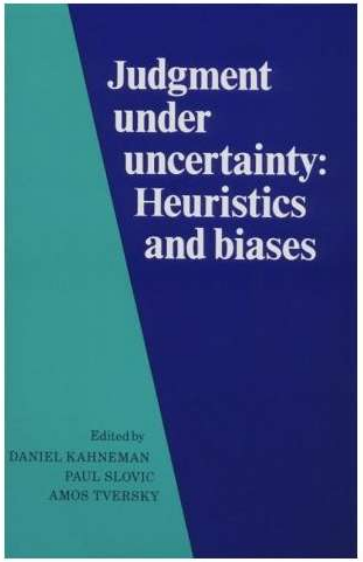
  importance of current situation as a **reference point** or "**anchor**"
  not value, but **gains & losses**

- more sensitive to losses than for gains : "loss aversion"

  → not losing is more important than winning
  → conservatism + break-even tendency

- profit situations : risk averse behavior
  loss situations : risk seeking behavior implied by loss avoidance :
  trying to recover losses

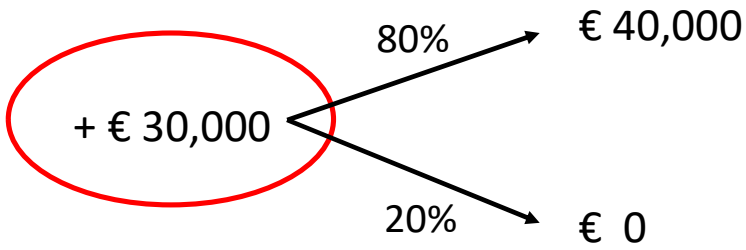
Kahneman, Slovic & Tversky : "Judgment Under Uncertainty", 1982 : **Prospect Theory**

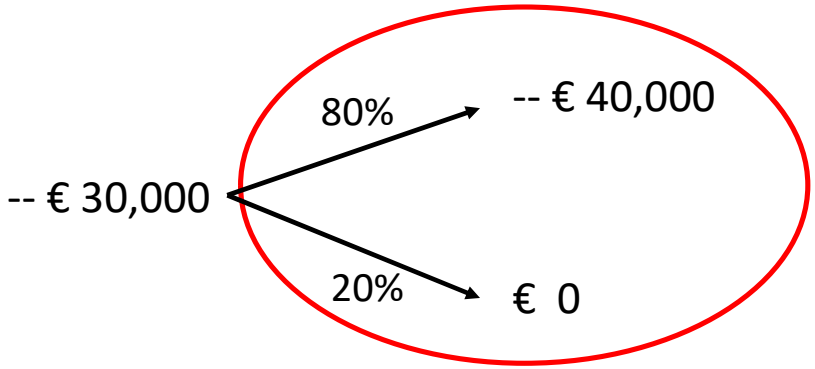


Risk attitude (3/8)

Different starting points : “anchors”

loss avoidance implies **risk seeking behavior in loss situations :**





Risk attitude (4/8)

Different starting points : “anchors”

current situation is **anchor against which profit / loss is evaluated :**

now :	**later :**	
0 : € 100	1a : € 100	
	1b : € 0	50%
	€ 200	50%
0 : € 200	1a : € 100	
	1b : € 0	50%
	€ 200	50%

Risk attitude (5/8)

Framing revisited

risk attitude even depends on **context framing :**

“loss” :

either sure loss of € 50

?

25% : 200 loss
75% : 0 loss

“cost” :

pay insurance premium of € 50

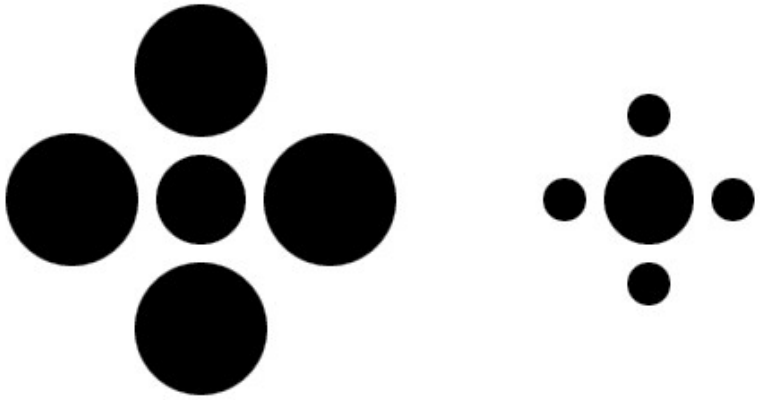
to avoid

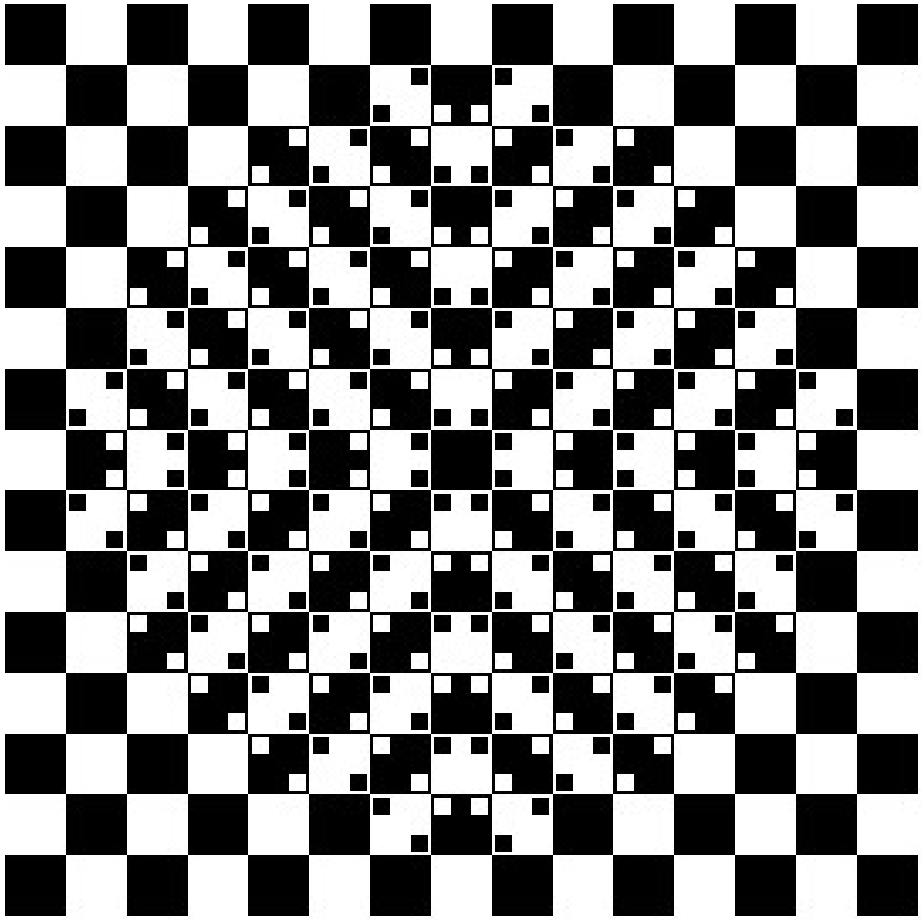
25% : 200 loss
75% : 0 loss

Risk attitude (6/8)

Framing revisited

success rate of 70% or **failure rate** of 30% ?





Risk attitude (7/8)

Evaluating uncertain outcomes

- myopic loss aversion : frequent performance checks increase sensitivity to downside volatility
- mental accounting : treat money differently depending on source & use, “separate accounts”
  “narrow choice bracketing” : take decisions in isolation
  ignoring correlations between opportunities :
  evaluating stand-alone performance,
  instead of contribution to diversified portfolio
- sunk cost fallacy : looking back on efforts already spent instead of to future rewards,
  “spilt milk”
- status quo bias : or “inertia” : preference for current state, sticky beliefs, perseverance
  more sensitive to risk than opportunity
- endowment effect : assign higher value to your current assets / positions / models

Risk attitude (8/8)

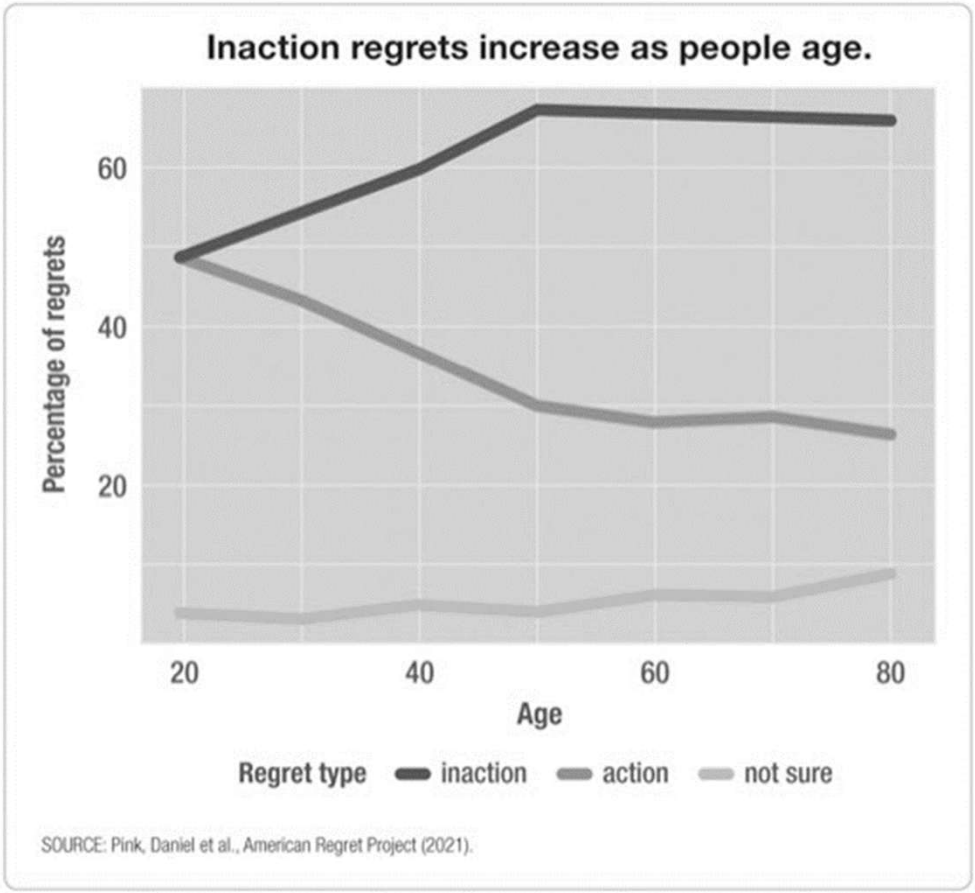
Perhaps strongest emotion ...

- extreme regret aversion :

  inaction / omission regrets :
  missed opportunities increase risk taking

  action / commission regrets :
  failed opportunities decrease risk taking

- Daniel Pink's
  https://worldregretsurvey.com/



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- Behavioral considerations : heuristics & biases
- Financial debacles : overview & Archegos

Some financial debacles

The top-5, as per ultimo 2023

- risks gone wrong,

  including both fraudulent and non-fraudulent losses

Nominal amount lost	Country	Company	Source of loss	Year	Person(s) associated with incident
USD 10 bn	United States	Archegos Capital Management	Total return swaps	2021	Bill Hwang
USD 9 bn	United States	Morgan Stanley	Credit Default Swaps	2008	Howie Hubler
USD 9 bn	United Kingdom	JPMorgan Chase	Credit Default Swaps	2012	Bruno Iksil
USD 8 bn	China	Tsingshan Holding Group	Short positions on nickel	2022	
USD 6.12 (EUR 4.9) bn	France	Société Générale	European Index Futures	2008	Jérôme Kerviel

Some financial debacles

Staggering losses, no learning ability …

- because of : the secretive nature of many investment vehicles (hedge funds), and
  the obvious reputational damage of disclosure

  this is only the **tip of the ice berg** ....

- "to educate and to entertain" : what can we learn from these debacles ?

- **do we really learn ?**
- **of the current top-20 debacles, 15 are NEW**

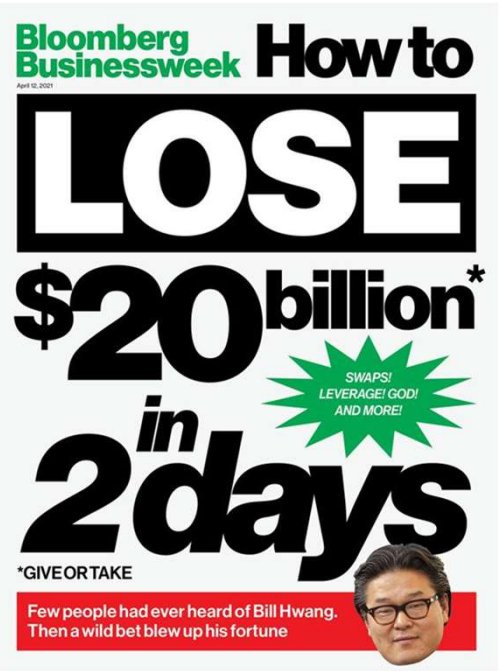
  since I started teaching risk management in the mid 1990s ....

ARCHEGOS
CAPITAL MANAGEMENT

Meet Bill Hwang

- 2013 : starts Archegos as family office (managing own money)
- high leverage, failing to meet margin requirements
- March 26, 2021 : loses USD 20 bln in 2 days

- irony : archegos means “one who leads the way so that others may follow”



Archegos Capital Management, LP

Investment Management · 1,613 followers

Archegos Capital Management, LP is a family investment office specializing in public equities primarily in the United States, China, Japan and Korea. The firm is located in New York City. The team employs a disciplined, research-driven approach to fundamental stock selection, while taking a multi-year approach to investing. Archegos Capital Management has a strong Mission and Values-driven culture and a deliberate focus on mentoring its people and growing them professionally.

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Background

- as a “family office”, Archegos : did not have to disclose positions
  was not subject to leverage restrictions
- stock picking strategy, huge & concentrated exposures via Total Return Swaps **TRS** :

pay LIBOR + 2% →

← *receive total return on reference asset*

→ enjoy full exposure to the reference asset without actually owning it

→ requires only small collateral (“margin”), so high leverage possible

→ conceals identity of investor + size of positions

→ each day, settle margin by receiving profits, paying losses

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Analysis

- **leverage :** 2021 : $ 20 bln AuM, leveraged to **$ 100 bln exposure** in only a few tech stocks
- **concentrated positions :** long positions in only a few media & tech stocks
- **hedging :** long positions not (partly) hedged by short positions in comparable stocks,
  but **only partly** with a "**portfolio short**", i.e. short in whole market via index futures,
  to mitigate losses if market plummets

  → problem if stock goes down but market does not ...
- **market impact :** building huge positions drives prices up : "positive feedback loop"
  huge returns → more capital → more investments with even more leverage
- paying huge **fees** to Credit Suisse, Morgan Stanley, Goldmans Sachs

- March 2021 : selected stocks plunge in a sideways market
- large margin calls deplete his buffer, but Hwang refuses to unwind swaps
- dilemma for banks : unwind TRS with big loss, or sit & wait … & pray

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The damage

- Deutsche Bank and Goldman acted quickly by unwinding the TRS & preventing losses
- Friday March 26 : Archegos fails to meet margin calls and defaults, banks start liquidating holdings
- Hwang loses $20 bln
- resulting fire sale knocked off $ 35 bln of value of US media and Chinese tech stocks

- big losses for broker banks, $10 bln total of which $5.5 bln for Credit Suisse
- loss of reputation, notable for **Credit Suisse :**

  “fundamental failure of management and controls”

- many other scandals,
  Greensill Capital debacle, > $2.5 bln loss

- March 19, 2023 : UBS acquires Credit Suisse

The New York Times

Daily Business Briefing ›

Credit Suisse finds incompetence but no criminal conduct in Archegos debacle.

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could this debacle have been prevented ?

- banks should have done **proper risk management**, should have limited leverage
- banks should have asked for **more transparency** of holdings :
  reveal total exposure
  prevent same collateral to be used for multiple TRS
- regulators should impose **more transparency**


FINANCIAL TIMES

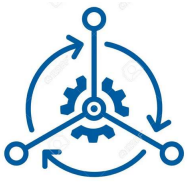
US COMPANIES TECH MARKETS CLIMATE OPINION WORK & CAREERS LIFE & ARTS HOW TO SPEND IT

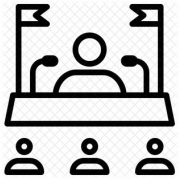
US financial regulation + Add to myFT

SEC proposes greater transparency for swaps at centre of Archegos collapse

Why do debacles still happen ?

- **increased complexity of financial firms and traded instruments** :
  high volume, multiple counterparties
  exotic instruments
- **insufficient risk management and internal controls :**
  cost-efficiency drive
  communication problems
  ineffective (bureaucratic) supervision
- **inefficient risk management and internal controls :**
  supervising incompetence, no collaboration
  no holistic supervision
- **collusion :**
  inadequate / no separation of functional responsibilities (front office – back office)
  cover-up (protect reputation)
- **agency problem :**
  adverse incentive system : fees, bonuses





Some final words …

"The best risk managers are judged by what doesn't happen to their companies. They don't have huge trading losses, their executives don't get investigated for fraud, and the names of their institutions don't disappear from the street…"

Some quant finance resources

A biased selection ….

How to become a quant : https://www.efinancialcareers.com/news/2022/01/quant-jobs-finance

@QuantEcon set of resources on quantitative economics and Python programming by economics Nobel prize winner Tom Sargent (@nyuniversity) & John Stachurski (@ANU_Research) : https://quantecon.org/lectures/
Separate lectures : Python Programming for Economics and Finance : https://python-programming.quantecon.org/intro.html
PDFs : . Intermediate Quantitative Economics with Python : https://python.quantecon.org/_pdf/quantecon-python.pdf
. Advanced Quantitative Economics with Python : https://python-advanced.quantecon.org/_pdf/quantecon-python-advanced.pdf

Free Quantitative Finance Resources : https://www.quantstart.com/articles/Free-Quantitative-Finance-Resources/

Online sources for quantitative finance research :
https://quant.stackexchange.com/questions/73853/online-sources-for-quantitative-finance-research

QuantLib : a free/open-source library for quantitative finance : https://www.quantlib.org/

EDHEC's Dominic O'Kane's Python Finance Library that focuses on the pricing and risk-management of Financial Derivatives, including fixed-income, equity, FX and credit derivatives : https://github.com/domokane/FinancePy , https://pypi.org/project/financepy/

The **CQF Institute**, network of quant finance professionals : https://www.cqfinstitute.org/