

Risk management: developing critical thinking in risk modelling with humanities and social sciences

Christian WALTER, Fellow IA, CERA

E-mail : christian.walter@msh-paris.fr

Academic and teaching blog: <https://epistemofinance.hypotheses.org/>

Outline

- Explain why humanities and social sciences are useful for developing critical thinking of actuaries in risk management
- Show how humanities and social sciences can enrich courses of actuarial science
 - Example of the quantification conventions of discounting

Why develop critical thinking in risk management?

- Professional standards ISAP and ASOP
 - Teach students about professional standards ISAP and ASOP
- ISAP 1 #2.7.2
 - The actuary should consider the **appropriateness of the assumptions** underlying each component of the **methodology** used.
 - Assumptions generally involve **significant professional judgment** as to the **appropriateness of the methodology** used and the parameters underlying the application of such methodology.
 - Assumptions may (...) be implicit or explicit and may involve interpreting past data or projecting future trends.
- ASOP 38 #3.3.4
 - The actuary should evaluate **whether the model is appropriate** for the particular actuarial analysis, and consider limitations of the model, modifications to the model, and the **assumptions** needed in order to apply the model output

Pierre Duhem's warning (for actuaries?)

- « To industrialists [**actuaries**] who do not care about the correctness of a formula provided it is convenient, we recall that the **simple, but false equation**, it is sooner or later, by an unexpected contrast of logic, the company that fails, the dam that bursts, the bridge that collapses, it's **financial ruin**, when this is not the disaster that mowing lives »
- « Aux industriels [**actuaire**s] qui n'ont cure de la justesse d'une formule pourvu qu'elle soit commode, nous rappellerons que l'équation **simple, mais fausse**, c'est tôt ou tard, par une revanche inattendue de la logique, l'entreprise qui échoue, la digue qui crève, le pont qui s'écroule ; c'est la **ruine financière**, lorsque ce n'est pas le sinistre qui fauche des vies humaines »

Pierre Duhem, *Revue des questions scientifiques*, 1893

2008: a lack of critical thinking?

Sarah Robertson
Risk manager



- **Calculations are right but the formula is worthless**
- What does that means ?
- The equation was simple but false.
- There are 8 trillion dollars of paper around the world on the line with that equation
- We are wrong



Jared Cohen
Head of Investment Bank



The formula that killed Wall Street

- The formula of David Li
 - Gaussian copula function
 - Based on the concept of probability
 - Bond investors are comfortable with the concept of probability
 - Performativity of the formula
 - Discourse: strong belief / wrong belief about the nature of uncertainty
 - Machines: bond investors, Wall Street banks, rating agencies, regulator etc.
 - Warnings about its limitations were largely ignored: financial *Logos*
 - Invisible technology
- **Financial risk modelling** questions the forms of calculation
 - Misplaced reliance on **financial risk modelling**
 - “*We are all wrong*”: self-fulfilling prophecy of risk model
 - **Quantification convention**
 - **The devil was in the “d-tails”: a tale of fat tails...**

feature

ASA Excellence in Statistical Reporting Award

The formula that killed Wall Street

Wall Street in the mid-1980s turned to the quants – brainy financial engineers – to invent new ways to boost profits. They and their managers, though laziness and greed, built a huge financial bubble on foundations that they did not understand. It was a recipe for disaster. The journalist Felix Salmon won the American Statistical Association’s Excellence in Statistical Reporting Award for 2010. We reprint his article, first published as the cover story of *Wired* magazine, because it brilliantly conveys complex statistical concepts to non-specialists.

In the years before 2008, it was hardly unthinkable that a math wizard like David X. Li might someday earn a Nobel Prize. After all, financial economists – even Wall Street quants – have received the Nobel in economics before, and Li’s work on measuring risk has had more impact, more quickly, than previous Nobel Prize-winning contributions to the field. Today, though, as dazed bankers, politicians, regulators, and investors survey the wreckage of the biggest financial meltdown since the Great Depression, Li is probably thankful he still has a job in finance at all. Not that his achievement should be dismissed. He took a notoriously tough nut – determining correlation, or how seemingly disparate events are related – and cracked

A formula in statistics, misunderstood and misused, has devastated the global economy

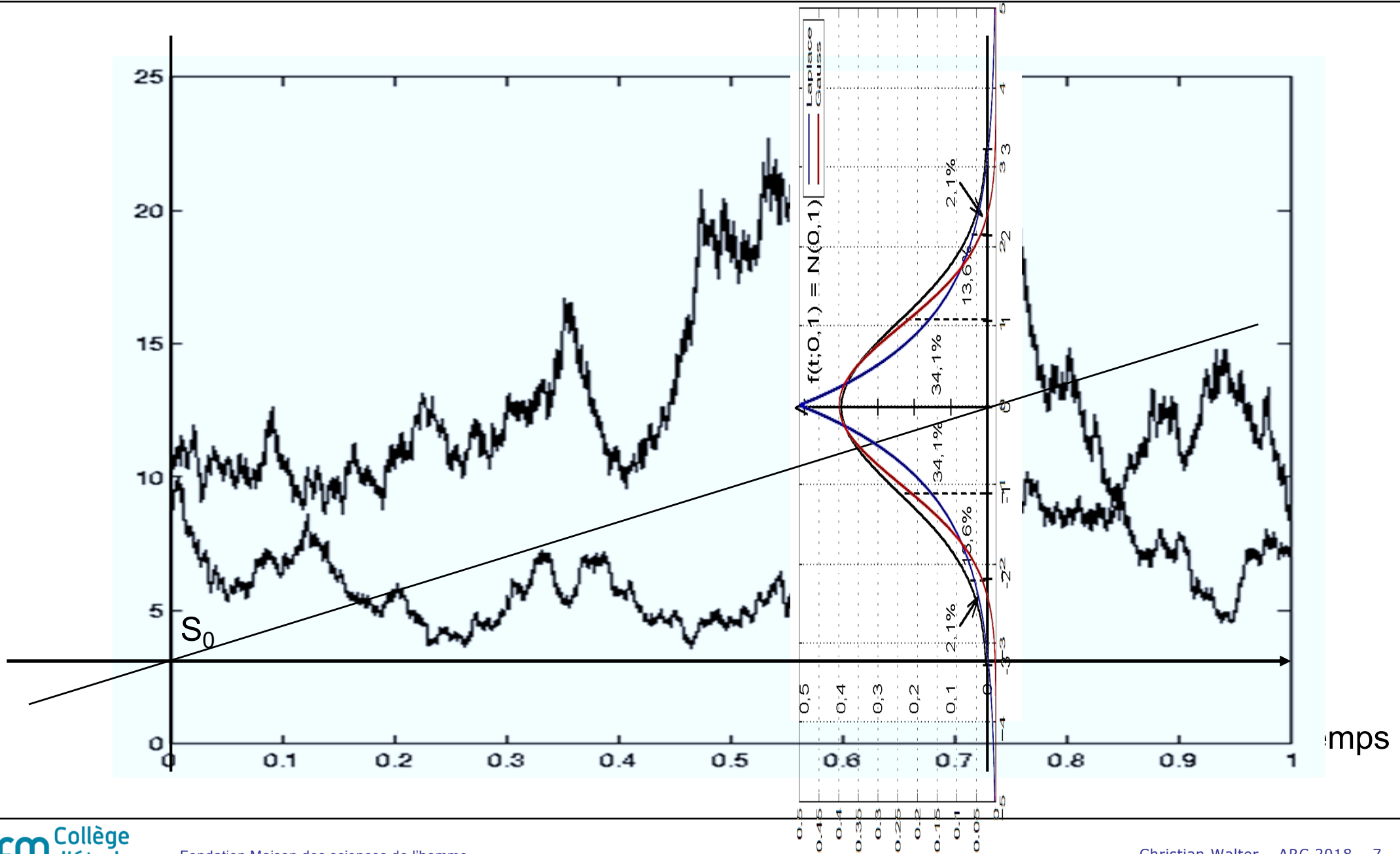
it wide open with a simple and elegant mathematical formula, one that would become ubiquitous in finance worldwide.

For five years, Li’s formula, known as a Gaussian copula function, looked like an unambiguously positive breakthrough, a piece of financial technology that allowed hugely complex risks to be modeled with more ease and accuracy than ever before. With his brilliant spark of mathematical legerdemain, Li made it possible for traders to sell vast quantities of new securities, expanding financial markets to unimaginable levels.

His method was adopted by everybody from bond investors and Wall Street banks to ratings agencies and regulators. And it became so deeply entrenched – and

Copyright © 2009 Condit Nast. All rights reserved. Originally published in *Wired*. Reprinted by permission.

Risk representation and D-tails



Why humanities and social sciences?

- What is (and what is not) an actuary?
 - Not just a “test-taker” (Alisa Walsh, ARC 2018)
 - Fill the “gap between exam-prep calculations questions and nuance of actuarial work” (Diana Skrzydlo, ARC 2018)
 - Necessity to “enrich courses with pedagogical challenges” (Russel Hendel, ARC 2018)
- What is useful to do:
 - 1) moving from “know the formulas” (today actuarial syllabi) to “know the **epistemic context of the formulas**”
 - 2) explaining maths with words (“speak in English”)

Trustworthy actuaries and expert judgment

- The professional expertise expected of actuaries, in particular their expert judgment, constitutes the basis of their trustworthiness
 - Problem: how to exercise “expert judgment” in complex situations in which there is no history of the relevance of a model to a given situation?
- Trustworthy actuaries should be capable of:
 - making an accurate diagnosis of risk models
 - seeing if their risk models are up to date
 - knowing the side effects of the risk models they prescribe
 - recognising the boundaries of their own capacities to master risk models
- Two issues:
 - importance of understanding the relationship between a mathematical model and its epistemic framework
 - need to identify possible dangers arising from the financialisation of epistemic frameworks

Why HSS are an efficient toolkit in risk management?

- To address these issues, an efficient toolbox can be found with HSS
- Epistemic virtue of HSS: showing the hazardous consequences of importing a model from one theoretical context (for example mathematical finance) to another (actuarial risk modelling).
- Retracing the history of a model means
 - to assess its epistemological value for the present
 - To open to the possibility of thinking otherwise
- Tackling problems under different angles
- What actuaries should know about HSS?

New course given at Sorbonne University

- Critical thinking education on risk management
- Paris-based experiment of teaching HSS to students in actuarial science
 - Two institutions: ISUP (Institut de statistique de Sorbonne Université) and FMSH (*Foundation Maison des sciences de l'homme*) members of Sorbonne Université
 - Project launched with Olivier Lopez (director of ISUP) and Michel Wieviorka (director of the FMSH)
 - Project managed by the Chair “Ethics and finance” (Collège d'études mondiales, FMSH)
 - 60 students ISUP per year, 20 students selected for the course
- Combine “actuarial science” and HSS to enrich courses in risk modelling
 - Not “either-or” but both
 - With the know-how of the Foundation MSH / Collège
- Feedback of two academic years: 2016-2017 and 2017-2018
 - Students outcomes: high course evaluations
 - Many students commented on usefulness

Why FMSH / Collège d'études mondiales?

- The foundation (FMSH)
 - International crossroads for Humanities and Social Sciences
 - The FMSH works in synergy with international scientific communities and networks, and **fosters collaboration amongst scientific fields**
 - The FMSH works towards the **identification of emerging themes, initiates and sets up innovative research operations** whose object is determined according to societal burning topics
 - For this course:
 - Actuarial, mathematics, finance, HSS
 - Applied to risk modelling
- The Collège
 - Structured around the Collège d'études mondiales, scientific platforms, chairs, innovative programmes and projects in partnership, the Research and prospective department supports research and networks that take an **interdisciplinary overview approach** to major present-day challenges
 - Chair “Ethics” of risk models
 - Ethics in the epistemic sense

Forms of calculation in risk modelling

- HSS allow to understand the forms of calculation used in the financial sector
 - Determinant in market construction
 - They facilitate construction of agreement on prices
 - Financial theory seen as “an engine, not a camera” (MacKenzie, 2006)
- HSS show the importance of combining two strands
 - Intellectual history of risk modelling
 - The story of how a given model came to be adopted by financial actors

A key notion of HSS: the quantification convention

- Important notion developed by HSS
- What is not a quantification convention: “micro-choices”
 - Financial valuation of an “object” (investment, equity, debt, bond, others) involves a large number of operations and choices
 - Example: DCF
 - Selection of time horizon
 - Selection of number of periods
 - Selection of discount rate
 - These choices are not “quantification conventions”
- What is a quantification convention: “macro-choice”
 - More like a “meta-convention”
 - A configuration of a coherent set of operations
 - Both cognitive and normative
 - Including selection of the items to take into account
 - Including relevant judgment criteria
 - Including choices of mathematical schemas

Dimensions of quantification conventions

- Epistemic dimension
 - A set of assumptions regarding what makes the value
 - Used to determine the decision
 - What shape of uncertainty the future will take
 - Specific mathematical models
 - Production of knowledge
- Pragmatic dimension
 - Make certain actions possible
 - The “efficient cause” of value
- Political dimension
 - Value can emerge
 - “Evaluation culture”

Overlapping of quantification conventions

- Arrival of a new quantification convention
 - Start of a new period
 - Start of a new age of calculation
- The old quantification convention is not totally replaced
 - The new quantification convention adds to the previous forms
 - The new quantification convention merges with previous forms to create hybrid calculations
- Conventionalist approach
 - Quantification systems have a history
 - It is possible to sketch out that history by identifying some major turning points in the conception of the phenomena we seek to understand

Financier's metrology

- Three majors conventions of financial quantification have arisen in a superimposed succession, progressively overlapping (Chiapello and Walter, 2016)
 - The **discounting convention** (DCF, next MPK)
 - Key object: actuarial rate
 - Key word: discounting
 - The **mean-variance convention** (M-V criterion with HARA)
 - Key object: optimisation technique
 - Key word: diversification
 - The **market-consistent convention** (EMH, next risk-neutral)
 - Key object: change of probability
 - Key word: arbitrage

The three stages of financialisation: the changes of discounting

- Three main periods
 - Difference in the expected return and uncertainty
 - To exhibit the periods: follow the discount rate (Ariane’s thread)
- The transformation of discounting
 - The **actuarial discounting convention**
 - Constant discount factor
 - IRR
 - Rate of return / risk premium: asset-specific
 - The **M-V convention**
 - Variable (non-random) discount factor with beta coefficient
 - CAPM
 - Rate of return / risk premium: related to market portfolio (MV-optimal)
 - The **market-consistent convention**
 - Stochastic discount factor (“deflator”)
 - MPK
 - Rate of return / risk premium: related to AOA (Log-optimal)

Q1

Q2

Two quantisations

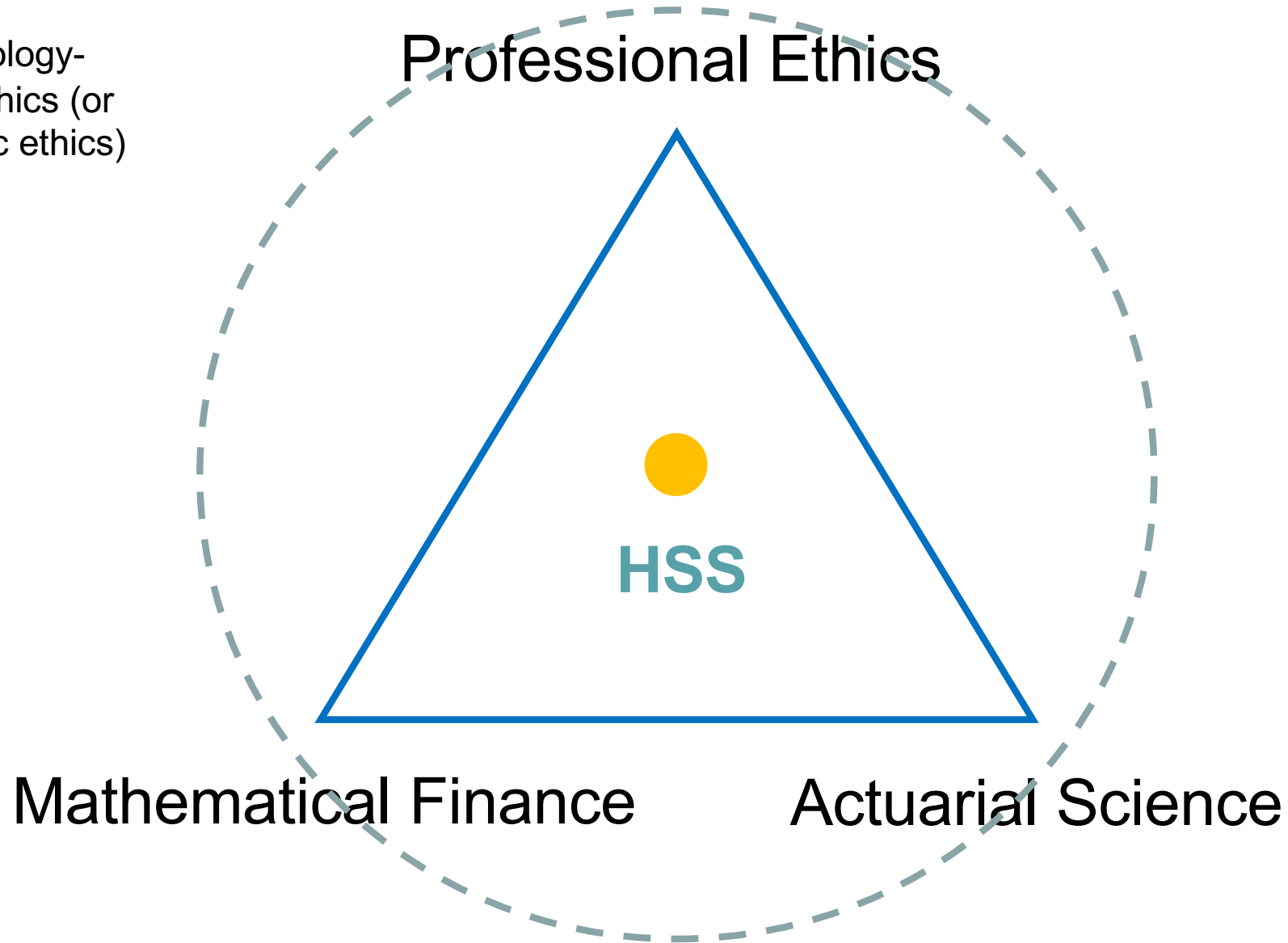
Convention	Discount factor
1	Constant
2	Variable but non-random
3	Stochastic

The financialisation and the second quantisation

- By the grace of the second quantisation, all assets and all liabilities can be securitised
- This is the property of “market-consistent” valuation
- This is what the second quantisation propose
- The second quantisation is associated with a overhaul of the EMH (1980s) in financial economics
- The key word is “arbitrage”
- One of the main cause of financialisation

HSS as centroid of a professional puzzle

Epistemology-
based ethics (or
epistemic ethics)



Source

- **2016.** « The three ages of financial quantification: a conventionalist approach to the financier's metrology », *Historical Social Research*, **41** (2), 155-177 (with Eve Chiapello).