Genealogy of the INCERTO

Legend:
- Mathematics
- Philosophy
- Social Science
- Legal Theory
- Real World

SKEPTICAL EMPIRICAL TRADITION (Philosophy)

Montaigne (essay method)

No overlap between skepticism and fat tails

FAT TAILS (Mathematics)

Pareto, Lévy (I)
Mandelbrot (I)
Polya, Feller
Zolotarev, Taqqu
Samorodnisky

Almost no Overlap between **LDT** and **Fat Tails** (Cramér condition for exponential moments)

Little overlap

Pyrrho of Ellis and the "Applied" Pyrrhonians Asymmetric Medicine: Menodotus of Nicomedia, Sextus Empiricus, Aenesidemus of Knossos, Antiochus of Laodicea, Herodotus of Tarsus,...

Algazel
Algazelist School (Nicolas d'Autrecourt, etc.)

ACADEMIA
Carneades
...Cicero

Extreme Value Theory

Modern PROBLEM of INDUCTION
Simon Foucher
Bayle, Huet, Hume, Mill, Russel, Ayer, Goodman...

Negative Empiricism
Brochard-Favier-Popper

Gnedenko, Resnick Embrechts, Balkema de Haan, Picklands, Falk, ...

Probability in Epistemology
Bayes, Peirce, Ramsey, Carnap, Levi, Kyburgh, Jeffreys, ...

Hayek Shackle

Complexity Theory
Econophysics

RUIN PROBLEMS/ LARGE DEVIATIONS THEORY

Overlap limited to psych of induction, machine learning

Paul Lévy (II), Mandelbrot (II)

Loss Models / INSURANCE (I)

CONVERGENCE LAWS
De Moivre, Markov Bienaymé, Chebychev, Bernstein, Kolmogorov, Luzhin, Berry, Esseen, Petrov, Nagaev brothers, Mikosch

Cramer, Lundberg, Denbo, Zeitouni, Varadhan, etc.

Black Swan (Anti)Fragility

Heuristics and Biases/ Decision Theory /Psychology of Probability

ETHICS

Real Options

STOCHASTIC PROCESSES

Economics of Uncertainty

Knightian "Uncertainty"

Agency Problem, INSURANCE (II)

Skin In The Game

Contract Theory scholastics:
Pierre de Jean Olivi and modern

Mathematical Finance / Derivative Theory/ Stochastic Calculus

No overlap between Heuristics and Biases and Fat Tails

FAT TONYISM
Real World Trader Lore

No overlap between Real Options and 1) fragility, 2) fat tails,3) skepticism...

"Knightian uncertainty" isolated mathematically and philosophically from traditions (skepticism & fat tails)

No overlap between concavity/fragility and both contract and decision theory

Little overlap between convergence laws (**LLN**) and the philosophical problem of induction

No overlap between economics of uncertainty and fat tails/skepticism/ induction

No overlap in literature between the world of ideas and FAT TONYISM except some treatments of ecological uncertainty
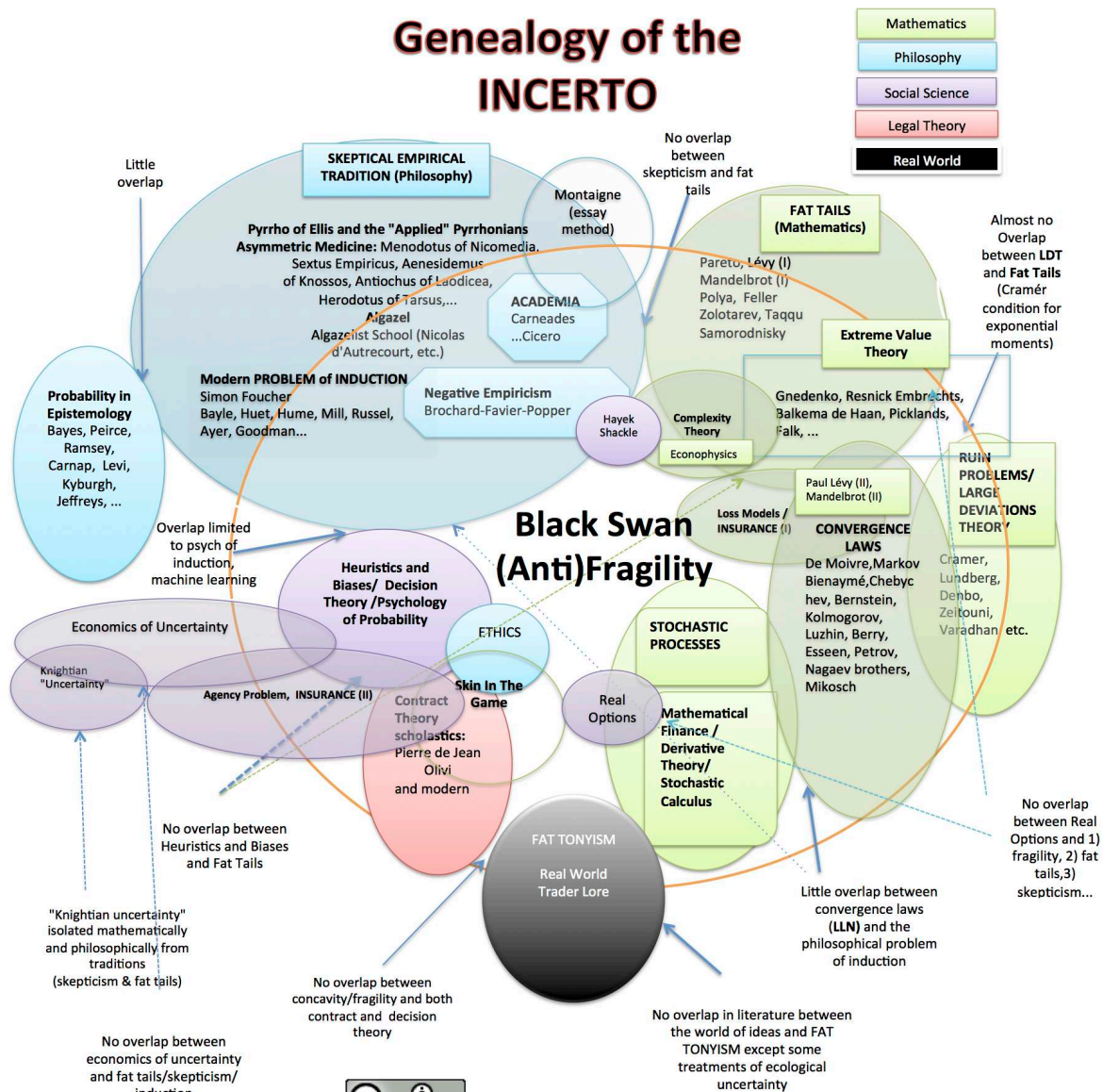
Map of the Incerto

This is an attempt at a genealogy of the Incerto and a cultural map of the subject. Why a map now? [1][i]

The necessity of a map came as follows. In my late forties, I embarked on two activities: weightlifting and a (sort of) serious "scholarly" career in applied probability and risk theory –before that, I had only been a remote occasional visitor to academia, which I mostly used to irritate economists[2]. I discovered that academics like to link matters to existing disciplines that have thought about a problem, both to give credit (so they can be credited back) and to show others via pedigree that their own ideas are not completely crazy. Academics, usually very fragile reputationally, are terrified of being mistaken for nuts and are torn between the need to say something new and the fear of venturing too far from *terra cognita*.

Luckily, I found a way to avoid making unnecessary direct links to research traditions in the *Incerto* outside of this map and put the work into an academic standing without corrupting the text and boring readers. How? I embarked on a mission to produce a parallel technical version of the *Incerto*, by publishing key results in technical journals and synthetizing them in a freely available technical companion, *Silent Risk*. I found the activity of doing applied probability –for entertainment –preferable to afternoon contract bridge or chess, though not as rigorous. (Note that of the two new activities, I much prefer weightlifting to academia, even after the worst of back injuries.)

Five disciplines have been historically involved in the subject. The circle at the center indicates the research traditions connected to the *Incerto* and their intersections. These disciplines are: **philosophy**, **mathematics**, **social**

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[1] To repeat, *fat tails* refer to the disproportionate role of a minority events in determining the total properties (what is called Extremistan throughout the *Incerto*).

[2] It is worth mentioning an unintended benefit: the title Herr Professor Doktor carries

[2] It is worth mentioning an unintended benefit: the title Herr Professor Doktor carries huge benefits in Germanic countries, particularly for hotel and restaurant reservations, but unfortunately might be a handicap in Anglo-Saxon cultures.

science, **legal theory**, and, of course, **the "real world" or Fat Tonyism** exemplified by Fat Tony and his rigorous but anti-intellectual approach to decisions –one may call this branch of learning "decision-theory" but Fat Tonyism fits our style and purpose considerably better. Of these disciplines, most have subdisciplines, that we indicate by name, or by the name of the scholar who represents a particular school of thought. And as the arrow at the boundaries point out, many disciplines, schools of thought, and, sadly, subdisciplines do not talk to each other. I mean, really, do not have any interest in one another.

The reader is invited to peruse the details of the map during and after, not before reading any part of the *Incerto*, which should act more like a computer positioning GPS than a conventional roadmap.

The colors describe the disciplines, the circles (or squares) show positioning of the subdiscipline, and the arrows points out to possible absence (total or partial) of overlap between neighboring units. For instance, some circles only partially intersect with a discipline: take the Skeptical Empirical Tradition to the North-West. Montaigne's works show partial overlap as, being rather independent (financially), he was only tangentially in that tradition; he was also a stoic –and, not seeing some inconsistencies, he was mostly *a human*. Note here that such independence is largely attributable to the fact that Montaigne was not a scholar, as scholars (that is, scholars on a salary) tend to stay firmly within available disciplines, much like bank tellers repair daily to the same office at a predictable and rarely variable hour. Professional scholars lack the sense of adventure of us humans –to wit the low level of erudition to be found in the Herr Professor Doktors around the world. The reader can see some interdisciplinary activity with contract theory which straddles ethics, law, insurance, and the psychology of uncertainty –but this is rare.

First, a bit of history to illustrate this pigeonholing of probability. If you ask a mathematician, or even a common person who spent some time listening to their professors, about the origins of probability, he would tell you that it all started in mathematics. Supposedly, the ancients were not sophisticated enough for that. But as explained repeatedly in different sections of the *Incerto*, if the ancients did not care about the calculus of probability, it is because they were more concerned with the broader problem of decision-making under opacity and the development of heuristics and "superstitions" as such tools. The ancients were not into *petty* probability. As an illustration of our ignorance of the subject, consider that in the widely read *Against the Gods*, Peter Bernstein repeats (and propagates) the fallacy that the Arabs were into algebra but, strangely, did not discover probability. Not true. In the Levant, during the Omayad era, about eight centuries before Fermat, people used evolved mathematical methods to decrypt

messages based on word frequencies. It turns out that Al-Kindi (Alkindus) in one of his treatises on cryptology discusses mostly probability (*Fi fakk rassa2l at-tashfir*, best translated as "the science of combinations" or "the science of probability"), providing us with a sophisticated numerical approach to frequencies.

It is just that people in the Middle Ages had their eye on the bigger ball and were not prone to the ludic fallacy. Indeed, people had to have been very sophisticated as their world was fraught with daily dangers; it is just that nobody cared about measurement as they found no imperative use for them. Understanding uncertainty meant surviving, avoiding starvation –not beating the roulette table in Las Vegas in a sequence of well defined bets. *Measuring* is still today a very small subset of probabilistic uncertainty — the more rigorous mathematicians discuss "bounds" rather than precise probabilities, hence turn the subject into a form of qualitative rationalism. Knowing if a domain is fat-tailed and the class of risks it entails is vastly more important than producing probabilistic estimates.

Now, let us discuss the interaction between disciplines We start with the least obvious. Who were the most sophisticated with nuances of probability? As the reader can guess from our previous paragraph, not the mathematicians. And most certainly not the social "scientists". Not quite the philosophers –in the standard sense. Legal scholars, it turned out. A large segment of legal theory is meant to mitigate uncertainty and the effects of contingency to specific and general agents. They had very sophisticated methods and a healthy way of thinking about the problem. For instance, Pierre de Jean Olivi, a scholastic thinker, had an impressively detailed understanding of contingency and risk sharing, and one that is hard to find even in modern times. Risk sharing? Yes, it leads us to contract theory.

Why contract theory? Because it entails the understanding of ways to find protection from Black Swans –rather than naive computation of odds that we will get wrong anyway.

For there are two manners to deal with uncertainty: 1) try to better understand the world in a way that allows you to formulate precise forecasts, or 2) try to avoid being harmed by what you do not understand.

We have accomplished very little through the first approach, perhaps underwent serious degradation, but made excellent leaps in the second. How? That's where legal and contract theory come in. Now, note that *Antifragile* is ensconced in the second approach: how to deal with *exposure to something* rather than focus on that *something*. If one cannot forecast, better benefit from random events and use randomness as fuel for improvement. Likewise the mapping of fragility allows the building of contracts that remove such fragility.

My option trading career lasted for more than twenty years (options are often called "derivatives"). My profession, option theory, which consists in designing structures that have a certain payoff under uncertainty, is closest to contract theory than anything else. How? You don't understand "tail events?" Don't fool yourself. Cut the exposure by making sure you have a *contract* for that. And sophisticated firms knew that it was better to employ (or use) three lawyers for every mathematician –with lawyers you get protection; with mathematicians you tend to blow up.

The reader will hopefully notice that understanding randomness doesn't allow one to understand fat tails. We see no overlap between skeptical empiricism and the mathematics of large deviations. Note a technical point that is not developed within the *Incerto* proper, but in parallel research: even within what is called large deviation theory within mathematics, there is no overlap between that theory and fat tails owing to the so-called Cramér condition.

Nor do we see overlap between the "heuristics and biases tradition" in psychology and decision-science pioneered by Kahneman and Tversky and fat tails, which is a tragedy: many pieces of research in fact pathologize people from worrying about fat tails –but, remarkably, the original Kahneman-Tversky works and the successor type of research explains biases making people underestimate tails via *underestimation of randomness and overconfidence*, which blows up in the tails. Just as economists who, knowing about fat tails without understanding them, make huge inferential errors. Some psychologists, alas, [and

nonpsychologists such as the verbose mouth-breathing legal commentator Cass Sunstein] find some of our risk-mitigation methods irrational, but as will see in Chapter x, it is the commentators who are irrational. ~~that we worry about planes crashing more than car accidents. This makes sense. But they also find it irrational that we worry about Ebola more than falls from ladders that have killed many more people than Ebola. But Ebola is multiplicative: it has a very small probability of very large uncontrollable spread in the age of physical connectivity. Falls from ladder are from Mediocristan. They can't decimate the European population. So it is the psychologists who, using the wrong models, are irrational, not humans~~.

Indeed logic deals with mistaking absence of evidence from evidence of absence –at the heart of Popperian asymmetry. No work has been done to show that, mathematically, the difference between absence of evidence and evidence of absence is greater in Extremistan. And needless to say that because of their lack of focus on fat tails, psychologists of uncertainty typically confuse the two – and make horrendous analytical mistakes.

Also it takes more data under fat tails to see what is going on, which links us to the problem of skepticism. The law of large numbers is a mathematical counterpart to the philosophical problem of induction, but the two are not linked in the tradition.

Finally, consider the point belabored in *Fooled by Randomness* about the link between statistics and skeptical philosophy. Unlike what proponents of "big data" want you think, statistics is there to provide a rational mechanism to eliminate certainties –and avoid being fooled by randomness by believing in chance associations and spurious links. It is first and last the application of skeptical empiricism to mundane affairs –and consequential ones.

I remember one day, close to fifteen years ago, having a discussion with a professor of the clueless variety cum a lot of publications on risk methods and many decorations. He had written a lot of papers on Monte Carlo studies that is, random simulations. It turned out that he had never considered that "variance" for a probability distribution (or the degree of variability) maps to degree of ignorance about outcomes and had an immediate epistemic mapping to real life.

And of course to philosophy. He even found the connection *strange*. I was altogether shocked, depressed, and excited at discovering that someone could spend a lifetime doing something without connecting the dots. This is naturally the result of writing about a subject without *skin in the game*, which enforces contact with reality –making decisions allows us to see *what connects to what*. The following fifteen years confirmed to me that such mental hurdle was the norm in academia because of the way the system was constructed.

So, in the end, the reader can see that the history of ideas of probability, risk and decisions has been broken up into unconnected small petty pursuits that it is high time to merge in one manner or another. The beauty of mathematical sciences (which include logic and most philosophy) is that no matter where you start you end up with the exact same result for the same problems and the same assumptions. The same cannot be said about social "science" and similar disciplines that depend on the use of words and can be fooled by them –for instance "risk" in social science mixes ruin probability and potential profits coming from variability –"not the same ting "as Fat Tony would say.

I thank the reader for his interest and wish that the map will not remove the trills of feeling occasionally lost in the topic of uncertainty, which I consider the mother of all disciplines.

POSTSCRIPT: SKEPTICISM AND "RELIGION"

People rarely mean the same thing when they say "religion", nor do they realize that they don't mean the same thing.

For early Jews and Muslims, religion was law. For early Jews it was also tribal; for early Muslims it was universal. For the Romans, religion was social events and festivals (law was separate, which is why Christianity, unlike Islam, stayed away from the law). For Jews today religion became ethnocultural, without the law --and for some, a nation. Same for Syriacs, Copts, and Maronites. For Orthodox and Catholic Christians religion is aesthetics, pomp and rituals. For Protestants religion is belief with no aesthetics, pomp or law. For Buddhists/Shintoists/Hindus religion is philosophy. So when Hindu talk about the Hindu "religion" they don't mean the same thing to a Pakistani as it would to a Hindu, and certainly something different for a Persian.

People keep talking past each other. When the nation-state idea came about, things got more complicated. When an Arab now says "Jew" he largely means belief; to Arabs, a converted Jew is no longer a Jew. But for a Jew, a Jew is someone whose mother is a Jew. But it somewhat merged into nation-state and now means a nation.

In Serbia/Croatia, or Lebanon, religion means something at times of peace, and something quite different at times of war.

If you look at the contents of the Skeptical Empirical Tradition in the North-West corner you will notice that the category is dominated by thinkers of the Pyrrhonian and Algazelist tradition –the intellectual descendants of Pyrrho of Ellis and Algazel, discussed at length in *The Black Swan*. In this class we find the skeptic "Fideists" such as Pierre Bayle, Isaac de la Perrière, bishop Huet, and others who were among the greatest erudites of their day. Theirs was a certain brand of skepticism that held that faith was not epistemic (the view currently associated with Wittgenstein), but that, on the other hand, everything epistemic needed maximal scrutiny.   Montaigne –a Pyrrhonian skeptic of sorts –is probably the most known of the skeptics because of his popularization of their ideas and his accessibility to the average reader.

I can safely say that the current scientific method was born of such brand of skepticism. How?

The greatest expositor of skepticism throughout the ages, Sextus Empiricus – himself a medical doctor –had a the following definition of skepticism (that we paraphrase):

> *Skepticism isn't about ancestral mores and traditions, but directed at experts –and expert knowledge.*

So skepticism wasn't about matters that were in the *technë* domain, but concerned those in the *epistemë*. In other words, explicit –and only explicit – language. In his *adversos mathematikos,* Sextus was going against the equivalent of today's intellectuals –debunking them, degrading them. The most prominent practitioner of the school, Menodotus of Nicomedia, like Sextus, a medical doctor, proposed following nature and tradition *as a default mode*, only to be overridden if the cure showed potency.

The Fideists practiced religion and pursued erudition –Hume's arguments in general and the problem of induction in particular come from them; they are in fact derived from Bayle.

The Pyrrhonian, simply, deplored the fragility –the frailty— of human knowledge.

A word on belief. As Paul Veyne put it: "Did the Greeks believe in their mythology? The answer is difficult because believe means many things." We will investigate in *Skin in the Game* the notion of belief in terms of revelation of preferences: belief is nonsterile justification that maps into risk-taking. All the rest is what Fat Tony calls "cheap tawk".

> *Belief is nonsterile justification that maps into risk-taking.*

Hence

> *Skepticism is avoiding to be a sucker.*

So, when I hear members of some sub-monotheistic literal religion called "atheism" today levy "scientific skepticism" against religion, I find something jarring: science is a well defined *literal* procedure that only exert itself in a narrowly defined domain and doesn't make claims elsewhere. Same as mathematics where things that cannot be proved rigorously aren't dismissed: they are just not part of mathematics. I can understand countering literal and epistemological claims by religion, those that lead into some classes of relevant decisions –not the nonliteral claims that may lead to some activities that wouldn't be carried otherwise. (As we see in Chapter x, most people who call themselves Christian are practically atheists in the secular domain.) And claims in the name of "science" contradict science. Centrally, science does not purport to solve *all* daily problems –its error rate is exceedingly high *and* it is conscious of it. Science is a collection of open problems, not fortune-cookie style dogma. Technology, which aims at solving daily problems isn't science and itself can't afford to make overarching claims as its survival rate is pitifully low (depending on how we define birth and death of a technological innovation, less than say one in ten thousand).

   This doesn't mean that *science* shouldn't occupy a larger share of our daily lives, except that we need care in mastering its error rate: the Soviets tried with well known results. In that context what is called the "new atheism" is an anachronistic relapse into the worst scientism decried by the pair Popper-Hayek.
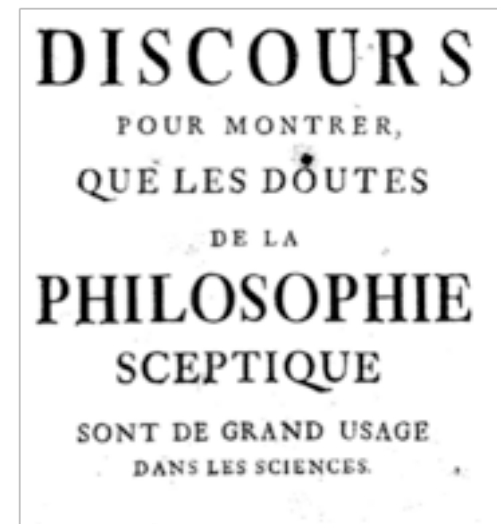

Figure 1 La Mothe Le Vayer

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