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# Extreme Risk Analytics and Management

(Risk Management in the Real World) FRE-GY.6041.I — Prof: Nassim Nicholas Taleb

Seven lectures followed by a party at Luciano.

## Office hours

On class days 11AM-5:00 PM by appointment.

## What is the course about?

This is an introductory course, in which the building blocks and general principles are presented. We discuss the dynamics and analytics of real risks events with a focus on their management and the avoidance of common consequential errors. We focus on fat-tailed distributions, although "thin tailed" ones (Poisson jumps) can also deliver extreme deviations.

The student will remember some sound risk management principles that are useful in managing real-world risks.

## Readings

Main text: *Silent Risk*, Freely available to download. The book has been written in sync with the class.

<http://www.fooledbyrandomness.com/FatTails.html>

A less technical book (with P. Cirillo) can also be used.

Papers supplied.

## Tools

Students should use mathematical tools such as Mathematica or Matlab or and do their own symbolic programming; it is preferable to avoid prepackaged statistical software unless they rewrite the functions from scratch.

## SYLLABUS: THEMATIC CLASSIFICATION

Note that the "themes" do not correspond to sessions, as they can be 3 sessions or 1/4 of one.

## Mathematical Foundations of the Precautionary Principle

Difference between risk and ruin —ergodicity —sensitivity to tails.

## Introduction to Fat Tails

### Lectures 1 and 2.

Definition: practical vs. mathematical — MAD/STD as an intuition — Norms  $\ell^1$ ,  $\ell^2$ ,  $\ell^\infty$  and the behavior of cumulants — Heuristics for detection of fat tails — Power laws/scalable vs. thin tails — Subexponential class —

Readings: *Silent Risk*[?]

## Risks and fat tails

Risks and fat tails — Fat Tails in higher dimensions — Readings: [1], [2], [3]

## Convexity/Fragility

Convexity and Fat Tails —Problems with VaR and — Probabilistic Risk Management —Fourth Quadrant in Depth — Readings: [2], [?] ,[4]

## Skin In The Game

Skin In The Game – Contractual framework — [5]

## Fragility detection heuristics

IMF heuristic.

Readings: [6]

## Estimations, Body and Extremum (Optional)<sup>1</sup>

Review of Estimation methods — Why the law of large numbers does not work well in real time — How tails exponents are easier to calibrate.

## Behavioral and cognitive biases with risk (Optional)

Risk Maps — Attribute Substitution — General heuristics — Linear regression outside  $\ell^\infty$  domains — Payoff confusions — Higher dimension: what is "correlation" and a substitute for correlation —

## Illusions of pattern under fattailedness

How data mining errors compound under fat tails. Slutsky-Yule effects under power laws — Principal component analysis, Wigner effects under fat tails —

## Option trading under fat tailed models (Optional)

Use of power laws with derivatives.

## GRADING

- Homeworks 1,2- Ask questions about the class.
- Final Homework – Ferret out convexities and concavities in finance (select one example each). The answer, if insightful, can be sufficient to determine the grade.
- Quiz 1 – 25% of grade
- Quiz 2 – 25-50% of grade

<sup>1</sup>Optional means discussions will not be tested in quiz. These are casual discussions in class.

## REFERENCES

- [1] B. Mandelbrot and N. N. Taleb, "A focus on the exceptions that prove the rule," *Financial Times*, vol. 23, 2006.
- [2] N. N. Taleb, "Errors, robustness, and the fourth quadrant," *International Journal of Forecasting*, vol. 25, no. 4, pp. 744–759, 2009.
- [3] D. Goldstein and N. Taleb, "We don't quite know what we are talking about when we talk about volatility," *Journal of Portfolio Management*, vol. 33, no. 4, 2007.
- [4] N. N. Taleb and R. Douady, "Mathematical definition, mapping, and detection of (anti) fragility," *Quantitative Finance*, 2013.
- [5] N. N. Taleb and C. Sandis, "The skin in the game heuristic for protection against tail events," *Review of Behavioral Economics*, vol. 1, pp. 1–21, 2014.
- [6] M. C. Schmieder, M. T. Kinda, M. N. N. Taleb, E. Loukoianova, and M. E. Canetti, *A new heuristic measure of fragility and tail risks: application to stress testing*. Andrews McMeel Publishing, 2012, no. 12-216.