Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Departement Management, Technology, and Economics

Lectures in Entrepreneurial Leadership
The Insurance Industry

5-8 Feb. 2008

ENTREPRENEURIAL LEADERSHIP

5-8 Feb. 2008

Tuesday
- Academics
- Entrepreneurs
- Group Work

Wednesday
- Academics
- Entrepreneurs
- Group Work

Thursday
- ZURICH

Friday
- Group Presentations
  - Investor Pitch
  - Risk Analysis

Tuesday, February 5th

- D. Sornette “Risk management: Mild versus wild risks”
- P. Embrechts “VaR-based Risk management: Sense and (non)-sensibility”
- D. Snowden “Leadership decision making”
- G. Dondi “Risks Involved with Systematic Investing Strategies”

Wednesday, February 6th

- P. Taylor, “Risks and the insurance industry”
- R. Crane & S. Pillai, “YouTube and Poker”
- M. Bauml, “Investor’s Pitch”
- K. Morrissey, “Google”
- B. Baumann, “Managing risk in my career and investing in startups”

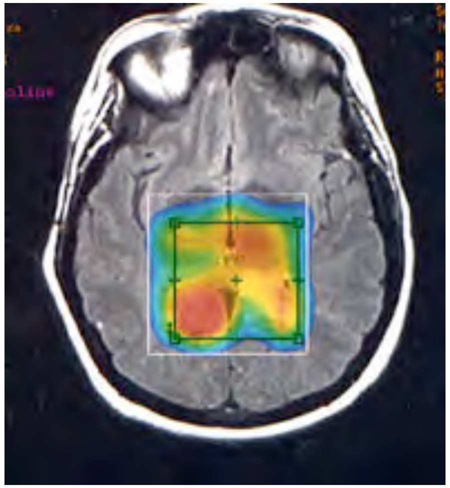
Thursday, February 7th

- James Schiro, Chief Executive Officer
- Axel Lehmann, Chief Risk Officer
- Christa Markwalder, Head Government & Industry Affairs Switzerland, National Councillor
- Arno Wicki, Head Government & Industry Affairs Europe
- Michael Kerner, Head Group Strategy
- Peter Zehnder, Head of Recruitment, Group Human Resources

Friday, February 8th

- 2 presentations
  - Investor Pitch
  - Risk Analysis
- Everyone will vote

Risk Management: Mild vs Wild



Didier SORNETTE

[1]Department of Management, Technology and Economics,ETH Zurich, Switzerland

[2]Department of Physics, ETH Zurich, Switzerland

[3]Department of Earth Sciences ETH Zurich, Switzerland

What is Risk? What are Risks?

Life is risk. Risk is life.

business risk, social risk, economic risk, safety risk, health risk, investment risk, military risk, political risk, etc.

Example Global Catastrophic Risks

- **Pandemic**: Avian flu or similar causes Black Death scale mortality
- **Runaway global warming**: Rapid positive warming feedback loop
- **Bio-disaster**: Deliberate or accidental pandemic from biological agent
- **Nuclear holocaust**: The one we've lived with for some time
- **Nanotechnology**: Self-replicating automata reduce us to ”grey goo”
- **Terrorist attack**: Non-conventional massive attack on a major city
- **Socio-economic collapse**: Disintegration from endogenous or exogenous cause
- **Flawed superintelligence**: Thinking machines get too clever
- **Asteroid collision**: Huge lump of rock splats the planet
- **Strangelet**: High-energy physics particle consumes the universe
- **Simulation shutdown**: We are living in The Matrix and it shuts down

Peter Taylor, 2007

A Taxonomy of Risks

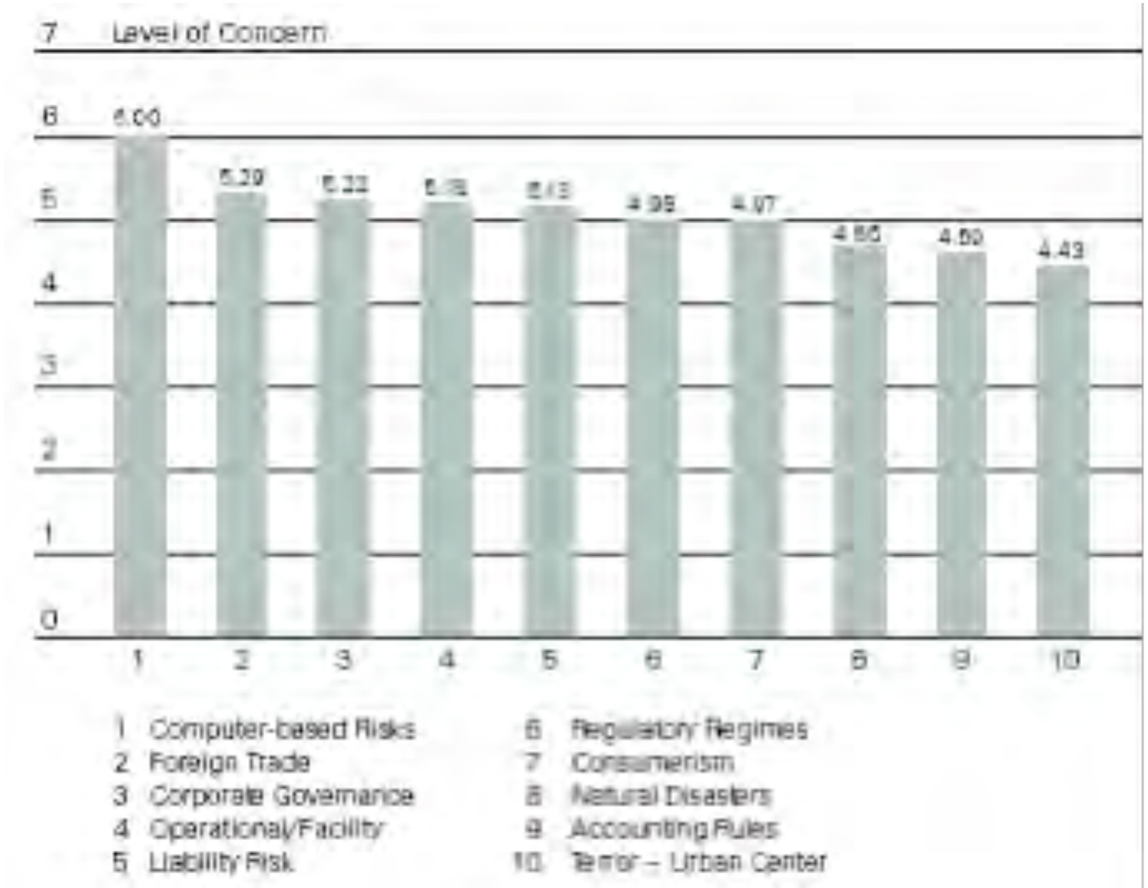
Category	Type	Unprecedented?	Global Catastrophic?
SocioPolitical	Political Risk	No	No
	Government	Yes	Possible
	Demographics	Yes	Possible
	Terror/Crime	Yes	Possible
Financial	Business Risk	No	No
	Financial Markets	No	Possible
Natural Hazard	Biological	No	Possible
	Drought	No	No
	Earthquake	No	No
	Flood	No	No
	Landslip	No	No
	Tornado/Hail	No	No
	Tsunami	No	Possible
	Volcano	No	No
	Wave	No	No
	Windstorm	No	No
	Space Radiation	Yes	Possible
	Space Impact	Yes	Likely
Man-made	Biological	Yes	Likely
	Climate	Yes	Likely
	Computer	Yes	Possible
	Nanotechnology	Yes	Likely
	Industrial	No	No
	Nuclear	Yes	Likely
Conjectural	High Energy Physics	Yes	Yes
	Simulation	Yes	Yes
	Computers	Yes	Yes
	Human Enhancement	Yes	Yes
	Extraterrestrials	Yes	Yes

Peter Taylor, 2007

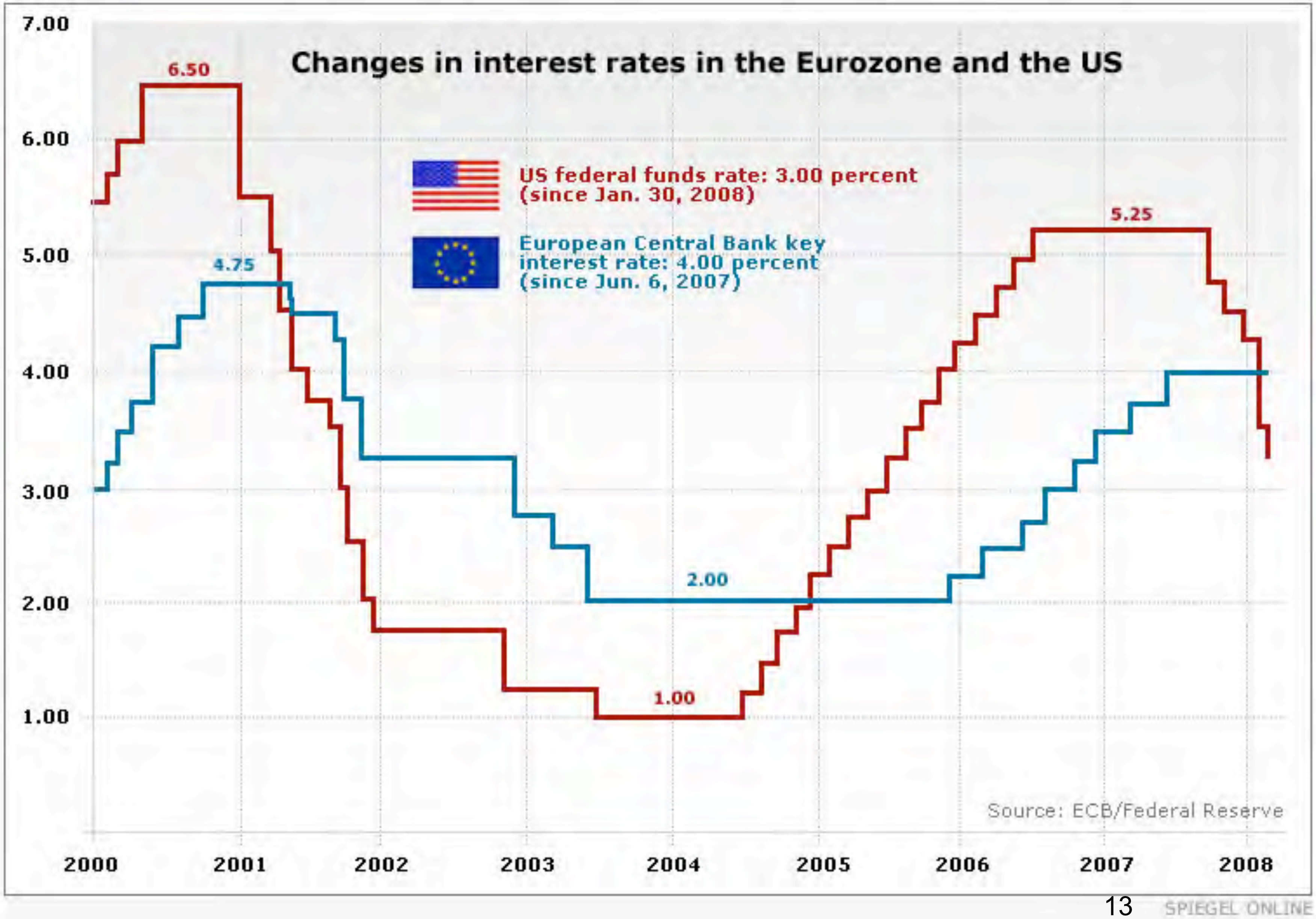
Les risques 2008 selon le Forum économique mondial – 28/01/08

Tableau : *The 26 Core Global Risks : Likelihood with Severity by Economic Loss*, extrait du rapport *Global Risks 2008* (WEF)

Top 10 Risks based on Concern



Source: Swiss Re Corporate Survey 2006 report


Changes in interest rates in the Eurozone and the US
US federal funds rate: 3.00 percent
(since Jan. 30, 2008)
European Central Bank key
interest rate: 4.00 percent
(since Jun. 6, 2007)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
6.50
4.75
5.25
2.00
1.00
2000
2001
2002
2003
2004
2005
2006
2007
2008
Source: ECB/Federal Reserve
SPIEGEL ONLINE

City	YoY Price Change, October	YoY Price Change November
Charlotte - NC	4.3%	2.9%
Seattle - WA	3.3%	1.8%
Portland - OR	1.9%	1.3%
Dallas - TX	-0.1%	-1.2%
Atlanta - GA	-0.7%	-2.0%
Denver	-1.8%	-3.1%
Chicago	-3.2%	-3.9%
Boston	-3.6%	-3.0%
New York	-4.1%	-4.8%
Cleveland - OH	-4.5%	-5.8%
Minneapolis- MN	-5.5%	-6.6%
San Francisco	-6.2%	-8.6%
Washington	-7.0%	-7.8%
Los Angeles	-8.8%	-11.9%
Phoenix - AZ	-10.6%	-12.9%
Las Vegas	-10.7%	-13.2%
San Diego	-11.1%	-13.4%
Detroit - MI	-11.2%	-13.0%
Tampa - FL	-11.8%	-12.6%
Miami	-12.4%	-15.1%
Composite-20	-6.1%	-7.7%

S&P Case-Shiller Composite: House Prices Fall 7.7%

the composite 10 is down 8.4% (ten cities),

the composite 20 is down only 7.7%.

Tuesday, January 29, 2008

Countrywide: One Third of Subprime Loans Delinquent

From Reuters: Countrywide--1 in 3 subprime mortgages delinquent

Countrywide said borrowers were delinquent on 33.64 percent of subprime loans it serviced as of Dec. 31, up from 29.08 percent in September.

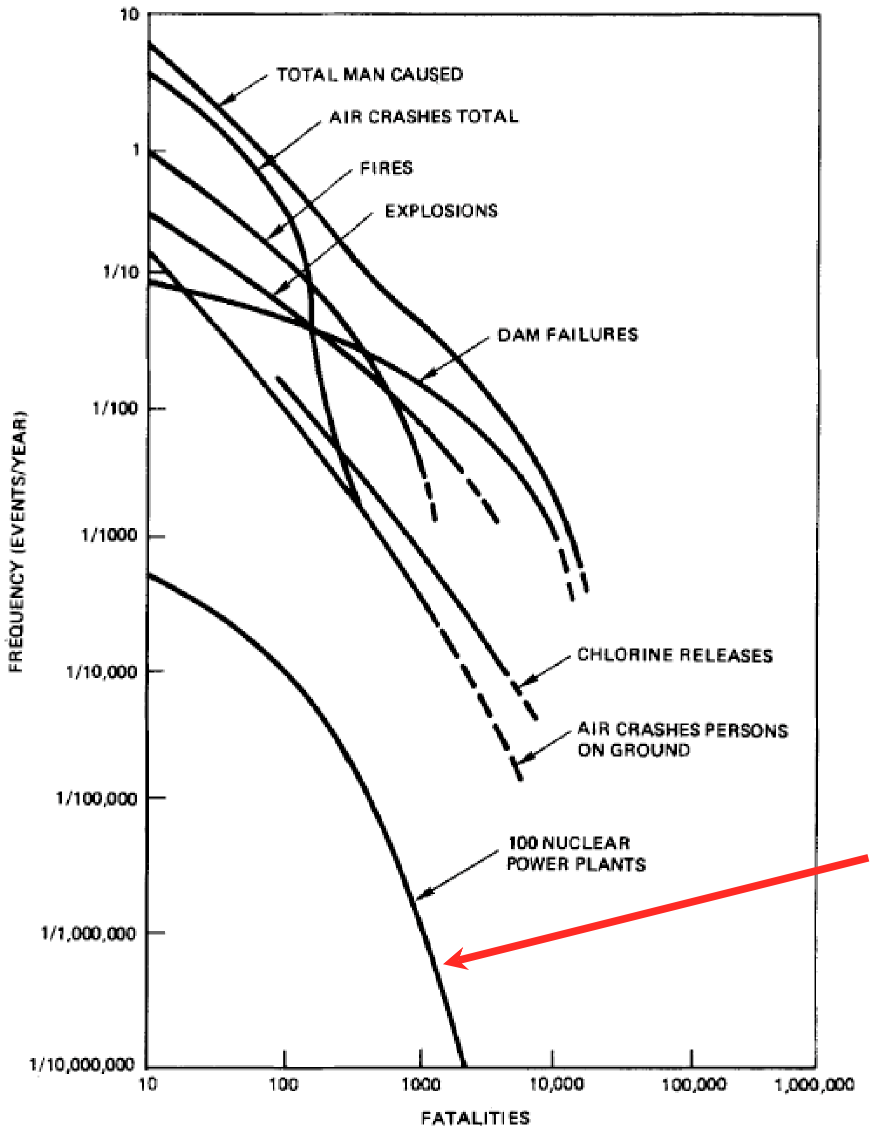
Mild Forms and Wild Forms of Societal Self-Organization

"What is the probability that someone has twice your height? Essentially zero! The height, weight and many other variables are distributed with 'mild' probability distribution functions with a well-defined typical value and relatively small variations around it.

What is the probability that someone has twice your wealth? The answer of course depends somewhat on your wealth but in general there is a non-vanishing fraction of the population twice, ten times, or even one hundred times wealthier as you are."

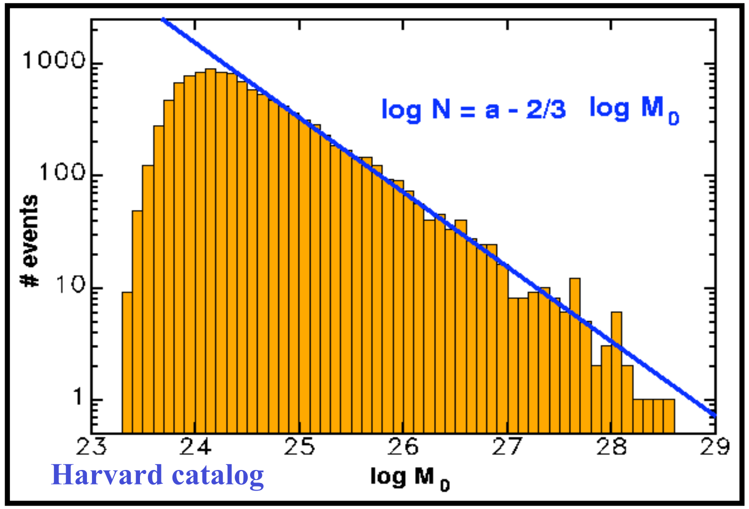
Didier Sornette (2004), 2nd ed., Critical Phenomena in Natural Sciences. Chaos, Fractals, Self-organization and Disorder: Concepts and Tools, Springer, Heidelberg

Frequency of fatalities due to man-caused events



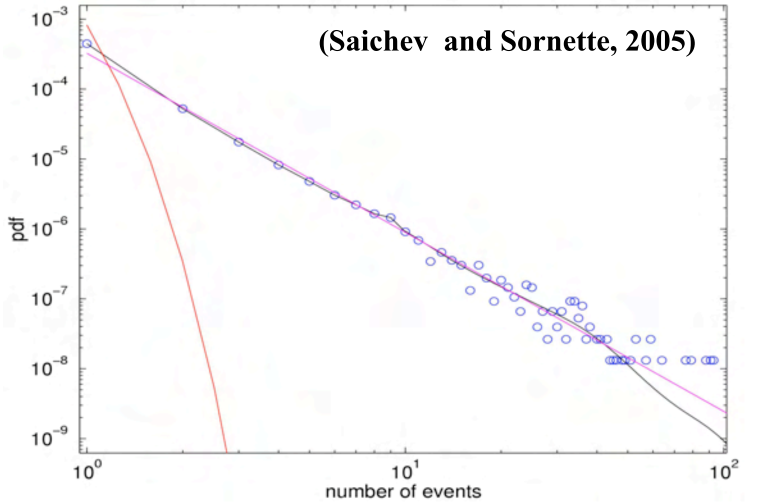
Not a power law ⇒ most probably WILDLY UNDERESTIMATED

Heavy tails in pdf of earthquakes

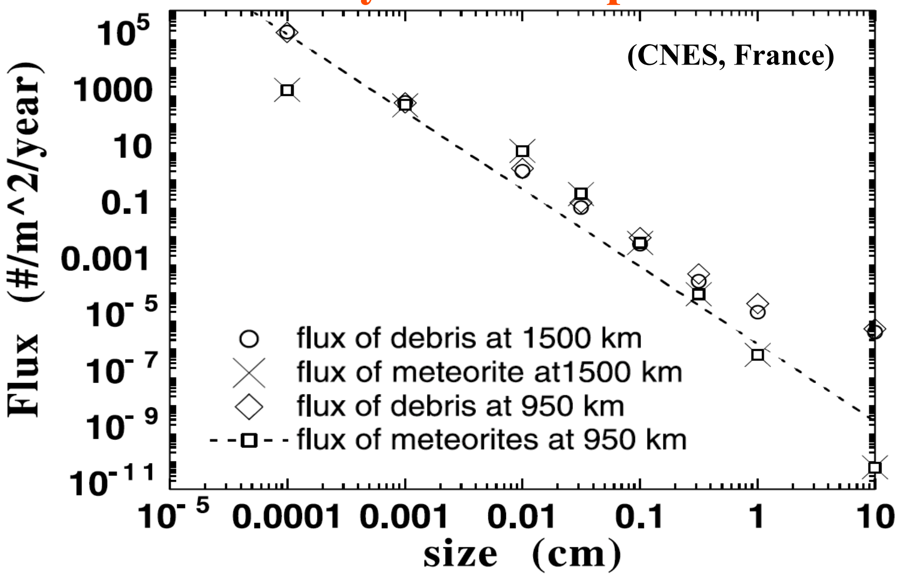


Heavy tails in pdf of seismic rates

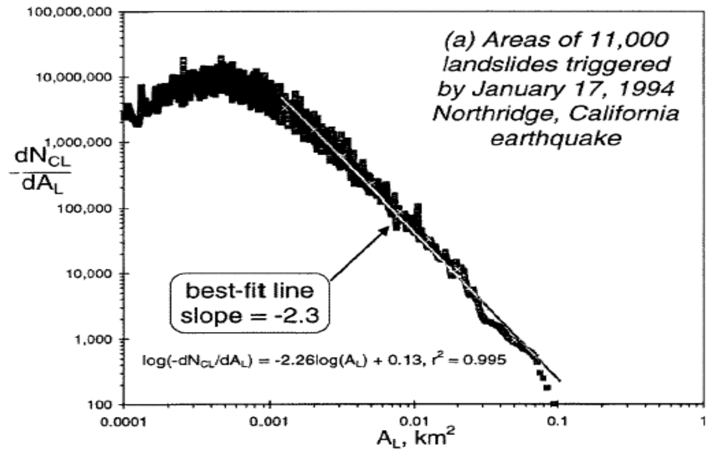
SCEC, 1985-2003, m≥2, grid of 5x5 km, time step=1 day



Heavy tails in ruptures



Heavy tails in pdf of rock falls, Landslides, mountain collapses



Turcotte (1999)

Heavy tails in pdf of forest fires

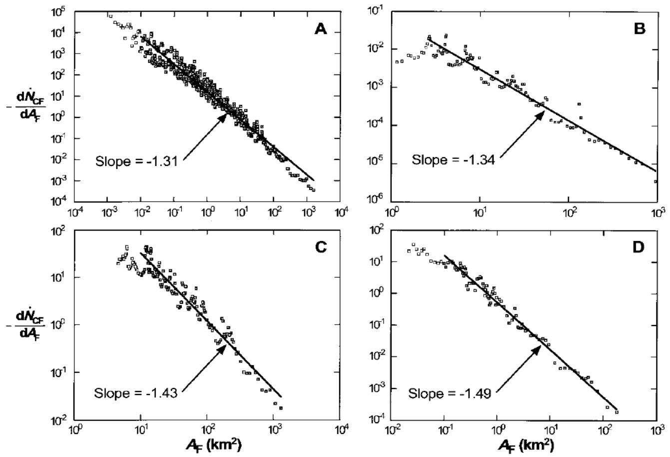
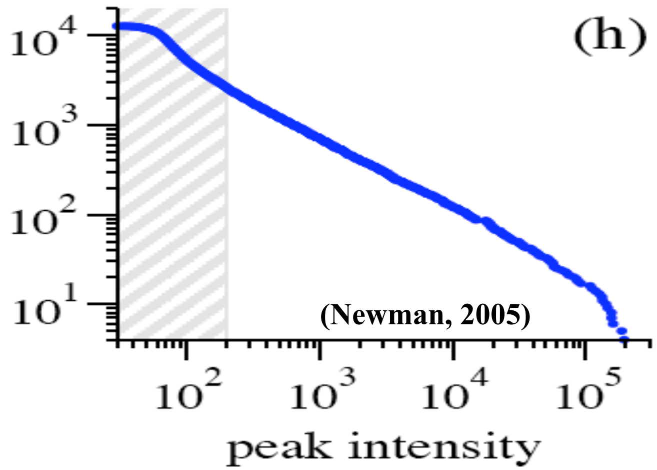


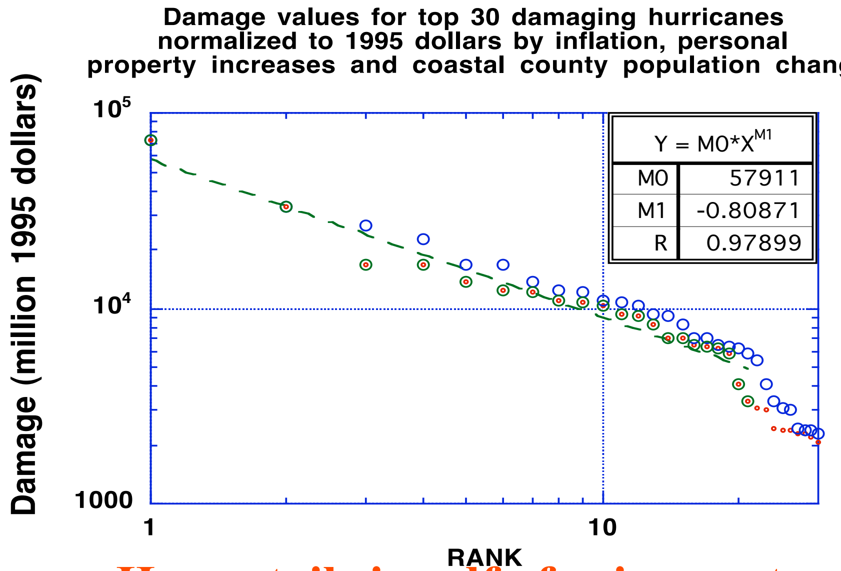
Fig. 2. Noncumulative frequency-area distributions for actual forest fires and wildfires in the United States and Australia: (**A**) 4284 fires on U.S. Fish and Wildlife Service lands (1986–1995) (*9*), (**B**) 120 fires in the western United States (1150–1960) (*10*), (**C**) 164 fires in Alaskan boreal forests (1990–1991) (*11*), and (**D**) 298 fires in the ACT (1926–1991) (*12*). For each data set, the noncumulative number of fires per year ($-d\dot{N}_{CF}/dA_F$) with area (A_F) is given as a function of A_F (*13*). In each case, a reasonably good correlation over many decades of A_F is obtained by using the power-law relation (Eq. 1) with α = 1.31 to 1.49; $-\alpha$ is the slope of the best-fit line in log-log space and is shown for each data set.

Malamud et al., Science 281 (1998)

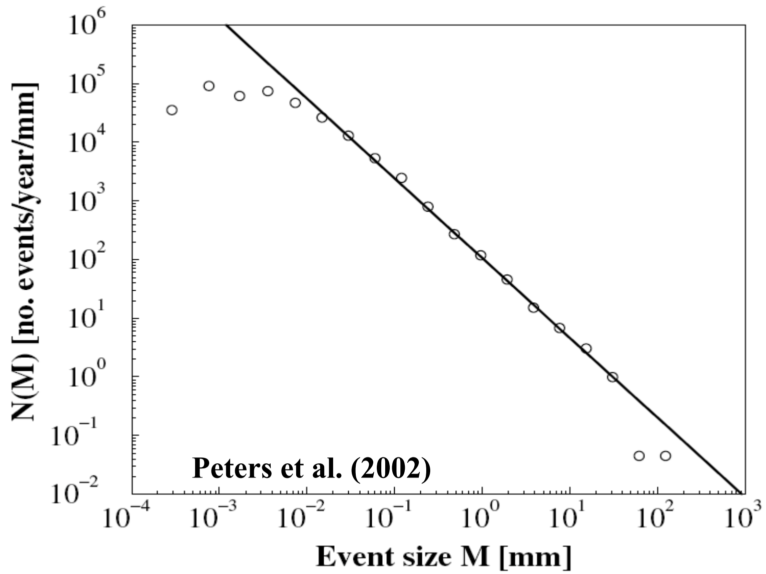
Heavy tails in pdf of Solar flares



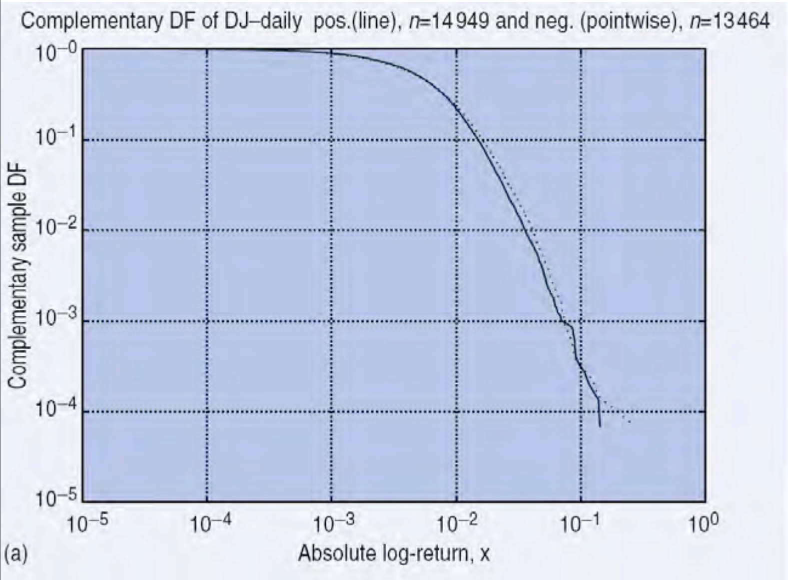
Heavy tails in pdf of Hurricane losses

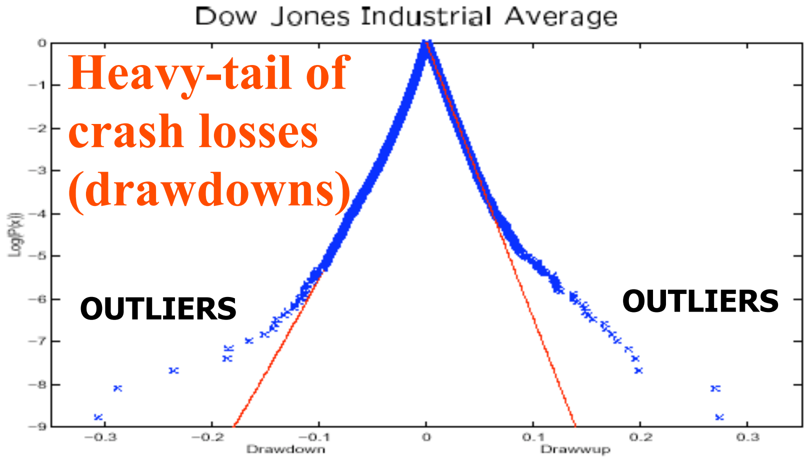


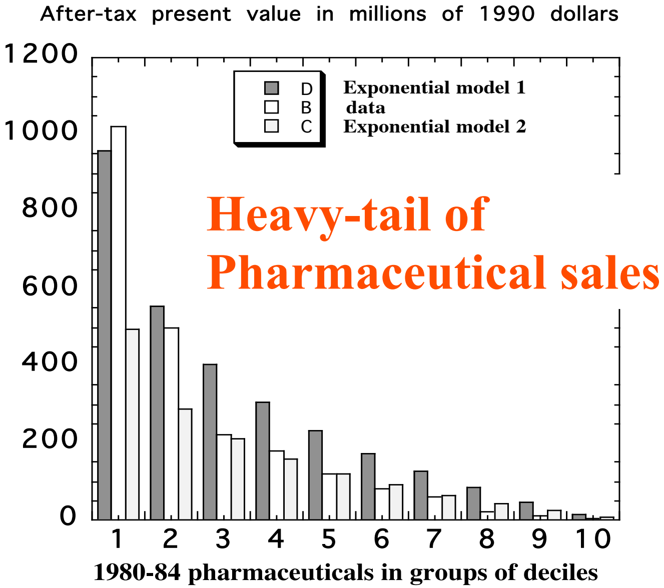
Heavy tails in pdf of rain events



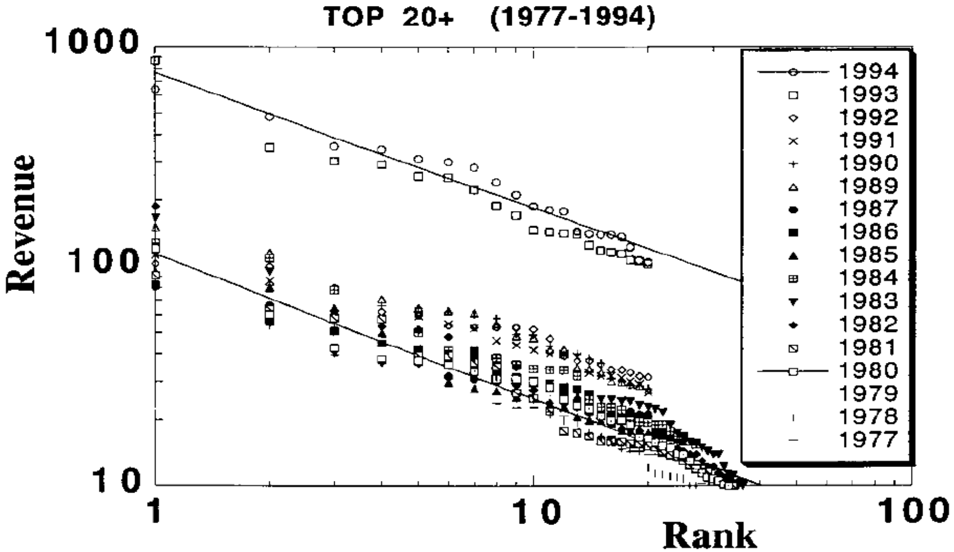
Heavy-tail of price changes

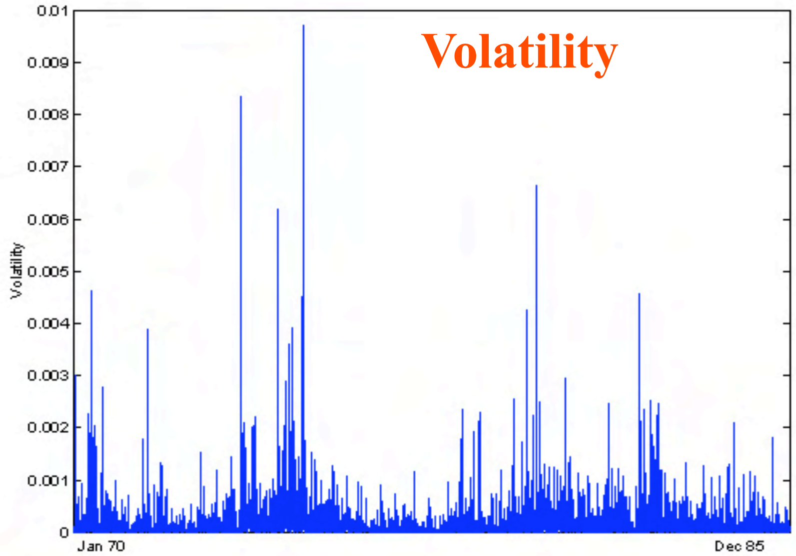


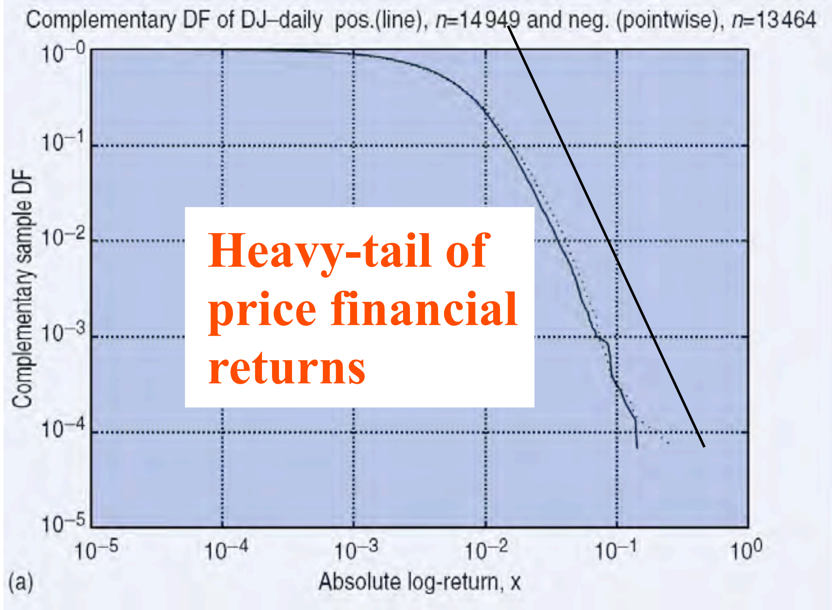


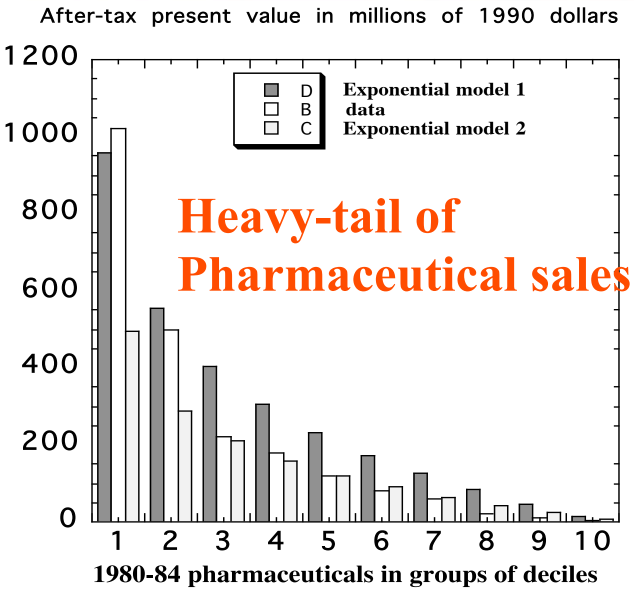


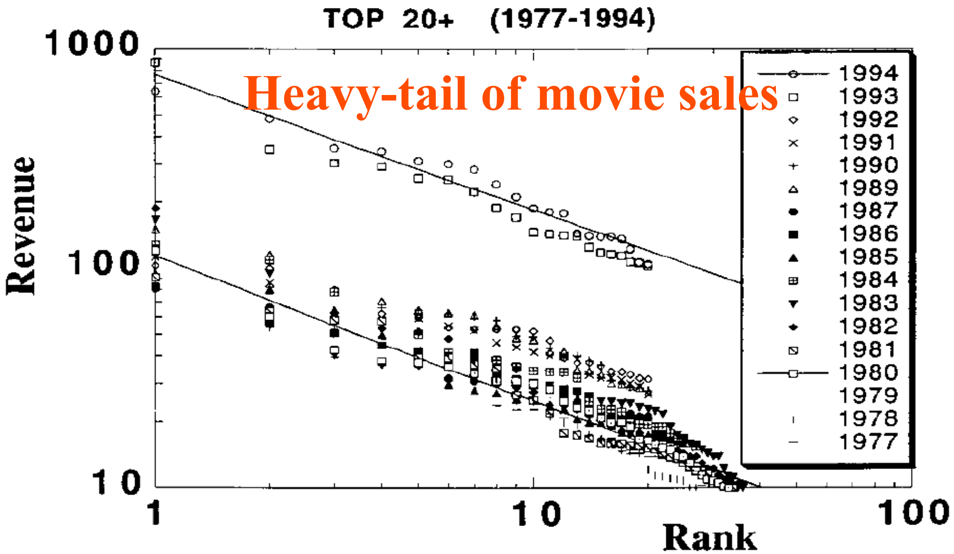
Heavy-tail of movie sales



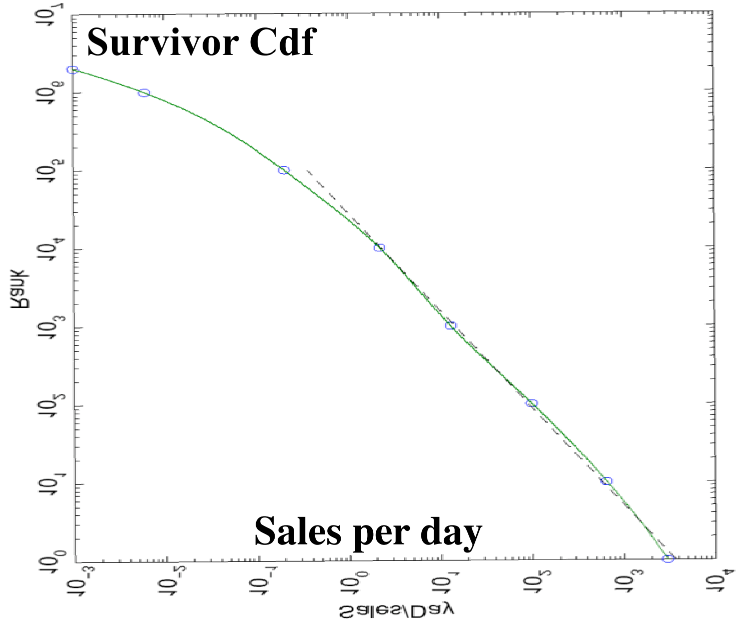

Volatility
Volatility
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Jan 70
Dec 85


Complementary DF of DJ–daily pos.(line), n=14949 and neg. (pointwise), n=13464
Heavy-tail of price financial returns
Complementary sample DF
Absolute log-return, x
(a)

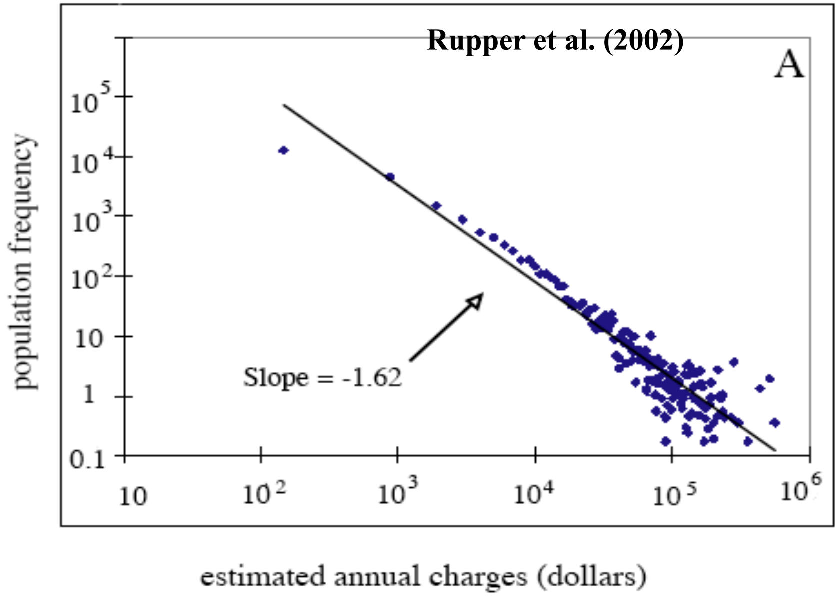

After-tax present value in millions of 1990 dollars
Heavy-tail of Pharmaceutical sales
D Exponential model 1
B data
C Exponential model 2
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10
1980-84 pharmaceuticals in groups of deciles


TOP 20+ (1977-1994)
Heavy-tail of movie sales
Revenue
Rank
1000
100
10
1
10
100
1994
1993
1992
1991
1990
1989
1987
1986
1985
1984
1983
1982
1981
1980
1979
1978
1977

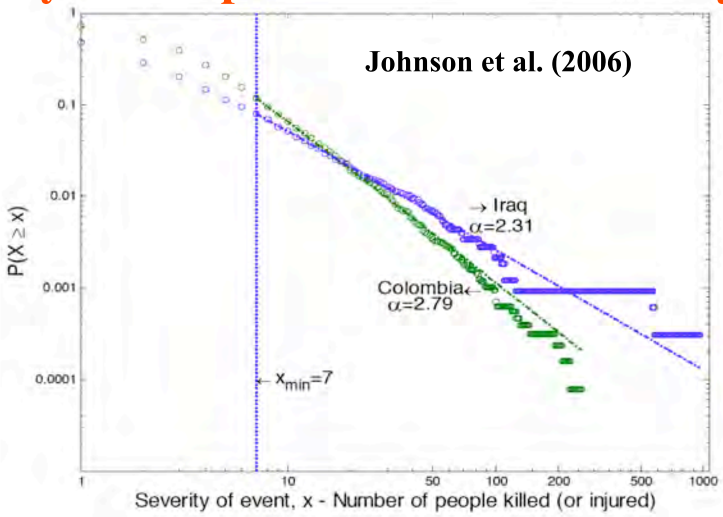
Heavy-tail of pdf of book sales



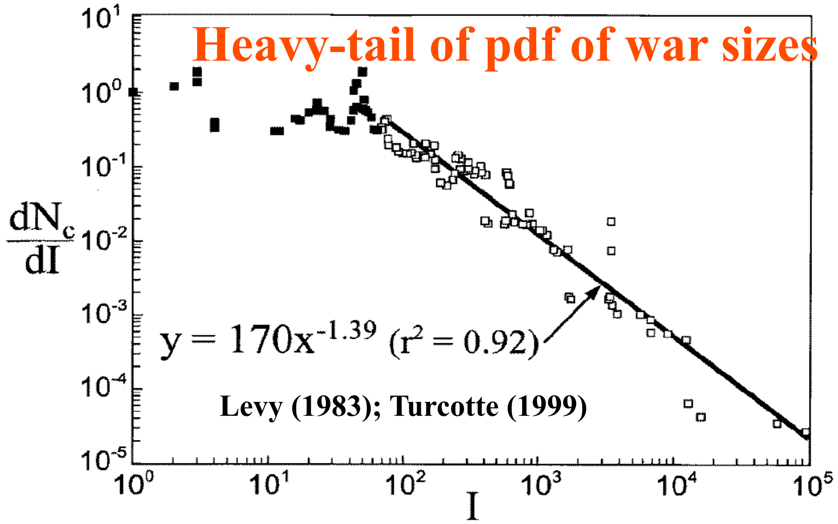
Heavy-tail of pdf of health care costs



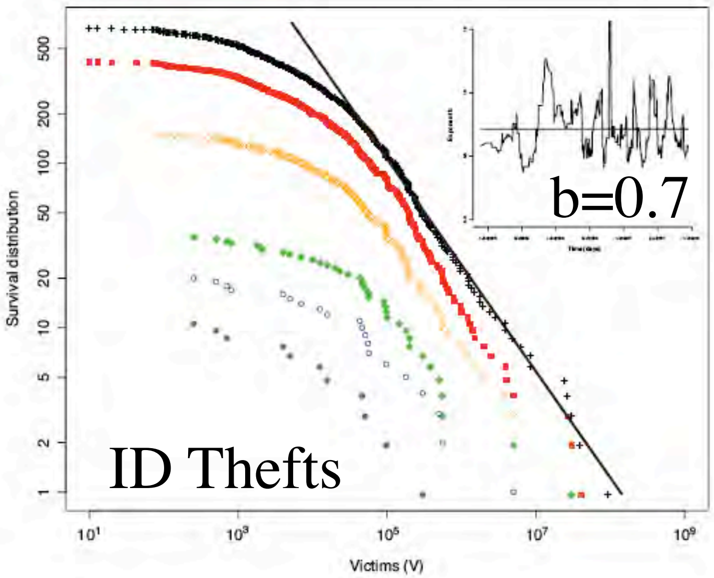
Heavy-tail of pdf of terrorist intensity



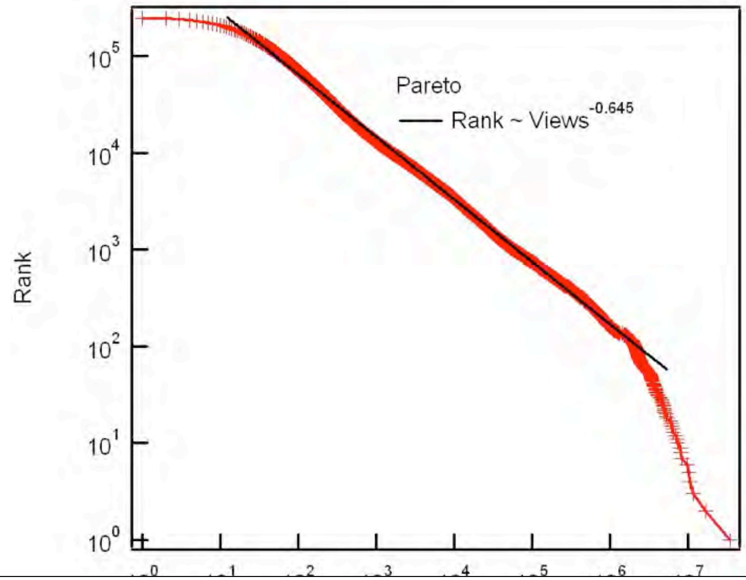
Heavy-tail of pdf of war sizes



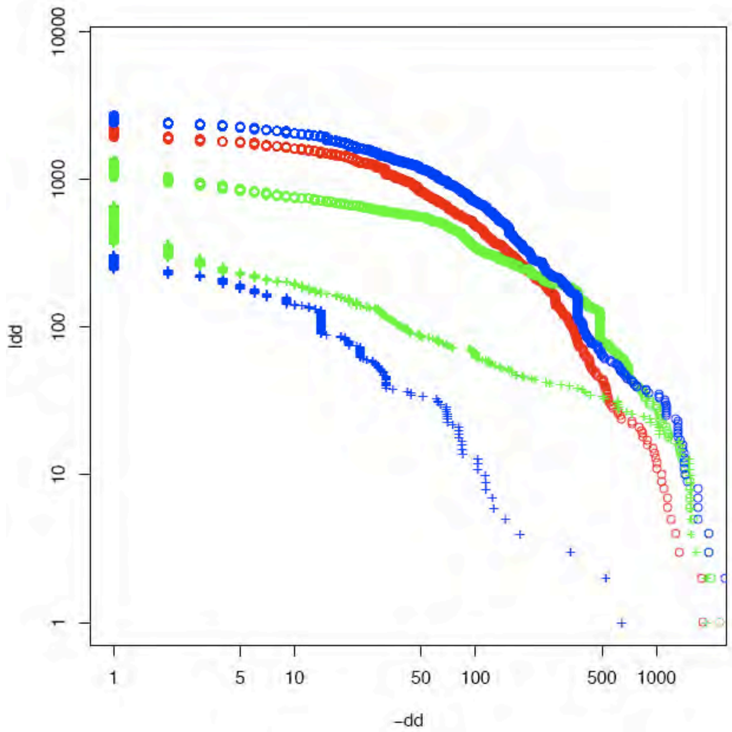
Heavy-tail of pdf of cyber risks



Heavy-tail of YouTube view counts



Software vulnerabilities

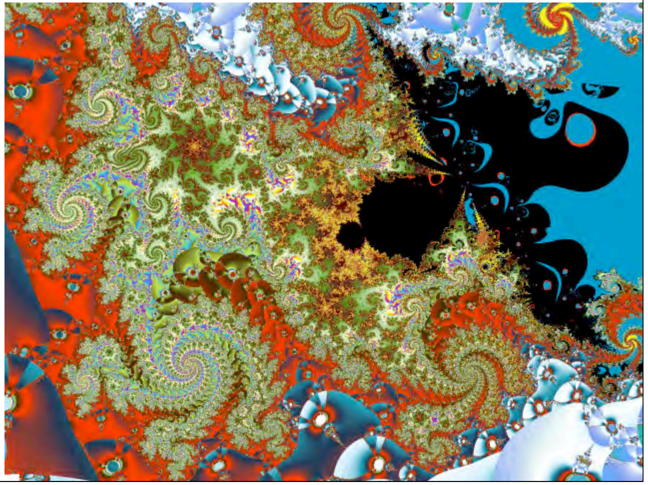


Power laws and large risks

- Power laws are ubiquitous
- They express scale invariance
- Probability of large excursion:

  -example of height vs wealth

- Gaussian approach inappropriate: underestimation of the real risks
  - Markowitz mean-variance portfolio
  - Black-Scholes option pricing and hedging
  - Asset valuation (CAPM, APT, factor models)
  - Financial crashes



X	$Probability_{>}$	*One in N events*	*Calendar waiting time*
1	0.317	3	3 days
2	0.045	22	1 month
3	0.0027	370	1.5 year
4	6.3×10^{-5}	15,787	63 years
5	5.7×10^{-7}	1.7×10^{6}	7 millenia
6	2.0×10^{-9}	5.1×10^{8}	2 million years
7	2.6×10^{-12}	3.9×10^{11}	1562 million years
8	1.2×10^{-15}	8.0×10^{14}	3 trillion years
9	2.3×10^{-19}	4.4×10^{18}	17,721 trillion years
10	1.5×10^{-23}	6.6×10^{22}	260 million trillion years

How probable is it to observe a return larger in amplitude (i.e., in absolute value) than some value equal to X times the standard deviation? The answer is given in this table for the Gaussian world. The left column gives the list of values of X from 1 to 10. The second column gives the probability that the absolute value of the return is found larger than X times the standard deviation. The third column translated this probability into the number of periods (days in our example) one would typically need to wait to witness such a return amplitude. The fourth column translates this waiting time into calendar time in units adapted to the value, using the conversion that one month contains approximately 20 trading days and one year contains about 250 trading days. For comparison, the age of the universe is believed to be (only) of the order of 10–15 billion years.

What model(s) for the Distributions of Returns?

- Models in terms of Regularly varying distributions:

$$\Pr\left[r_t \geq x\right] = \mathcal{L}(x) \cdot x^{-\mu} \qquad (\mu \approx 3-4)$$

Longin (1996) , Lux (1996-2000), Pagan (1996), Gopikrishnan et *al.* (1998)…

- Models in terms of Weibull-like distributions:

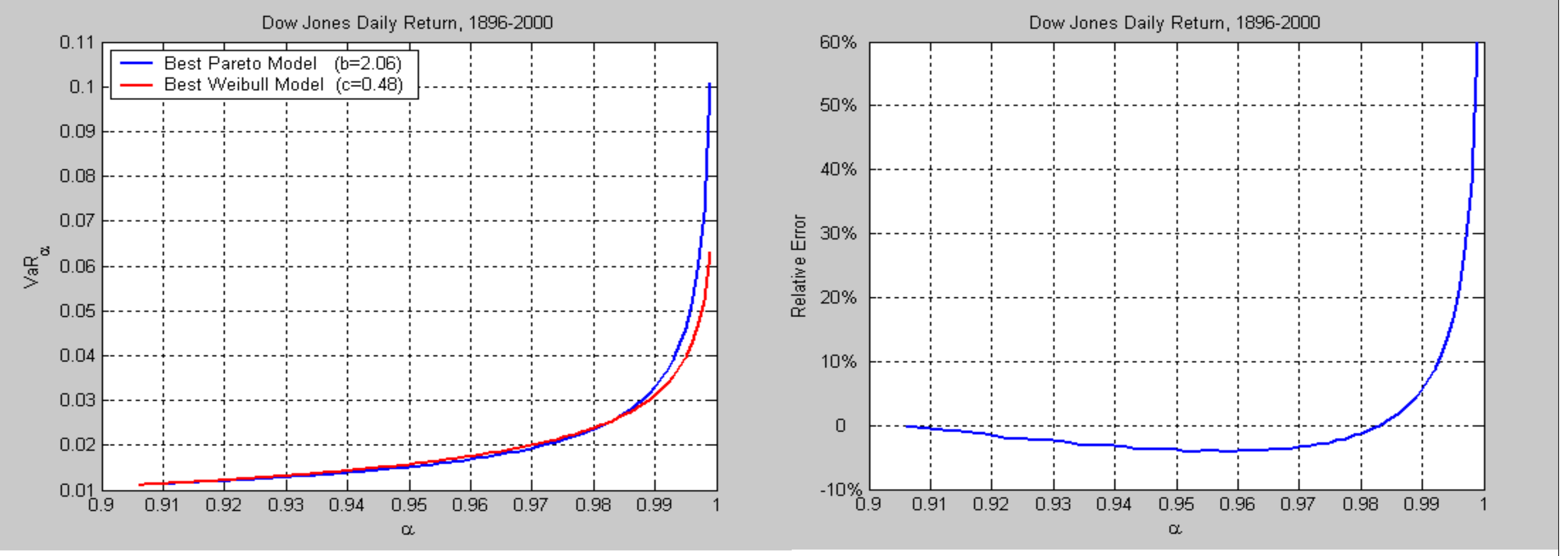
$$\Pr\left[r_t \geq x\right] = \exp\left[-\mathcal{L}(x) \cdot x^{c}\right] \qquad (c < 1)$$

Mantegna and Stanley (1994), Ebernlein et *al.*(1998), Gouriéroux and Jasiak (1998), Laherrère and Sornette (1999)…

Implications of the two models ON THE VALUE AT RISK

Practical consequences :

- Extreme risk assessment,
- Multi-moment asset pricing methods.



Standard measure of dependence: the correlation coefficient

$$\rho_{12} = \quad \rho(X,Y) = \frac{\mathrm{Cov}\,[X,\ Y]}{\sqrt{\mathrm{Var}\,[X] \cdot \mathrm{Var}\,[Y]}}$$

Pearson estimator:

$$\hat{\rho}_T = \frac{\frac{1}{T}\sum_{i=1}^{T}(x_i - \bar{x}) \cdot (y_i - \bar{y})}{\sqrt{\frac{1}{T}\sum_{i=1}^{T}(x_i - \bar{x})^2 \cdot \frac{1}{T}\sum_{i=1}^{T}(y_i - \bar{y})^2}}$$

ρ is a linear measure of dependence

$$Y = \beta X + \epsilon \quad \Leftrightarrow \quad \rho = \beta \sqrt{\frac{\mathrm{Var}[X]}{\mathrm{Var}[Y]}}$$

The correlation coefficient is invariant under an increasing affine change of variable

$$X' = a \cdot X + b, \quad a > 0$$
$$Y' = c \cdot Y + d, \quad c > 0$$

But lack of invariance with respect to NONLINEAR change of variables

- local correlation and generalized correlation for N>2 variables
- Kendall's tau

$$\tau = \Pr\left[(X_1 - X_2) \cdot (Y_1 - Y_2) > 0\right] - \Pr\left[(X_1 - X_2) \cdot (Y_1 - Y_2) < 0\right]$$

$$\tau(C) = 4 \int\int C(u,v)\; dC(u,v) - 1$$

- Spearman's rho $\quad \rho_s(C) = 12 \int\int_{[0,1]^2} C(u,v)\; du dv - 3$

$$\rho_s = 3\left(\Pr[(X_1 - X_2)(Y_1 - Y_3) > 0] - \Pr[(X_1 - X_2)(Y_1 - Y_3) < 0]\right)$$

- Gini's gamma $\quad \gamma(C) = 4\left[\int_0^1 C(u,u)\; du + \int_0^1 C(u, 1-u)\; du - \frac{1}{2}\right]$

Concordance measures of dependence

Kendall's tau, Spearman's rho, Gini's gamma share the following properties

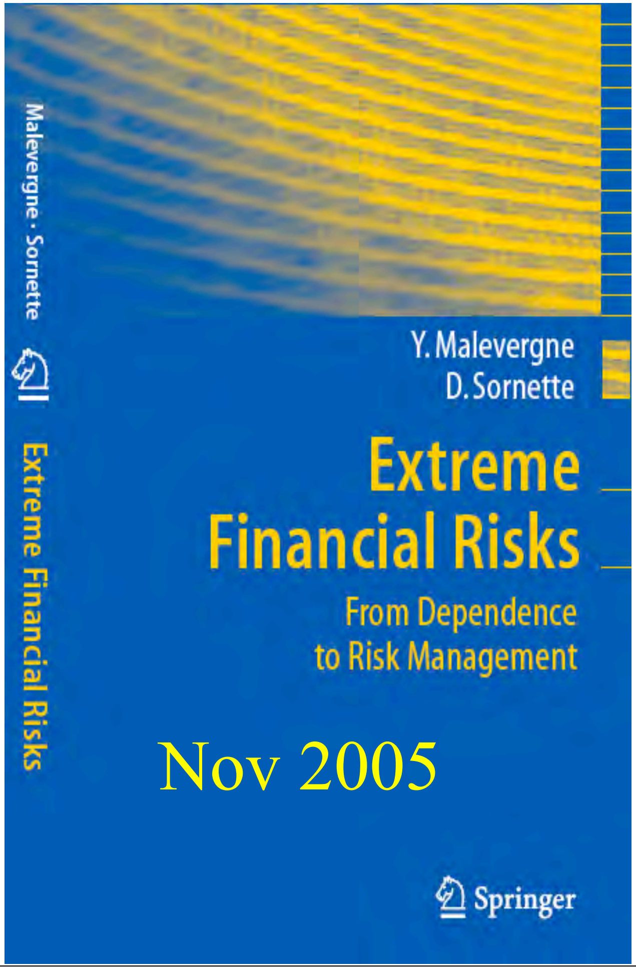
1. they are defined for any pair of continuous random variables X and Y,
2. they are symmetric: for any pair X and Y, $\tau(X,Y) = \tau(Y,X)$, for instance,
3. they range from -1 to $+1$, and reach these bounds when X and Y are countermonotonic and comonotonic respectively,
4. they equal zero for independent random variables,
5. if the pair of random variables (X_1, X_2) is more dependent than the pair (Y_1, Y_2) in the following sense:

   $$C_X(u,v) \geq C_Y(u,v), \quad \forall u, v \in [0,1],$$

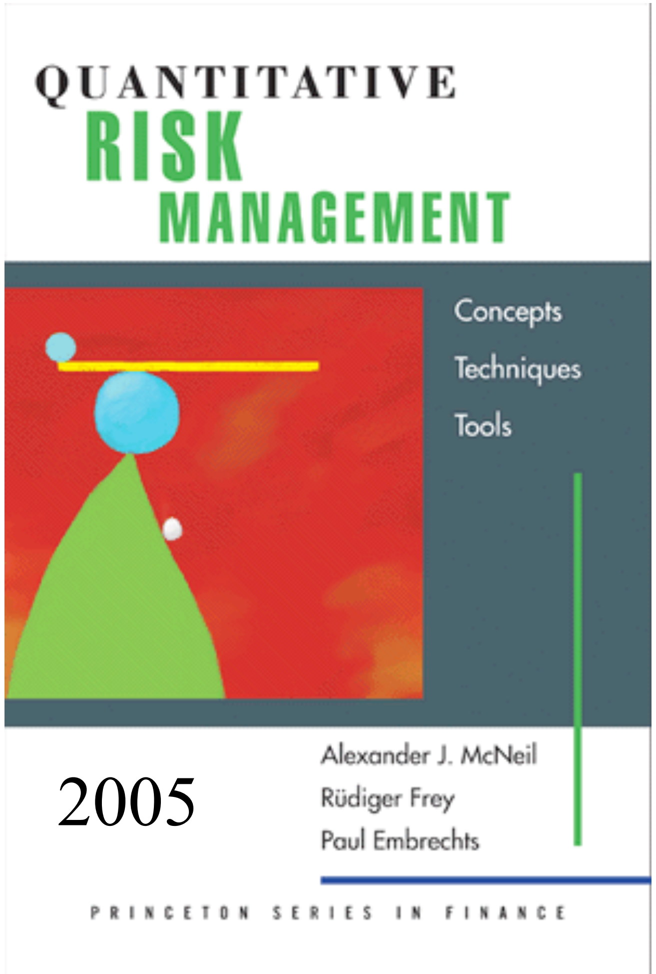
   then the same ranking holds for any of these three measures; for instance, $\tau(X_1, X_1) \geq \tau(Y_1, Y_2)$.

Copulas, Higher-Moments and Tail Risks

Optimal "orthogonal" decomposition of multivariate risks
in terms of -marginal distributions
-intrinsic dependence



Nov 2005



2005

Extreme dependence

$F(x,y) = C(F_X(x), F_Y(y))$ **Definition of copula**

coefficient of lower tail dependence between the two assets X_i and X_j,

$$\lambda_{ij}^{-} = \lim_{u \to 0} \Pr\left\{X_i < F_i^{-1}(u) \middle| X_j < F_j^{-1}(u)\right\}$$

$$\lambda_{+} = \lim_{u \to 1^{-}} \frac{1 - 2u + C(u,u)}{1 - u}$$

coefficient of upper tail dependence

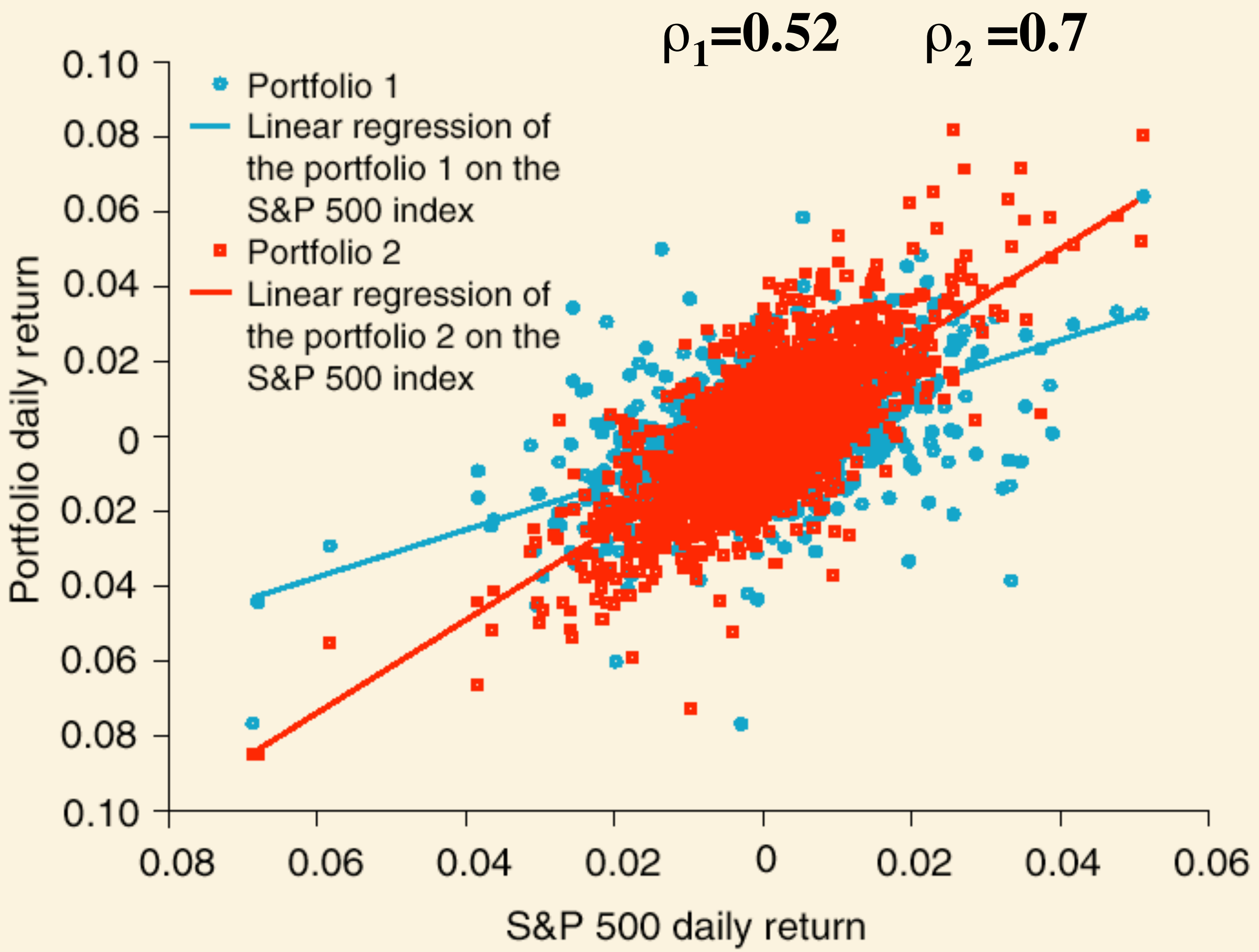
$$\lambda_{ij}^{+} = \lim_{u \to 1} \Pr\left\{X_i > F_i^{-1}(u) \middle| X_j > F_j^{-1}(u)\right\}$$

A. Coefficients of tail dependence

	Lower tail dependence	Upper tail dependence
Bristol-Myers Squibb	0.16 (0.03)	0.14 (0.01)
Chevron	0.05 (0.01)	0.03 (0.01)
Hewlett-Packard	0.13 (0.01)	0.12 (0.01)
Coca-Cola	0.12 (0.01)	0.09 (0.01)
Minnesota Mining & MFG	0.07 (0.01)	0.06 (0.01)
Philip Morris	0.04 (0.01)	0.04 (0.01)
Procter & Gamble	0.12 (0.02)	0.09 (0.01)
Pharmacia	0.06 (0.01)	0.04 (0.01)
Schering-Plough	0.12 (0.01)	0.11 (0.01)
Texaco	0.04 (0.01)	0.03 (0.01)
Texas Instruments	0.17 (0.02)	0.12 (0.01)
Walgreen	0.11 (0.01)	0.09 (0.01)

This table presents the coefficients of lower and upper tail dependence with the S&P 500 index for a set of 12 major stocks traded on the New York Stock Exchange from January 1991 to December 2000. The numbers in brackets give the estimated standard deviation of the empirical coefficients of tail dependence

3. Portfolios versus market



Daily returns of two equally weighted portfolios P_1 (made of four stocks with small $\lambda \leq 0.06$) and P_2 (made of four stocks with large $\lambda \geq 0.12$) as a function of the daily returns of the S&P 500 from Jan 1991–Dec 2000

- Gaussianization of multivariate distributions
- Copulas
- Test of the Gaussian copula hypothesis
- Extreme conditional dependence measures
- Tail dependence for factor models

Characterization of the pdf of EXTREMES

$$\max_N = \max(x_1, \ldots, x_N) \qquad\qquad (\max_N - b_N)/a_N \rightarrow Y$$

three limit pdf's with three domains of attraction:

$$H_\xi(x) = \begin{cases} \exp(-(1+\xi x)^{-1/\xi}), & -\infty < \xi < +\infty, \quad \xi \neq 0, \;\; 1+\xi x > 0, \\ \exp(-\exp(-x)), & \xi = 0, \quad -\infty < x < \infty. \end{cases}$$

Gnedenko-Pickands-Balkema-de Haan theorem (G-P-B-H theorem)

$$G(x/\xi, s) = 1 + \ln(H_\xi(x/s)) = 1 - (1 + \xi x/s)^{-1/\xi}$$

Generalized Pareto Distribution (GPD)

for the pdf of events conditioned to be larger than some threshold

Defining $x_F = \sup\{x : F(x) < 1\}$,

excess distribution $F_u(x) = P\{X - u < x | X > u\}, \quad x \geq 0$

Gnedenko-Pickands-Balkema-de Haan Theorem

$F(x) \in \mathrm{MDA}(H_\xi)$ if and only if there exists a positive function $s(u)$ such that

$$\lim_{u \uparrow x_F} \sup_{0 \leq x \leq x_F - u} |\bar{F}_u(x) - \bar{G}(x/\xi, s(u))| = 0.$$

In practice: $\bar{F}(x + u) \cong \bar{G}(x/\hat{\xi}, \hat{s}) \times (n_u/N).$

Power law tail behavior (Frechet), exponential (Gumbel) or finite upper value (Weibull):

$$\bar{G}(x/\xi, s) \cong (\xi x/s)^{-1/\xi}.$$

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New Approach to Constructive Model Validation

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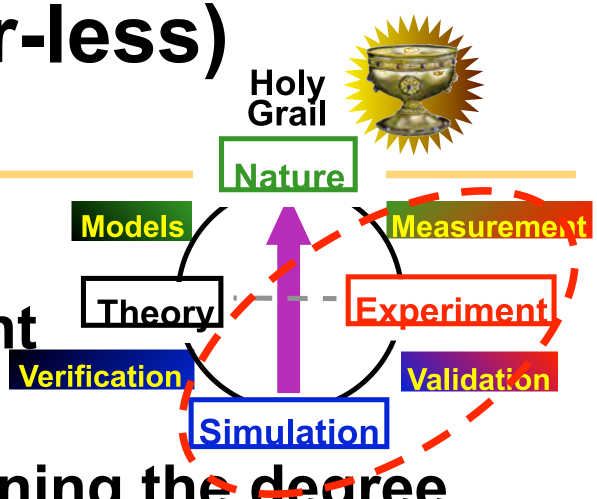
"Validation" has a (more-or-less) consensus definition.



- <u>ASC</u>: The process of confirming that code predictions adequately represent measured physical phenomena.
- <u>AIAA/ASME</u>: The process of determining the degree to which a model is an accurate representation of the real world from the perspective of its intended uses.
- <u>Schlesinger</u> (1979): The substantiation that a model within its domain of applicability possesses a satisfactory range of accuracy consistent with the intended applications of the model.
- <u>P. Roache</u> (1998): Validation is demonstrating that one solves the correct equations.

Validation is about physics

Studies from a range of disciplines suggest that principled validation is necessary.

"The two most common biases are over-optimism and overconfidence. Overconfidence refers to a situation whereby people are surprised more often than they expect to be. Effectively, people are generally much too sure about their ability to predict. This tendency is particularly pronounced amongst experts. That is to say, experts are more overconfident than lay people. This is consistent with the illusion of knowledge driving overconfidence."

J. Montier, in *The Folly of Forecasting: Ignore All Economists, Strategists & Analysts*

"Nobody's perfect, and most people drastically underestimate their distance from that state."
Mahaffy's First Law of Human Nature

We propose a validation "loop" with four distinct steps.

1. **Start with a prior trust of the model's value, measured by the quantity V_{prior} .**
   - ➢ V_{prior} **is a gauge of accumulated trust or confidence.**
   - ➢ **On the first iteration of this loop, arbitrarily set V_{prior} = 1.**
   - ➢ **The *change* in V_{prior} is important, not its absolute value.**
2. **Conduct an experiment or observation, perform the corresponding simulation, and compare results.**
   - ➢ **Each of these three tasks presents its own challenges.**
     - **Which experiments?**
     - **How to calibrate a simulation?**
     - **How to compare experimental data and model results?**

"In science, if you know what you are doing, you should not be doing it."
Richard Hamming

A complete iteration in this validation process has well-defined characteristics.

3. Assign a metric-based "grade" of the quality of the comparison between observations y_{obs} and model M.

- **This is ideally formulated as a statistical test of significance in which the hypothesis (i.e., the model results) is tested against the alternative, which is "all the rest."**
- **This grade $p(M \mid y_{\text{obs}})$ quantifies the quality of the comparison compared against the reference likelihood q of "all the rest."**

4. Update to obtain the posterior trust as:

$$V_{\text{posterior}} / V_{\text{prior}} = F[p(M \mid y_{\text{obs}}),\ q\ ;\ c_{\text{novel}}]$$

- $V_{\text{posterior}} > V_{\text{prior}} \Rightarrow$ **trust/confidence has *<u>in</u>creased*.**
- $V_{\text{posterior}} < V_{\text{prior}} \Rightarrow$ **trust/confidence has *<u>de</u>creased.***
- c_{novel} **measures the novelty or impact of the experiment.**

"Mathematics is an interesting intellectual sport but it should not be allowed to stand in the way of obtaining sensible information about physical processes." Richard Hamming

“Seven Deadly Sins of V&V”

- Assume the code is correct.
- Only do a qualitative comparison (e.g., the viewgraph norm).
- Use problem-specific special methods or settings.
- Use only code-to-code comparisons.
- Use only one mesh.
- Only show the results that make the code look good, viz., the ones that appear correct.
- Don’t differentiate between accuracy

- Lust
- Gluttony
- Envy
- Wrath
- Sloth
- Pride
- Avarice

Traditional “7 Deadly Sins”

Hieronymus Bosch. 1485

Otto Dix, 1933

“Seven Virtuous V&V Practices”

- Assume the code has flaws, bugs, and errors then find them—and fix them!
- Be quantitative.
- Verify and Validate the same thing.
- Use analytic solutions & experimental data.
- Use systematic mesh refinement.
- Show all results—reveal the shortcomings.
- Assess accuracy and robustness separately.

- Prudence
- Temperance
- Faith
- Hope
- Fortitude
- Justice
- Charity

Traditional
“7 Cardinal Virtues”

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Portfolio diversification: examples

Top 25 US Colleges and Universities' endowment portfolio allocation in 2004

Univeristy	Endowments (in $bn)	Operating Budget (in $bn)	2004 Return (%)	Investments' Diversification							
				Cash	Stocks	Private Equity	Hedge Funds	Venture Cap.	Bonds	Real estate	Other
Brown U. (Providence, R.I.)	1,7	0,5	16,1	3,3%	39,8%	2,9%	31,0%	1,1%	13,6%	4,1%	4,2%
Columbia U. (New York)	4,5	2,2	16,9	3,0%	25,0%	13,0%	35,0%	6,0%	13,0%	3,0%	2,0%
Cornell U. (Ithaca, N.Y.)	3,2	2,0	16,1	0,1%	43,2%	2,9%	13,8%	2,9%	23,4%	8,5%	5,2%
Dartmouth College (Hanover, N.H.)	2,5	0,6	18,6	0,0%	40,7%	0,0%	20,6%	13,4%	15,4%	9,9%	0,0%
Duke U. (Durham, N.C.)	3,3	2,7	18,0	3,0%	65,0%	0,0%	0,0%	0,0%	15,0%	0,0%	0,0%
Emory U. (Atlanta)	4,5	0,6									
Harvard U. (Cambridge, Mass.)	22,6	2,6	21,1	2,3%	39,6%	7,7%	11,4%	-	21,6%	5,6%	11,8%
Massachusetts Institute of Technology (Cambridge)	5,9	1,8									
Northwestern U. (Evanston, Il.)	3,7	1,1									
Princeton U. (N.J.)	9,9	0,9	16,8	3,1%	33,7%	6,7%	28,3%	4,0%	11,1%	8,5%	4,5%
Rice U. (Houston)	3,3	0,3	17,2	3,0%	53,0%	1,0%	19,0%	5,0%	10,0%	3,0%	6,0%
Stanford U. (Calif.)	10,0	2,6									
Texas A&M U. System and Foundations (College Station)	4,4	2,5									
The Johns Hopkins U. (Baltimore)	2,1	2,7	15,3	2,5%	54,0%	5,2%	5,7%	0,0%	14,6%	1,5%	16,5%
U. of California System (Oakland)	6,6	18,0	14,7	0,0%	52,0%	10,0%	5,0%	0,0%	28,0%	5,0%	0,0%
U. of Chicago	3,6	1,3	16,6	3,0%	43,0%	17,0%	17,0%	0,0%	13,0%	7,0%	0,0%
U. of Michigan (Ann Arbor)	4,2	4,0	20,7	0,5%	41,2%	6,4%	20,5%	3,4%	15,6%	7,0%	5,4%
U. of Notre Dame (South Bend, Ind.)	3,1	0,7									
U. of Pennsylvania (Philadelphia)	4,0	3,7	16,8	0,0%	53,4%	3,3%	17,4%	0,0%	22,3%	3,6%	0,0%
U. of Southern California (Los Angeles)	2,4	1,5	16,9	0,0%	50,2%	4,3%	14,5%	5,0%	17,3%	7,0%	1,7%
U. of Texas System (Austin)	10,3	7,8									
U. of Virginia (Charlottesville)	2,8	1,7	12,7	7,8%	15,3%	10,0%	56,4%	2,8%	5,0%	2,7%	0,0%
Vanderbilt U. (Nashvile)	2,3	1,9	16,9	1,1%	48,1%	4,7%	19,0%	4,8%	12,1%	6,8%	3,4%
Washington U. in St. Louis	4,1	1,4	18,2	0,7%	63,3%	3,0%	13,2%	1,9%	17,1%	0,5%	0,3%
Yale U. (New Haven, Conn.)	12,7	1,7	19,4	3,5%	29,6%	14,8%	26,1%	0,0%	7,4%	0,0%	18,8%
Average			**17,2**	**2,1%**	**45,0%**	**6,3%**	**19,7%**	**2,8%**	**15,3%**	**4,7%**	**4,4%**

Investing in the UNKNOWN

Most great investors, from David Ricardo to Warren Buffett, have made most of their fortunes by betting on UUU (Unique, Unknown, Unknowable) situations.

Ricardo allegedly made 1 million pounds (over $50 million today) – roughly half of his fortune at death – on his Waterloo bonds.

Buffett has made dozens of equivalent investments. Though he is best known for the Nebraska Furniture Mart and See's Candies, or for long-term investments in companies like the Washington Post and Coca Cola, insurance has been Berkshire Hathaway's firehose of wealth over the years. And insurance often requires UUU thinking.

Many experts saw as a UUU insurance situation, so they steered clear; but he saw it as offering excess premium relative to risk, so he took it all.

The three largest risks to the financial and economic systems:

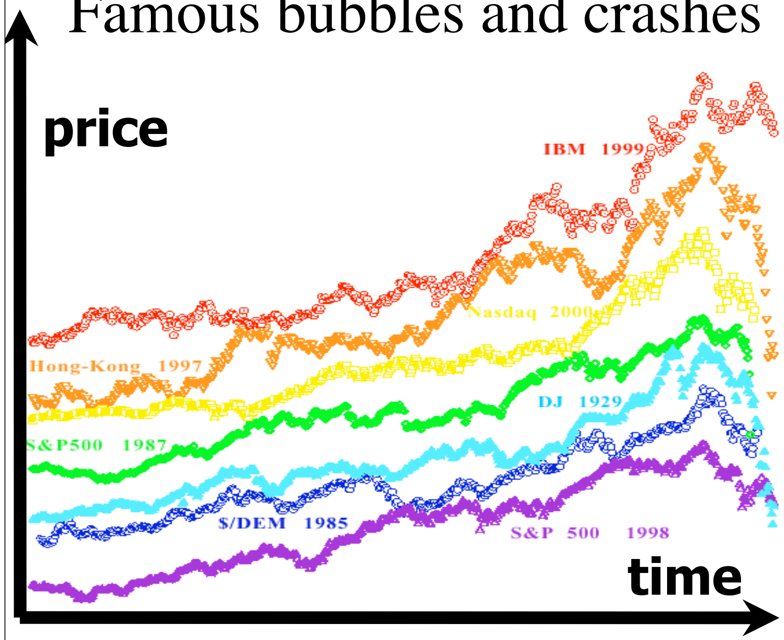
-moral hazard

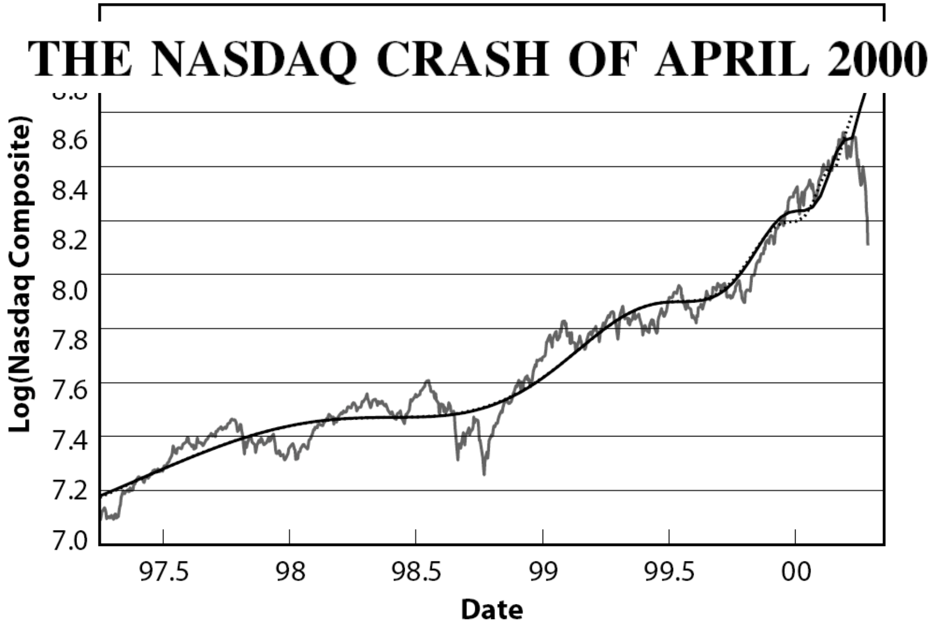
-herding

-Three and more bubbles: towards the perfect storm

Managing the economy and the financial stock markets ?

Famous bubbles and crashes





“We, at the Federal Reserve…recognized that, despite our suspicions, it was very difficult to definitively identify a bubble until after the fact, that is, when its bursting confirmed its existence…

Moreover, it was far from obvious that bubbles, even if identified early, could be preempted short of the Central Bank inducing a substantial contraction in economic activity, the very outcome we would be seeking to avoid.”

A. Greenspan (Aug., 30, 2002)

My Research Agenda to Address Risks in Financial Management

- Added-value strategies / expected returns
  1. Asymmetric information between managers and investors
  2. Reverse engineering of hedge-funds and derivative strategies
  3. Combining portfolio and investment strategies
- Risk measure and control
  1. Scenario and crises analyses
  2. Robust statistical methods to address model error
- Bubbles, crashes and extreme risks of unsustainable regimes
  1. The "Crisis Observatory" and crash alarm index
  2. Robust multivariate scanning of world assets
  3. NL models with positive and negative feedbacks
- Macro and micro economic analyses
  1. Separating information from "noise" and false consensus
  2. Endogenous vs exogenous extreme risks