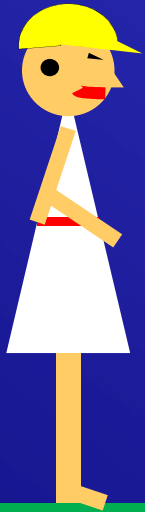


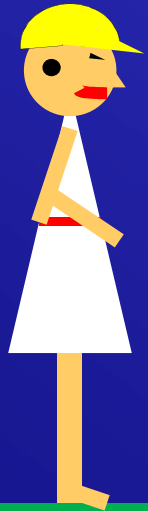
A composite image of Earth from space. The left side shows the sun rising over the horizon, creating a bright lens flare. The right side shows the Earth at night, with city lights visible across the continents of Europe and Africa. The text "The world is not an average" is overlaid in the center in a yellow, sans-serif font.

The world is not an
average

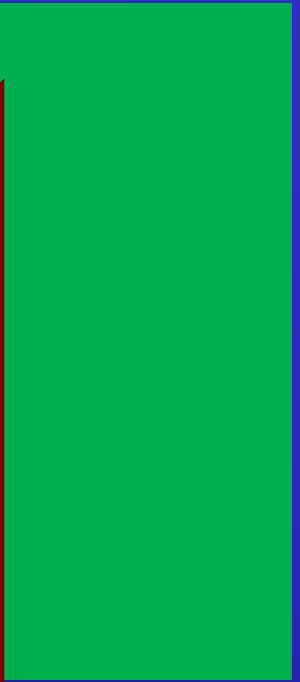
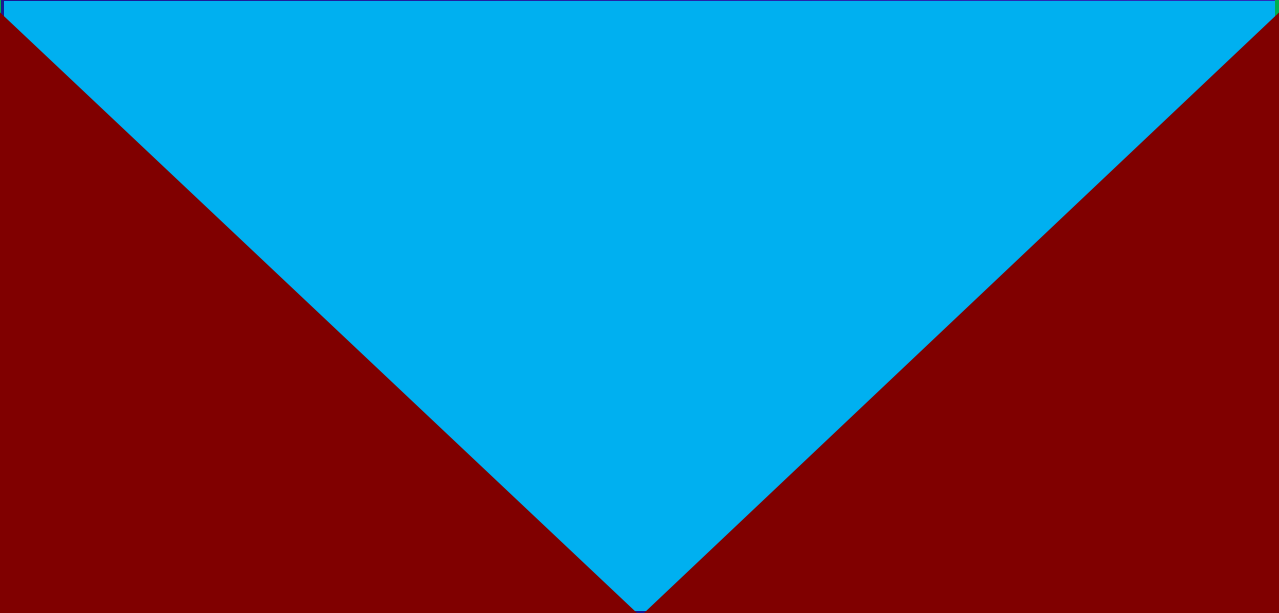
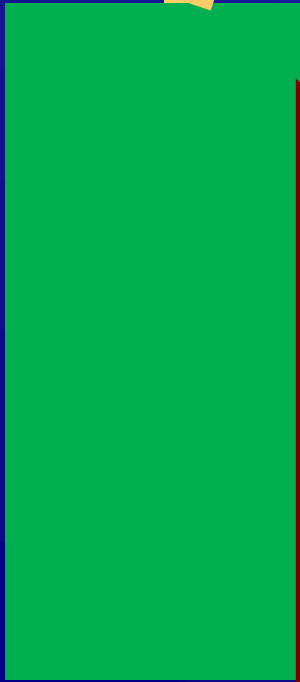
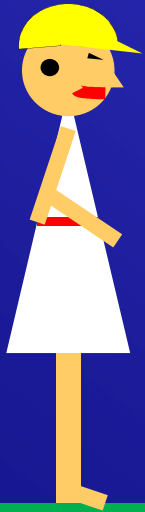
Uncertainty?



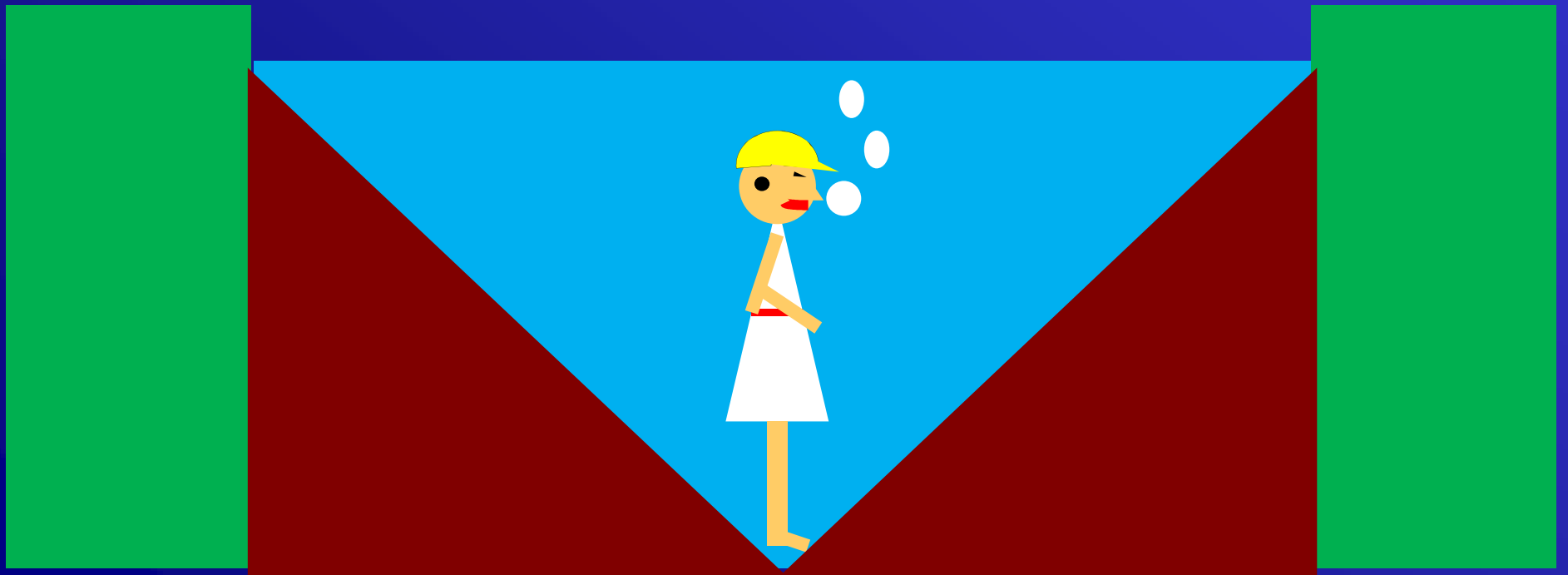
Not only the average



Not only the average
But also the variance



Not only the average
But also the variance
Is important
(and may cost you your life)



Incomplete knowledge?

- Know knowns
- Known unknowns
 - Next throw with a die
 - (cannot be fixed)
 - Effect of CO₂ emissions
 - (cannot be fixed either)
 - Stuff we had no time/money to sort out
 - (could be fixed if we want, but may be we do not want to)
- Unknown knowns
 - Stuff other people know
 - But we do not know they know
 - Or we ignored them
 - Stuff we used to know
- Unknown unknowns
 - That we really do not know
 - Or we think we know but we don't



Swans

- Were all white
- Untill 1697
- There proved to be black ones too
 - Willem de Vlamingh



But what does this mean for

Hacking governmental computers



GREETINGS PROFESSOR FALKEN

HELLO

A STRANGE GAME.
THE ONLY WINNING MOVE IS
NOT TO PLAY.

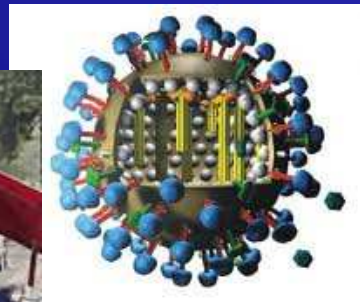
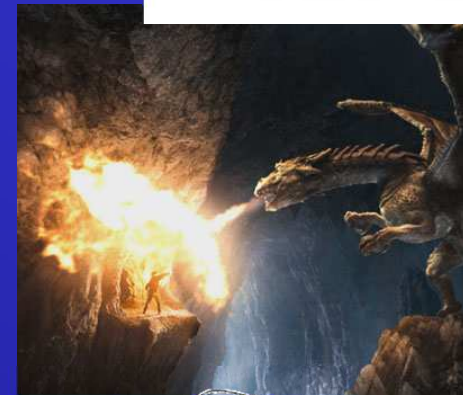
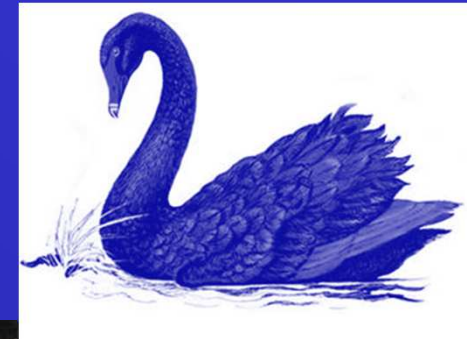
HOW ABOUT A NICE GAME OF CHESS?

The gate in Veere (feb 2012)

- Opened by children thinking it was a game
- Uname “veere”
- PW: “12345”



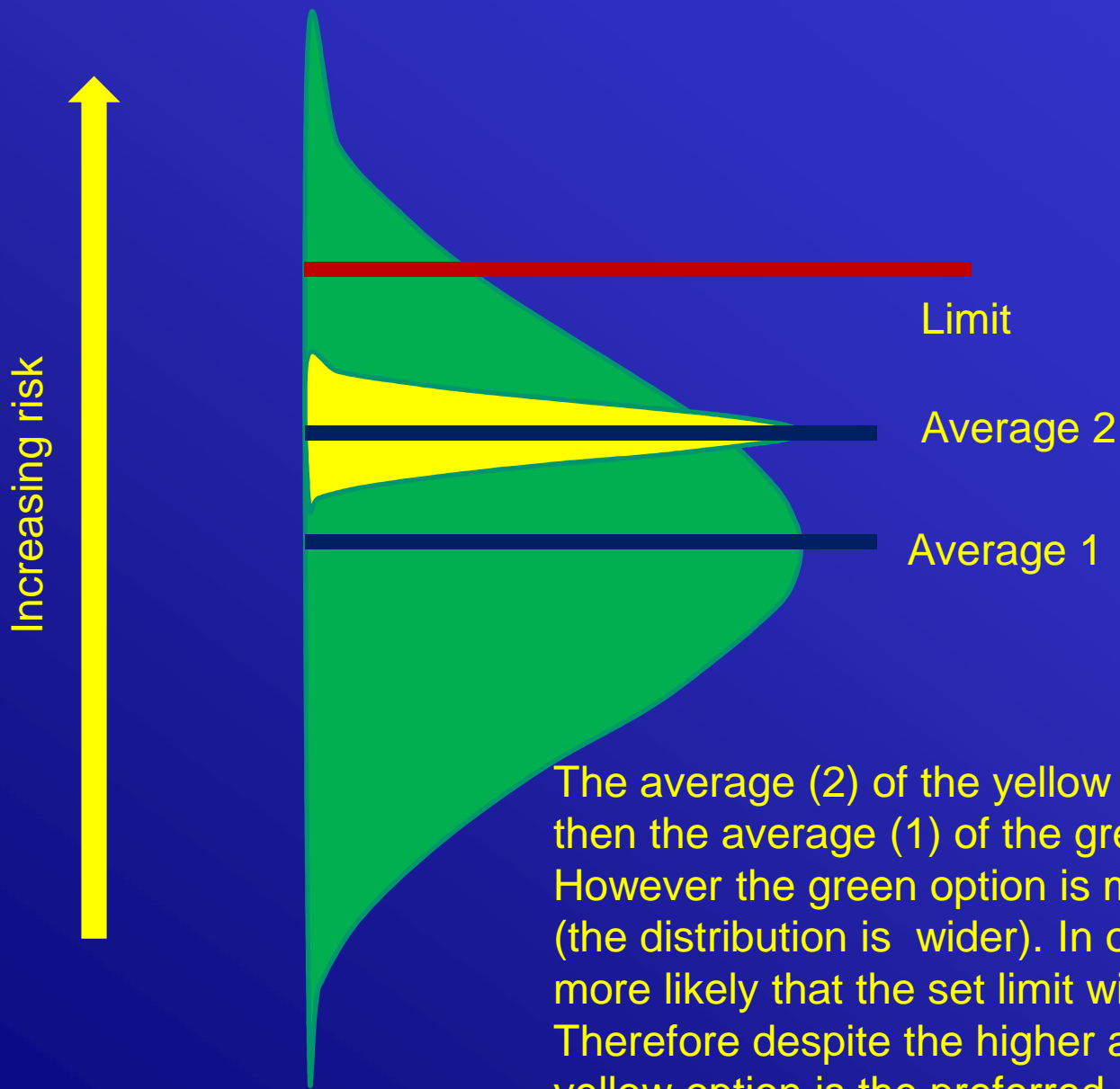
- Hacking governmental computers
- Blue swans
- Fire throwing dragons
- Triffids
- Pathogens
 - Measles in america
 - Who start their own career
- People who nitrate plastic bags
 - London



Dragons

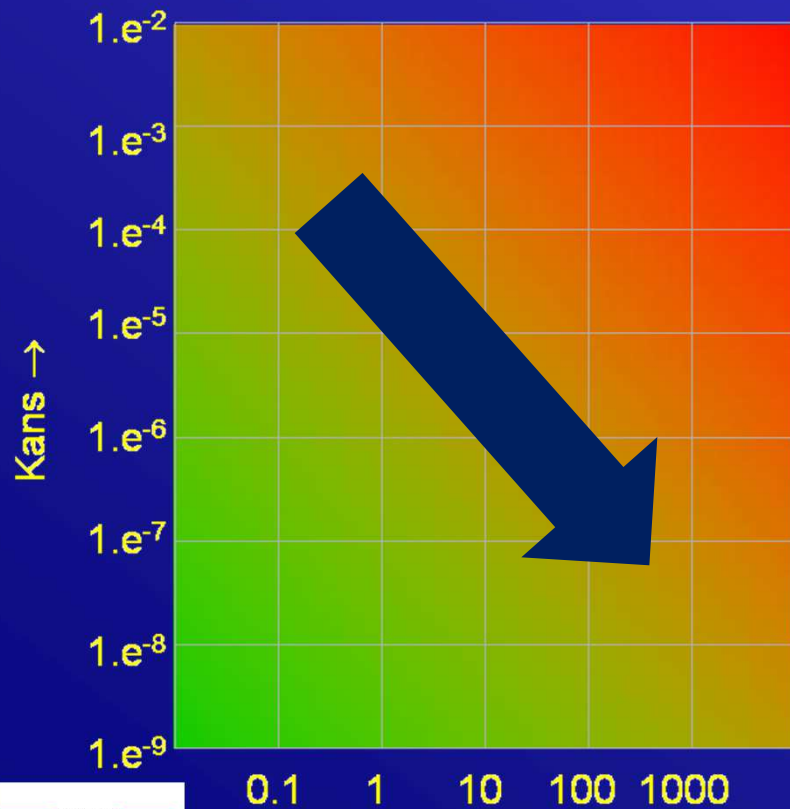
- There are millions of books about dragons
 - (and there was not one about black swans)
- Do we need an anti dragon defense shield
- And if we think we don't, what are we going to say when one appears.

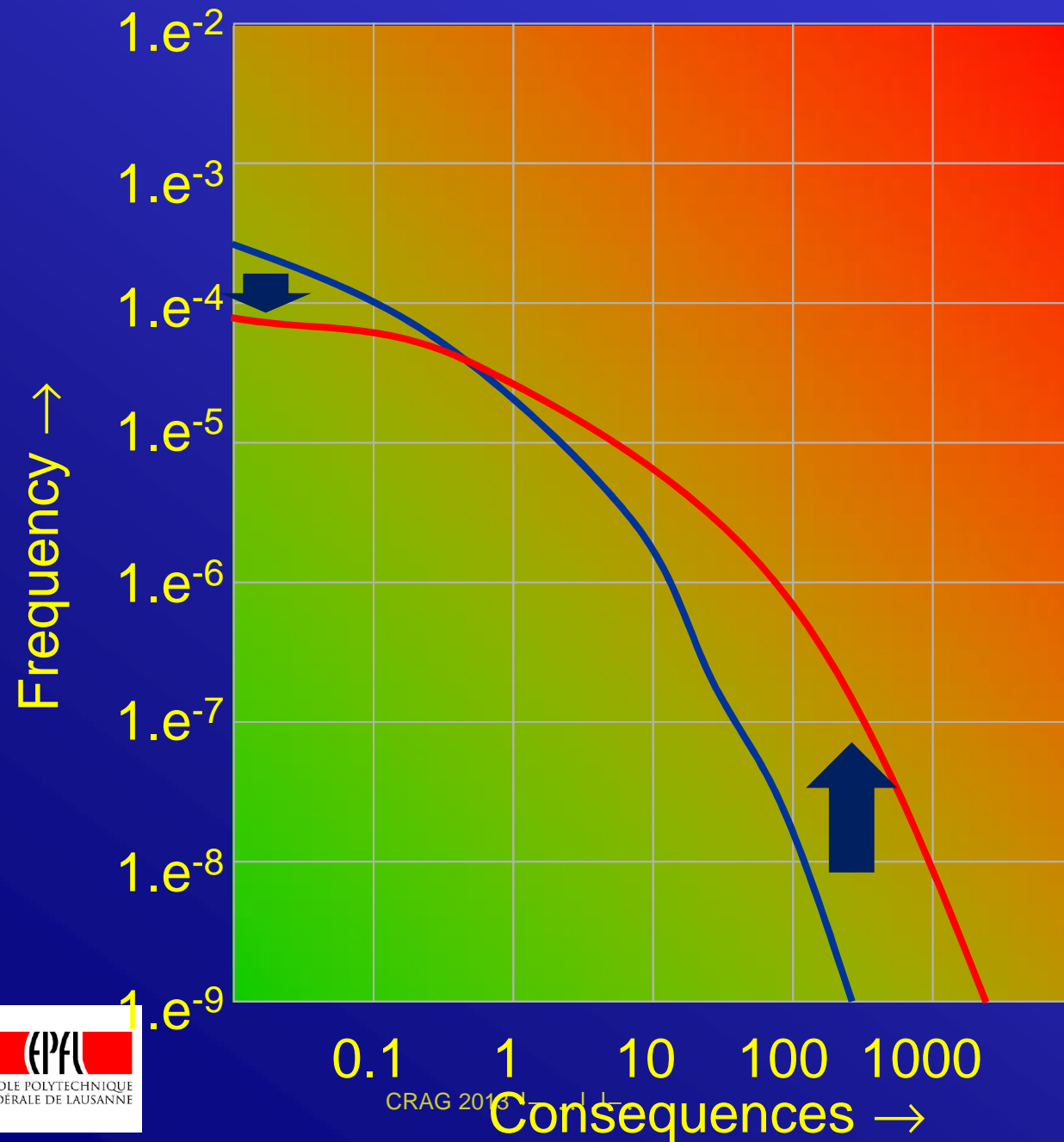




The average (2) of the yellow option is higher than the average (1) of the green option. However the green option is more uncertain (the distribution is wider). In option 1 it is more likely that the set limit will be exceeded. Therefore despite the higher average, the yellow option is the preferred one if the aim is not to exceed the limit.

Large consequence, small probability, large uncertainties





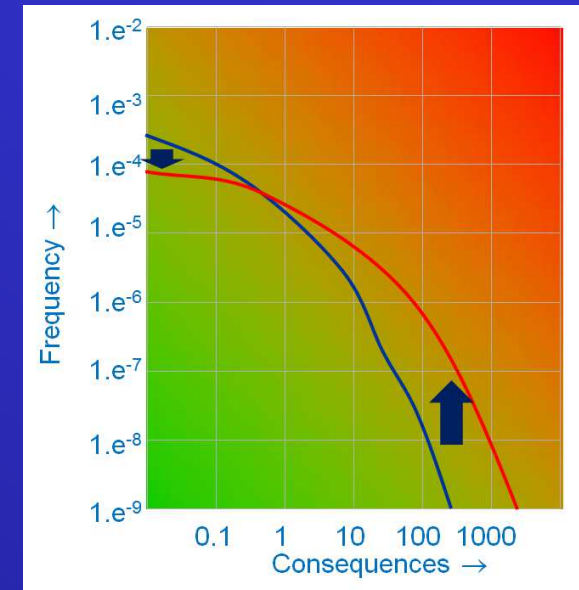
Variability rotates the FN curve counterclockwise

If we treat epistemological uncertainty the same as variability it has the same effect.

But variability we (could) know
In uncertainty we do not know

Non zero is NOT ZERO

- Tunnel diode
 - Eleven meter tsunami's
 - Stock prizes going down
 - People not paying there debts
 - Floods in the Netherlands
 - Oil wells kicking back
 -etc
-
- Much of the political debate is because politicians (and managers) confuse low probability with zero probability
 - (This will not happen to us)

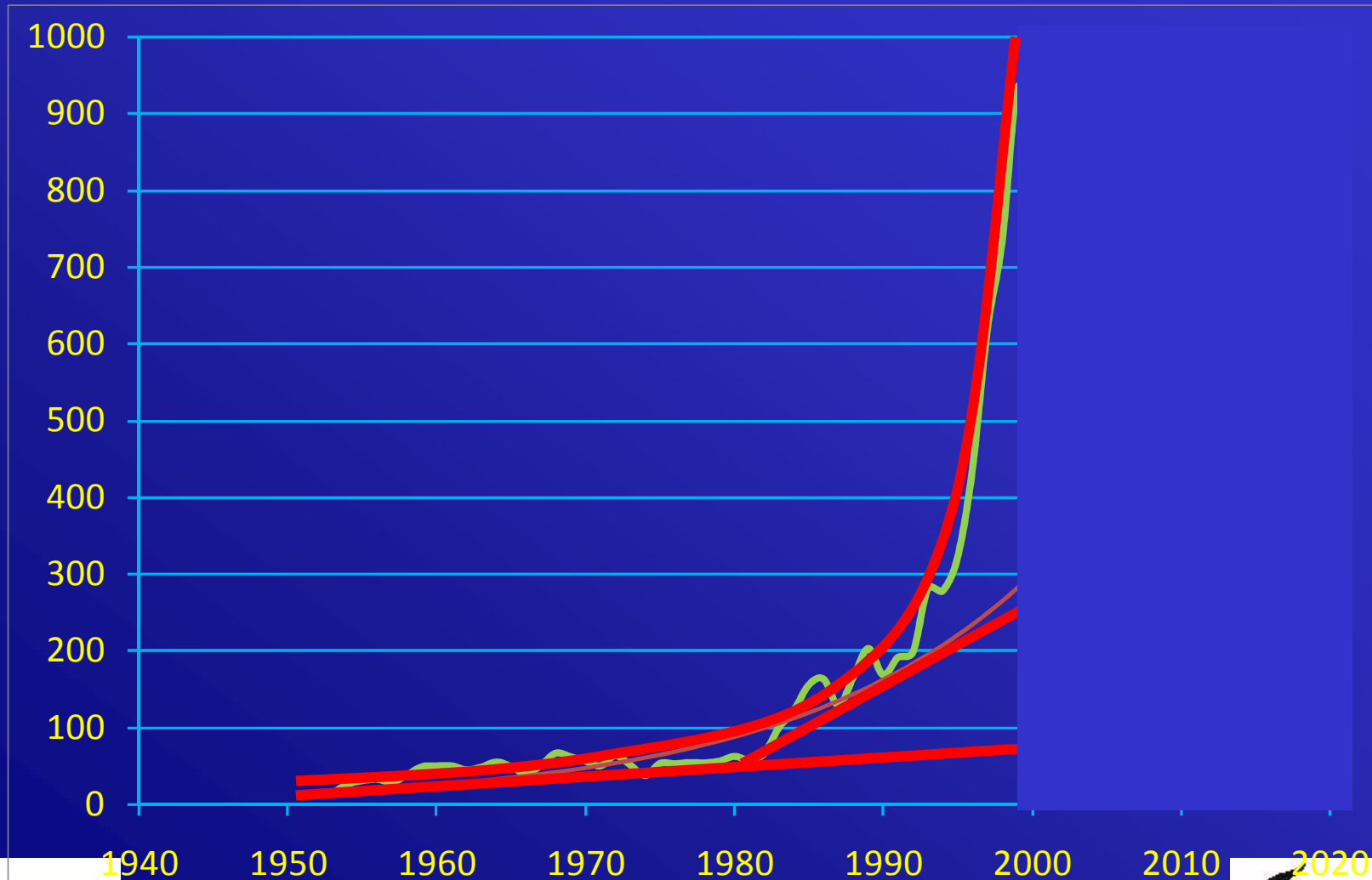


Certainty?

- The probability of death is 1
 - No exceptions known to date
- 6.5 % of all people who ever were born is still alive*
 - That does not make the probability of death $6.5 \cdot 10^{-2}$
- When the frequency is > 0 the probability = 1.

*<http://www.prb.org/Publications/Articles/2011/HowManyPeopleHaveEverLivedonEarth.aspx>

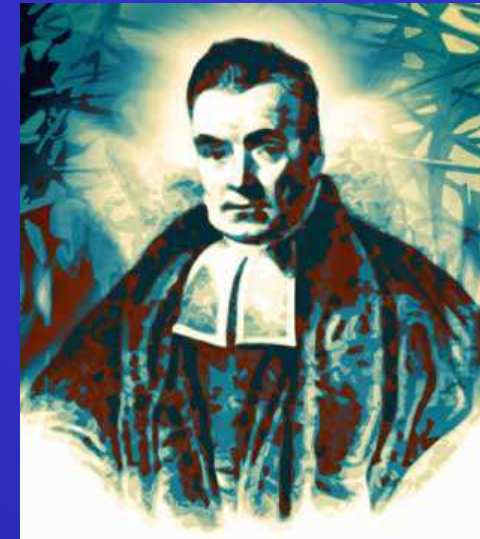
AEX (or exponentials go to infinity)



Bayes

When the prior equals 0, the posterior remains 0, no matter the evidence

THIS WE CALL DENIAL



$$P(A|E) = P(E|A) * P(A) / \{P(E|A)P(A) + P(E|A^*)P(A^*)\}$$

$P(A)$ = Probability of A

$P(A^*)$ = Probability of NOT A

$P(A|E)$ = Probability of A given E

$P(E|A)$ = Probability of E given A

Prior

Posterior

If you can

- Do some work and improve your information position
 - But for purely aleatory problems this will not help
- Better estimate of the outcome
- Better estimate of the uncertainty
- You might learn something.

What is a mortgage

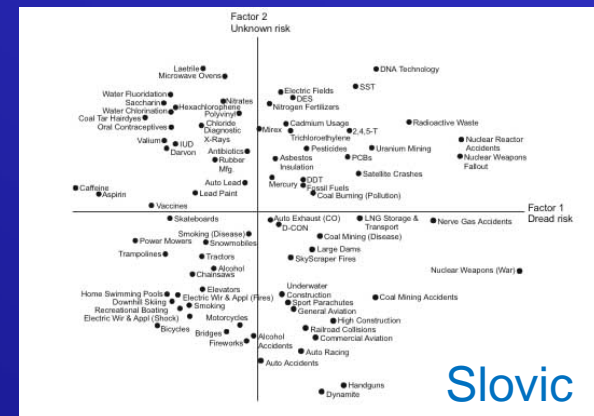
- Give somebody a loan to buy something
- Under the assumption
 - (1) that he can pay the loan back in 30 years
 - (2) that what he buys will have and keep a value at least equal to the loan
- Therefore: what is wrong
 - Overvalued mortgages
 - Mortgages on consumption goods
 - Mortgages on stamps and stocks/bonds
 - Loan somebody 6 times his yearly income
 - Give bonuses for mortgages sold

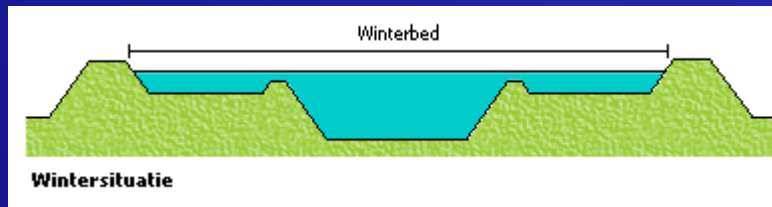
Uncertainties

- Are not black Swans
 - If you don't know, you don't know
 - Even if you have given it a name
- They probably are not fire breathing dragons either
 - That we probably would know by now
- Usually it is about “when”
 - The six comes up or the dikes fail
- Sometimes about “whether”
 - Earth temperature increases by ?? degrees

Decision making

- There is no law of nature from which one can derive an acceptable level of risk
 - Regardless the certainties or uncertainties in the science
- There may be not enough time to resolve the known unknowns
 - Or it is impossible.
 - Or we just do not feel like it.
- Different people judge differently
 - On the color of their car and on the acceptability of a risky activity.
- There is a time limit to the discours
 - Options get depleted
 - No decision is also a decision.





How High Must We Make The Dikes??????

How high must we make our dikes

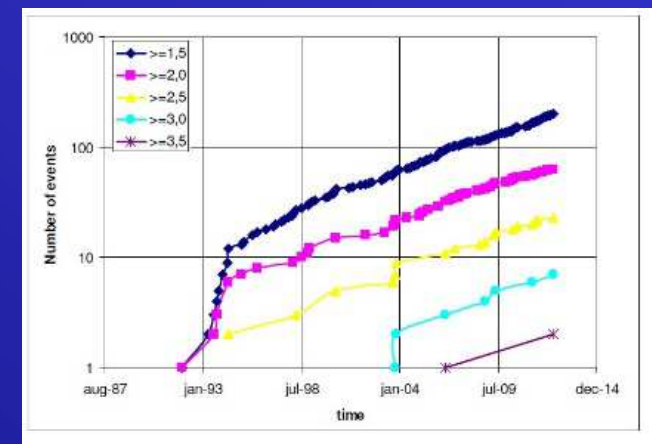
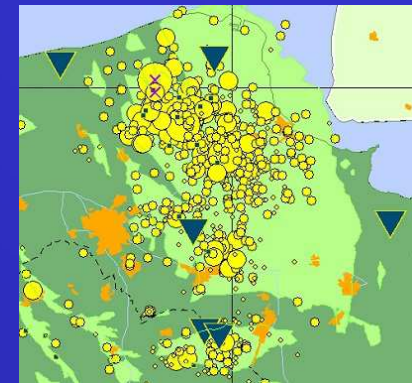
- Based on average probability of death
- Based on maximum probability of death
 - 10^{-5} or 10^{-6}
- Based on economic loss
- Express human life in money
 - And how much then (current value 6.4 Meuro)
- Based on best estimate
- Based on extreme value (90, 95, 99% confidence??)

This looks like a “discours” problem

- Rainfall increases
- Germany improves flowrate in rivers making our problem bigger
 - We are the end of the “pipe”
- Sea level rises
 - But we do not know by how much
 - So should we go for the worst there or for an average
- It takes 50 years to adapt all the dikes
- AHH: so we have to start soon to finish all before the flood hits us.
- This puts a cap on the discours.....

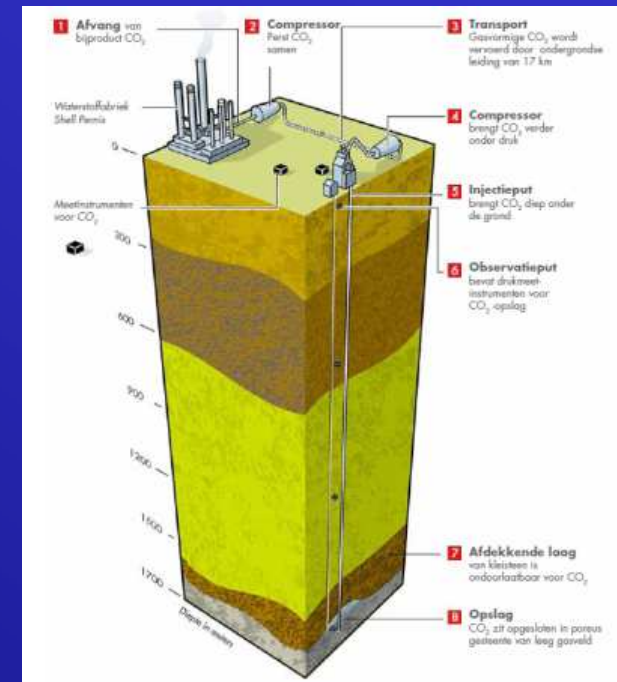
Natural gas in Groningen

- Major source of income for NL for over 50 years now
 - (Dutch disease)
- The people were promised
 - Sinking of ground would be small
 - Sinking of ground would be even
- However
 - Sinking of ground was double expectation
 - Sinking was NOT even
- Result
 - Earth quakes and damage
 - Outraged people
 - Houses cannot be sold
 - Financial compensation does not cover immaterial damage
 - Family homes for centuries
 - People going to the north for the quiet.



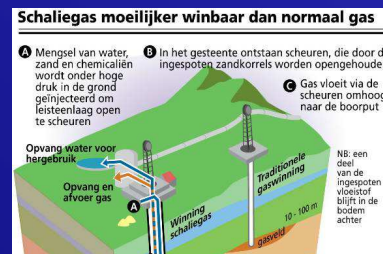
CO₂ Under Barendrecht

- People found out because Shell received subsistence to do experiment under Barendrecht
- Minister said all is safe but did not know about accidents in the past
 - When asked on TV
- Public uproar
- Shell abandoned project
 - Did not want to damage image



Shale gas (Fracking)

- Boxtel
- The inhabitants found out when an oil company got a permit for an experiment
- Afraid for pollution of soil and (worse) drinking water supply
- Government said nothing was final
- But were found out decision was made years earlier
- Government now it “ rethinking”



Unresolved really

- You have to talk to the people
 - But for how long
 - And should that be parallel, in contrast to or to support regular decision making processes
- Discours
 - Good – when you can take the result, whatever it is
 - Bad – when some outcomes are unacceptable
 - (such as not reducing your deficit to below 3%)
 - Ugly – when used to keep “them” occupied when the decision is already made
 - (such as cutting all the trees while the court case is running)

Science

- Science helps to get better estimates of the uncertainty in the outcomes
- Uncertainty can be (ab-)used to make a political decision a scientific one
 - The value of a statistical life discussion
 - Delay until more is known
 - Let the scientists debate, that keeps us in the clear
- But it is a two sided sword
 - It can be LOWER but also LARGER then the estimate
- But most of the time it helps understanding the problem and do something about it.

A popular excuse after an accident is that hindsight is easy

Or “If we would have known what we know now....”

But most knowledge of today is the same as the knowledge of yesterday (there is a six on the die)

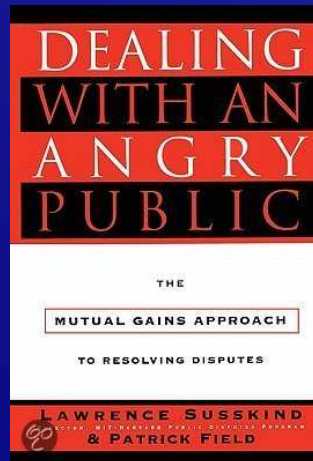
The only difference is that we threw six (gambled and lost)



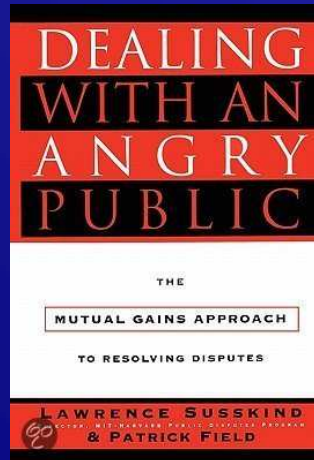
- Laws of nature – as we understand them - usually apply
 - A change in our understanding is very unlikely
- Mathematical logic usually applies
 - But this is sometimes difficult to accept
- Often the question is not **WHETHER** something can happen but **WHEN** it will happen.
 - And whether you can avoid the consequences.

Angry people

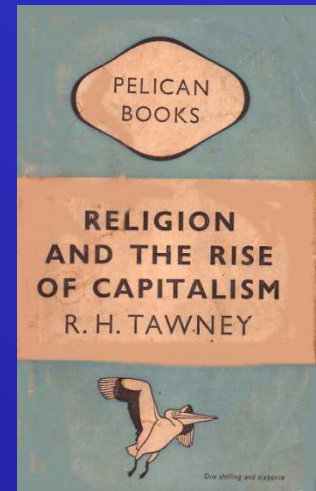
- Acknowledge the concerns of the other side.
- Encourage joint fact-finding.
- Offer contingent commitments to minimize impacts if they do occur, and promise to compensate unintended (but knowable) effects.
- Accept responsibility, admit mistakes, and share power.
- Act in a trustworthy fashion at all times.
- Focus on building long-term relationships.



A reasonable estimate of economic organization must allow for the fact that, unless industry is to be paralyzed by recurrent revolts on the part of outraged human nature, it must satisfy criteria, which are not purely economic.



R.H. Tawney (1926) , Cited by W.D. Rowe (1974)



A composite image of Earth from space. The Earth is shown as a dark blue sphere with white clouds and city lights. A bright sun is on the left, creating a lens flare. The text "The world is not an" and "The end" is overlaid in yellow.

The world is not an
The end
average