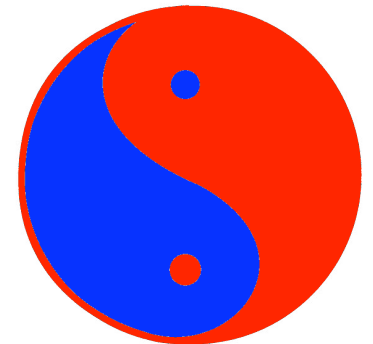# Learning from Lucia

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Introduction

Shifts	with incident	without incident	Total
with Lucia	9	133	142
without L.	0	887	887
Total	9	1020	1029

- The case of Lucia de Berk
  - Lucia's vital statistics
- Forensic statistics, learning

Lucia: my connection

- 2001: Witch-hunt
- 2002: Witch-trial by statistics
- 2004: Re-trial, "medical proof only"
- 2006: Ton Derksen & Metta de Noo's book
- 2006: Study verdict, join fight
- 2010: Lucia is innocent, but who did it?

Lucia: my motives

- Shame

- Anger

- Passion (for statistics, science)

Dramatis Personae

Dramatis Personae

Dramatis Personae

17 judges: Fokkens, Fokkema, Fokking...
JKZ director Smits
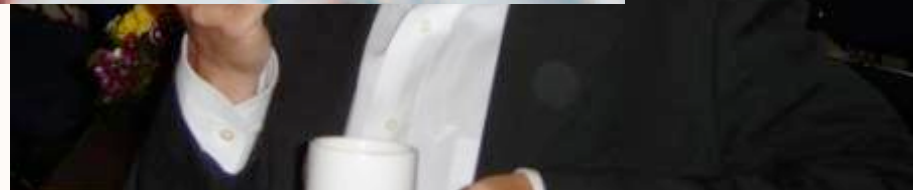The Derksen family
An army of medical experts
...

Dra... ...hae

17 judges: Fokke...
JKZ director Smit...
The Derksen fami...
An army of medic...

...

MEDUSA FILM
PRESENTA

CINEMA
romefilmfest2006
PREMIERE

LA
SCONOSCIU
TA

un film di giuseppe tornatore

Pauw & Witteman (NEDERLAN...

PAUW &
WITTEMAN

00:12:02

SKY

www.medusa.it

Dramatis Personae

17 judges: Fokker
JKZ director Smith
The Derksen fami
An army of medic
...

2001: JKZ, the Hague

- 4 Sept, early morning: baby Amber unexpectedly dies; <u>natural death</u> registered

- Later that day: a nurse goes to *chef de clinique* with "bad feeling": *Lucia was on duty again …*

- C-C does Excel spreadsheet statistics: <u>no coincidence</u>

- … goes to director Smits

- 5 Sept: Amber's death is now <u>unnatural</u>

- 5–17 Sept: 30+ incidents & deaths at JKZ and RKZ attributed to Lucia; gossip; …

- 17 Sept: press conference; newspaper report; 5 deaths and 5 suspicious incidents reported to police

2003: the Hague
Lower court

- Lucia pleads innocent

- and gets life sentence for 4 murders + 2 attempts at JKZ, RKZ, Leienburg

- Statistics essential: "1 in 342 million"

- No medical proof. Only statement of co-detainee

- Both defence and prosecution appeal

Elffers: "Your honour, it was <u>not</u> chance. The rest is up to you."

2004: the Hague
Upper court

- Lucia gets life sentence +<u>TBR</u> for 7 murders + 3 attempts

- Medical proof that Amber died of digoxine; it was administered by Lucia (opportunity); motive: compulsion

- No statistics

- <u>Chain argument</u>

- Defence appeals (*novum* – mislaid Strasbourg lab finding "no digoxine")

<u>TBR</u>= *ter beschikking rechter* = permanent detention in psychiatric care

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<u>TBR</u>= *ter beschikking rechter* = permanent detention in psychiatric care

2006: the Hague
Supreme court

- Conviction is upheld except that <u>TBR</u> is ruled illegal (*)

- Upper court (a new one) complies

- Lucia suffers a stroke

(*) No relevant psychiatric disorder + non-guilty plee

Meanwhile ...

- <u>Medical doctor</u> Metta de Noo (*née* Derksen), sister-in-law of JKZ chief paediatrician Arda Derksen (*née* Lubsen) becomes uneasy

- The Derksen family is split; "committee Lucia de B." researches case

- <u>Philosopher</u> Ton Derksen publishes *Lucia de B: reconstruction of a miscarriage of justice* growing media interest

- <u>Computer scientist/statistician</u> Peter Grunwald reads it and makes me read it too

growing media interest

- 2006: Derksen submits to CEAS: Committee for Evaluation of Closed Cases

Lucia de B.

Reconstructie van een gerechtelijke dwaling

Ton Derksen

2007
Report of the CEAS

- Prosecution of case was tainted by tunnel-vision from very beginning

- "Experts" were chosen from small circle around JKZ, later advised police, later advised courts

- Experts disagree on cause of death of Amber

- Case should be reopened

The public debate

- Slowly, the media change sides

NATURE !

- Petition for reopening the case to minister; candle-light demonstration at prison; newspaper full page advert; ...

Nobel laureate!

- The legal establishment digs in its heels

- Politicians are silent

Undermining the foundations of the state!

- The medical establishment is silent

- Intellectuals, artists, scientists become involved

- Public opinion and academic opinion are won for Lucia

- Key figures in legal establishment are won for Lucia

2008 The supreme court

- Advocate-General sees no *novum* in CEAS report

- <u>Despite this</u>, he commissions a multi-disciplinary medical investigation into case of Amber

- <u>Lucia's sentence is temporarily suspended</u>

- Investigation findings: Amber's death could well have been natural (exhaustion)

- A-G notes that Lucia did not lie about her doings <u>and</u> asks key trial expert if he agrees with new findings – <u>Yes</u>; he had been given incomplete information! A-G requests Supreme Court to reopen the case

- Supreme Court: <u>that</u> is indeed a *novum*

2009: the last act

- Prosecution proposes major new *forensic-criminalistic* investigation (vs. defence's *theoretical-scientific*), on lines of "tender" by <u>Independent Forensic Services</u>

- ... but the court continues A-G's medical investigation into cases of Amber, Achraf, Achmad only
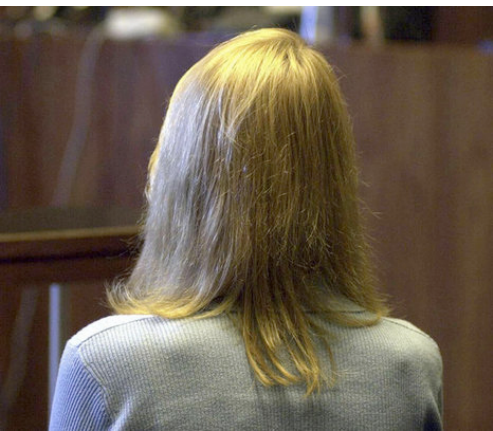
- *Still never been heard*:
  - a professional statistician
  - from medicine: the 2 qualified persons with overview of whole case (Arda Derksen, Metta de Noo)

2010: the verdict

- Lucia is innocent

- All the deaths were "natural"

- Nurses' professional conduct was exemplary

- Usual medical errors in diagnosis, treatment, ...

- Minister of Justice and Chief Public Prosecutor and Head of Judiciary apologize

- *Still never been heard*:
  - a professional statistician
  - from medicine: the 2 qualified persons with overview of whole case (Arda Derksen, Metta de Noo)
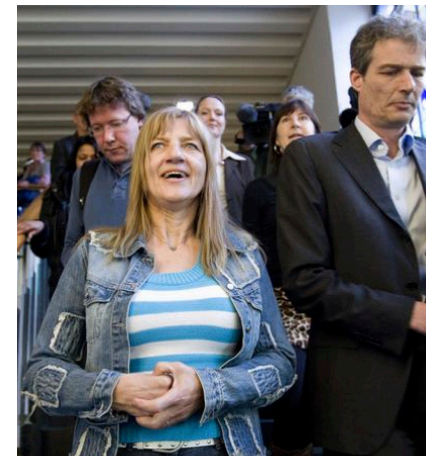
2010: the verdict

- Former director of JKZ: would do the same again today

- Chef-de-clinique at JKZ: would do the same again today

- Board of hospital: "we are a great hospital, and we always cooperated fully with justice department"

- 30% of Dutch population believes "she did it"

- *Still never been heard*:
  - a professional statistician
  - from medicine: the 2 qualified persons with overview of whole case (Arda Derksen, Metta de Noo)
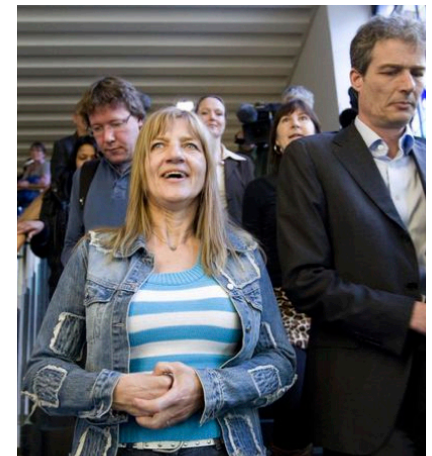
Where was statistics?

- Statistics initiated the case

- Statistics central to 2003 conviction

- 2004: "*no statistical probability calculation*"; "*all deaths and incidents shown by incontrovertible medical-scientific evidence to be unnatural*"

- ... yet from publication of Derksen's book, statisticians at the heart of public movement to reopen case: why?

The Statistics
Lucia's working places

- Juliana Kinderziekenhuis (JKZ), *mcu*

- Rode Kruis Ziekenhuis (RKZ), *icu-42*

- Leijenburg Ziekenhuis

- Penintentiaire inrichting, Scheveningen

The Statisticians

For the police, and later for the lower and higher court:

- Henk Elffers (*law psychologist*)

- Richard de Mulder (*law and ict*)

For the defence (on appeal)

- Ronald Meester (*probability theory*)

- Michiel van Lambalgen (*AI, logic*)

Elffers' data

Shifts	with incident	without incident	Total
with Lucia	9	133	142
without L.	0	887	887
Total	9	1020	1029

JKZ (2nd year only)

Shifts	with incident	without incident	Total
with Lucia	6	52	58
without L.	9	272	281
Total	15	324	339

RKZ-42

Shifts	with incident	without incident	Total
with Lucia	1	0	1
without L.	4	361	365
Total	5	361	366

RKZ-41

Elffers' 1 in 342 million

- Three Fisher exact tests

- JKZ: *post-hoc* correction by Bonferroni: 26 nurses

- Multiplication of three p-values

- Elffers emphasized that correlation $\nRightarrow$ causation

- *By way of example*, perhaps:

  - Lucia is a bad nurse (but not a murderer)

  - Lucia has more difficult shifts

  - Lucia has more night shifts

  - Someone is trying to set Lucia up

de Mulder confirms

- Elffer's methodology is correct

- Even if the data is not completely correct, conclusions won't be changed

- It is certainly not a coincidence

- Lucia must explain why she was there

Statistics out, from 2004?

- The incidents at JKZ occurred in a short period in a ward where usually nothing happened

- Lucia was present every time

- A natural cause was ruled out, medically, in every case

- Lucia couldn't explain why she was repeatedly present

Statistics out, from 2004?

- The incidents at JKZ occurred in a short period in a ward where usually nothing happened   ?

- Lucia was present every time   ?

- A natural cause was ruled out, medically, in every case   ?

- Lucia couldn't explain why she was repeatedly present   ?

The legal concept of irrefutable medical-scientific proof of unnatural death

- If the precise time of a death from complex causes can't be predicted, the (time of) death is *inexplicable*

- An *inexplicable* death is a *suspicious* death if Lucia is present, and hence perhaps *unnatural*

- For every case separately, a majority of medical experts thought the death was natural; but always one could be found who thought it unnatural

- In two cases, only one expert thought it was unusual; why? *Only* because Lucia was there!

Elffers and de Mulder's expertise come in handy

- Chain proof: we have a lying murderess who was present at similar medically inexplicable events

- <u>She</u> must explain her presence (de Mulder), escape clauses (Elffers) are ruled out by herself

  Judge: "*Mrs de Berk: were you a bad nurse?*"
  Lucia: "No, your honour, my superiors and colleagues ..."

  Judge: "*Mrs de Berk: did you work more difficult shifts than your colleagues?*"
  Lucia: "No your honour, we shared all the work fairly ..."

More sharp legal thinking

A-G anticipates supreme court counter-arguments

- That Amber died of exhaustion on Sept 4 doesn't mean that she wouldn't otherwise later have died of digoxine poisoning

- That there were similar clusters of events at JKZ in earlier and later years doesn't mean that every one of the deaths in "Lucia's cluster" are natural

Old data

, , JKZ

	Incident	Normal
Lucia	9	133
Others	0	887

, , RKZ41

	Incident	Normal
Lucia	1	0
Others	4	361

, , RKZ42

	Incident	Normal
Lucia	6	52
Others	9	272

Latest data

, , JKZ

	Incident	Normal
Lucia	7	135
Others	4	883

, , RKZ41

	Incident	Normal
Lucia	1	2
Others	4	359

, , RKZ42

	Incident	Normal
Lucia	5	53
Others	10	271
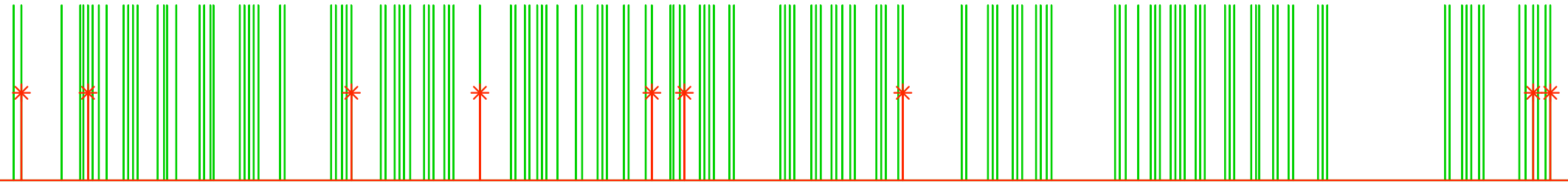
- Three children represent 7=2+2+3 of the now 11 incidents (one illegal euthanasia removed)

- Two incidents actually occurred in the shift *after* Lucia's

- At least two incidents outside of Lucia's shifts are missing (they weren't *suspicious* incidents)

The present *p*-values

- <u>Cochran-Mantel-Haenszel test</u>
  JKZ; RKZ-41, -42; & Elffers' post-hoc correction
  1 in 916

- <u>Ultimate stratification</u>
  11 *days* at JKZ with both incident & Lucia on duty
  1 in 25

- <u>Gamma(1) heterogeneity over Poisson intensity</u>
  JKZ, RKZ pooled
  1 in 25

& what about ... ?

- *Post-hoc* problem

- Data selection problem

- Information from outside Lucia period;
  total number(s) of incidents.
  [Elffers analyses distribution of incidents *between* nurses,
  within period]

Statistics in Court:
3 Approaches

- Significance testing

- Grand Bayesian synthesis

- Likelihood Ratio

Likelihood Ratio

- What is hypothesis of defence, H_0?

- What is hypothesis of prosecution, H_A?

  - <u>Elffer's</u> H_0: conditional on shifts, incidents are uniformly random

  - Defence: you can't use statistics
    H_0 : the incidents would have happened anyway

  - Prosecution: the incidents happened because Lucia proved them, so they were certain
    H_A: the incidents were happened because Lucia was there

Basic empirical research for H_0 still missing

(let alone H_A)

- Events are strongly clustered

- Shifts fall in regular patterns

- Variation between nurses
  [a nurses' actions can *define* when/what is an incident]

- Differently qualified nurses <u>do</u> get different shifts

- A hospital ward is in a non-constant environment
  [winter/summer, changing admissions/discharge policy, opening/closing other wards]

- Multiple incidents concerning same patient

- Hidden confounders cause heterogeneity between nurses, between days

- $\mathrm{var}(X) = \mathrm{E}(\mathrm{var}(X|Y)) + \mathrm{var}(\mathrm{E}(X|Y))$

- *Independent uniform* random rare events (<u>Elffers</u>): variance $\approx$ mean

- Unmeasured heterogeneity: variance $\gg$ mean

The basic empirical research for H_0 is still missing ...

and as long as it remains so, statistics does not help the prosecution (though it might help the defence!)

Likelihood Ratio problems

- parties must *agree* on "sampling frame"

- who owns the hypotheses?

- posthoc hypotheses <u>not</u> allowed

- **nuisance parameters**

- ...

- The defence isn't obliged to play the game (the *prosecution* must convince the *court* that, beyond reasonable doubt, ...)

Lucia Lessons

- Many reforms are being made

- "Science" and "Justice" are talking together; the media are critical

- Still: gut reaction of "system" is: *create rules, checklists, registers*

- <u>We</u> want honest cops, upright magistrates, intelligent and knowledgable lawyers, wise judges who weigh all the evidence and use their common sense and intellect and humanity

- <u>We</u> want the system to admit mistakes so that it can learn from them

"Science" vs. "Justice": was this a typical case of *two cultures*?
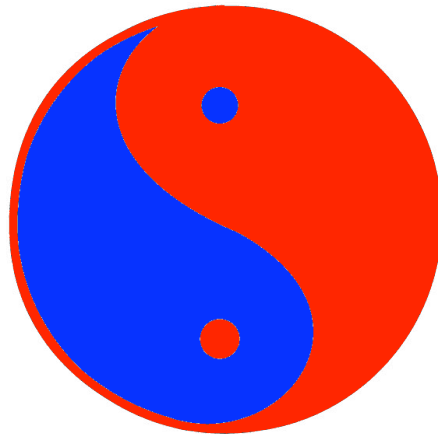
- No!
  - scientific community – creative thinking
  - legal community – bureaucratic thinking

"Science" vs. "Justice": was this a typical case of *two cultures*?

- No!
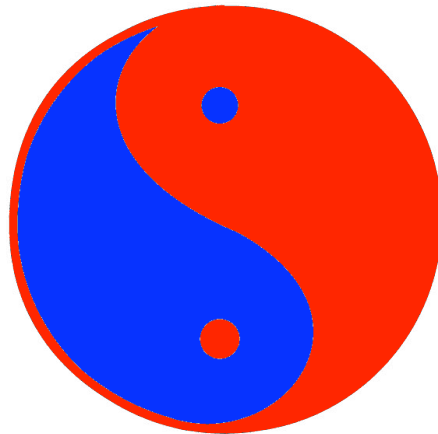
  - scientific community – chaos, change

  - legal community – harmony, certainty

For an establishment like a national legal system,

Learning represents the possibility of
failure
and must thus be avoided if possible

- S.E. Fienberg & D.H. Kaye (1991), Legal and statistical aspects of some mysterious clusters. *J. R. Stat. Soc. (A)* **154**, 61–74   (part 1)

- B.C. Yorker et al. (2006), Serial Murder by Healthcare Professionals. *J. Forensic Sci.* **51**, 1362–1371

- K. Ramsland (2008), *Inside the Minds of Healthcare Serial Killers*, Times-Warner ...

- R.D. Gill et al. (bis), to appear ...

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2010: Postscript

- Foundation of <u>Bureau of Lost Causes</u>

  - Kevin, José, ...

- RDG tells true story of the case on internet blogs and is being sued by Hagahospitals