

Are the claims for lighting benefit true? How can we tell?

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The Basic Points

- Need sound science to find the truth.
- Otherwise poor methods may see things which aren't there. (We don't want to miss things which really are there, however. Both errors can be avoided by sound science.)
- Dubious claims may be seized by a marketing operation to promote its cause.
- Aim to encourage understanding of the discipline of statistics so claims in general can be properly investigated.
- To avoid wasteful, potentially damaging and costly schemes (of all sorts: not just lights) being implemented.

The Earth By Night



- “We know good lighting can reduce night time traffic accidents by up to 30%. It can also reduce street crime by 20%.”

Karen Buck, Transport Minister 8 Dec. 2005 at Institution of Lighting Engineers/Surveyor Magazine Seminar.

- Is it true? (What indeed does it mean?!)

- The words “can” and “up to” are problematic.
- In science we would have “X, in circumstances like such and such, has an expected effect Y within a likely range (i.e. confidence interval).”
- HORS251 (Farrington and Welsh 2002) claimed a crime reduction of 20% within 15%-25%. (i.e. a definite crime reduction effect.)
- I have not yet examined the claim that road lighting is beneficial against death and injury in collisions.

- I pointed out problems with HORS251. In response, its authors now (2006) still seem to be saying lighting reduces crime but now with a lower confidence limit of about 9%.
- It certainly ought be independently checked in all the cases where lighting is going in, at considerable expense.
- Leeds PFI £100M

Brief history of lighting and crime

- US studies
- UK studies early 90s / late 90s
- UK Crime and Disorder Reduction Act 1998
- 1999 ILE documents

- I maintain that HORS251 remains flawed and the effect of lighting on crime is unknown as I stated on BBC Radio4's 'More or Less' 27 July 2006.
- Light is certainly necessary in order to see at night but does it reduce or increase crime.
- My recent presentation at 'Evidence Based Policy Policies and Indicator Systems' can be seen at www.cemcentre.org/eb2006
- The problem is that Ms Buck, the Transport Minister, is unlikely to have checked the claim she has been told. Yet she repeats the claim in a way with little hint of doubt.

- Michael Rutter at eb2006
 - “...science provides the means of answering fundamental questions...goes way beyond the collection of facts.” and “...view with considerable caution and wariness the peddlers of certainty”
- Voltaire “Doubt is not a pleasant condition but certainty is an absurd one.” in 1764
- Astronomy and medicine/healthcare are superb examples of successful advance, where entrenched ideas have been overthrown by scientific thinking.
- The history ill-health /health-care is interesting. e.g. Roy Porter’s books

Healthcare of old

- Why did people of old believe such strange things? (Why do they still?)
- People would seek out strange remedies and of course others would gladly make a living from providing them.
- Crime has similarities to ill-health.
- “The clear implications of Dr Marchant’s critiques are that nothing works” Farrington and Welsh 2006.
- Of course some folk medical remedies did/do work; e.g. Foxglove for heart conditions; William Withering

William Withering...Publication Bias

- "It would have been an easy task to have given select cases, whose successful treatment would have spoken strongly in favour of the medicine, and perhaps been flattering to my own reputation. But Truth and Science would condemn the procedure. I have therefore mentioned every case in which I have prescribed the Foxglove, proper or improper, successful or otherwise." William Withering 1741-1799

More Recently

- Ben Goldacre's excellent column 'Bad Science' in the UK national newspaper the Guardian. June 10th 2006 on publication bias
<http://www.guardian.co.uk/life/badscience/story/0,,1794440,00.html>
- Publication bias is a problem in medical trials. One must wonder to what extent it occurs in other research.
- Although statistics is much better understood in health than elsewhere, there are still problems. E.g. sometimes results seem to be 'spun' for pecuniary reasons. Note Marcia Angell's book 'The truth about drug companies'.

Beware of endorsement without a clear line of reasoning.

- Endorsement is used greatly in marketing.

- Note Richard Feynman:

“Science is the belief in the ignorance of experts”.

- Credibility should be based solely on sound evidence. Need to understand the evidence. It is not good enough to simply repeat the claims of others. (this is likely to take us into the discipline of statistics)

Commercial interest can be problematic

- Tobacco, Asbestos used to be seen as benign.

Of course money-making is not everything (yet conflicts of interest need to be declared.)
Distortions can occur for a whole range of reasons.

E.g.

- simple error .
- or subtle belief; the reason for blinding physicians/assessors in clinical trials.

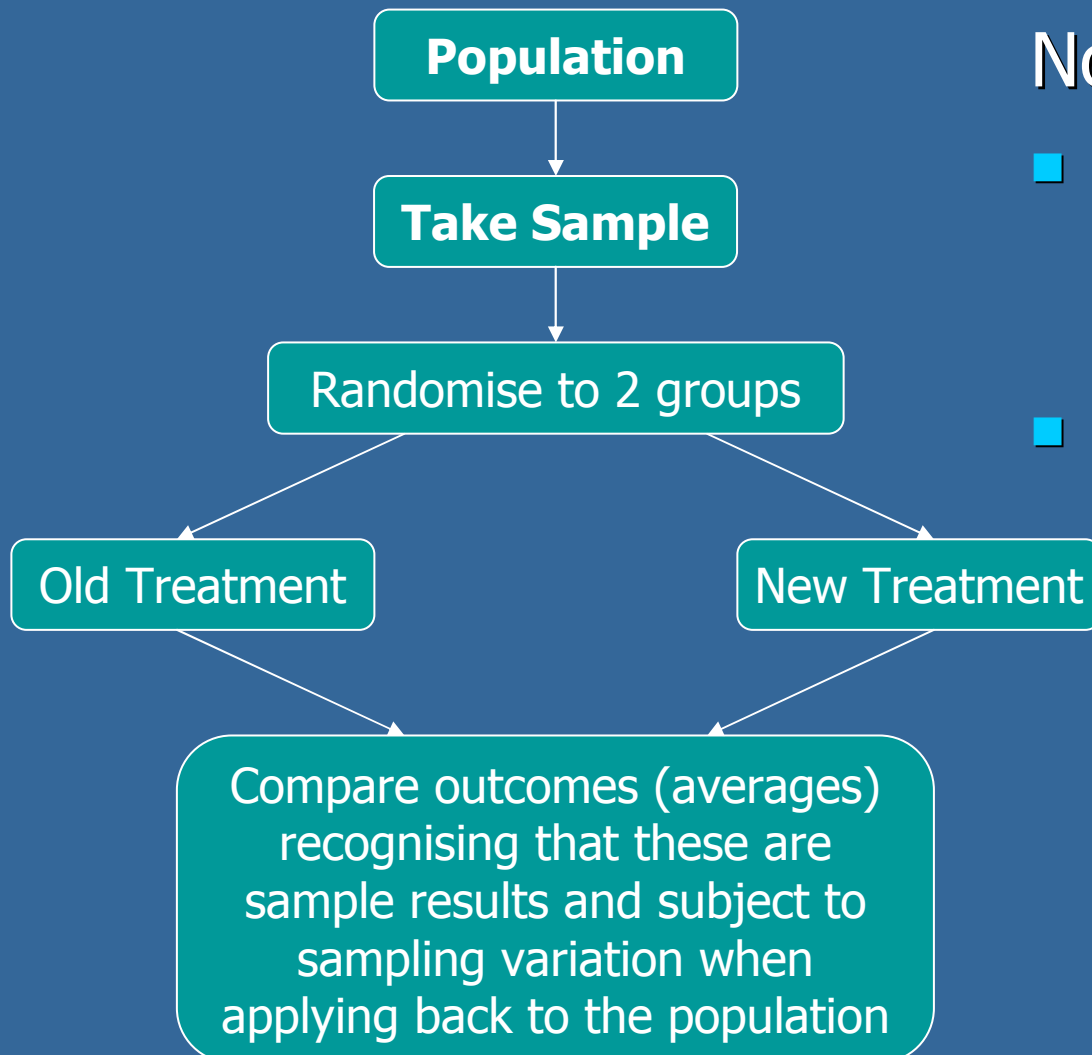
Need transparency and good science

- We all benefit.
- No one wants ineffective, or even worse counterproductive, policies/treatments in general.
- The discipline of statistics is crucial in knowing 'what works' in crime reduction. We need to be clear that any change seen when a crime reduction intervention is in place really is different from what might have happened anyway; i.e. how does it compare with variation which occurs when nothing in particular is introduced.

Time Variation in Crime

- It appears that little is known about how crime varies on the small scale.
- Therefore it is difficult to be clear if any changes are due to a crime reduction intervention.
- Much more needs to be known about the occurrence of crime events to know how to analyse them properly to be able find effects.
- Need access to suitable data sets to examine this issue.
- (Need to guard against systematic error too.)

The Randomised Controlled Trial (A truly marvellous scientific invention)



Note to avoid 'bias':

- Allocation is best made tamper-proof.
(e.g. use 'concealment')
- Use multiple blinding of:
 - patients,
 - physicians,
 - assessors,
 - analysts ...

Crime counts before and after in two areas one gets a CRI

	Before	After
Treatment Area (Intervention is introduced between the 2 periods)	a	b
Comparison Area (Nothing is changed)	c	d

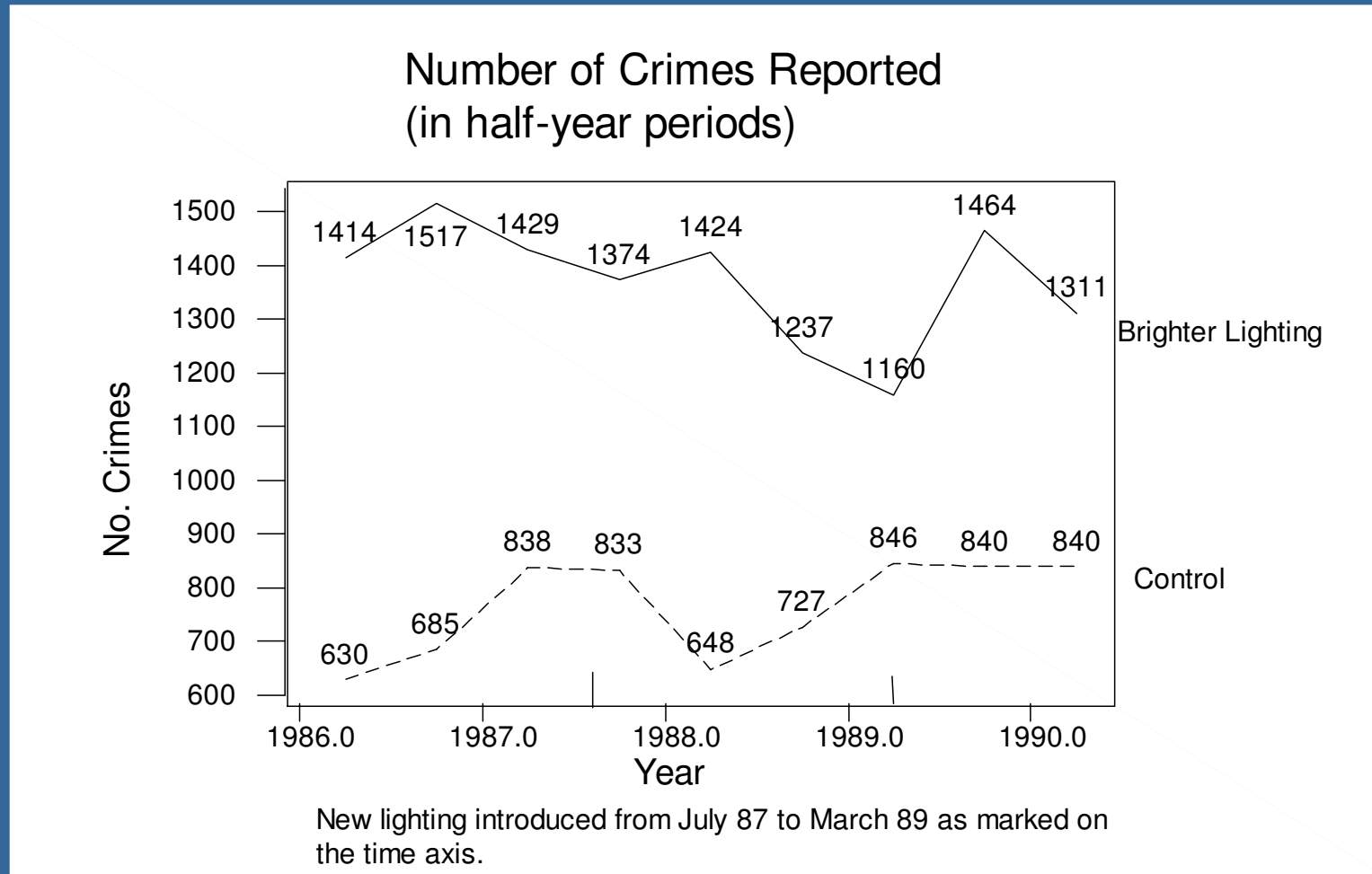
This is not the same as a RCT set up as:

- 1 Not randomised, so no statistical equivalence exists at the start.
- 2 The unit is area, rather than crime event.
- 3 Therefore can't say how 'reliable' the ratio of the before/after ratios, CPR, is.

The problem

- The essential problem HORS251 is the data were analysed as though it were from RCTsbut not so.
- One can see there is far too much variation in crime counts in areas where nothing is changed. (Heterogeneity).
- A way of making the heterogeneity problem go away is to stretch the confidence intervals. This has been done, same for all studies, but studies which are supposed to be show a clear effect for lighting, don't seem to. Suggests this approach is doubtful.
- The studies are few, some are 'grey literature', some others could not be traced.
- More need knowledge about crime variation.
- Need good quality studies. Need RCTs. Could be done at fraction of the cost of a massive lighting programme.

The Bristol Study (Shaftoe 1994)

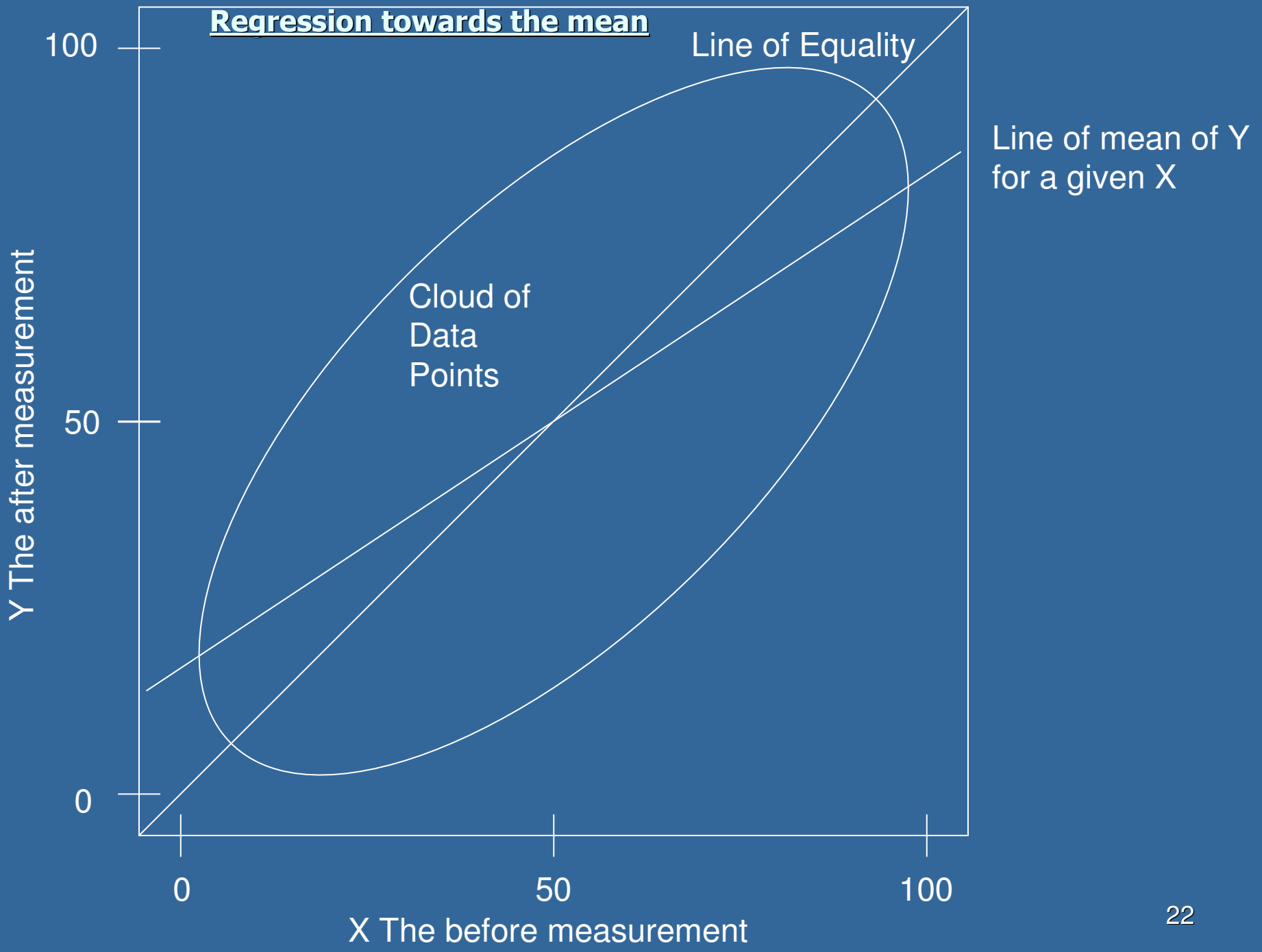


Shaftoe said 'no discernable lighting benefit' but HORS251 said $z=6.6$
Note: had the data for the year immediately prior to the introduction of the relighting, i.e. periods 2 and 3, been used rather than unnaturally using periods 1 and 2 which leaves a gap of $\frac{1}{2}$ year, the effect found would have been half of that claimed. (Shows large variability.)

Lack of equivalence between areas

Invariably it is the most crime-ridden area that gets the lighting, whereas the relatively crime-free comparison area is not re-lit. So there is lack of equivalence at the start. One effect of this is to allow '*regression towards the mean*' RTM to operate.

Francis Galton 1880s examined heredity: parents heights and their (adult-)offspring heights are related. (Like crime counts in an area from one period to the next.)



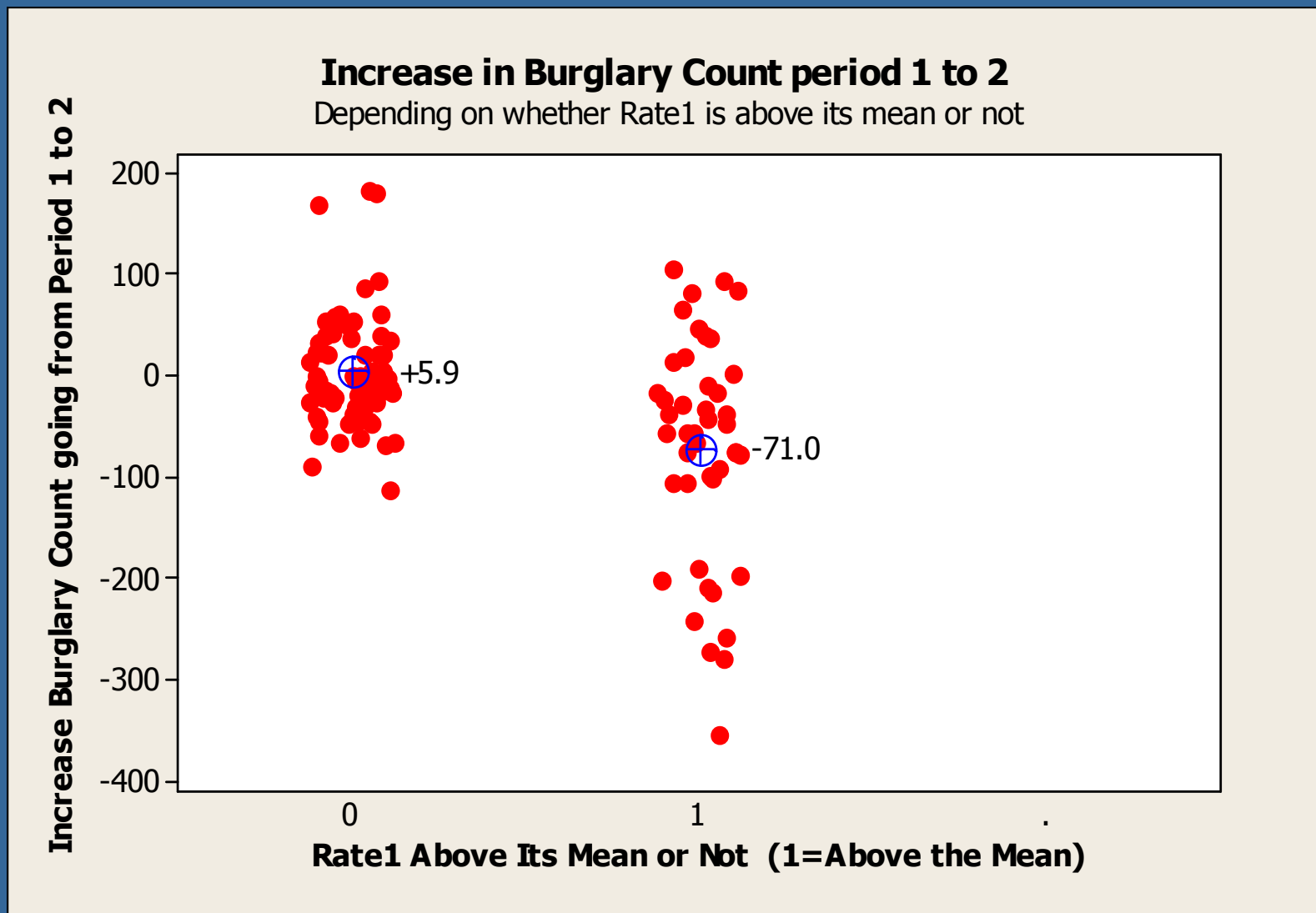
The response given to the lack of equivalence between the 2 areas. (RTM)

- Farrington and Welsh (2006) claim that RTM is a not problem because the effect in counted crimes in 250 Police 'Basic Command Units' going from 2002/3 to 2003/4 showed only small effect (a few %). This is hardly surprising as the areas and hence the number of crimes counted are an order of magnitude larger than in HORS251 so the year to year correlation is expected to be higher than for the small lighting study areas.
- Note Wrigley (1995) "This tendency for correlation coefficients to increase in magnitude as the size of the areal unit involved increases has been known since the work of Gehlke and Biehl (1934)".

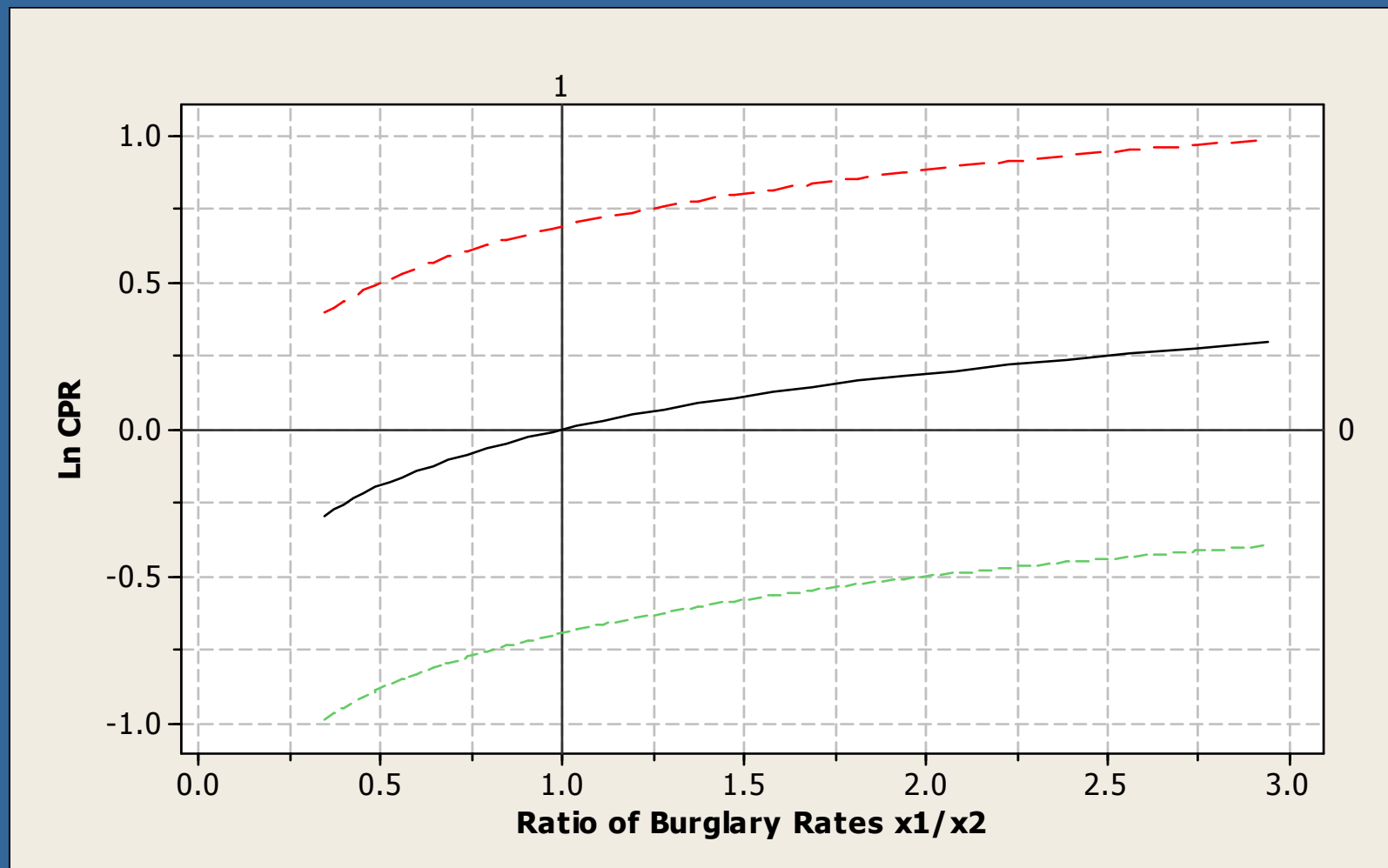
Estimation of the effect of RTM

- A simple model of crime rates suggests that the high year to year correlation typically 0.95 for the BCU data, would indeed give an effect of a few %.
- However the smaller areas used in CRI evaluation would be expected to have lower correlation
- Burglary data from a study of 124 areas has correlation of about 0.8 giving, all else equal, an expected effect 4 times larger, comparable to the claimed lighting effect.
- Note: in general we don't know the correlation nor rates being compared for the lighting studies. However, we do know, whereas the crime rate ratio at the start is 1.40 for Dudley, that for Stoke is 2.51 giving a much larger expected RTM effect.
- Without better knowledge we can't judge the impact of RTM but the indications are that it is serious.

Illustration of regression towards the mean using burglary data (Tilley et al.)



Modelling RTM effect as crime rates differ, for burglary data



Further problems with correlation

- When combining studies, the correlations may well be different.
- The household survey studies, i.e. Dudley and Stoke on Trent, suffer from spatial correlation (amongst other things not taken account of.)

Beware of flimsy cost benefit analyses

- Cost benefit analysis has been done based on very few studies by lighting and crime researchers Painter and Farrington 1999, 2001 (and gives a highly favourable result for lighting). However doing this only increases the problem. As an unknown, unproven benefit/harm is being compounded with uncertain costs.
- Small systematic errors can have a major effect.
- Used to claim that lighting is a sound crime reduction method.
- We need to get much better information to do such an exercise properly as otherwise it tends to look 'scientific' to the eye of a novice, when in fact it isn't, because of flimsy data and method.

My 'Interest'

"...Paul Marchant, statistician at Leeds Metropolitan University who argues that statistics used in the Home Office Study 251 could equally be used to show that street lighting actually increases levels of crime. This is an argument which the APPLG, alongside the ILE, would hope to show as utterly absurd. Of course it is worth noting that Paul Marchant is also an astronomer as well as being a statistician, and that this may lead to some bias in his interpretation of the statistics he refers to."

P56 of the March/April 2004 issue of the Lighting Journal, the magazine of the Institution of Lighting Engineers.

APPLG = The All-Party Parliamentary Lighting Group
ILE = The Institution of Lighting Engineers

My take on lighting and crime

- It may be that lighting reduces crime, or perhaps it increases crime. We have to look at the evidence as given. The conclusion, at present, is: We do not know.
- Comment from the 'More or Less' presenter Andrew Dilnot "Paul Marchant's doubts about the statistics are serious and reasonable and show us how fiendishly careful we have to be in evaluating evidence. These doubts have not yet to our knowledge been satisfactorily answered, and though we asked various people involved in the research to take part in this programme, none replied."

Note that the programme makers were up-to-date on the references on both sides of the argument at the time.

- We really ought to know the effect in order to spend money rationally.
- Note, I know of no scientific trials of exterior 'Security' lighting. So it is not known if these work. Note: lighting does not feature as a consideration given by burglars 'HO249 Findings'. (Hearnden and Magill 2004)
- We ought to take a 'Popperian' view and entertain the possibility of light being ineffective or worse, against crime.
- Of course we all need light at night, to see by. However there is no sound evidence that we need light to protect us from crime, in spite of claims.
- Need better research (and evaluation of existing projects) to be able to tell.

Light does not always stop crime

The burnt out car is easily visible from dwellings on the side of the road from which this photo is taken.



Final thoughts

- Statistical/scientific issues need to be properly addressed and embedded in deciding policy.

“Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write”. HG Wells.

- Need good research. It can be done.
- Check and do use sound scientific principles to challenge ‘experts’.

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