Statistics and the fight against Modern Slavery

Florence Nightingale Lecture 2022

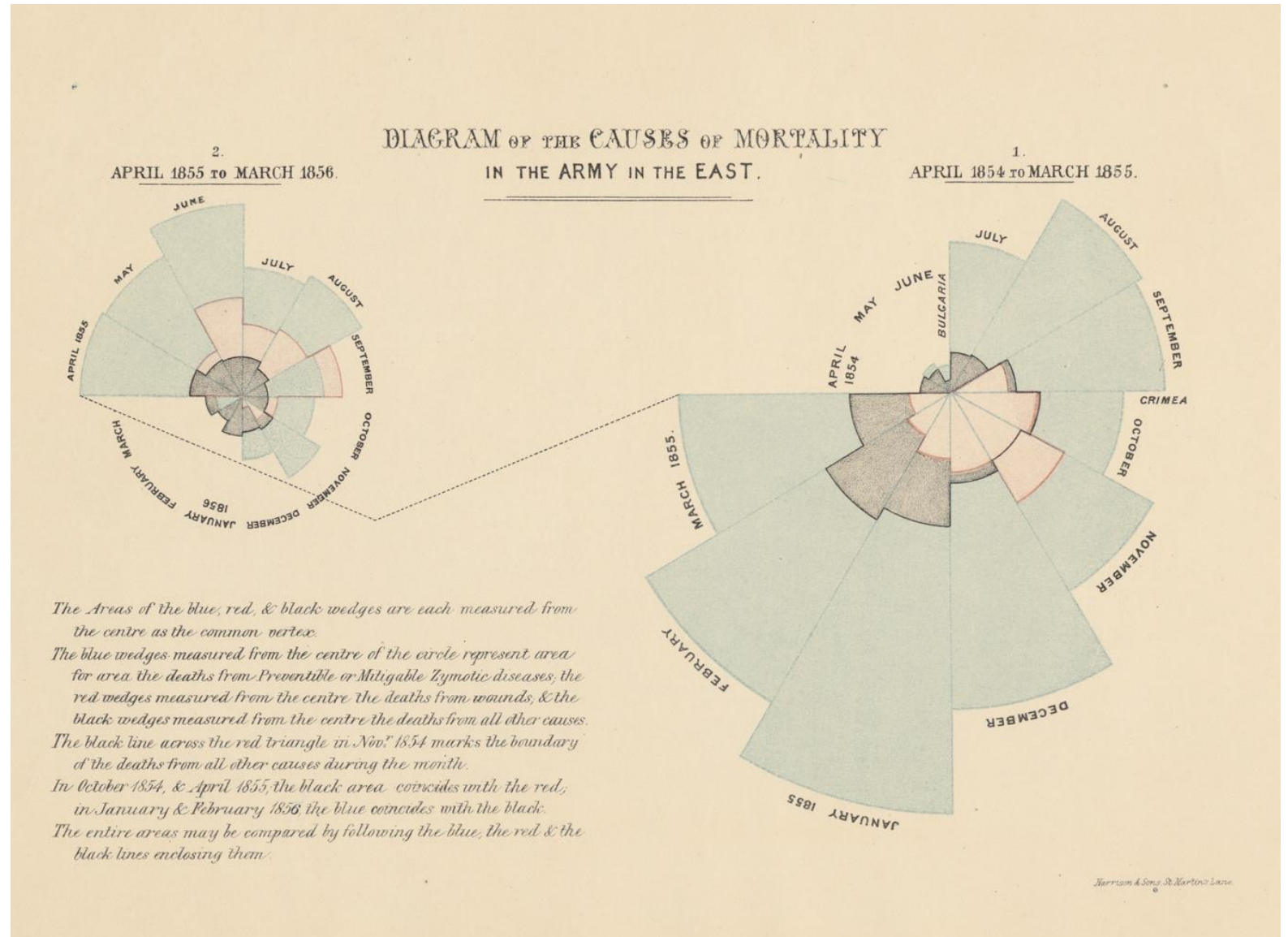BERNARD SILVERMAN

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How can statistics (however inaccurate) contribute to public policy

- Florence Nightingale was acutely aware of the use of statistics to influence public policy

- Her lifetime's work was a combination of collecting and marshalling evidence and then using that for advocacy

- Was it evidence-based policy or policy-based evidence? Certainly she had very strong opinions about the ways that things should be done.

Nightingale's famous diagram

From the book (attributed to her):
A contribution to the sanitary history of the British army during the late war with Russia

What was it based on?

- The book (actually 16 pp) is available at https://tinyurl.com/fncrimea

- Worth a read!   The diagram is based on a range of published data, but there needed to be a lot of "pre-processing"….

The presumptive evidence all goes to show that the Adjutant's Head Roll of Burials is nearest the truth, as exhibiting the approximate monthly mortality of the Hospitals at Scutari, exclusive of Kululi.   Anyway, the returns are in such a state of confusion that they make good, if anything can do so, the recommendation of the Royal Commission, that the statistical element should be effectively introduced into the Army Medical Department, before anything like sanitary progress is possible.*

* An obscure pamphlet, circulated without a printer's name, reproduces nearly every possible statistical blunder on this and other points.   It purports to be a defence of the defunct Army Medical Department, "By a Non-Commissioner," but it is more like a *jeu d'esprit*.

And what was the interpretation?

No. 1 shows what can be done with an army by neglect of the laws of nature, No. 2 shows what we may expect from their observance. Similar diagrams might be constructed for towns in their unimproved and improved state, and even for single buildings, inhabited by large numbers of persons. Nature is the same everywhere, and never permits her laws to be disregarded with impunity.

The most cursory inspection of these diagrams will show that the whole question as to the cause of the mortality narrows itself into an inquiry as to what laws of health had been so violated as to lead to so great a destruction of life from five diseases only.

Contagion or hygiene?

Again, as regards the proposed Sanitary Service and the teaching of Hygiène, there cannot be a doubt that the greatest benefits will flow to the Army from both. The recently published Correspondence of the Army Medical Officers during the Russian War† shows how very small a number of these Officers was acquainted with even the elements of the subject. In the present (so-called) enlightened time, sound principles of Hygiène are by no means widely spread even among the civil medical profession. To this circumstance it appears to be mainly owing that the belief in contagion as an unavoidable cause of death from epidemic disease is still so prevalent. This very doctrine

The Sanitary Commission to the rescue….

during the winter. In the second week of March 1855, the works recommended by the Sanitary Commission were begun, and were carried out as rapidly as possible. Windows were immediately broken to admit of the escape of foul air, and sailcloth flaps were at once placed over the mouths of the sewers to prevent the wind blowing through them into the Hospitals; the Hospital drainage was improved and flushed; the Hospitals were cleansed, ventilated, and lime-washed; the numbers of sick were also reduced, and nuisances were removed. From that time the sick had every requisite for recovery,

However….

according to Hugh Small (Florence Nightingale, Avenging Angel, 1998)

- The diagram "was the start of her campaign for public health legislation, based on the terrible lessons of the Crimean War."

- She created the 1875 Public Health Act, against opposition from the medical elite. This saved millions from fatal epidemic disease and started off an astonishing improvement in life expectancy long before modern scientific medicine.

What is Modern Slavery?

- Modern slavery encompasses many aspects of human trafficking and exploitation. There are tens of millions of victims world-wide, e.g.
  - Captivity within family or community
  - State-sponsored modern slavery
  - Debt bondage
  - Domestic servitude
  - Labour exploitation in mining, agriculture, fisheries, car washes, nail bars, cannabis farms, paving businesses
  - Sexual exploitation and forced prostitution
  - No country is free from Modern Slavery

- "Modern Slavery" and "Human Trafficking" are closely related

My work for the UK Modern Slavery Act 2015

- In 2013, the National Crime Agency identified 2,744 potential victims of trafficking, the best figure at the time

- The sources of information can be grouped

LA	Local authorities
NG	Non-governmental organisations, charities
GO	Government organisations e.g. UK Border Force, Gangmasters and Labour Abuse Authority
PF	Police forces, National Crime Agency
GP	General public (various routes)

The dark figure

- Despite all efforts, known cases can only present a partial picture
  - Human trafficking is a hidden crime
  - Victims may be controlled or still in servitude
  - Victims may not come forward because of fear or shame
  - Victims may not be identified as such by professionals who encounter them
  - Victims may not view themselves as victims of exploitation
  - Coverage is incomplete: not all agencies respond to the intelligence requirement (e.g. in 2013, 37 police forces and only 4 NGOs)

- **Multiple systems estimation (MSE)** can be used to estimate the "dark figure" of potential victims that did not come to attention

Mark-recapture: simplest form of MSE

- Proposed in 1895 as a method of estimating the number of fish in a pond (though it is a much older idea).
  - Catch 100 fish, mark them, and then release them.
  - Later take a new catch (another 100) and see how many of the second catch were part of the original first catch.
  - Suppose the overlap between the two catches is 20: the natural estimate of the whole population size is 500.

- Used in the census to estimate the undercount—the proportion of the population not "caught" by the initial census—by conducting a survey and assessing the overlap between the census and the survey.

More than two lists

LA	X					X	X	X									X	X	**X**	
NG		X					X		X	X	X					X	X	X	**X**	
PF			X						X			X	**X**			X	X		**X**	
GO				**X**						X		X		X		X	X		**X**	
GP					X						X		**X**	X						
	54	463	995	**695**	316	15	19	3	62	19	1	76	**11**	8	4	1	1	**1**	**??**

For example: 695 cases appear on list GO only. 11 cases on PF and GP but not others. One case on all four of LA, NG, PF and GO, but not GP.

The "dark figure" is the number which should appear in the last column—those cases which do not appear in any list.

A lot of work went into this table!

The standard MSE model

- MSE works by fitting a model to the observed data.

- It fits <u>main effects</u>, for example the odds of appearing on list *i*

- It also allows for <u>interaction effects</u>, where the odds of appearing on both lists *i* and *j* are not simply the product of the individual odds.   For five lists there will be ten possible interaction effects, but we try to fit a simpler model where only some of these are included

- Once the effects are all estimated, the model provides an estimate (with a standard error) for the total size of the population

- The fitted interactions show which interactions are positive and which negative.

10,000 to 13,000 victims

- The estimated confidence interval is from 10K to 13K, so this suggests that the Strategic Assessment was aware of 20% to 25% of all the potential victims of trafficking in the UK in 2013

- A tentative conclusion: the model is based on assumptions that (while perhaps sensible) can't be easily verified and it inevitably uses data that have limitations; this was made clear in the press release at the time

- Analysis also reveals correlation between various sources: e.g. cases reported to NGOs are more likely also to be known to police; cases reported by general public are less likely to be in other lists

- The confidence interval is conditional on the model selected; there are thousands of possible models to choose from according to which interactions are allowed to be estimated

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Results: interactions

- Cases reported by a local authority are somewhat more likely also to be reported by an NGO or the police.
  - This may reflect the existence of referral pathways for potential victims between these agencies.
  - It may also reflect joint operations where victims are identified by more than one agency.

- There's a negative interaction (very little overlap) between GP and most other lists, so it suggests that the general public are "fishing in a different pool" in some way or possibly that victims are not well identified.
  - However to check robustness we tried leaving these out altogether and the results were scarcely different

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10,000 to 13,000 victims: subsequently…

- The figure hit front page headlines and was pivotal in bringing the issue to public attention

- It didn't just facilitate the passing of the Act but also provided a spur to action

- There's now enormous public consciousness of the issue but of course a long way to go

- Since the passing of the Act far more victims have come to light each year so it's clear that the figure is a very conservative estimate

- Theoretical work has produced methods that take account of the model choice in finding confidence intervals

Eliminating modern day slavery

Modern slavery is around us all the time, but it's not always visible. Fortunately, there are ways you can help us to stamp it out. We've partnered with The Royal Borough of Kensington and Chelsea, as well as charity partners, to take on the task of ending modern slavery in both boroughs. Through the Modern Day Slavery & Exploitation Strategy we have outlined the various ways we are responding to this issue and, most importantly, how we can all play a role in removing it from our communities. We are also hosting two training sessions for community leaders and organisations, and professionals on:

- Monday 17 January, from 2 – 4.30pm.
- Tuesday 15 March, from 10am – 12.30pm.

📍 To sign up for a training session or to learn more about how you can help us to tackle modern slavery, visit westminster.gov.uk/modern-slavery

Westminster Reporter (free city council newsletter)

Modern slavery

In accordance with Section 54 of the Modern Slavery Act 2015, the University is required to prepare a slavery and human trafficking statement for each financial year, setting out what steps it has taken to ensure modern slavery is not taking place in its business or supply chains.

The University's slavery and human trafficking statement for the financial year ended 31 July 2021 is below.

Slavery and human trafficking statement for the financial year ended 31 July 2021 (issued pursuant to section 54 of the Modern Slavery Act 2015)
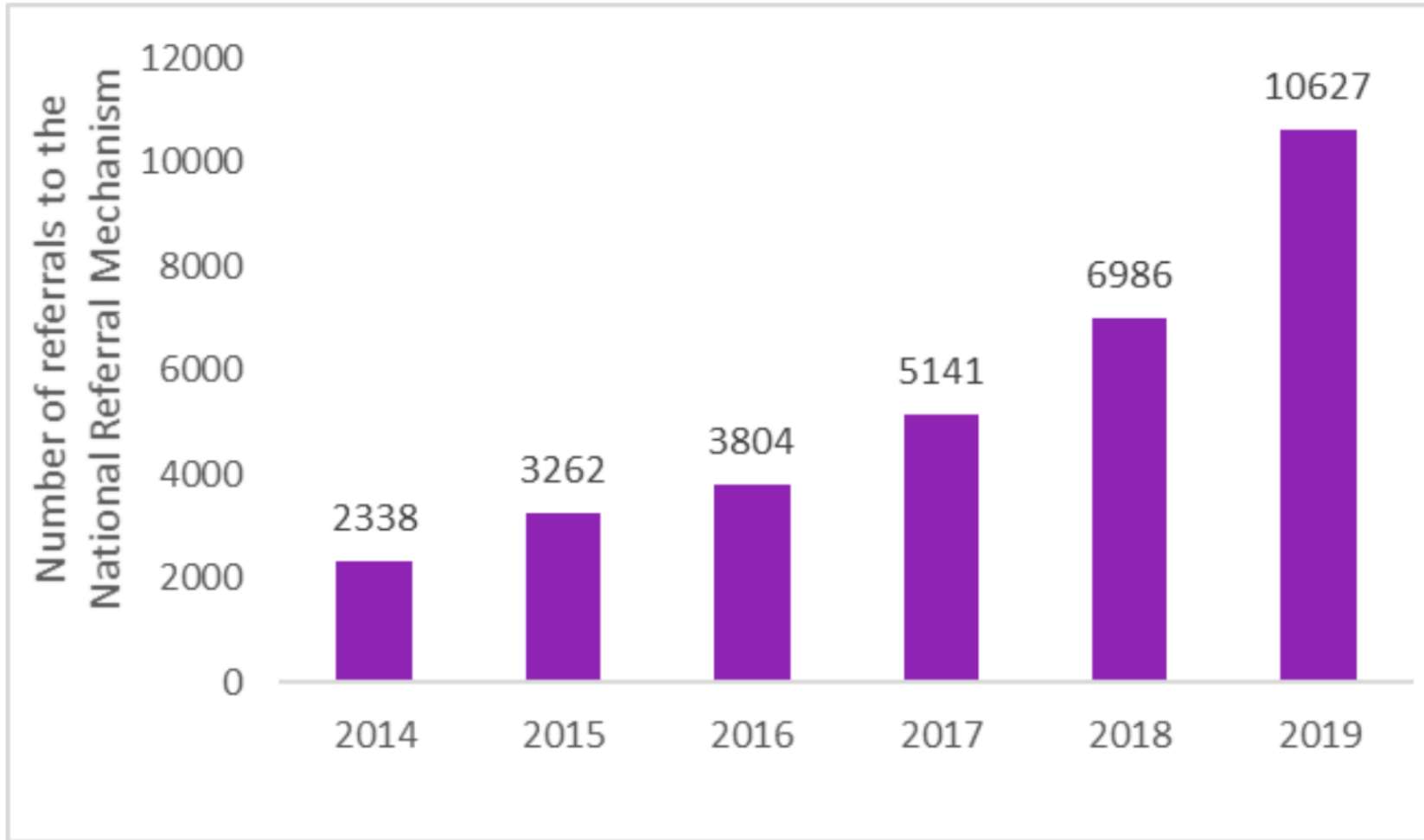
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POLICY STATEMENT ⌄

THE STRUCTURE, BUSINESS AND SUPPLY CHAIN OF THE UNIVERSITY OF OXFORD ⌄

OUR POLICIES ⌄

DUE DILIGENCE PROCESSES AND ON-GOING MONITORING ⌄

RISK ASSESSMENT ⌄

TRAINING ⌄

FURTHER INFORMATION ⌄

Oxford University's Modern Slavery statement though not all are as thorough

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Number of NRM referrals from 2014 to 2019

In 2013 the total figure in the Government's National Referral Mechanism was 2744.
It seems unlikely there's been an increase in underlying prevalence; it is probably all due to increased awareness.

Of course, the NRM figure will only ever be partial so it's now obvious that the original figure was extremely conservative

Though the method has remained controversial

One of the greatest challenges within human rights is the estimate or measurement of human rights violations, which are often hidden from view. In the case of modern slavery, estimating the number of victims, even roughly, has only recently been possible. For countries with a higher prevalence of slavery, random sample surveys have proven useful, but until the application of MSE there was no equivalently reliable way to measure slavery victims in the richer countries that have lower prevalence. Before MSE there was simply no reliable way to measure slavery in many locations. Appropriate estimation can support appropriate policy and law enforcement responses, and that means saved lives and crimes halted. This statistical argument is simply a brick in the foundation of an informed and effective response to modern slavery.

Vincent et al. (2020) (five authors who have used the same method in various contexts)

Difficulties in developing the methodology

- It's recognised that you can do better if you include covariates in the analysis but there are (to my knowledge) no real data sets available in the public domain for researchers to develop their methods---and precious few that give even the amount of detail given above

- This is entirely understandable because of privacy concerns

- The safety of individual victims is paramount and many agencies are extremely reluctant to share data (and some are simply not allowed to)

- Simulation studies and theoretical analysis are all very well but they will mostly only tell you about data that actually follow the model, rather than helping to understand in what ways real data don't

- Getting any sort of "ground truth" is in practice impossible

A vulnerability model: the Global Slavery Index

Surveys in 48 countries (none in) are correlated with "vulnerability measures" and then extrapolated to other countries . The surveys were focused on countries with high expected prevalence and/or large populations; none were in North America, Western Europe, or richer parts of Asia. Respondents were asked whether they or their immediate family had been subjected to forced labour or forced marriage. For details see Diego-Rosell & Joudo Larsen (2018)

- The vulnerability measures were broadly as follows:
  - Governance, including areas such as political instability and regulatory quality.
  - Nourishment and Access, including areas such as undernourishment and social safety net.
  - Inequality, including measures such as being able to come up with money.
  - Disenfranchised Groups, including treatment of immigrants and other minorities.
  - Effects of Conflict, including impact of terrorism and displaced persons.

- The prediction intervals are extremely wide (e.g. from less than nothing to 4 million for the USA)

- For the UK, the method produces a prevalence estimate of 0.38% with a standard error of 0.31%. (Similar figures for other Western European countries).

- Overall the approach is arguably better at identifying risks and vulnerabilities than it is for estimating prevalence

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Natural language processing of documents

- West Midlands Police have analysed police documents, work [published by Centre for Social Justice.](#)
  - Use machine learning/natural language processing (NLP) to analyse lengthy police documents, both crime reports and intelligence logs
  - Their approach suggests that as many of 90% of cases are not actually flagged as Modern Slavery
  - Work is still ongoing. The algorithms are quite simple and involve looking for words like "slavery" or "trafficking" in the records. It remains unclear how as many of 9 out of 10 cases are missed where these words are actually used in the police report or intel log.

- Again, this approach suggests a total number of cases in the UK in the hundreds of thousands

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Network scale-up method

- Ascertain from respondents how many people they know in general. It is best to do this through categories (e.g., immediate family; birth family; people in your class; close friends; people known through hobbies/recreation; people known through faith-based organizations; people known from your neighbourhood; people known through others; childhood friends etc.);

- Then ascertain from respondents how many implicated individuals (victims and traffickers) and households they know;

- Determine the number of individuals in each personal network who have been trafficked and scale this up based on the total population.

- This is the summation method. An alternative is the known population method, described as follows: "Each respondent is asked about the number of people they know in various populations of known size. For example, if a respondent in Egypt reports knowing five people named Ahmed, one could combine that with the fact that there were about 2 million men named Ahmed in the country (using birth registration data from 2008). We could estimate that the respondent knows about 5/(2 000 000) = 0.0000025 of all Egyptians. As there are approximately 90 million Egyptians (from census data), we would estimate that the respondent has a personal network size of 225. To reduce the variance of this estimate, we ask about many populations of known size."

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Discussion points

▪ On the scale of "hard to count" populations, the number of victims of Modern Slavery is even harder to count than many others (deaths in conflicts, intravenous drug users, etc.)

▪ As statisticians we have educated people to expect point estimates and confidence intervals: hence the 10k to 13k figure

▪ It's easy to criticise the use of any particular model or figure: see the Discussion of my 2020 JRSS-A paper and the subsequent paper Vincent et al. (2020)

▪ So what should be our ethical position? Say nothing till we can say everything? Or state clearly our modelling assumptions etc and rely on George Box: "All models are wrong, but some are useful".

▪ FN was fundamentally wrong in pushing "hygiène" vs "contagion" but nevertheless saved the lives of millions……..is there any analogy with our statistical conundrum over Modern Slavery?

▪ How can and should statistics (however flawed) influence public policy?