

## STATISTICS IS DEAD

Statistics was an ingenious but doomed attempt to apply Probability Theory to the real worlds of Science and Human affairs. It flourished between about 1880 and 2020 when the secrets of Common Sense were unearthed and the inconsistencies of Statistics were finally exposed to light and found incurable. More importantly the need for it evaporated because Common Sense could do the vital job of Hypothesis Testing far better.

Probability Theory was developed in the 17<sup>th</sup> century to analyse the Odds in games of dice and cards where it proved to be very useful. It was natural therefore for some on both sides of the divide between Science and Mathematics to suppose it could be adapted to solve fateful problems in areas such as Medicine and Economics. A promising start was made led by pioneers at University College London, notably Francis Galton (a cousin of Darwin) and his successor there Karl Pearson. Their approach looked so promising that H. G. Wells could write *“Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.”* while universities opened units to teach Statistics to a wide variety of students from Physics to Sociology. And that is when things began to go seriously wrong – but it was to take more than a century before Statisticians themselves could be effectively challenged. Alas by now they and their disciples across all branches of culture hold too much authority to relinquish it easily.

So what *is* wrong with Statistics?

(A) Mathematics, including Probability Theory, is Deductive; i.e. from assumed truths (axioms) it arrives at theorems logically; on the other hand Science (and most real knowledge) has to be Inductive, i.e. truths have to be sought for amidst shards of incomplete, imperfect and often conflicting evidence. Philosophically speaking the two modes of thought are irreconcilable, poles apart. But by placing their Statistics units within Mathematics departments (after all they both used algebra) universities inadvertently crippled the entire enterprise. In many Maths departments which also taught Statistics bitter internecine feuds broke out between Deductivists and Inductivists. The Mathematicians wanted to teach Statistics deductively, after all they'd been taught to despise Induction within their own subject, while the Inductivists knew

that could not be right. The two sides of this philosophical divide could never be reconciled, though many sincere but misguided attempts were made to do so, particularly by text-book writers who tried to disguise the uncomfortable truth, as much from themselves as from their readers. That thoroughly confused the more perceptive students and explains why such a vast number of Statistics texts were written. In a coherent subject that would not have been necessary.

(B) There is an absolutely fundamental distinction between games of chance and the real world. Games are CLOSED, that is to say every combination of cards can be imagined and its probability precisely calculated. The real world is OPEN; there may well be causes at work totally unknown to the researcher. Thus it is impossible to enumerate and therefore to calculate precisely the probability of any hypothesis  $H$  that might be responsible for some observed evidence  $E$ . What of the probability of  $E$  given  $\bar{H}$  where  $\bar{H}$  stands for ‘All hypotheses, apart from  $H$ , that might be responsible for  $E$ .’ Without assigning some value to that it is impossible to update one’s Odds on  $H$  in the light of new evidence  $E$ .<sup>1</sup> This seems so obvious that one wonders why it took so long to come to light. It was a quirk of history. Newton, who gave the first demonstration that the Natural World could be precisely calculated, assumed that the Solar System was Closed, i.e. that there were no other forces acting between the Sun, the planets and their moons. And, fortuitously, that turned out to be true, because the nearest stars to the Solar System are so far away that, on human timescales at least, they play no significant role in its dynamics. [Likewise in Atomic Physics one can calculate many properties without any cognisance of neighbouring molecules – again an approximation]. Such fortuitous accidents were however no licence to suppose that most real phenomena can be analysed as Closed. Most Statistics textbooks totally ignore (do not even index) this fatal flaw, presumably because there is no obvious way around it.

(C) Allied to the distinction between Open and Closed is Keynes’ Principle of Limited (Independent) Variety (PLV). It states that: “If there are too many hypotheses to choose between, Induction cannot work”. Take Dream Interpretation. There are an innumerable, perhaps an infinite number of ways to interpret a dream. Thus no Inductive scheme can devise a way to construct rational Odds on any of them – so it is fruitless to even try. This prohibition is fundamental, not specific to Statistics. But it does warn us not to seek for, or be impressed by, spurious precision in topics where the alternative hypotheses are uncountable. Economics and Psychology certainly fall into this category, and

yet they have become all too popular playgrounds for statistical ingenues. But, because of the PLV, such subjects can never use Induction and thus can *never become Sciences*.

(D) Induction relies on assuming that certain simplifying principles apply to its subject matters (David Hume 1739 <sup>2</sup>). First is The Principle of Uniformity that assumes that all agents of a certain kind are much the same – all Oxygen atoms for example. Or that all geological processes which formed the Earth in the past are still operating today (James Hutton 1795 <sup>3</sup>). This last is an instance of the more general idea that the past can be regarded as a useful guide to the present, and the present to the future. We cannot prove such principles but without them it is generally impossible to do Science, or indeed to lead a rational life. But if such Principles of Uniformity apply widely in the Natural World, that is no good reason to apply them to the Social; for instance all individual humans are *not* the same. That alone should drastically curtail the ambitions of Statistics.

(E) History reveals that Science (& indeed culture in general) is plagued, indeed dominated by Systematic Errors, unknown unknowns, sometimes huge, which make a nonsense of the formal errors which Statisticians try to calculate – which may be trifling by comparison. Just consider the following such Elephants in the Room:

The World was formed by God in 4004 BC.

The Earth is flat.

The continents are fixed

Women are inferior

Black people (only) are a variety of ape

The Pope is infallible.....

(F) This brings one to the revealing ‘Cult of Precision’ in Statistics. Statistics books and packages are full of tables with 4-figure accurate functions<sup>4</sup>. But many important clues (say motive in the forensic context) cannot be assigned Odds more precise than a factor of 2. Thus the combined (multiplied) Odds of all the evidence cannot be more precise than the Odds on the *least* precise (multiplied) factor. This means that Statistics had to either ignore vital clues, or admit that their whole cult of precision was ill-found and vain. They would not.

(G) Before blinding us Statisticians often blinded themselves by appealing to arcane mathematics which allowed them, so they imagined, to introduce

simple algebraic functions into a subject where one would never have imagined that such simplicity would apply. A prominent example is the infamous ‘Normal Distribution (ND)’ which they usually justified by appealing to The Central Limit Theorem (CLT). Indeed Galton, founding father of Statistics, said of the ND: *“I know of scarcely anything so apt to impress the imagination as the wonderful form of cosmic order.”* – a remark recently supported by the current President of the Royal Statistical Society, Sir David Spiegelhalter who writes *“He was right—it really is an extraordinary law of nature.”*<sup>5</sup> But if we deconstruct the CLT argument we discover not profundity but a triviality which barely justifies anything, and certainly not the application of the ND to many real-world situations. Yes one might expect many measurements to cluster about some average central value. However the detailed shape of that distribution of measurements should depend on the particular physics of the situation. But when you throw most of the available information away by, for instance, rounding off errors, discarding outliers, taking samples, then averaging samples etc.... you are bound to finish up with the simplest possible distribution containing *the least possible information*. And that happens, as one can prove<sup>11</sup>, to be the Normal Distribution, one governed by only a single parameter, sigma. Of course it does – you have forced it do so by throwing away all the information that might have allowed it to be any different! That should be cause for dismay – not wonder. Fitting a ND to data which has a central tendency is no better than fitting a straight line through noisy data which has not. It’s a pretty poor show – really no better than a grudging admission of defeat. If Statisticians could not or would not confess to that, what were we to make of their other arcane algebraic lucubrations? Sadly, too many students, and their elders who should have known better, were fooled into using NDs when they were entirely inappropriate and sometimes dangerous. For instance here is the Open University<sup>5A</sup> advising its first year science students: *“.....it is very rare that scientists make a sufficiently large number of measurements to obtain a smooth continuous distribution .....However it is often convenient to assume a particular mathematical form for distributed measurements, and the form assumed is the so called normal distribution, so called because it is very common in nature.....The more data are collected, the closer they will come to describing a normal distribution curve.”* Utter and complete nonsense! Dogmatic statisticians like RA Fisher liked the ND because it allowed them to make precise and dramatic ex-cathedra pronouncements which seemed, because

of the background mathematics, unarguable. How many patients have died because of such necromancy? Millions probably.

What is bringing Statistics to its end? It had long been suspected that Hypothesis Testing, the Scientific Method and Common Sense were much the same thing. For instance Einstein wrote <sup>6</sup>: “*Science is no more than a refinement of everyday thinking....The physicist cannot proceed without considering critically a much more difficult problem (than physics), the problem of analysing the nature of everyday thinking.*” Finally, when someone asked the right question – ‘How do animals think?’ the truth came tumbling out: Categorical Inference, the Principle of Animal Wisdom and so on <sup>7,11</sup>. Common Sense provided a far better means to winnow information out of data, and one which could be taught to 14-year olds without all that bamboozling algebra. Considering how many internal inconsistencies it contained, how its gurus disagreed so violently with one another<sup>8</sup>, it is a wonder Statistics has survived for over a century, particularly since its real successes have been few. Even its iconic discovery of the link between smoking and lung cancer had been unearthed beforehand in Nazi Germany, using a handful of cases and Common Sense<sup>9,10</sup>. It was not *all* wrong of course: notions such as Principal Component Analysis for the exploratory analysis of data, will continue to be useful, but Statistics must not be allowed back into the vital field of Hypothesis Testing. To do that properly, we all of us, scientists especially, need to fully understand the mechanics of Common Sense<sup>11</sup>.

As a working observational astronomer for 50 years and a university professor for 40 I used and taught Statistics more enthusiastically than most. Now I look back ruefully and wonder why. For two main reasons I suppose. The idea that Profound Truths lie hidden in noisy data, ready to be unearthed by arcane means, is infinitely seductive; it goes back all the way to Delphi, and very very occasionally it works. Then again it is very much harder to spot what has either been left out of, or implicitly included in a plausible argument, than to spot a flaw in the logic. Hovering as it did between Mathematics and Science, Statistics could, whenever challenged, escape into the philosophical shadows in between. And so it too often did.

But now all is up with it, even though Statisticians don't realise that yet. Common Sense Thinking has found it out. And we should all be grateful for that, not least because we won't have to learn all that algebraic gobbledygook

any more, or employ professional Statisticians to interpret it. It simply doesn't work; and worse still it can lead the gullible astray. If instead we familiarize ourselves with Common Sense Thinking we can again make those vital judgements for ourselves.

## NOTES

1 The way we update our Odds on some hypothesis H in the light of a piece of new evidence E is Bayes' Theorem in Odds form:

$$O(H | E) = W(E | H) \times O(H)$$

where

$$W(E | H) \equiv \frac{P(E | H)}{P(E | \bar{H})}$$

Thus one cannot estimate  $O(H | E)$  without first estimating  $P(E | \bar{H})$ . But how? Recall that  $\bar{H}$  stands for "All those hypotheses, bar H, that could explain the evidence E: all!"

2 Hume, David, 1738, *A Treatise on Human Nature*.

3 James Hutton, 1795, *Theory of the Earth*.

4 E.g., "New Cambridge Statistical Tables", Lindley & Scott, CUP, 1984

5 *The Art of Statistics*, 2019, David Spiegelhalter, Pelican books, p 239

5A. *Maths for Science*, Open University, 2016, Kindle version, Sect (2:12).

6 Einstein A, 1936, *J. of Franklin Inst.* 221, pp 349-382

7 Disney M J, 2012, 'The Scientific Method and Common Sense Thinking' (see better 2020 reference below, Chapter 11, entitled 'Statistics or Terror Analysis' )

8 Jaynes ET, 2003, *Probability Theory the Logic of Science*, CUP

9 Lickint, F. 1929, [See Procter *The Nazi war on Cancer*, Princeton UP, 2000]

10 Muller FH, 1940, *Tabakmissbrauch und Lungcarcinoma*, *Z. Krebsforsch*, 49, 57-85

11 Disney M J, 2020, *Thinking for Ourselves*, Amazon Books.