

What are the chances of a third world war?

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IN [a recent] issue of *Significance* Mr. Peter McIntyre asked what the chances are that World War III will occur this century.

Prof. Michael Spagat wrote that nobody knows, nobody can really answer—and we totally agree with him on this. Then he adds that "a really huge war is possible but, in my view, extremely unlikely." To support his statement, Prof. Spagat relies partly on the popular science work of Prof. Steven Pinker, expressed in *The Better Angels of our Nature* and journalistic venues. Prof. Pinker claims that the world has experienced a long-term decline in violence, suggesting a structural change in the level of belligerence of humanity.

It is unfortunate that Prof. Spagat, in his answer, refers to our paper [1], which is part of a more ambitious project we are working on related to fat-tailed variables.

What characterizes fat tailed variables? They have their properties (such as the mean) dominated by extreme events, those "in the tails". The most popularly known version is the "Pareto 80/20".

We show that, simply, data do not support the idea of a structural change in human belligerence. So Prof. Spagat's first error is to misread our claim: we are making neither pessimistic nor optimistic declarations: we just believe that statisticians should abide by the foundations of statistical theory and avoid telling data what to say.

Let us go back to first principles.

Foundational Principles

Fundamentally, statistics is about ensuring people do not build scientific theories from hot air, that is without significant departure from random. Otherwise, it is patently "fooled by randomness".

Further, for fat tailed variables, the conventional mechanism of the law of large numbers is considerably slower and significance requires more data and longer periods. Ironically, there are claims that can be done on little data: inference is asymmetric under fat-tailed domains. **We require more data to assert that there are no black swans than to assert that there are black swans** hence we would need much more data to claim a drop in violence than to claim a rise in it [2].

Finally, statements that are not deemed statistically significant—and shown to be so—should never be used to construct scientific theories.

These foundational principles are often missed because, typically, social scientists' statistical training is limited to mechanistic tools from thin tailed domains [2]. In physics, one can often claim evidence from small data sets, bypassing standard statistical methodologies, simply because the variance

for these variables is low. The higher the variance, the more data one needs to make statistical claims. For fat-tails, the variance is typically high and underestimated in past data.

The second—more serious—error Spagat and Pinker made is to believe that tail events and the mean are somehow different animals, not realizing that the mean includes these tail events. **For fat-tailed variables, the mean is almost entirely determined by extremes. If you are uncertain about the tails, then you are uncertain about the mean.** It is thus incoherent to say that violence has dropped but maybe not the risk of tail events; it would be like saying that someone is "extremely virtuous except during the school shooting episode when he killed 30 students".

Robustness

Our study tried to draw the most robust statistical picture of violence, relying on methods from extreme value theory and statistical methods adapted to fat tails. We also put robustness checks to deal with the imperfection of data collected some thousand years ago: our results need to hold even if a third (or more) of the data were wrong.

Inter-arrival times

We show that the inter-arrival times among major conflicts are extremely long, and consistent with a homogenous Poisson process: therefore no specific trend can be established: we as humans can not be deemed as less belligerent than usual. For a conflict generating at least 10 million casualties, an event less bloody than WW1 or WW2, the waiting time is on average 136 years, with a mean absolute deviation of 267 (or 52 years and 61 deviations for data rescaled to today's population). The seventy years of what is called the "Long Peace" are clearly not enough to state much about the possibility of WW3 in the near future.

Underestimation of the mean

We also found that the average violence observed in the past underestimates the true statistical average by at least half. Why? Consider that about 90-97% of the observations fall below the mean, which requires some corrections with the help of extreme value theory. (Under extreme fat tails, the statistical mean can be closer to the past maximum observation than sample average.)

A common mistake

Similar mistakes have been made in the past. In 1860, one H.T. Buckle used the same unstatistical reasoning as Pinker and Spagat.

That this barbarous pursuit is, in the progress of society, steadily declining, must be evident, even to the most hasty reader of European history. If we compare one country with another, we shall find that for a very long period wars have been becoming less frequent; and now so clearly is the movement marked, that, until the late commencement of hostilities, we had remained at peace for nearly forty years: a circumstance unparalleled (...) The question arises, as to what share our moral feelings have had in bringing about this great improvement.

Moral feelings or not, the century following Mr. Buckle's prose turned out to be the most murderous in human history.

We conclude by saying that we find it fitting –and are honored –to expose fundamental statistical mistakes in a journal called *Significance*, as the problem is precisely about significance and conveying notions of statistical rigor to the general public.

[1] Cirillo P., Taleb N.N. (2016), On the statistical properties and tail risk of violent conflicts. *Physica A: Statistical Mechanics and Its Applications*.

[2] Taleb, N.N. (2007), *The Black Swan: The Impact of the Highly Improbable*, Penguin.

[3] Buckle, H.T. (1858) *History of Civilization in England, Vol. 1*, London: John W. Parker and Son.