Applied Statistics On Trial Factors











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"Statistics is merely a quantisation of common sense"

XKCD on statistics



XKCD on statistics



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Motivation

The probability of rolling four sixes in a row is $(1/6)^4 = 0.00077$

Imagine that you roll four times and get four sixes. That should make you highly suspicious of the dice.

But then imagine that you roll four times... again and again 1000 times... and **one time get this result**. What do you conclude then?

The overall conclusion is that one of course has to take into account the number of times that an (independent) experiment is repeated.

Trial factor / Look-Elsewhere Effect

"If you look enough times or places, you will find something unlikely"

The "Look-Elsewhere Effect" refers to observing an **apparent** statistically significant observation, which has arisen from searching a large parameter space (i.e. many places).

To account for this, one uses a **trial factor**, which is the ratio between the probability of observing a possible excess at some fixed point, to the probability of observing it anywhere in the range.

The significance of the (fitted) amplitude tells you the <u>local</u> significance. As you might be searching in many places, this reduces your certainty to the <u>global</u> significance:

$$p_{global} = 1 - (1 - p_{local})^N \approx N \ local$$

Thus, the global significance is (roughly) reduced by the trial factor.

A good paper with discussion of statistical treatment: <u>https://arxiv.org/abs/1005.1891</u>

Example case

A Swedish study in 1992 tried to determine whether or not power lines caused some kind of poor health effects. The researchers surveyed everyone living within 300 m of high-voltage power lines over a 25-year period and looked for statistically significant increases in rates of **over 800 ailments**.

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The problem with the conclusion, however, was that they failed to compensate for the **look-elsewhere effect**; in any collection of 800 random samples, it is likely that at least one will be at least 3 standard deviations above the expected value, **by chance alone**. Subsequent studies failed to show any links between power lines and childhood leukemia, neither in causation nor even in correlation.

[Jon Palfreman, "Currents of fear" (1995-06-13), Frontline, PBS]