

# Bayes, likelihood ratio and homeopathy

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In 1763 reverent Thomas Bayes published his brilliant theorem describing the way we learn from experience. He showed how we make valid predictions about the future from past experiences. Unfortunately his theory came with an awkward formula using odds\* instead of chances. The introduction of the computer resolved the problem with this formula. Now we can use chances and let the computer perform the calculations. Bayesian reasoning has since invaded every field of science, because it can produce valid conclusions in real-world phenomena. Now medicine can be assessed without placebo-control and randomisation, science can be used for improving instead of proving homeopathy.

## From experience to prognosis

The bayesian principle is in fact quite simple: a diagnostic test is better as it is positive more frequently in people with the disease than in other people. Hahnemann also made this observation and in the same fashion he concluded that rare and peculiar symptoms are the most valuable symptoms. Likelihood ratio (LR) expresses the relation between the prevalence of the symptom in the population with the illness and the population without the illness. In the homeopathic translation: the relation between the prevalence of the symptom in the population cured by a certain medicine and the rest of the treated population.

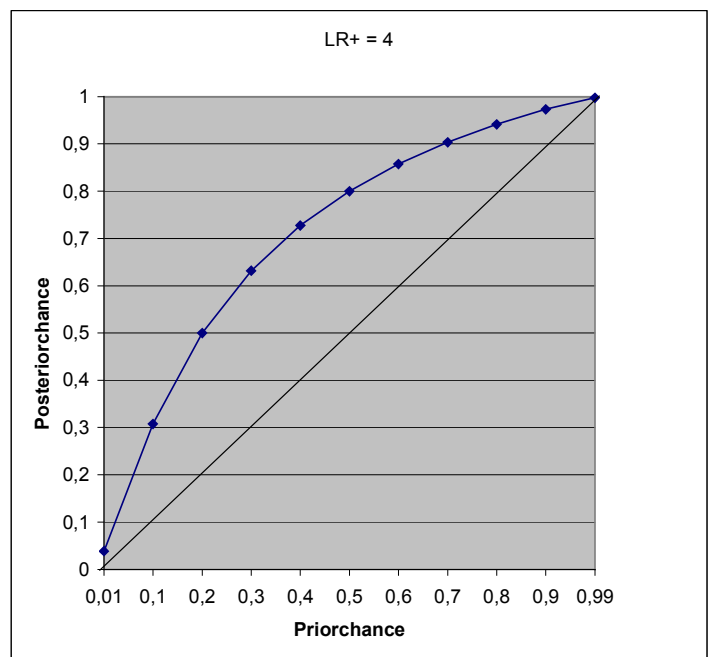
	Rhus-t.	Others	
<i>"Amelioration by motion is 10 times more frequent in rhus-t. patients than in other patients"</i>	50%	5%	<b>LR=10</b>
<i>"Rare symptoms are most important"</i>	20%	0.1%	<b>LR=200</b>

A symptom with a higher LR is more important. This is what we already know from homeopathic experience. At the moment there is vast confirmation of the predictive capacity of the bayesian theorem in all kinds of industrial processes and in medicine. The bayesian formula is as follows:

Posterior odds = LR x prior odds

The problem is that we are used to chances instead of odds. Fortunately the computer can help us to do the necessary translation from chance to odds and reverse. The relation between prior-chance and posterior-chance is not linear, so LR=2 does not mean that posterior-chance is twice prior-chance. This would give impossible outcomes if prior-chance is more than 50% (eg 2 x 60% = 120%). The relation between prior-chance and posterior-chance if LR=4 can be expressed by the graph at the right.

If prior-chance = 20% (a differential diagnosis of five medicines), posterior-chance after a new symptom with LR = 4 becomes 50% (not 80%). If prior-chance = 50%, posterior-chance becomes 80%. In the graph you see all possible posterior-chances related to prior-chances if LR = 4. So, we need the computer to perform the calculations.



\* Odds = chance / (1-chance); in words: the chance that something will happen divided by the chance that it will not happen. Odds = 1 means: chance is fifty-fifty

## Homeopathic diagnosis

The choice of a homeopathic medicine is usually not based on one fact (diagnosis). In bayesian perspective we can describe the decision-process of a homeopathic physician: if we add symptoms, our certainty about the curative effect of a medicine will grow; if our symptoms are better (eg if they are peculiar) our certainty will grow faster. Suppose that the chance that a homeopathic medicine is 1% if there are no symptoms, than our conviction that *Rhus toxicodendron* will be curative grows as follows with 3 subsequent symptoms:

Cure by Rhus-t.?	Chance of cure (cumulative)
0. No symptoms	1%
Symptom 1: Motion ameliorates (LR=10) →	9%
Symptom 2: Desire cold milk (LR=6) →	37%
Symptom 3: Wet weather aggravates (LR=4) →	72%

After the first symptom posterior chance = 9%; after the second symptom posterior chance=37%; etc. Do not mind about the formula, that's the computers' job.

This is a normal procedure in homeopathy. The patient visits the doctor because of joint pains. The homeopathic doctor then asks about circumstances that influence the complaint. If the patient tells him that the pain is ameliorated by motion, the homeopathic doctor thinks of *Rhus toxicodendron* as one of the possibilities. If further investigation learns that the patient has a definite desire for cold milk his expectation that *Rhus toxicodendron* will help grows. The last symptom, aggravation from wet weather, is subsequently enough to prescribe this medicine.

## A new repertory

Bayesian thinking is a perfect starting point for scientific update of the homeopathic method. Homeopathic symptoms can be assessed as diagnostic instruments, like any other diagnostic test eg ultrasonography. In conventional medicine we seek for the relation between test and diagnosis, in homeopathy we seek for the relation between symptom and cure.

Computers make it possible to collect an enormous amount of data about our prescriptions with a minimal amount of work. Then it is easy to evaluate which cases were successful and which symptoms led to these cases. And which did not!

Assessment of homeopathic symptoms becomes relatively easy. After thousands of cases we know the prevalence of the investigated symptom. Here we take '*Fear of death*' as a hypothetical example. We can measure the prevalence (say 5%) and its 95% confidence interval (4.5 – 5.5%). Then we can calculate the prevalence of this symptom in the cured cases. LR = the prevalence of the symptom in the population cured population divided by the prevalence in the rest-population.

The change in the present repertory, after incorporating these data, is at first sight futile. But these are hard facts, not estimates out of the brains of an unknown number more or less unknown colleagues. LR of each medicine is indicated between hyphens, like **Acon.(6)**:

FEAR
- <b>Death</b> , of: in general, more than expected considering circumstances; occurring almost daily. <i>Prevalence 5% (±0.5)</i>
<b>Acon. (6)</b> , act-sp., agn. (2.5), all-s, ..., apis (3), arg-n. (3), <b>Ars. (4)</b> , asaf., aur.(1), ..
<i>lach.(3.5)</i> , <b>Lat-m. (6)</b> , led., ...

In this repertory-rubric we see some differences compared to the existing repertory. First, of course, there is LR. But there is more. The symptom is better described, according to consensus between the doctors that were participating in the research. The prevalence of the symptom in this assessment is indicated, so every doctor can check if his population is similar. If not, he should correct LRs; if

prevalence of 'Fear of death' in his practice is higher, LR is lower than the values indicated in this rubric.

In this repertory-rubric we see a medicine, that was not in this rubric in Kent's original repertory: *Latrodectus mactans*. This symptom, however, is one of most important symptoms of this medicine. This is often the case concerning medicines that are seldom used. There is a systemic error in the repertory: symptoms are entered if they occur repeatedly. This might be due only to the frequent use of the medicine, while the symptom does not occur more frequently than in the general population. In this hypothetical assessment LR = 1 for *Aurum*, indicating that the symptom 'Fear of death' does not indicate *Aurum*. From our pilot-study on LR we learned that *Sulphur* is not 'Loquacious', although it is mentioned in the rubric 'Loquacity'.

### **Necessary number of symptoms**

Another advantage of the use of LR is better estimation of the number of symptoms needed to make a prescription. LR gives much more information about the value of a symptom than typeface used in the present repertory. In the rubric 'Fear of death' we see several medicines in bold type. This, however, a very inaccurate indication. If we know, say, that 'Fear of death' occurs 6 times more frequently in the Aconitum-population (LR = 6) and 4 times more frequently in the Arsenicum-population (LR = 4), we can differentiate between Aconitum and Arsenicum. LR=6 or LR=4 makes a definite difference; you need 4 symptoms with LR=4 to reach the same certainty as 3 symptoms with LR=6.

Symptom	Certainty with LR=6 (%)	Certainty with LR=4 (%)
1	6	4
2	26	14
3	68	39
4		72

### **Daily symptoms**

We already know that each homeopathic medicine has its own 'keynotes', symptoms that are not rare, but still indicative for that medicine. But is 'Fear of death' more indicative for *Aconitum* or for *Arsenicum album* or for *Latrodectus mactans*? Only prospective LR-assessment of a large number of cases can reveal this kind of information. Systematic assessment can reveal information that was not noticed beforehand, especially about frequently occurring symptoms. Better distinction between medicines using LR makes middle-sized and large rubrics more useful. These rubrics match symptoms that are frequently presented in everyday practice and many patients do not have very peculiar symptoms.

### **Is LR-research difficult?**

The next things we need are some groups of enthusiastic colleagues willing to assess a number of symptoms. For many practitioners science and research are frightening words. But homeopathic symptoms must be assessed in practice, not by scientists. And it is really not difficult, provided that we use proper software. If there is a computer on your desk, you can save a lot of time using a program for billing and other administrative jobs, like WINCHIP or HARP. The HARP-program is already adapted for LR-research. With this software research is only a matter of seconds in each consultation. During each first consultation you check the small number (six or less) of symptoms under investigation and it takes one mouse-click for each symptom that is present in that patient. Then you have to fill in the prescribed medicine. In follow-up consultations you have to fill in the result of the medicine. A research-group of 10 doctors needs 3 to 5 years to gather enough data.

Preparation is the magic word here. The research-group needs proper software and one co-ordinator with some knowledge about computers and statistics. The group must be willing to meet on a regular basis to reach consensus about scoring of symptoms and results.

We can supply the research-protocol and the co-ordination between different research-groups. Contact Lex Rutten. E-mail: [lexrtn@concepts.nl](mailto:lexrtn@concepts.nl).

More information is available at the website: [www.dokterrutten.nl/Inc.html](http://www.dokterrutten.nl/Inc.html)

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