Applications à la statistique médicale[*]

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CALCULATION OF PROBABILITIES: Mr. Jules Bienaymé exposes the following observations on the application of the calculus of probabilities to medical statistics.

"The difficulties of this application hold not only to the obstacles which are encountered when one wishes to collect exact experiences on the majority of maladies. They depend moreover on that which one knew not How to separate entirely the effects of a determined treatment from those which are able and must produce nature abandoned to itself, or the simple treatments on which each dispute is raised. The ratio of the number of cures to the number of observed maladies is found therefore to be a complex expression of many probabilities; and the difference between the ratios of this kind result from two different treatments, does not express precisely how much the salutary action of one of these treatments has surpassed the action of the others. This excess of an action on that which is compared to it is found divided by a number perhaps very considerable, and capable consequently of hiding nearly entirely the sought result. One is assured, by an easy calculation, that this divisor is no other than the quotient of unity by the fraction which expresses the possibility of not curing under the ordinary conditions, and setting aside the treatments on which is raised some doubts.

"These consideratons lead to many formulas of which arise among others the following conclusions:

"1° In order to obtain some rather precise mean results in medical statistics, it will be necessary often to collect many more observations than the theorems of Bernoulli, or rather of Bayes, seems to indicate, of which Laplace, Fourier and Mr. Poisson are themselves served, when the statistics data were simpler. Indeed, the formulas which these theorems give require some modifications, either in their elements, or in their interpretation, before being applied to the questions of medical statistics for which they have not been constructed.

"2° The real effect of a contested treatment, that is the proportion of individuals saved out of the individuals who would not at all be cured without this treatment, will be always very difficult to determine since the cures due to the contested treatment

are confounded naturally with some other cures, of which the statistic will arrive to separate them only with many precautions and with constant sorrows of a high sagacity.

"3° It will be likewise with it for the real difference between the salutary effects of two treatments, awaited that the difference given by observation will be extended from the real difference in an unknown ratio most often.

"4° But happily the exact knowledge of this difference is not necessary in order to pronounce between two treatments employed under some identical circumstances, because the probability that one of the effects surpasses the other, without specifying by what quantity, becomes independent of the unknown divisor of which there has been question. Only then, in order that the comparison had some value, it will be necessary to be assured that the number of observations is rather great; for the probability obtained will be able to be very small, either because one of the treatments is in reality only not very preferable to the other, or because both will be exercised on a too small number of maladies in danger of not curing, in order that the difference is able to acquire some certitude. This indecision will be presented in all necessity in many of the cases where good sense does not suffice alone to pronounce. One will arrive to the decision only by an approximate account being rendered of the proportion of the number of the maladies which would have been able to cure without the treatments set in comparison.

"5° The annoying indecision of which it was just spoken has place yet when one obtains a great probability that one treatment is preferable to another. This great probability is able to result from this that the number of experiences, being rather elevated, decides with very considerable precision of the not very marked superiority of one treatment over another. It is able to result also from this that the superiority is on the contrary very pronounced, although the experiences are not very numerous. One will be able to raise doubt only by the same approximative process of the evaluation of the number of maladies which would have been able to cure or not cure without the treatments. It is necessary to swear that this will be there a source of delicate discussions, until one possesses very multiplied statistical data.

"Finally, the construction of new formulas prove that medical statistics is not very advanced; for of the information as much as it is not very exact had made already to sense the defects of the application that one has believed to be able to make of the formula of Bayes. It is, indeed, the statistical statements which give birth by the same facts that they develop the proper formulas to determine from them the laws and the probabilities.

"Everyone knows that it is thus in all the sciences of observation, and that the formulas are not created and are not rectified but after experiences. Each science wishes first a good statistic. It is important therefore that the medical statistic gather great series of facts, before one is founded to apply some sufficiently suitable formulas to the particular nature which characterizes it. The calculation of the probabilities is applied to all things; but it is able only to accompany the research of the facts. It is this that demonstrates without retort the numerous illusions by which are permitted to seduce even great minds who have not studied enough the practical data in the researches of probabilities."