

Summary

SUR LES PROBABILITÉS*

Marquis de Condorcet

Mémoires Acad. Sciences Paris, 1778, pp. 43–46

All the questions of the Calculus of Probabilities are able to be reduced to a single hypothesis, to that of a certain quantity of balls of different colors mixed together, of which one supposes that one draws at random different balls in a certain order or in certain proportions. If one supposes known the number of balls of each kind, one has the ordinary calculus of probabilities such as the Geometers of the last century have considered it: but if one supposes the number of balls of each kind unknown, & that by the number of balls of each kind that one has drawn, one wishes to judge either of the proportion of the number of these balls, or of the probability of drawing them in the sequence according to certain laws, one has a new class of problems. These questions of which it appears that Messers. Bernoulli & Moivre have had the idea, have been examined since by Messers. Bayes & Price; but they have limited themselves to expose the principles which are able to serve to resolve them. Mr. de la Place has considered them with more extent, & he has applied the analysis. One is able to suppose the number of balls finite or infinite; if it is finite, the questions depend on the integral calculus in the finite differences; if it is infinite, one has need only of the integral calculus properly said. The case of the infinite number is the one which holds when one applies the questions to natural events: in fact, it is easy to see that then they embrace the immensity of time, & that the number of combinations is infinite.

We suppose that one has drawn a certain number of black balls & a certain number of white balls, one is able to demand how much there is to wager that in a number of given trials, one will draw more white balls than black balls, or in general what will be the probability of the different events that one is able to imagine must arrive? If one applies next that which the theory teaches on these abstract questions to some natural events, as to the proportion between the number of births of boys & of girls: one will depart first from a fact; for example, that is is proven, by a long sequence of observations, that there is born at Paris a greater number of boys than of girls & in a certain proportion. One is able to demand then what is the probability that, in the future, the number of boys will surpass the one of the girls, & this probability is the same as that of the existence of a determined cause to which it is necessary to attribute this phenomenon, of which consequently is it reasonable to research the physical causes? One is able to demand next with what advantage one is able to wager, in a number of

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given births which express the one of the births in a year, for example, the common law will be observed, how many years will be necessary in order to wager an equal game, that it will happen one time that the same law is not observed? Finally if one has for two different places, a different number of experiences & a different ratio between the number of births of boys & of girls, one is able to demand what is the probability that the law will be observed in one of these places rather than in the other? Thus Mr. de la Place finds that there is a probability very great & nearly equivalent to moral certitude, that the excess of the number of births of the boys has a physical cause for Paris; that there is odds 259 against 1 that in the next year the number of girls will not exceed the one of the boys; that one is able to wager in an equal game that this event will arrive from here in one hundred seventy-nine years; that the certitude that this effect has a regular physical cause, is incomparably great for London than for Paris.

Instead of supposing that all the proportions among the number of balls of different colors are possible, one is able to suppose that these proportions are contained between certain limits; for example, if one makes enter into some Problems on the games of commerce,¹ the unknown ability of the players, one must suppose that this superiority of ability has some limits; it is likewise if one wishes to seek the errors which have been able to arrive in a series of astronomical observations. One is also able to suppose that all the possible proportions among the number of balls of different colors are it or equally, either with more or less probability, according to a known law, or to seek likewise the law according to which they are more or less possible; there results thence so many classes of Problems, of which the solutions are applicable & to the errors of astronomical observations & to the inequality of ability among the players. Such are the different questions that Mr. de la Place has proposed himself: since all depend on integrations for the determined values, & it suffices, in a great number of cases, to have some approximate integrations. The Author himself has delivered on these two objects, to some very extended analytic researches; he gives a method of approximation for the integrations in the differences, either finite, or infinitely small, very convenient for the question that he has proposed & which are able to be applied with advantage to some Problems of another kind; he determines equally for some particular values, the rigorous integrals of functions not integrable in general, by a very ingenious particular method. The applications of this part of the calculus of probabilities, are much more extended & more useful than those of the ordinary calculus; in fact, all our physical & moral knowledge is reduced to some probabilities of this kind; it is because an event is arrived constantly, that we judge that it must arrive again; it is because two phenomena are always coexisted, that we judge that one is the cause of the other, it is because a prodigious sequence of observations have taught us that the laws of Nature are constants, that some repeated experiences suffice in order to make us believe the truth of a fact: so that there exists for us only an absolute certitude, which holds only for the abstract Sciences, or in the other Sciences for the legitimacy of the consequences that one draws from a principal supposed given, & this probability, more or less great, but always of the same kind, a single kind of certitude what one is able to seek in the natural Sciences, as in the conduct of life.

¹*Translator's note:* Games were classified according to three types—games of skill (e.g., tennis), games of commerce (e.g., card games) and games of chance (e.g., craps).