Chapter 9
A Statistical–Probabilistic Path

ABSTRACT

This chapter is borderline compared to the previous ones, since the topics are not really mathematical. In fact, the objectives and learning content of statistics and probability are different from those of mathematics. It also follows a methodological diversity of teaching. All this will be clarified below. However, the main focus of the goal, that is the possible contribution that the computer with the correct programming can give to the learning of the discipline, is no less evident and will be clearly delineated. In particular, graphical representations of statistical data will be widely examined. A TLS will also be schematized on the introduction of the concept of probability, in which the use of the computer with the MatCos 3.X environment will be very useful.

The time may not be very remote when it will be understood that for a complete initiation as an efficient citizen of one of the new great complex world-wide states that are now developing, it is as necessary to be able to compute, to think in averages and maxima and minima, as it is now to be able to read and write. ~H. G. Wells (1903, p. 204)

1. INTRODUCTION

This chapter is slightly different compared to the rest of the book, as is highlighted in the title. In fact, our main intention is to show how it is concretely possible to support the teaching / learning of Mathematics in primary and secondary schools, with the computer and a programming environment which is appropriate to the context. The subject of Statistics is different from that of Mathematics in terms of objectives and methods. Statistics is a quantitative science, but the “statistical” way of thinking is different from the “mathematical” way, for at least two reasons:

- statistics cannot be separated from the context (contextualized data or numbers);

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- the logic of statistical inference is not based on deduction, as in mathematics, but on induction: from the particular (what has been observed) to the general. This concept of induction is also very different from mathematical induction.

For Statistics, Mathematics has an instrumental role, which is that it provides the tools that allow for statistical analysis. These differences have implications for teaching methods:

- to teach Statistics well it is not enough to know Mathematics and statistical theory;
- it is essential to have real examples and know how to use them to involve students and lead them to develop critical judgment skills, to make decisions and forecasts in conditions of uncertainty;
- today we could add: it is also necessary to have adequate calculation tools for data processing and printing.

For the subject of Probability similar considerations hold; the focus of decisions in situations of uncertainty makes probabilistic reasoning something different from mathematical reasoning. Indeed, the probabilistic reasoning is different from logical reasoning because in a logical reasoning a proposition is always true or false and we have no complete certitude about a proposition concerning a random event. In arithmetic or geometry, an elementary operation can be reversed and this reversibility can be represented with concrete materials. This is very important for young children, who still are very linked to concrete situations in their mathematical thinking. For example, when joining a group of two apples with another group of three apples, a child always obtains the same result (five apples); if separating the second set from the total he/she always returns to the original set; no matter how many times this operation is repeated. These experiences are very important to help children progressively abstract the mathematical structure behind them. In the case of random experiment, we obtain different results each time the experiment is carried out and the experiment cannot be reversed (we cannot get the first result again when repeating the experiment). Even though simulation or experimentation with random generators, such as dice and coins have a very important function in stabilizing children's intuition and in materializing probabilistic problems, these experiences do not provide the key to how and why the problems are solved. It is only with the help of combinatorial schemes or tools like tree diagrams that children start to understand the solution of probabilistic problems. This indicates the complementary nature of classical and frequentist approaches to probability. However, on the methodological level there are similarities, for example both Statistics and Probability, like Mathematics, can make extensive use of problem-solving techniques. Similarly, the computer with programming is functional to all three disciplines. The teaching of Statistics and Probability does not explicitly appear as an autonomous discipline in the curriculum of primary and secondary school students, at least in many countries. For example, in Italy the introduction of Statistics and Probability is planned within a chapter of the teaching of Mathematics, titled "Data and Forecasts". This led us to elaborate a few genetic commands in the MatCos 3.X environment concerning Statistics and Probability, referring, where necessary, to a number of packages of specific software: (Biehler & Rach, Software tools for statistical data analysis in education and teacher training, 1990), (Boker, 1990). Consequently, in the following, we will limit ourselves to considering some examples that illustrate the genetic commands that MatCos 3.X has, not before having mentioned the relationship between computers and Statistics and Probability.