A PLEA FOR A RELATIVELY STRONG ROLE FOR PROBABILITY WITHIN STOCHASTICS CURRICULA

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More recent developments have decreased the role of probability within stochastics curricula. Emerging from Tukey's (1977) milestone book on Exploratory Data Analysis (EDA), the international trend in stochastics education had an accentuated focus on data handling, starting with the ASA-NCTM project on Quantitative Literacy, with its more recent culmination in the data handling thread throughout the curriculum worldwide. Data handling is more flexible than the traditional descriptive statistics (not only with respect to the methods used, which are highly interactive now but also with respect to the required assumptions, which no longer cover random samples as an indispensable prerequisite for conclusions from the data). To lay the accent on data handling answers a lot of demands on modern curricula; to name only two:

- It comes closer to a kind of mathematics for all. According to societal and economic thinking we need to qualify more students for the school leaving examination and university studies, as this is seen as a source for creating an innovative potential for the future.
- It fulfils the demand for applications. According to many modern didactic strands – not only the Freudenthal (1983) school of thought – applications are inherent to the concepts and teaching without the aspect of applying cannot give full insight into the notions. For the same reason, traditional applications like the games of fortune have been discredited as being not relevant – neither for applications nor for the concepts.

THE ROLE OF PROBABILITY IN TOPICAL TEACHING

An investigation among researchers within the didactics of stochastics (Nemetz, 1997) has confirmed that probability is rapidly vanishing out of the curricula internationally. The reasons given for this development were: (i) Probability is orientated too much towards mathematics; (ii) Probability is too tightly connected to games of fortune; and (iii) Probability is only required to justify the methods of inferential statistics.

Reason (i) may partially be met by new techniques like simulation and interactive animations. Reason (ii) shows a public puritanism neglecting the huge business behind games of fortune including state lotteries. Morally, games of fortunes have to be banned and therefore we should keep our young students apart from such games instead of helping them to clear up the situation by teaching the mathematics behind the games to them. And, by the way, probability concepts originate from games and early insurance enterprises (which are nothing but an abstract version of games of fortune): it may well be that a sound understanding has to refer to these roots in order to understand the peculiarity of the concepts. Reason (iii) reveals a basic misconception of probability, or at least a basic ignorance about its relevant character as a tool to investigate and/or structure reality. Remaining risk of accidents of atomic power plants, or reliability of a technical device, which is used for a space mission, are only two examples of such applications.

IMPORTANCE OF PROBABILITY TEACHING

Examples (to be elaborated – only one or two may be referred to in the panel) show that a deeper understanding of the "new" methods cannot be reached at the cost of probability:

- Only in rare cases do results from data handling speak for themselves and allow such a clear message that no reference to probability is required.
- Teaching more probability to students allows for better understanding the assumption of random samples for generalizing findings from samples to a larger population.
- Only a sound notion of conditional probability enables learners to grasp any method of inferential statistics.

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- Extended elaborations on probability concepts are necessary to reveal the peculiarity of stochastic thinking in contrast to logical, causal, or mystic thinking.
- A sound understanding of probability will help to clarify the abundance of intuitive, personal thought on probability and related misconceptions.
- Only a lot of experience in probability helps learners discuss and clarify the mutual dependencies between objectivist and subjectivist mathematical concepts and related intuitive thought.
- Reference to a firm foundation of probability within the curriculum allows for explanation of basic notions like expected value, variability (of a random variable), or risk, which otherwise might be reduced to void phrases.
- Betting and games of fortune have played a substantial role in the emergence of probability – related concepts need the connection to their roots for a deeper understanding even if they have been applied to other contexts quite early. Here, this context may serve to establish simple mental images in the learners' cognitive system, which could serve both as prototypes for modelling other problems and to order one's intuitive thought.
- A restricted primitive interpretation of probability as relative frequency (primitive and restricted if exaggerated, which seems quite fashionable nowadays) hinders sound and transparent applications of probability in contexts of reliability, or risk, and it impedes also a sound interpretation of methods of inferential statistics.
- Probability is only *one* kind of approach to a problem, which might also be solved by differential equations, e.g., this corroborates that probability models have more the character of *scenarios* than that of other models. The notion of model encompasses its feature to fit well to the real situation and to make the discrepancy between model and real situation as small as possible. However, even if a specific scenario does not aim at depicting the situation meticulously, it may make decisions transparent. It allows investigation of the situation under the auspices "what would be the consequence if ..". Again an argument against a primitive frequency interpretation of probability.

CONCLUSION

Some arguments for a strong role of probability within stochastic curricula are: (i) Probability is indispensable for understanding the methods of inferential statistics: (ii) Probability offers a type of tools for modelling and or "creating" reality; (iii) Probability offers a type of thinking, with which one can reflect on reality. From these arguments one may see that to abandon probability within the curricula means reducing the repertoire of intellectual possibilities. From here, the author argues for a substantial role for probability in teaching the next generation. New didactic methods may be used to reduce mathematical sophistication. Simulation and or interactive animations are but two promising tools.

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