(e)Learning the Basics of Probability

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1. Introduction

Knowledge of probability is of great importance in modeling random events as well as in statistical education. Furthermore, the understanding of randomness is fundamental in applying statistical procedures. In data analysis the user should be aware of the fact that the data is generated by a random process or it is possibly subject to measurement errors. Moreover, statistical reasoning is based on stochastic models, and therefore statistical decisions can only be interpreted having the underlying model in mind.

Due to these reasons, probability has become a fundamental part of education in many courses in undergraduate studies as well as secondary schools. There are a lot of textbooks (e.g., Feller 1968) available on this subject that provide excellent introductions to probability on different levels of abstraction. However, the presentation is restricted to the capacity of a textbook. In particular, random experiments and simulations can be described by words or graphics only. In order to support learners in understanding the nature of random processes, the demonstration of random experiments has to be a part of probability courses. But, due to the reasons mentioned, such illustrations for the most part have to be carried out by the teacher during the classroom lessons. Although simple experiments as tossing a coin can be repeated by students on their own, the realization of such methods is in general far more difficult even impossible when using traditional teaching material, particularly in case of complex random experiments and simulations. These difficulties can be overcome by the use of computers in order to illustrate random effects by simulation tools. Such tools are available in many forms of appearance, e.g., as computer programs on CD-ROM, as a part of powerful simulation packages, and as web-based applications (JAVA-applets, Flash animations, etc.). But, for the most part, content and tools are separate products and the user has to consider at least two different media, which generally are not connected to each other. An integration of both the textbook and simulation tools improves the quality of education significantly. Learning and teaching environments like EMILeA-stat realize such requirements.

2. Learning probability with EMILeA-stat

EMILeA-stat is a multimedia, web-based, and interactive learning and teaching environment in applied statistics funded by the German Federal Ministry of Education and Research (bmb+f). Among others it contains the following fields and subjects of quantitative methodology: descriptive and inductive statistics, exploratory data analysis, elementary mathematics needed in statistics, probability, and various applications of statistics and probability in, e.g., finance, insurance mathematics, quality control, and ecology. For more details regarding architecture, didactic aspects, and contents, we refer to Cramer et al. (2002, 2003).

Since probability is fundamental for many of the aforementioned applications, EMILeA-stat provides these contents as well. It combines both the textbook and the simulation tools in one system. The theoretical content is illustrated by interactive visualizations throughout, such as JAVA-applets and Flash animations. Since interactivity is a crucial feature of EMILeA-stat (cf. Cramer et al. 2002), it is possible to control the applets by adjusting parameters in order to study various effects in greater detail. Owing to the close connection of contents and visualizations, users have the opportunity to fill the abstract topics with more life. Consequently, this increases the acceptance of the theoretical background necessary for the understanding of many statistical procedures and, in addition, leads to a more appealing kind of presentation. The learning process is significantly supported by the fact that users can rerun the applets at any time and from any place provided they have access to the Internet. Moreover, EMILeA-stat serves as an ebook where users can easily obtain all the information they require for understanding and solving their problems. The content is supplemented by many exercises and examples so that skills can be trained easily.

As mentioned above, users can retrieve the information by surfing through the content modules of EMILeA-stat and using the interactive features to consolidate their knowledge. As a supplement and an alternative, EMILeA-stat offers an introductory course that guides users throughout the basics of probability.

REFERENCES

Cramer, E., Cramer, K., Kamps, U. (2002) e-stat: A web-based learning environment in applied statistics. In: W. Härdle, B. Rönz (Eds.) COMPSTAT 2002 – Proceedings in Computational Statistics, Physica, Heidelberg 309-314.

Cramer, E., Härdle, W., Kamps, U., Witzel, R. (2003) e-stat: Views, Methods, Applications. This Volume.

Feller, W. (1968) An Introduction to Probability Theory and Its Applications Vol. I. Wiley, New York, 3 edn.