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Borovcnik, Manfred; Kapadia, Ramesh

Modelling in probability and statistics. Key ideas and innovative examples.

Maasz, Jürgen (ed.) et al., Real-world problems for secondary school mathematics students. Case studies. Rotterdam: Sense Publishers (ISBN 978-94-6091-541-3/pbk; 978-94-6091-542-0/hbk; 978-94-6091-543-7/ebook). 1-43 (2011).

From the text: This chapter explains why modelling in probability is a worthwhile goal to follow in teaching statistics. We start with innovative examples of probabilistic modelling to whet the appetite of the reader. We then explain the usual approach towards probability – and the sparse role that modelling plays therein by typical examples, ending with a famous and rather controversial example (Nowitzki task) which led to some heated exchanges between professionals. In the third and fourth sections, basic properties of Bernoulli experiments are discussed in order to model and solve the Nowitzki task from the context of sports. The approach uses fundamental properties of the models, which are not always highlighted as they should be in teaching probability. In the fifth section, the fundamental underlying ideas for a number of probability distributions are developed; this stresses the crucial assumptions for any situation, in which the distribution might be applied. A key property is discussed for some important distributions: waiting times, for example, may or may not be dependent on time already spent waiting. In the sixth section, the statistical question – (is Nowitzki weaker in away than in home matches?) – is dealt with thoroughly. This gives rise to various ways to tackle this question within an inferential framework. We deal informally with the methods that comprise much of what students should know about the statistical comparison of two groups, which forms the core of any introductory course at university for all fields, in which data is used to enrich research. The final two sections resume the discussion of teaching probability and statistics, some inherent difficulties, and the significance of modelling. Conclusions are drawn and pedagogical suggestions are made.

Classification: K64 K65 K74 K75
Keywords: stochastics; teaching; probability theory; statistics; probabilistic modelling; binomial model; medicine; pooling; engineering; normal distribution; lifetime of bulbs; exponential distribution; Poisson distribution; telephone call costs; spam mail; conditional probability; stochastic independence; sport; mathematical applications; Bernoulli processes; statistical inference; estimation theory; hypothesis testing; assumptions; distributions; binomial distribution; hypergeometric distribution; geometric distribution; Weibull distribution; homogenization idea; empirical research; stochastic thinking