Stochastic modeling and statistical thinking in technology supported environments

Joachim Engel
University of Education, Reuteallee 46, 71634 Ludwigsburg, Germany
engel_joachim@ph-ludwigsburg.de

To explore the role of technology in students modeling attempts we examined the efficacy of a Five-Steps-Program in a third-year statistics class for students preparing to be teachers:

1. Introduction of a "real-world" problem involving some aspects of data analysis; Activity or experiment to experience the dynamics of the phenomenon of interest;
2. Constructing a simulation model representing an aspect of the problem. Representing the simulation model in a technological environment (Lisp-Stat, Fathom);
3. Collecting and analyzing simulated data; Derivation of a simulation-based result;
4. Critically evaluating the simulation-based result and its conclusion; Validating the model by reflecting on the impact of the assumptions in the modeling step (sensitivity analysis, what-if scenarios) considering the role of stated assumptions, limitations of the model and possibly refining the model; how much do the conclusion depend on the assumptions? How do results change after slight deviations from these assumptions?
5. Mathematical analysis, arguments and proof involving concepts of probability and mathematical statistics.

The topics included capture-recapture models, patterns in coin flipping sequences, tests based on runs, rencontre problem, coupon collector, randomized response techniques, regression and curve fitting. Each student prepared a topic and led a class session following above five-step plan. In the preceding semester all participants attended an introductory stochastics class.

Goal of the study

To investigate the impact of two different environments (Fathom and List-Stat) to enable students to develop mathematical modeling and statistical thinking competencies.

Methods of Evaluation

Student learning diary, student interviews before and after their presentation

Results

Activities and simulations were unanimously considered a great motivation booster to investigate the assigned topic and to grasp the dynamics of the problem. Students with a stronger interest in computer modeling preferred Lisp-Stat because of its "natural language", students focusing on analysing the simulation data found it more helpful and easier to work with Fathom. Both groups considered the previous activity and simulations an important help to work through the mathematical analysis of the involved concepts.

For more documentation, see: www.ph-ludwigsburg.de/mathematik/personal/engel/statmodel

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