

# Virtual Experiments and Their Use in Teaching Experimental Design

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## Summary

The ability to design experiments in an appropriate and efficient way is an important skill, but students typically have little opportunity to get that experience. Most textbooks introduce standard general-purpose designs, and then proceed with the analysis of data already collected. In this paper we explore a tool for gaining design experience: computer-based virtual experiments. These are software environments which mimic a real situation of interest and invite the user to collect data to answer a research question. Two prototype environments are described. The first one is suitable for a course that deals with screening or response surface designs, the second one allows experimenting with block and row-column designs. They are parts of a collection we developed called ENV2EXP, and can be freely used over the web. We also describe our experience in using them in several courses over the last few years.

*Key words:* Design of experiments; teaching; data collection; applets; web-based teaching tools.

## 1 Introduction

At the core of all graduate statistics programs should be a solid course in experimental design. Many larger universities also teach applied experimental designs to graduate students from other disciplines. While the ability to appropriately and efficiently design and analyse experiments is critical to modern science, few students actually experience designing an experiment before leaving the university. The popular textbooks for experimental design courses introduce the basic concepts of design and then proceed through a series of standard general-purpose designs with more emphasis placed on the analysis of data already collected than on the actual process of design. Some recent textbooks (e.g. MacGillivray & Hayes, 1998; Cobb, 2002; Dean & Voss, 1998; see also ExperimentsAtSchool, 2007) stress on the importance of including projects in which the students actually have to prepare, perform and analyse a real experiment. Such projects provide an invaluable experience, but are very time- and resource consuming, for the student as well as for the teacher. We have examined alternative ways of giving students this design experience through the use of computer-based virtual experiments.