

Rönz, Bernd

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MM*Stat - a multimedia tool for teaching of statistics

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MM*Stat - a multimedia tool for teaching of statistics¹

Bernd Roenz

Institute for Statistics and Econometrics, School of Business and Economics, Humboldt-University Berlin, Spandauer Straße 1, 10178 Berlin, Germany, email: roenz@wiwi.hu-berlin.de

Summary

MM*STAT is a HTML-based and flexibly applicable computer tool for supporting teaching and learning statistics in introductory courses via the internet or from a CD. It can be used in class rooms or for reviewing the lecture subjects by the students on their own. The main elements of MM*STAT are:

- lecture pages,
- more information,
- three kinds of examples,
- multiple choice questions at the end of paragraphs,
- a glossary.

A special feature of MM*STAT is its interaction capability. This allows the user to study statistical methods under varying application conditions or by using different data sets without any additional software overhead. The interaction is enabled by a Java client of the computing environment XploRe.

Keywords: multimedia teaching statistics, interactive computational statistics

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1 Introduction

In this information age, ever-increasing special knowledge of statistics is demanded, since data of increasing complexity and size need to be understood and analyzed. In practice no statistical analysis is carried out without a computer and an elaborated statistical software package. Thus, teaching statistics for students must comprise a broad spectrum of applications of statistical methods combined with the acquisition of computational capabilities. To address this demand and to ensure an effective education in statistics, the current teaching methodology has to be revised. The traditional methods of teaching statistics (blackboard work, overhead transparencies and textbooks) must be extended by new teaching and learning tools, which use computer-aided components, new multimedia technologies and the internet.

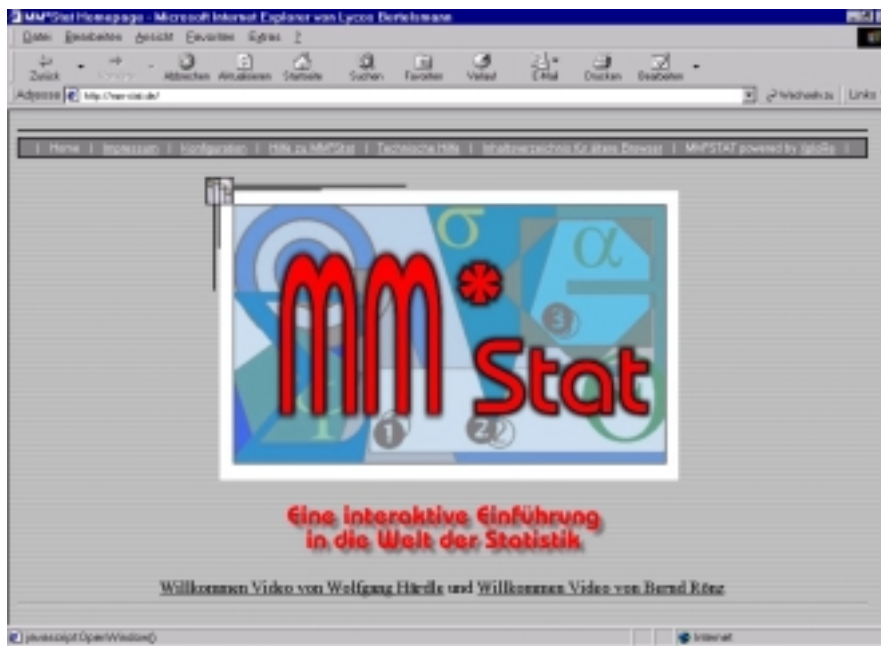


Fig 1. Logo of MM*STAT

The multimedia tool MM*STAT is a HTML-based and flexibly applicable computer tool for supporting teaching and learning statistics in introductory courses via the internet or from a CD. It can be used in class rooms or for reviewing the lecture subjects by the students on their own.

At present the full version of MM*STAT is only available in German, but translations into English, French, Italian and Czech (<http://www.md-stat.com>) are already in progress, but not yet finished.

The general design of MM*STAT reproduces the natural succession of statistics lectures (Derby, N., Härdle, W., Rönz, B., 1999): lecture units with the explanation of statistical methods and models, additional background information and examples, revision of statistical methods already introduced in previous lectures.

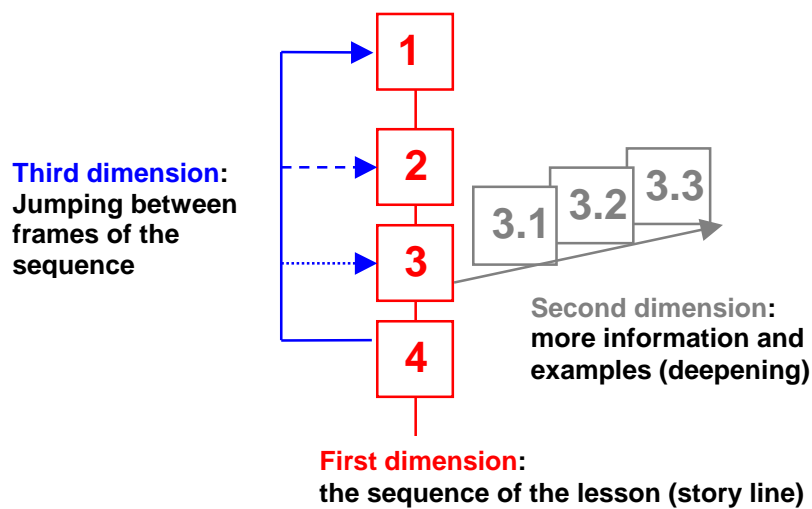


Fig 2. Three dimensions of teaching statistics

The user interface of MM*STAT is a composition of filing cards, which contain the various components of MM*STAT. Up to 10 cards can be opened at the same time. This allows fast access to each card and enables the user to switch at any time between different components by clicking on the filing tabs while leaving the other cards open to be viewed again.

2 Main components of MM*STAT

The main components of MM*STAT are

- lecture units,
- additional information,
- examples
- multiple choice questions

- glossary.

Each of these components is characterized by an other background colour.

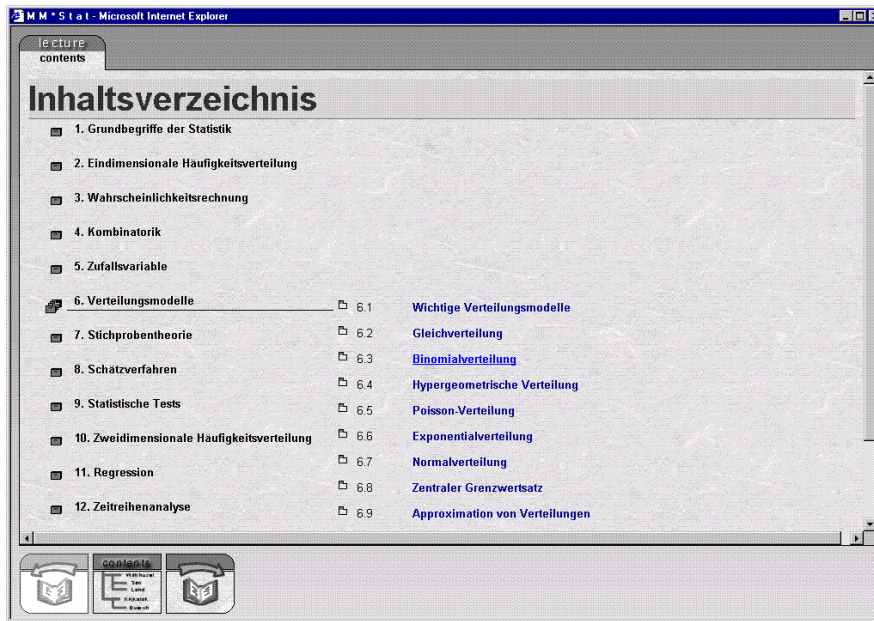


Fig 3. Lecture contents

The first filing card, which appears after the start from the logo of MM*STAT (Fig 1.), contains the table of lecture contents (Fig 3.). MM*STAT comprises the common and well-known topics for an introductory statistics course.

Pointing with the cursor at a selected topic opens the corresponding filing cabinet and displays which lecture units are available. From here the user can move along the lessons' sequence.

Clicking either on the "contents" icon at the bottom of the screen or on the filing tab "lecture contents" at the top of the screen will display this "lecture contents" card, no matter from which part of MM*STAT it will be done.

Each **lecture unit** provides a brief outline of the topic which include the basic concept, definitions and formulas of the statistical method considered and fundamental requirements of its application. Two icons on the lower left of the screen, the "Forward" icon and the "Backward" icon, enable the user to open the filing card of the next and the previous lecture unit respectively.

Icons on the lower right of the lecture unit screen indicate which options are available for the lecture unit just considered (see Fig 4 and 5). The options are:

- more information and
- three types of examples.



Fig 4. Icons of available options for a lecture unit

Of course not every lecture unit is connected with each of these options. But these options allow to deepen the acquisition of statistical knowledge to the users like. Upon clicking on one of these icons, a new filing card is additionally opened to the cards already open.

More **“Information”** presents additional explanations concerning the content of the lecture unit, which is not necessary for the elementary use, but for a broader and deeper understanding of the statistical methods (e.g. the derivation of the method, the model or of a special formula, comments on the main applications and so on).

Major attention in designing MM*STAT was paid to **examples** because they are essential for understanding the statistical methods. In principle three types of examples are implemented in MM*STAT:

- fully explained examples,
- enhanced examples and
- interactive examples,

but not every type of example is available for each lecture unit. The icons on the lower right of the screen (see Fig 4) indicate the examples connected with the selected lecture unit.

The examples can be additionally opened to the lecture unit card and the information card. Now the advantage of the filing card system becomes apparent: The user can switch between lecture unit, information and examples only by clicking on the filing tabs (see Fig 5).

Fully explained examples are directly related to the content of the lecture unit and, as the term implies, they provide a complete explanation of the statistical problem to be solved.

The screenshot shows the MM*STAT software interface. At the top, there is a navigation bar with tabs for 'lecture', 'examples', 'enhanced', and 'interactive'. Below this, the main content area is titled 'Binomialverteilung'. The text explains that the binomial distribution is based on a random experiment with two outcomes, A and A-bar, with probabilities p and 1-p respectively. It defines the discrete random variable X as the number of successes in n trials. The probability mass function is given as $f_p(x; n, p) = \binom{n}{x} p^x (1-p)^{n-x}$ for $x = 0, 1, \dots, n$, and 0 otherwise. The cumulative distribution function is given as $F_p(x; n, p) = \sum_{k=0}^x \binom{n}{k} p^k (1-p)^{n-k}$ for $x > 0$, and 0 for $x < 0$. The interface also includes a toolbar at the bottom with icons for navigation and search.

Fig 5. The filing card system of MM*STAT

Enhanced examples are fully explained as well, but go into more depth than the first level of examples. That means, (1) they may include the application of the same statistical method on different variables or data sets; (2) they may refer not only to the lecture unit just considered, but also to previous ones, enabling the application and comparison of various statistical methods.

The most important characteristic of MM*STAT is its interactive capability embodied in the interactive examples. The interactive examples (see Fig. 6) allow the user to perform repeatedly the examples (1) with several variables or data sets, (2) with changed sample size or parameters of the statistical method applied, or (3) as repeated estimations, and view the results. The opportunities for such interactive examples are numerous, and, if possible, they are based on real data sets. With this type of examples the user can actively try out different ideas and see what happens.

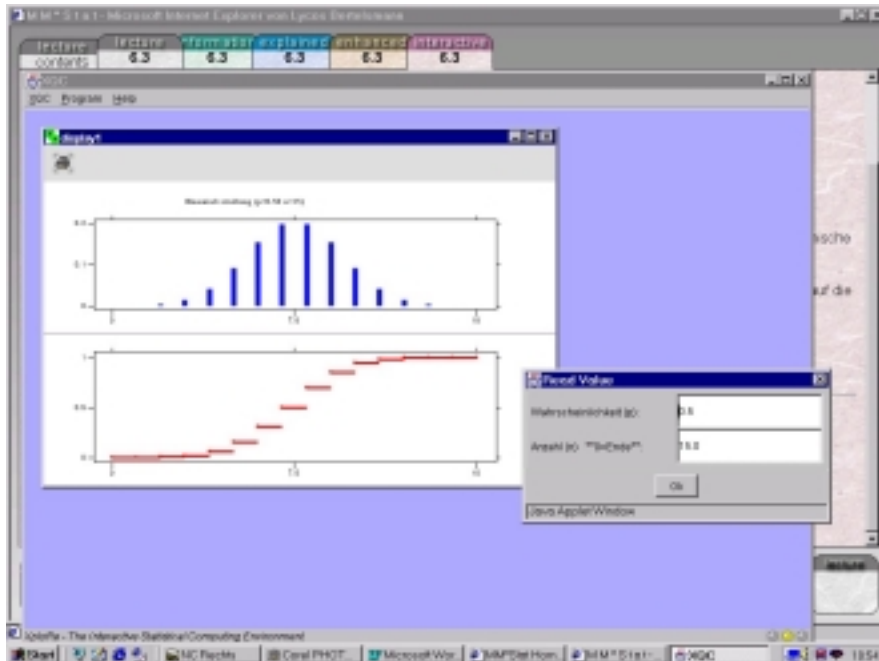


Fig 6. Interactive example

The implementation of the interactive examples into MM*STAT is based on the XploRe Quantlet technology. For a detailed explanation of this technology see Härdle, Kleinow, Tschernig (2000) and Kleinow, Thomas (1999).

Multiple choice questions are provided at the end of each topic. These questions give the user the opportunity for a first check of his/her knowledge. A feedback showing the correctness of the response to the questions can be displayed on request.

Moreover MM*STAT offers a **glossary**. When viewing a lecture card important terms and definitions, already introduced in previous lectures, are hyperlinked to the glossary. Within the glossary the term is again hyperlinked to the lecture unit in which the term is explained in detail (by a small filing card symbol). Sometimes it is by all means necessary to reinforce completely statistical concepts and methods. In this case, a direct hyperlink to the corresponding lecture can be found in the lecture unit. Both, the glossary and the direct hyperlinks, enable the user to review to a previous statistical idea without starting from the very beginning.

3 Technical requirements of MM*Stat

MM*STAT is based on HTML 4.0 combined with JavaScript and Cascading Style-Sheets (CSS). The technical minimum requirements for an optimal use of MM*STAT are:

- Microsoft Internet Explorer 5.0 (or higher) or Netscape Navigator 4.5 (or higher),
- Javascript 1.1/1.2 or JScript,
- JavaPlugin 1.3 from Sun Microsystems,
- CD-ROM drive (for the CD-version of MM*STAT),
- Internet connection (for the MM*STAT online version),
- Screen resolution of at least 1024x768 pixel,
sound card and audio/video plugin for the used webbrowser.

References

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