# HYPERMEDIA AND WWW FOR THE TEACHING OF STATISTICS

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*We consider the potential for using hypermedia and WWW in the teaching of statistics. The considerations made herein emerge from the direct experience of using these tools in a basic statistics course at our university.*

## INTRODUCTION

The application of new technologies to the teaching of statistics is still in an experimental phase and at the moment we have limited significant experience. On the other hand, numerous teachers are trying to introduce new technologies to the teaching of basic statistics. The considerations made in this paper emerge from direct experience at the Faculty of Economics of the University of Urbino.

Our efforts in this area derive from the attempt to introduce statistical software to the teaching of introductory statistics. The shortcomings of this attempt soon emerged:

- students need to quickly learn how to use statistical software, but not all students succeeded in doing so;
- the analysis structure and outputs of the software were often too complex compared with the real needs of the course;
- students with their own PC could not practice at home because of copyright issues;
- a number of PC features which should have had an educational impact were not exploited: graphics and picture displays, learning tests, interactive drills, educational software, motion video....

During the summer of 1994 we began to design a hypermedia devoted to descriptive statistics. This was published on ‘96 (McGraw-Hill Italy) as a CD-ROM inside a text book containing the textual part of hypermedia.
We also set up the WEB site http://space.tin.it/scuola/adiciacc, regarding the teaching of statistics and containing free software and other tools for the teaching of statistics. The last edition of our hypermedia can interact with the material present on the WEB site, so the students can update the software of the CD-ROM.

## IS THIS THE INEVITABLE DEVELOPMENT OF DIDACTICAL TOOLS?

Observers agree that within a few years a large slice of the publishing trade will have converted to electronic publishing and inevitably the increasing availability of PCs in the home, together with information highways and increasing network services, will produce a generation of young people who will be particularly aware of these new technologies.

It may be foreseen that over the next few years PCs will gradually become as widely available as televisions, and that many institutions, companies, schools and universities will be able to offer multimedia educational products “on-line”.

Will teachers be capable of adopting those new technologies which will be proven effective in teaching over the next few years? Unfortunately, many teachers are not willing to change their traditional teaching methods.

In any case, perhaps the greatest obstacle to movement in this direction is that the effort to project, produce and experiment education multimedia is enormous and a variety of skills are required. Considering, too, that the cover price and the number of copies sold of a university text are not sufficient to justify the investment necessary to produce multimedia material, the only hope is that Universities will encourage this form of development and set up staffs whose task would be to assist teachers intending to develop advanced teaching aids.

## MULTIMEDIA AND HYPERMEDIA

The term *hypermedia* can be defined as a work available on a CD-ROM and where consultation can be non linear, with a high degree of user-interaction, containing non textual documents, such as graphs, videos and animation. The term *multimedia* (a collection of textual and non-textual documents) is often used as synonym for hypermedia.

A hypermedia can contain all the information contained in a textbook. On the other hand, hypermedia, as a means of transmitting knowledge, has a number of advantages compared with standard texts: non sequential viewing, interactivity, hypermedia features.

*Non sequential viewing (hypertext)*

The structure of a real hypertext is much richer and more effective as information technology speeds up, simplifies and facilitates navigation through the knowledge available. There is no limit to the amount of educational material which can be inserted as it is shown only when requested.

*Interactivity*

Enormous educational potential is offered by a hypermedia which is capable of interacting with the user, providing answers, paths, digressions, specific information and instruments in answer to the user's "behavior" or requests.

*Hypermedia features*

How best to explain a telephone interview than showing one being performed? What is better way to show how the commands of a statistical package work than actually using the package? A multimedia PC can include motion video, animation, audio, software and graphs which enrich a hypertext, as well as augmenting its educational impact.

The hypertext and hypermedia also present some potential risks. One risk is *cognitive overload*: when reading a hypertext several choices may be made regarding access to possible paths or explanatory documents. The range of options available generates intense decision-making on the part of the reader, compared with more traditional formats where the author has already made most of the decisions. Another risk is *disorientation*: the large choice of paths offered by the hypertext often causes confusion about where one is or how one got there, which may result in choosing unsuitable or inappropriate paths.

These risks are particularly acute when studying a subject which requires a certain sequentiality in the learning process, at least at a first reading. Most of these risks may be eliminated if the structure is well designed and the navigation process functions properly.

Interesting multimedia material for the teaching of statistics can be:

- video material of statistical interest, color graphs, two/ three-dimensional animation;
- exercises promoting a level of user interaction;
- drills containing tailor-made educational software to illustrate the topics;
- multimedia guides to statistical software.

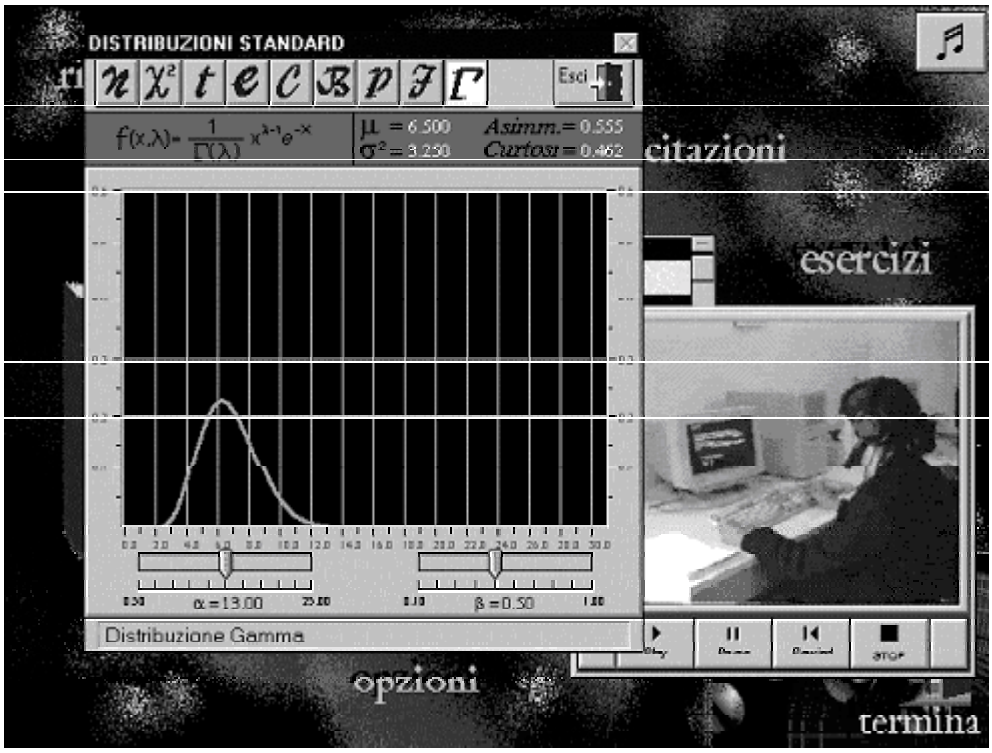
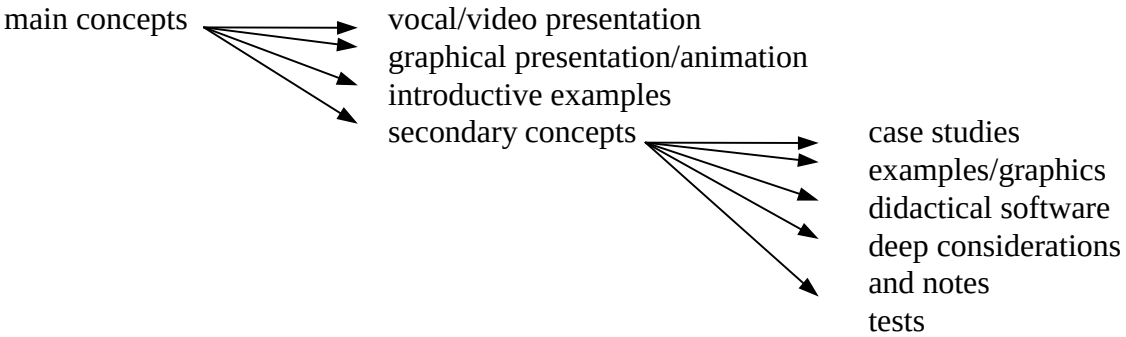



*Figure 1*. Multimedia tools

In our hypermedia we introduced well-defined paths:




In our case, as the hypermedia is targeted at University students enrolled in a basic course in statistics, we decided to produce a traditional textbook with a CD-ROM inside. Naturally this option is fairly onerous but it would have been impossible for a university

course to propose only a hypermedia software support, as this would have entailed the constant availability of a multimedia PC for every student.

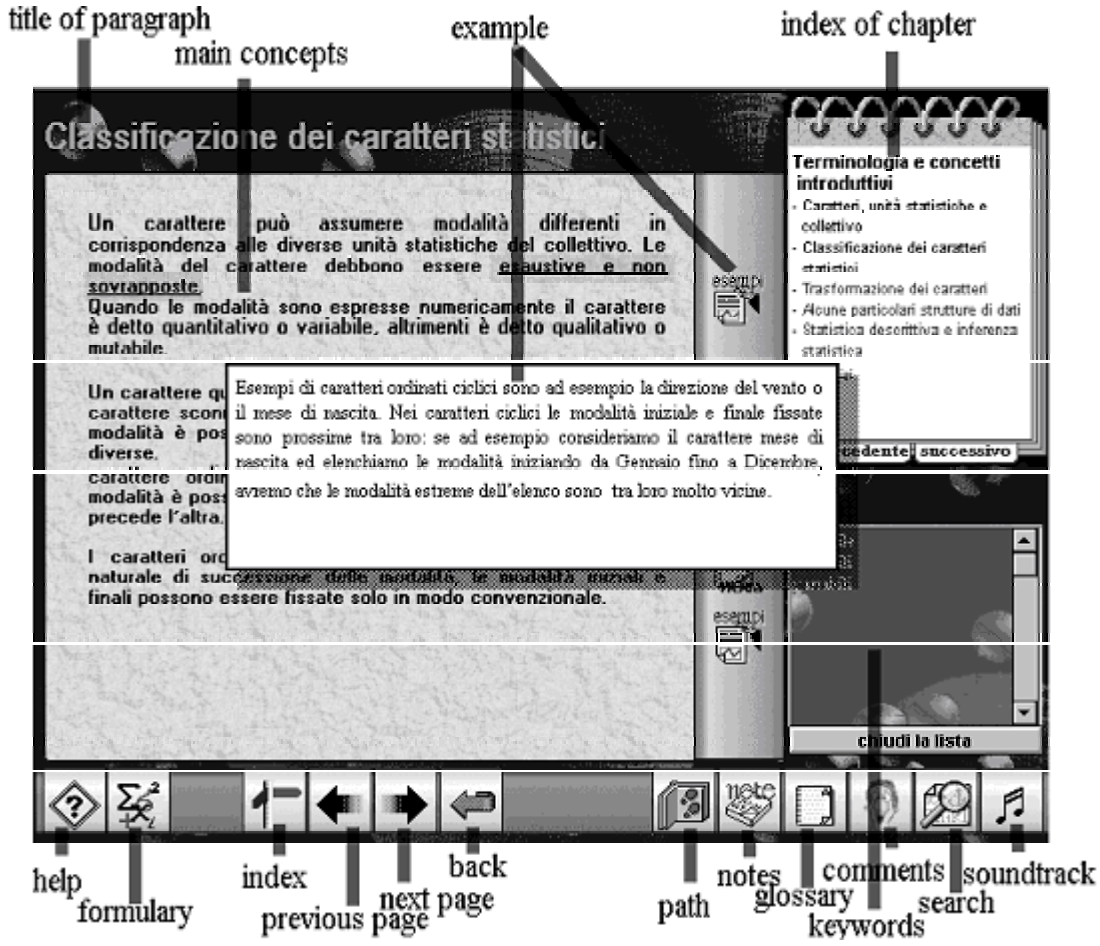



*Figure 2.* One page of a statistical hypermedia

I believe it is necessary to resolve a number of common doubts regarding the type of hardware necessary to fully exploit a hypermedia product. The minimum configuration advised is composed of 486DX2, 8MB of RAM, some MB of hard disk, a double speed CD drive (which may be shared on a network), a SVGA video, mouse, and an audio device. All the PCs bought for home now use fulfill these requirements.

## NETWORKS AND TEACHING

To date we have looked at how an educational hypermedia may be used with a multimedia PC and a supporting CD-ROM. However, this is only one of the possible uses which can be made of this system and fails to take into account the potential offered by a network. This potential is rapidly changing communication as we know it in numerous

sectors and will no doubt have a remarkable impact on training and education in the future.

Figure 3 shows a possible learning environment, which exploits the possibilities offered by a network (either local or geographic), supplemented with traditional lessons. According to this the student may:

- Consult the hypermedia from within the local network (e.g. the university INTRANET), or externally, using Internet on a commutated line. In order to consult videos, use audio or particularly complex software, a CD-ROM containing at least the multimedia material could be necessary.
- Regardless of place, the student can study the lesson and perform the final course assessment quiz: the teacher is able to control, via computer, which students have accessed the network and their results to date. Should it be necessary, the teacher may alter the learning path of the individual student in line with their results or requirements;
- Regardless of place, communicate with the teacher, either indirectly (E-mail) or directly at designated times: dialoguing by voice or video with the teacher using the PC video as an electronic blackboard. The teacher can provide these services regardless of place as long as access to the network is guaranteed.

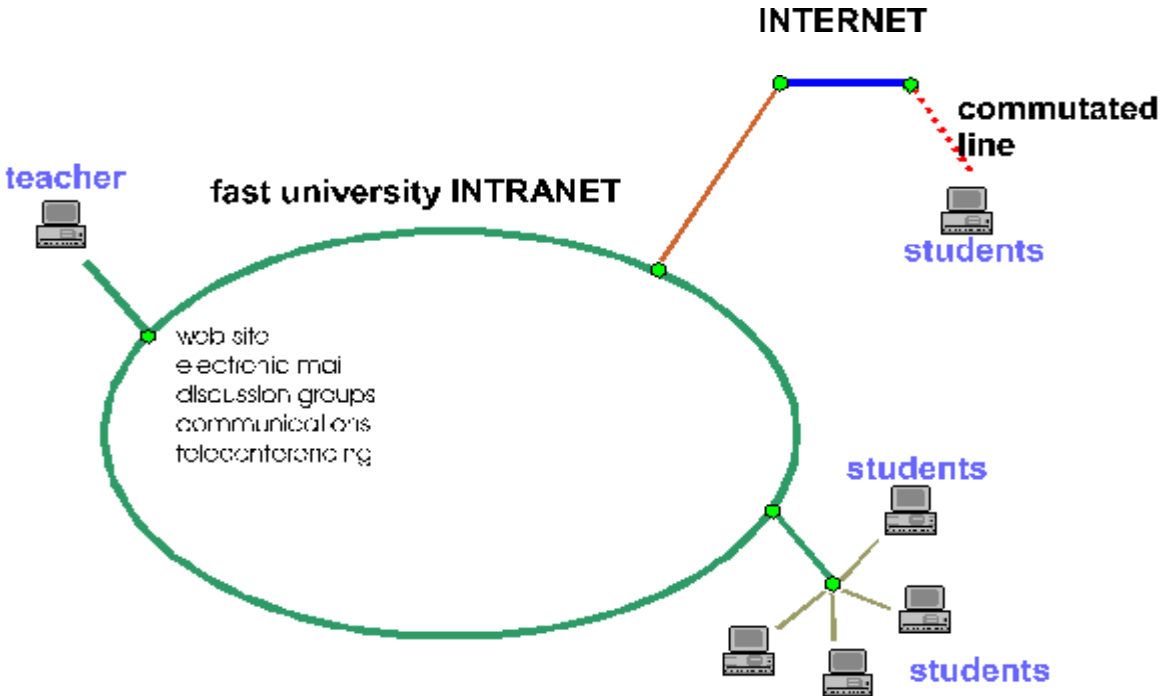



*Figure 3.* A learning environment using a network

This outline may appear somewhat unrealistic, however all the necessary technology to implement this is already available on the market at accessible prices.

Of particular note is that, with the increasing integration of the European Union, Universities could, using a network system as described above, extend their range beyond regional and even national borders. For example, an Italian student could study and take his degree at any university in the EU by using the possibilities offered by networking, and only have to physically go to the University at exam time.
To exploit the full potential offered by networking, we are presently working on setting a WEB site regarding the teaching of statistics:

http://space.tin.it/scuola/adiciacc

containing exercises and drills, so that students could test their comprehension level and teacher could gauge the students' standards on the various topics.

## CONCLUSIONS

It suffices to say that governments in all developed countries have promoted experimental programs to introduce multimedia techniques into schools to understand that new technology will have a major role to play in future education.
Our experience to date has been moderately positive. From survey performed to grasp the real impact of hypermedia educational material on our course, the availability of hypermedia resulted as having had a positive outcome for the students. However many of them did not use the hypermedia as they do not have a computer available. The students above all appreciated the availability of exercises, software drills and other multimedia material contained in the CD-ROM (used mainly together with the text book), while they were less interested to the hypertext.