SMART: INTRODUCING SPECIALIST STATISTICAL TECHNIQUES VIA THE WEB

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SMART is a collaborative approach to the production and delivery of training in specialist statistical techniques using the World-Wide-Web. The training is primarily focused on individuals with some experience of basic statistical principles and who wish to quickly familiarise themselves with a new technique which they believe may be useful in their work. The SMART system provides a suite of multimedia presentations on a range of statistical techniques. A demonstrator version of the system is available for general access at http://www.bioss.sari.ac.uk/smart/unix/moutline.htm.

INTRODUCTION

There is increasing awareness of the need to update the skills of those at work. This applies particularly to professional specialists, e.g. scientists, engineers, who often rely for their skills in quantitative methods on what they were taught at graduate level some years earlier. These skills quickly become obsolescent in a rapidly-changing computer-based field. Such specialists are often located in small dispersed groups in universities, colleges, research institutes or industrial enterprises. Traditional courses in specialist or more advanced techniques are difficult to organise, or justify, for such small groups.

Recognition of the problems outlined above has inspired a collaborative WWW-based training initiative under the title "Statistics and Mathematics as Advanced Research Tools (SMART)". SMART aims to provide a cost-effective way for experts in a topic to present that technique to those in their own or other disciplines in a convincing manner through the exploitation of WWW tools.

SMART is directed at individuals with some training in basic statistics, aiming to broaden their vision of what statistics can do. Though we use the term "advanced" in practice we mean "specialist" - that is, useful techniques which may be of interest to relatively few and for which it may be difficult to justify a formal course. SMART takes these more specialist techniques and shows: what the methods involve; where they might be useful; and how they can be applied.

FEATURES OF THE SYSTEM

- Provides on-call training - ‘just-in-time’ as opposed to ‘just-in-case’;
- Gives a taste for technique - 10-20 minute overview, but with links for deeper study;
- Application orientated - shows the technique in operation in an area with which the learner may be familiar;
- Supplies links to software tools in order to encourage exploration;
- Highly modular - material can be readily adapted to different situations;
- Facilitates email links between learner and specialist;
- Uses widely available software and hardware - can be viewed from standard browsers and is accessible from a server or on a stand-alone personal computer;
- Cost-effective in terms of resources required to produce training material.

SYSTEM STRUCTURE

The SMART system is composed of topic modules with each module representing a nugget of expertise on a subject and prepared to a common standard. Modules are structured as a sequence of pages linked together at three levels (Figure 1):

- Level 1, the primary level, consists of a series of slides, each one occupying approximately a screen. These slides can be viewed in sequence to provide a rapid overview of the technique, including its uses, assumptions, limitations. The technique is illustrated with a motivating example and includes a description of the aims, results, and interpretation.
- Level 2 provides a more detailed explanation on difficult points and is organised in a loop, eventually bringing the user back to the starting point in Level 1;
- Level 3 provides references and glossaries which are usually accessible from any page and from which the user returns using the ‘Back’ button.

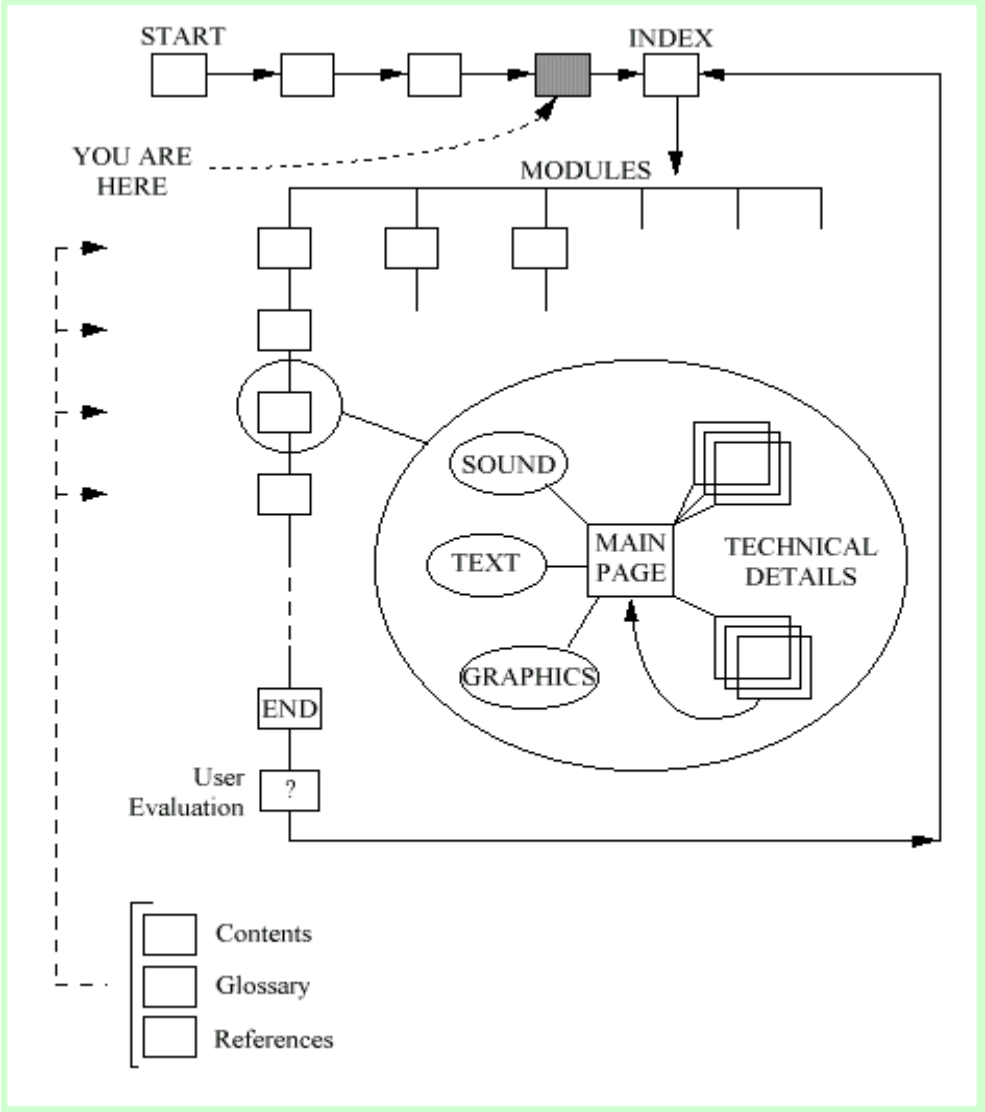

Figure 1. Organisation of the SMART HTML pages.

Figure 2 provides an example of a page from a module. By clicking on the right arrow on each page the user is lead in a natural progression through a presentation. However, the control icons can be used to follow other routes, for example, by selecting individual pages from a contents list. A typical page of a module includes:

- bullet-style summary points in text form;
- a link to a page with text giving a fuller explanation of the summary;
- in the case of some modules, a link to the spoken explanation held in audio (.wav) format;

- a link to page which captures comments from the user on the material being presented;
- photographs illustrating situations where the techniques may be applied.

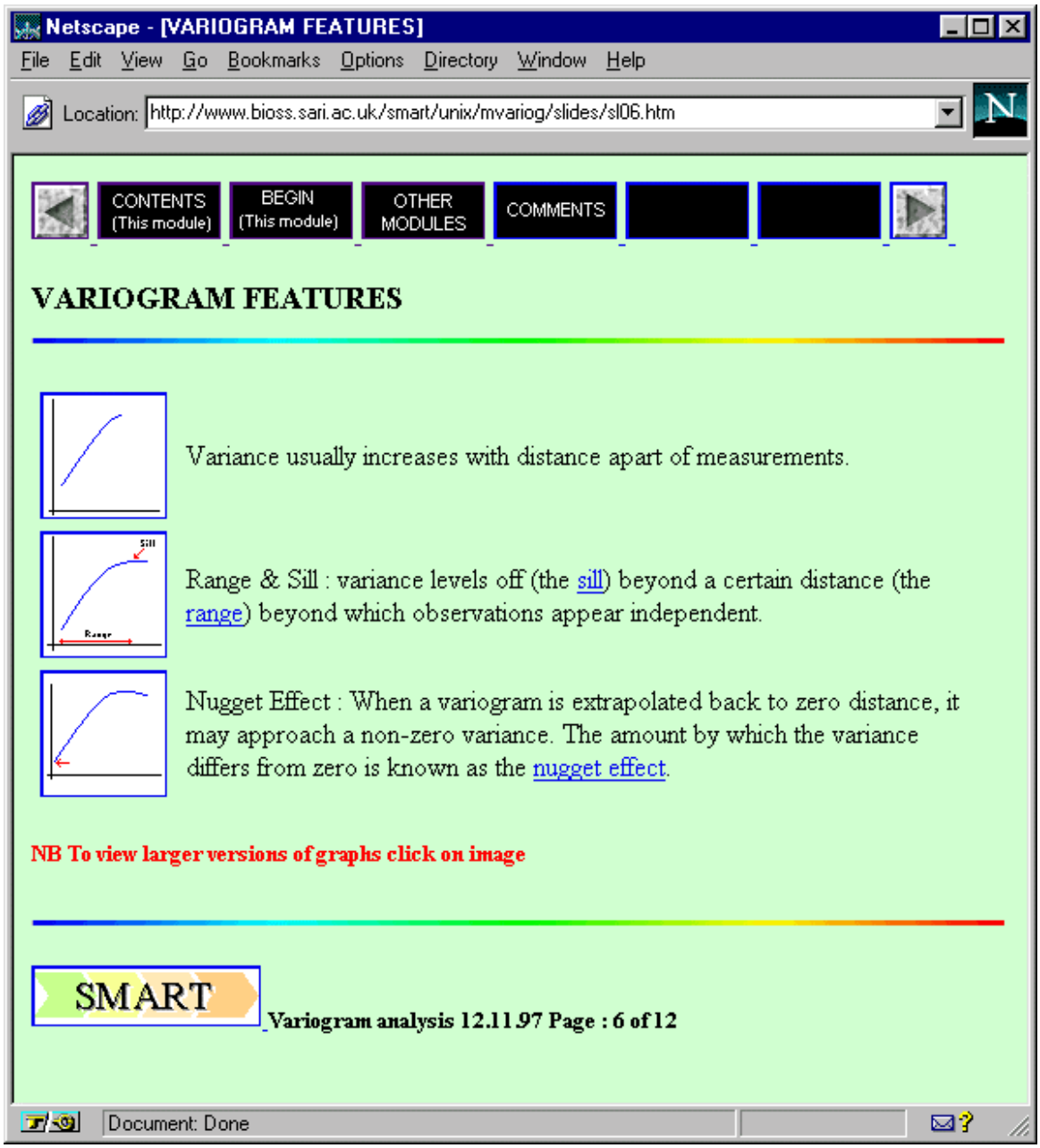

Figure 2. An example of a page from a SMART module on variogram analysis.

LINKS TO APPLICATION PROGRAMS

Two approaches have been followed in providing links to statistical software. One is illustrated in a module on sequential acceptance sampling where the user can, from

within the browser, directly input data, run the program and view the main features of a sampling plan.

The more typical approach is to provide, in Web pages, the program instructions and data as text files which can be copied-and-pasted to other windows on the user's machine for running with locally-mounted applications software. Software systems for which instructions have so far been provided include Genstat, SAS and S-Plus.

DEVELOPMENT ISSUES

Collaboration

SMART is a collaborative venture and partners in a number of countries are contributing modules: there are versions of SMART currently available in five languages apart from English. The basis of collaboration is that material is shared amongst groups which contribute modules and that the copyright of a module belongs to its author(s).

Costs

Ease of preparing a module has been an important design issue. We wish to encourage specialists in a topic to contribute material and they will do this only if the technology is user-friendly. To this end we provide a set of example pages which specialists can edit with their own HTML editor or word-processor to create a presentation. When the specialist already has material prepared for a talk then it can take no more than 5-6 hours to produce the first version of a module in HTML format.

Quality Assurance

Before a module is released it is evaluated by two or more reviewers in respect of technical accuracy and ease of understanding. At least one of the assessors should be familiar with the technique while the other assessor should be relatively new to the technique in order to detect difficulties with explanations.

Feedback from users

Forms for capturing feedback on users' experience are incorporated in the system. Also, at the end of each module users are asked to complete a short questionnaire which is collated on a central server. An important advantage of using the Web is that modules may be continually improved in response to feedback.

DISCUSSION

SMART has been freely accessible on the Internet for more than a year and the monitoring of usage has shown a variety of responses. Other statisticians tend to be supportive in principle, but occasionally critical of details. Non-statisticians have, in general, welcomed the material but asked for more topics to be covered.

For the teacher the Web-based medium has drawbacks and benefits. It requires some effort to become familiar with the technology. It is also necessary to have at hand good audio-visual material for an effective presentation. However, the main advantage is that, for only little more effort than is required for a talk or tutorial, specialists can maximise the impact of their efforts.

We plan to increase the number of modules available in SMART and, where appropriate, to package sets of modules for target groups of learners. The modular structure, and the flexible links to software packages, means that such packaging is relatively easy to implement.

Many of the applications covered so far relate to the biological sciences, since this is where all of the present contributors work. However, we would very much welcome collaborators from all disciplines.

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INTEGRATING TECHNOLOGY INTO TEACHING - THE SCOTTISH HIGH-SPEED NETWORKS

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The CTI aims to promote good teaching practice, with particular emphasis on effective use of learning technologies. This UK Higher Education funded initiative comprises twenty-four subject-based centres, one of which is the CTI Centre for Statistics. The main focus of this paper concerns a collaboration with the TALiSMAN project. The high-speed Metropolitan Area Networks (MANs) which link all Scotland's Higher Education institutions have given the country a world lead in HE networking infrastructure. TALiSMAN is an acronym for Teaching And Learning in Scottish MANs. CTI Statistics assisted TALiSMAN in the presentation of an on-line distance education course on effective use of the Web to locate and utilise relevant resources, and on Web-based teaching and learning. This paper discusses the course and some issues arising.

INTRODUCTION - THE COMPUTERS IN TEACHING INITIATIVE (CTI)

CTI Statistics [1] is one of twenty-four subject-based CTI centres within the UK. The principal aim of each of these centres is to promote, support and disseminate information on the use of computers in teaching within a particular subject area in Higher Education.

Activities carried out by CTI Statistics include

- commissioning software reviews, and articles on the use of computers in teaching
- the publication of the quarterly newsletter *Maths & Stats*, with CTI Mathematics
- the publication of a *Guide to Software for Teaching*, now in its Third Edition
- running workshops on a variety of topics related to statistics in teaching
- the maintenance of the general-purpose statistics e-mail broadcast list, Allstat
- maintaining a comprehensive information gateway to statistics Web resources
- visiting University departments to discuss the use of computers in teaching
- handling information requests in relation to statistical software used in teaching.

THE TALiSMAN PROJECT AND THE SCOTTISH MANS

TALiSMAN [2] is an acronym for Teaching And Learning in Scottish Metropolitan Area Networks (MANs). This is a staff development strand of the Use of MANs Initiative (UMI) to promote effective and efficient use of the MANs, and the integration of networking technology and network-based learning methods into teaching and learning.