STATSTUTOR: AN ON-LINE STATISTICS LEARNING AND TEACHING RESOURCE

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Statstutor is an on-line statistics learning and teaching resource, being developed by the sigma *Centre for Excellence in Teaching and Learning (CETL) at Loughborough and Coventry Universities, in collaboration with the Royal Statistical Society Centre for Statistics Education. It differs from existing on-line resources, focusing on the practical application of statistics using both a topic based approach for learning, as well as opportunities for learning through a problem solving approach using case studies. It combines video, paper-based and other electronic media into one environment. It is a pilot project which will form part of the mathcentre family of on-line mathematics resources (www.mathcentre.ac.uk). This paper describes the project's development, and lists the resources that are available. We hope the paper will motivate discussion of our approach and the content of statstutor and, in turn, help to inform us about directions we should take for post-pilot developments of the resource.*

INTRODUCTION

Many students on undergraduate and taught postgraduate degree programmes are faced with learning some aspects of statistics during their course of study. In addition, the statistical analysis of data, sometimes real, is a feature of many student projects at university, and is often a required element of PhD research in subjects that use applications of statistics. Many UK universities have dedicated mathematics learning support centres (see www.mathcentre.ac.uk/mlsc_links.php), that may also provide statistics help and advice. However, many of these centres may not always be able to offer the depth of statistical expertise and/or time that students require, particularly in relation to student projects and postgraduate research. Some UK universities also provide a dedicated one-to-one statistics advisory service (see for example http://mlsc.lboro.ac.uk/servicesstat.php), but not all institutions currently offer this level of support.

Where no suitable face-to-face statistics support is available, students can be directed to a number of helpful on-line resources that are freely available for self-study. Examples include the STEPS Glossary, available at www.stats.gla.ac.uk/steps/glossary/index.html and the collection of Computer Aided Statistics Textbooks (CAST), available at http://cast.massey.ac.nz/collection_public.html. However, many of the on-line resources, that are potentially of use to students in HE, do not offer the type of support these students require in order to undertake practical analyses of real data. In addition, many of these resources are simply text based and do not make use of the broader range of software and hardware now available to develop and present materials on-line. Finally, awareness of the existence and location of these resources, particularly by non-statistics teaching staff, is not helped by the lack of a central focal point, or portal, where these can be accessed.

In order to address some of these problems and issues, the *sigma* Centre for Excellence in Teaching and Learning (CETL), based at Loughborough and Coventry Universities, has been conducting a pilot project, in collaboration with the Royal Statistical Society Centre for Statistics Education (RSSCSE), to develop a new on-line statistics learning and teaching resource called *statstutor*. The aim is to provide an on-line statistics resource that provides self-learning opportunities with the practical application of a range of statistical methods. The intention is that this could be used where face-to-face support is not available, but could also be used to enhance face-to-face support by providing an additional learning resource to which students can be directed to.

In this paper we describe the background to the *statstutor* pilot project and discuss the rationale for the approach being taken in the development and presentation of the teaching and learning materials that will be made available. We showcase the content that should be available from April 2010, and discuss the aims and objectives for the potential longer term development of the resource.

In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8, July, 2010), Ljubljana, Slovenia*. Voorburg, The Netherlands: International Statistical Institute. www.stat.auckland.ac.nz/~iase/publications.php

BACKGROUND

The *sigma* CETL secured a small amount of funding to undertake a pilot for the development of *statstutor*, with the aim of developing a restricted range of high quality resources. If the pilot is successful we will bid for further funding to extend the range of material available.

A scoping study was conducted in the summer of 2009 to identify what types of help and advice HE students typically require in relation to statistics, and to prioritise the areas to be included in the pilot. This study included mainly informal discussions with staff in a number of UK HE institutions, that provide support either in a mathematics learning support centre, or through a statistics advisory role. There was general agreement that most students requesting help with statistics are often non-mathematics specialist students. There was also a general consensus that many students request help in relation to a particular study or experiment, and that this is often in relation to a final year undergraduate project, a master's dissertation or postgraduate research. However, there was also evidence of significant demand from a second distinct group of students, who typically request help with a particular statistical topic that they have met on their course of study.

The scoping study also revealed strong opinion in favour of presenting materials for *statstutor* using a problem solving approach. The argument is that this replicates more closely what statisticians do in practice, and better reflects the context in which statistics advice is given face-to-face in relation to a project or research. The RSSCSE have previously developed materials aimed at teachers of the 14-16 age group, that adopts a statistical problem solving approach, and uses four iterative stages of: *Planning*, *Collecting*, *Processing*, and *Discussing*, see Gibson et al (2007) and Marriott et al (2009) for details. The RSSCSE extended this approach to produce resources for undergraduate teaching and this is reported in Marriott and Davies (2009). This problem solving approach also matches the paradigm of scientific enquiry and is mirrored by the Deming cycle of: plan; do; check; act.

Where students request help in relation to the design and analysis of a particular study or experiment, this is most often in relation to the following areas:

- questionnaire design;
- determination of the most sensible analysis to achieve project/research aims and objectives;
- interpretation of the output obtained from software;
- coding, entering and manipulating data using software;
- using software such as Minitab and SPSS.

Where students request help with a particular statistical topic this is most often in the following areas:

- two-way tables, including when column or row percentages;
- Chi-squared tests;
- two-sample hypothesis tests, including paired and independent samples and their non-parametric counterparts;
- analysis of variance and multiple comparison tests;
- linear regression and correlation, including multiple regression.

DEVELOPMENT OF MATERIALS

The pilot focused on the production of two distinct types of resource. The first of these is a small set of *casestudy based* resources, presented using the four stage iterative problem solving approach, that includes the *Planning*, *Collecting*, *Processing* and *Discussing* stages. It is anticipated that these case studies would be of value to students requiring help with statistical analysis as part of a project or research study, as they would be more likely to invest the time that would be required to study these types of materials. In order to meet the needs of students that are not willing to invest the time required to work through these case studies, it was agreed that a second type of *topic-based* resource will be produced that would be shorter in length and would focus more on the *Processing* and *Discussing* stages of a statistical analysis, and focus less on the *Planning* and *Collecting* stages.

For both the case study resources and the topic based resources, it was envisaged that a range of different media should be considered to present the content. These include video, PowerPoint slides with audio, pdf materials, software demonstrations using screen capture software such as Adobe Captivate (see www.adobe.com/products/captivate) and electronic capture of hand written applications of statistical formulae using devices, such as the Pulse smartpen produced by Livescribe (see www.livescribe.com/smartpen/index.html) etc.

Access to the materials would be via two routes, the first of which would be through the domain www.statstutor.ac.uk. However, the materials should also be made available via the *mathcentre* site at www.*mathcentre*.ac.uk. Established in 2002, the *mathcentre* site provides a range of innovative learning resources in mathematics, specifically aimed at the HE level, and has since become one of the most popular mathematics content sites, with its resources being accessed and viewed over 546,000 times in 2009. The *statstutor* materials will therefore follow a similar structure to those already provided by *mathcentre*.

For the case study resources, we developed two exemplars, based on the materials the RSSCSE had previously produced for teaching through a problem solving approach. These were planned to be presented using a combination of video, interspersed with PowerPoint slides with audio overlaid. An example of one of the PowerPoint slides developed for this is shown in Figure 1, which includes tabs at the top of the screen to remind students of the four stages of the problem solving cycle. In addition, the stage currently being undertaken is enlarged, which in the example in Figure 1 is the *Process* stage. The idea was to use video particularly during the "Process" stage, and to feature a member of statistics staff and one or more students. This was to recreate the potential discussion a student may have with a supervisor or statistical advisor, regarding the designing of the survey/study, and the planning of the data to be collected and the analysis to be performed.

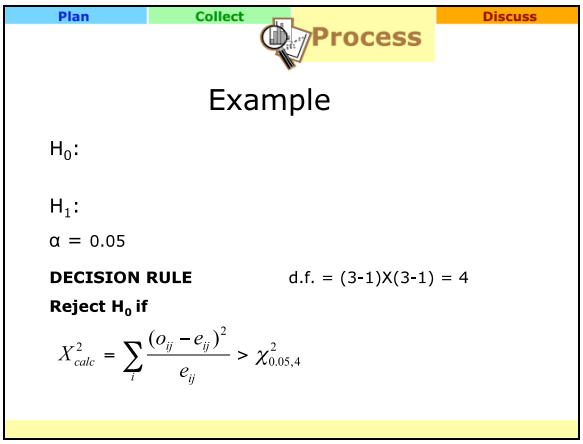

Figure 1. Example Slide from Case Study Materials

For the shorter topic based resources, outline plans for the development of statstutor were presented at various statistics education workshops in England and Ireland in the Autumn of 2009, and interested potential contributors were invited to develop these materials.

Only limited guidelines were provided to the contributors in terms of the types of media they should use and the design and layout of the materials, since it was felt that the pilot should also serve as a vehicle for contributors to experiment with their ideas. It is envisaged that the pilot materials will subsequently be assessed by both student users and the statistics teaching community. Indeed, we would welcome comments and feedback from the audience at this year's ICOTS conference.

INDICATIVE PILOT CONTENT

The two case studies chosen to be developed by the RSSCSE in the pilot were:

- analysis of crime data using a chi-square analysis;
- analysis of data on student accommodation using analysis of variance.

For the shorter topic based resources, the developers of the STEPS Glossary agreed to allow the Glossary materials to be used as a framework/gateway, as means of providing a list of topics to display on an initial screen on the *statstutor* site. Selecting one of these topics should then link to the original Glossary entry found on www.stats.gla.ac.uk/steps/glossary/index.html. A copy of the Glossary materials will reside on the server housing the *statstutor*. For the particular topics for which additional materials are being developed in the pilot, there should then be additional links to these new additional resources. The topics selected to be included in the pilot included:

- Presenting data, to include plots, outliers, sample variance and standard deviation.
- Random variables, to include the basics of the normal probability distribution.
- Hypothesis testing, to include both paired and unpaired two-sample tests.
- Correlation and regression, to include Pearson's and Spearman's correlation coefficients, simple linear regression and possibly an introduction to multiple linear regression.
- Contingency tables, to include choice of row or column percentages.
- Nonparametric methods, to include the Wilcoxon Mann-Whitney and Kruskal-Wallis tests.

SUMMARY AND LONG TERM AIMS AND OBJECTIVES

We hope that the pilot project will serve to illustrate the ideas that the various contributors have used in relation to the development of on-line learning materials for *statstutor*. The content for the pilot was chosen to reflect a consensus view, obtained from an informal scoping study, of the most common type of requests made by HE students for help with statistics. Materials commissioned in this pilot project should start to become be available on-line (see www.statstutor.ac.uk or www.mathcenter.ac.uk) from Easter 2010.

We hope the paper will motivate discussion of our approach to the project as well as the content of *statstutor* and, in turn, help to inform us about directions we should take for post-pilot developments of more resources. We are therefore actively seeking your views, as well as those of students using the materials. We hope, subject to future funding, to further extend the range of case studies and topics available, utilizing the approaches to the presentation of the materials considered most effective by both educators and students.

REFERENCES

Gibson, L., Marriott, J., & Davies, N. (2007). Solving the Problem of Teaching Statistics?, *56th Session of the International Statistical Institute 22 - 29 Aug*, Lisboa 2007.

Marriott, J. M., Davies, N., & Gibson, E. (2009). Teaching Learning and Assessing Statistical Problem Solving, *Journal of Statistical Education*, *17*(1). Online: www.amstat.org/publications/jse/v17n1/marriott.html.

Marriott, J., & Davies, N. (2009). Helping Undergraduates to Contribute to an Evidence Based Society. *IASE satellite conference Durban*, South Africa 2009.