
Workshop Report

Computer-Aided Assessment in Statistics at Heriot-Watt University

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On Tuesday 5 March 2002 under the auspices of the LTSN Maths, Stats & OR Network there was a seminar on "Computer-Aided Assessment (CAA) in Statistics at Heriot-Watt University" held in the Department of Statistics & Modelling Science at the University of Strathclyde. The seminar was conducted by Cliff Beevers (Director of CALM), Athol Korabinski (Senior Lecturer in Statistics) and Jane Paterson (Research Fellow in Assessment) all based on the Riccarton campus of Heriot-Watt University in Edinburgh.

The seminar was in four parts:

- (i) A history of CALM (Computer-Aided Learning in Mathematics)
- (ii) CAA in Statistics in current use at Heriot-Watt
- (iii) Statistics in the Scholar Programme
- (iv) An introduction to the CUE Assessment System

Cliff Beevers introduced a video outlining the history of the CALM Project in the Department of Mathematics at Heriot-Watt. Commencing in 1985 Phase 1 (CALM1), funded by the Computers in Teaching Initiative, involved the creation of a computerised tutorial to replace the conventional tutorial in the teaching of first year Calculus to large service classes of engineers and scientists. The CALM Calculus software was sold to many other universities both in the UK and abroad. Cliff emphasised the importance in Mathematics of prompting for mathematical expressions as answers rather than relying on the multiple choice format. In 1990 with funding from the DTI and British industry the CALM2 courseware was developed at the level of Scottish Higher Mathematics. In 1992 with TLTP funding CALM became one of the three principal resource centres for the Mathwise consortium, part of which involved summative assessment and educational evaluation. This resulted in the continuous assessment element of the Heriot-Watt mathematics modules for engineers and scientists being conducted in the computer laboratories, forming in some cases as much as 40% of the final assessment.

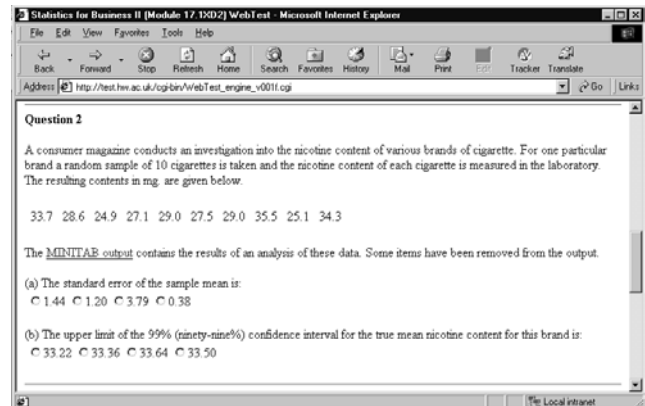
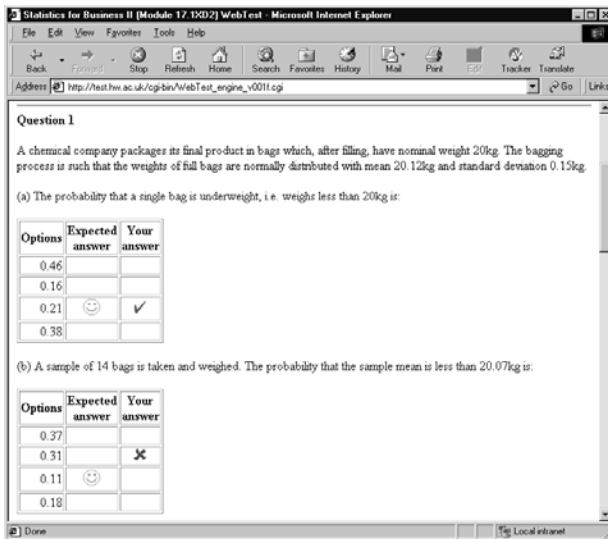
In 1995 CALM won the first Bank of Scotland Award to Higher Education for its innovative teaching of Mathematics. The prize money of £30,000 enabled the team to build two commercial CD's entitled "Interactive PastPapers" for A-level/Higher Mathematics and GCSE/Standard Grade Mathematics published in 1997 and 1998 respectively. One of the latest projects for the CALM team is as part of SCROLLA (The Scottish Centre for Research into On-Line Learning and Assessment) which has been funded by SHEFC and incorporates three directing institutions, the University of Glasgow and the University of Edinburgh as well as Heriot-Watt University. The On-Line Assessment is led by Heriot-Watt and includes the use of the assessment system CUE, details of which are covered in the last part of this report.

For more information on CALM the interested reader is directed to: <http://www.calm.hw.ac.uk> and on SCROLLA: <http://www.scrolla.ac.uk/>

Athol Korabinski then outlined the Computer-Aided Assessment that is currently being used at Heriot-Watt. Somewhat ironically following earlier comments by Cliff that computer assessment does not have to be restricted to simple multiple-choice questions, Athol indicated that the current tests in Statistics being used at Heriot-Watt do largely use multiple-choice questions. The reason for this is that the three major service courses in Statistics are assessed using multiple-choice examinations. The development of "Web Tests" for these courses started in 1996 and a conscious decision was made to present



A statistics teaching and learning workshop organised through the LTSN Maths, Stats & OR Network



the questions in the style of the examination. The three courses, Statistics for Business I and II and Statistics for Science & Engineering, are all assessed using 85% from the end of module examination and 15% from two Web Tests. The Web Tests were developed using third year students on paid summer projects under the supervision of staff. A typical structure of one of the Web Tests was illustrated:

Q1 (3 multiple-choice parts)

involves the sampling distribution of the mean; random choice of one out of six questions, each involving a different application or scenario and each with a randomised mean and sd from suitable ranges.

Q2 (2 multiple-choice parts)

involves confidence intervals for a mean; random choice of one out of four questions, two for large n with randomised sample mean and sd, and two for small n with twenty different versions with Minitab output.

Q3 (2 multiple-choice parts)

involves confidence intervals for a proportion; random choice of one out of four questions, with x and n randomised in each one.

The students are able to practice these tests as often as they wish and then they take a formal test supervised in one of the computer labs.

For more information on Heriot-Watt Web-tests see <http://test.hw.ac.uk>

Athol then demonstrated some of the latest Statistics

material being developed in the next stage of the Scholar Programme. "Scholar" has been developed by Heriot-Watt in collaboration with Local Education Authorities and Further Education Colleges, and currently involves Mathematics, Physics, Chemistry, Biology and Computing for Advanced Higher, 'A'-level, HNC Units and first year courses at Heriot-Watt. This year it is being used in about 75% of Scottish secondary schools with even greater coverage expected next year. The resources include written materials, on-line simulations and CUE assessments, discussion areas and frequently asked questions. Materials for the Higher Statistics unit (equivalent to 'AS'-level in England, Wales and N Ireland) are now being developed by school teachers on secondment to Heriot-Watt. These make use of the CUE assessment system (see below).

For more information on the Scholar Programme please consult <http://scholar.hw.ac.uk>

Jane Paterson concluded the talks by describing the development of the CUE assessment system. CUE developed from a fruitful collaboration between CALM, UCLES (University of Cambridge Local Examination Syndicate) and EQL Livingston (a commercial company). CUE provides a wide variety of question types and response types, which are designed to be suitable for all subjects including Mathematics. The CUE system includes question and test editors, which are easy to use by subject authors and academics. There is a more detailed article by Jane in this issue and the reader is referred to that for full details. The intention is that CUE will become freely available to any interested institution within Scotland (and perhaps beyond) wishing to implement CAA research.

The seminar led to a lively discussion with several enquiries as to the availability of the latest software including the commercial version known as I-assess from EQL (see <http://www.i-assess.co.uk>).

Editor's Note: For more on CAA see the "CUE Assessment System" article written by Jane Paterson on page 22