I have been developing computer-aided learning and assessment programs integrated with spreadsheets for six years. Partial funding for this work was provided by a Maths, Stats & OR Network project grant of £6000 to me, jointly with Neville Hunt and Sidney Tyrrell at Coventry University, for the development of web-based teaching material. The material relevant to this application can be accessed at www.mis.coventry.ac.uk/~nhunt/cpa. A recent publication [1] describes the interactive spreadsheets developed so far for critical path analysis. The programs described in this publication are available for use by the academic community at:

www.mis.coventry.ac.uk/research/or/bmb_sheets/cpa.html.

The current proposal will complement the existing spreadsheet programs (which enable students to practise analysing networks that have already been drawn), thus providing a complete assessment package for this widely taught topic in quantitative methods for business. The new programs will be included in the web-site above for use by the academic community.

Outcome Expectations

• A program for computer-aided teaching and assessment of students on large modules.

• Students will use ordinary spreadsheet tools to construct a network model for a project; a companion computer program will provide feedback or deduct marks when students make mistakes.

Summary

Students will be required to draw the network within the spreadsheet in a prescribed manner to facilitate using the model for experimentation/sensitivity analysis in accordance with traditional OR practice. I have already produced a spreadsheet-based tutorial describing exactly how to do this and used this tutorial very successfully with many students. The major development will be a companion computer program which generates an apparently endless sequence of different problems and, for each problem, checks in detail whether the student has constructed the model correctly, giving on-screen feedback to indicate anything that the student has done incorrectly. This will include a check on the presentation and will inform students if arrows cross unnecessarily, or are directed in a right-to-left sense, as well as checking that appropriate formulae have been entered into the spreadsheet to perform all the calculations for a standard critical path analysis. The student will then be able to modify the model. The processes of computer-checking and student-modification will iterate until the model is error-free.

Students will progress to the assessment version of the program when they judge themselves to be ready. This will give no instant feedback, but will deduct marks for mistakes or poor presentation. Different problems will be generated for each student, eliminating the simple copying which can take place at this level with traditional methods of assessment.
Computer-aided learning and assessment of critical path analysis

Barrie Baker

**Links to Undergraduate Provision**

In many universities, modules in quantitative methods for business are provided for non-specialist students, covering material such as critical path analysis. Student numbers on these courses can be very large and, for such non-specialist courses, there can be a wide range of student ability. The purpose of the programs is to overcome the difficulties of teaching large groups of mixed ability students and provide a fast, error-free and consistent method of marking. It provides a more satisfactory experience for students, who can vary their practice time to suit their own individual needs, and saves a lot of time for lecturers in setting and marking assignments. Students generally respond more positively to this approach than to laborious exercises performed by hand and, as a result, the learning objectives of gaining and demonstrating competence in the basic techniques of critical path analysis are achieved to a high degree.

At Coventry University, the programs developed so far are used each year for the teaching and assessment of the module Data and Decision Analysis, which is compulsory for Coventry Business School students, and for Business Analysis and IT in the School of Mathematical and Information Sciences.

**Evaluation**

Anonymous feedback forms have shown that 75% of students found the existing computer-aided learning programs to be good or excellent and 94% of students thought that the programs were at least fair. 77% of students preferred the computer-aided learning programs to traditional pencil-and-paper exercises.

Anonymous feedback will be obtained in a similar way for the new programs.

**Level of innovation and timeliness**

Universities now face the challenge of achieving high levels of staff efficiency whilst offering the highest possible standards and value for money to students. Methods that suit distance learning are also attractive to part-time students, an important area for future recruitment. The programs I have devised meet this challenge and, through integration with Excel, one of the most popular software packages which is installed on almost all computers, they can be used on almost any computer. It is important to maintain momentum and develop this work further, in order to keep pace with the challenge that all universities are facing.

**Impact**

The programs which are already in use have been entered for EASA2004 (European Academic Software Award), a prestigious biennial competition and, at the time of writing, the entry has successfully passed stage 1 of the competition.

The first publication [1] has already led to these programs being adopted for use in at least one other university (Aberdeen, for use with a class of 330 students).

**Dissemination plan**

This work will be submitted for publication in an international journal such as *Computers and Operations Research* and a description will be submitted to *MSOR Connections* for publication under the monthly series on computer-aided assessment in Maths.

Further dissemination activities could be undertaken in conjunction with the Maths, Stats & OR Network: running and promoting a small number of half-day regional workshops on this material, or perhaps helping to find appropriate partners to run joint workshops, presenting this material alongside other developments in the maths, stats and operational research area.

**Costing**

Coventry University is providing a grant of £3000 to support this work during the coming academic year, this being the maximum award under the Coventry University scheme for this type of research.

**Reference**