

Program Abstracts/Algorithms

Computer assisted unit mastery quizzes for PSI courses

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One of the major problems in preparing and administering a PSI (Personalized System of Instruction) Keller plan course (1968) is the preparation of unit mastery quizzes. The unit mastery quiz serves as an important form of feedback to both student and instructor. Completion of a unit requires that the student pass some form of unit mastery quiz, and progress through a PSI course is determined by the rate at which units are completed. Since a student may not pass a mastery quiz on the first attempt, it is necessary to have several forms of each unit quiz available. Preparing multiple forms of unit mastery quizzes can consume large amounts of the instructor's time. This time would be better spent on other aspects of PSI course administration (e.g., development of instruction manuals, training peer proctors, etc.).

In order to reduce quiz preparation time, we attempted to automate the production of unit mastery quizzes in a PSI statistics course by using two types of test items, short answer questions and numerical problems.

To automate the process of generating multiple forms of unit mastery quizzes with answer keys, we have written three types of computer programs: (1) a series of programs each of which produces a file on magnetic tape consisting of multiple copies of statistical problems with solutions; (2) a program to build question files on magnetic tape; and (3) a program that can access both files and produce the unit mastery quiz. Each of these programs is discussed separately.

Problem generators. To generate multiple forms of numerical test items, we set up a series of statistics programs on a PDP-8 computer written in BASIC (Notes 1 and 2) (e.g., correlation, t tests, etc.). These are general statistics programs that can be used to analyze research data. We then modified these programs to generate data input via a pseudorandom number generator and placed each program in one large loop with an upper limit that could be changed for each run. The number of problems produced, therefore, was under problem control. After adding other features (e.g., allowing variable question text on each run and requests for parameters in interactive mode), the programs request run-time parameters, type out statistical problems, solve them, and separately type the answers with summary totals. On successive iterations, the same problem is printed with different pseudorandom data, solved, and the solution printed. This series of programs, called the Basic Statistic series (BST), is used to generate practice problems for our statistics students (see Figure 1). Finally, slight modifications in the program were made and the problems and solutions stored in files on DEctape (see Notes 4 and 5). These programs make up the problem generator (PG) series (see Appendix).

Question files. The second program QFCRUD (Question File Create and Update), is used to build a file consisting of short answer questions and answers for each unit. The program, also written in interactive mode, is usable by clerical personnel, and asks the operator for all necessary information at appropriate places. The purpose is to build a question and answer file in which each set consists of 10 items that are variations of simi-

lar questions relating to one objective. The number of items in a complete file, therefore, is any multiple of 10. (This can be changed by minor preprogramming.) QFCRUD can be used to update an existing question file. New questions can be added and old questions replaced.

Test generator. The test generator (TSTGEN) program can generate two kinds of tests. It can generate a quiz consisting of only short answer questions by accessing only one of the question files; one question is selected at random from each set of 10 and the questions printed as a unit quiz with an appropriate header. TSTGEN also produces mastery quizzes consisting of both short answer questions and numerical problems, with questions from the question file specified by the operator and problems from a problem file created by a PG program (see Figure 2).

In summary, tests can be generated in two ways: (1) a PG program is run which creates numerical problems and solutions on tape and *chains* (see Note 3) to TSTGEN which in turn generates mastery quizzes consisting of both short answer questions and numerical problems; and (2) TSTGEN is run directly to generate mastery quizzes consisting of short answer questions only (see Figure 3).

Although the package was originally designed for a statistics course, it can generate mastery quizzes for any PSI course. The questions that make up the question files must, of course, be related to the objectives of the PSI course.

Hardware and software. This system runs on commonly available PDP-8 computers. Features that are required and are not universally standard are: 12K core, BASIC, BRTS (OS), and

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UNIT# 3          NAME.....
EXAM# 1          DATE.....

1
THE MEDIAN IS THE SCORE AT THE 50TH PERCENTILE (T OR F). 4
2
THE PRESENCE OF ONE EXTREME SCORE IN A DISTRIBUTION IS A REASON
TO FAVOR THE MEDIAN OVER THE MEAN AS A MEASURE OF CENTRAL TEN-
DENCY (T OR F). 4
3
CALCULATE THE MEAN, MEDIAN, AND STANDARD DEVIATION
FROM THE DATA LISTED BELOW.

DATA ARE
INTERVAL      FREQUENCY
13 TO 14      5
15 TO 19      6
23 TO 24      3
25 TO 29      1
33 TO 34      9

ANSWER KEY
UNIT# 3      EXAM# 1
1           TRUE
2           TRUE
3

MEAN = 21.8148      FX = 589 FXS3 = 14573
SD = 8.14313

EXACT LL = 14.5
P SU3 3 = 3.9375
N = 27

MEDIAN = 19.1875
    
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Figure 2. A sample of a unit mastery quiz and answer key containing both short answer questions and numerical problems.

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RUN

BSTIII BA 3.0 19-AUG-75

EXAM NO
71
QUESTION NO
72
# ITERATIONS
72
WHAT SHALL I CALL COLUMNS? (10 CHARACTERS, RIGHT JUSTIFIED)
? DISTRICT
AND THE ROWS?(10 CHARS AGAIN)
? METHOD
PLEASE TYPE IN QUESTION TEXT
7A PROGRESSIVE METHOD (1) OF TEACHING READING WAS COMPARED TO THE
7CONVENTIONAL METHOD (2) IN TWO DIFFERENT SCHOOL DISTRICTS OF NYC.
7DO THE RESULTS BELOW SHOW ANY DIFFERENCE BETWEEN THE METHODS?
PLEASE ENTER # COLUMNS, # ROWS, # REPLICATIONS PER CELL
72,2,5

QUESTION 1 . 1 . 2
A PROGRESSIVE METHOD (1) OF TEACHING READING WAS COMPARED TO THE
CONVENTIONAL METHOD (2) IN TWO DIFFERENT SCHOOL DISTRICTS OF NYC.
DO THE RESULTS BELOW SHOW ANY DIFFERENCE BETWEEN THE METHODS?

        DISTRICT 1   DISTRICT 2
METHOD 1
        52           40
        83           30
        19           90
        24           68
        73           40
METHOD 2
        83           52
        50           72
        94           73
        84           51
        86           40

        DISTRICT 1   DISTRICT 2
METHOD 1
        40           27
        92           11
        60           98
        79           17
        88           55
METHOD 2
        94           20
        51           94
        28           52
        78           18
        68           93

SOLUTION 1 . 1 - 2
CELL TOTALS
251
298
399
288
GRAND TOTAL 1236
ROW TOTALS
549
687
COLUMN TOTALS
650
586
SUM OF THE SQUARES 85826
SUM OF CELL TOTALS SQUARED 393950
CORRECTION TERM 76384.8
ROW TOTAL SQUARES 77370
COLUMN TOTAL SQUARES 765896

SOLUTION 1 . 2 - 2
CELL TOTALS
359
288
329
277
GRAND TOTAL 1173
ROW TOTALS
567
636
COLUMN TOTALS
688
485
SUM OF THE SQUARES 86379
SUM OF CELL TOTALS SQUARED 357115
CORRECTION TERM 68796.4
ROW TOTAL SQUARES 688725
COLUMN TOTAL SQUARES 788569

A N A L Y S I S   O F   V A R I A N C E
SOURCE      SUM SQUARES   DF      MEAN SQUARE   F-RATIO
ROW MEANS   952.203       1        952.203       2.16533
COLUMN MEANS 234.797       1        234.797       0.465712
INTERACTION 1248.2        1        1248.2        2.83844
SUB-TOTAL   2405.2        3
RESIDUAL    7836         16        439.75
TOTAL       9441.2       19

A N A L Y S I S   O F   V A R I A N C E
SOURCE      SUM SQUARES   DF      MEAN SQUARE   F-RATIO
ROW MEANS   76.8625      1        76.8625      0.881372
COLUMN MEANS 2850.45      1        2850.45      2.28428
INTERACTION 490.047      1        490.047      0.524254
SUB-TOTAL   2626.56      3
RESIDUAL    14956        15        934.75
TOTAL       17582.5     19
    
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Figure 1. A sample run of BSTIII showing two copies of an analysis of variance. Different data are used in each problem.

APPENDIX

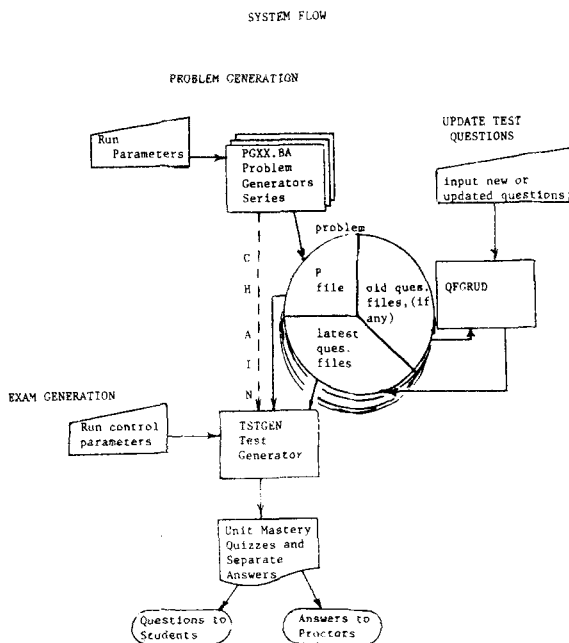


Figure 3. System flow chart. Note four tapes, each of which contains the entire set of programs, as well as compiler and file transfer programs, exam questions for four to six quizzes, and empty space for problem file storage.

one TD8E DEctape (or another mass storage device). These programs can, of course, be converted to timeshare, other hardware, other languages, etc., at varying levels of increased cost due to conversion and/or run-time costs.

Availability. All programs (statistical, file update, test generator, and problem generators) are available from the authors via paper tapes or DEctapes at cost. Requests should be sent to the authors at the above address.

PG (problem generator) Series
 General designation PGXX.BA
 PG32.BA - Calculation - mean, median, and SD from group data
 PG70.BA - Chi-square test
 PG80.BA - t test and either Mann-Whitney or Wilcoxon
 PG100.BA - Correlation (Pearson and Spearman)
 PG110.BA - One and two way ANOVA

BST Series

General Designation -BST xx.BA
 BST 32.BA - Mean, Median, standard deviation
 BST 70.BA - Chi Square
 BST 81.BA - t test
 BST 82.BA -Mann-Whitney U-test
 BST 83.BA -Wilcoxon T test
 BST 100.BA -Pearson correlation
 BST 101.BA -Spearman's Rho
 BST 111.BA -ANOVA -one- or two-way

REFERENCE

Keller, F. S. Good-bye teacher. *Journal of Applied Behavior Analysis*, 1968 1, 79-89.

REFERENCE NOTES

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2. Programming Languages, Digital Equipment Corporation, Maynard, Mass. 1972. Chap. 12.
3. OS/8 Handbook, Digital Equipment Corporation, Maynard, Mass., 1974. Pp. 6-68.
4. Introduction to Programming PDP-8 Series, Digital Equipment Corporation, Maynard, Mass. 1973. Pp. 7-1 to 7-6.
5. TU96 DEctape Transport Maintenance Manual (DEC-00-HRTC-D). Digital Equipment Corporation, Maynard, Mass. 1973. Pp. 1-1 to 1-4, pp. 2-8, pp. 303. Chap. 4.