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Research Project
Department of Computer Science
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A TOOL FOR MEASURING THE EFFECTIVENESS OF UNIVERSITY COMPUTING SERVICES

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1. INTRODUCTION

Criteria for evaluating computer systems have traditionally been considered by computer scientists and professionals from the viewpoint of machine efficiency rather than user satisfaction. This has been justified by arguing that, although some explanation of human behaviour is required in any form of man-computer interaction, "... [it is] not part of the legacy of the computer sciences" [Jutila and Baram 1971, p. 344]. But since it is the human user who utilises the computer as a problem-solving tool, he will judge and base future expectations of how well the tool performs for him. So, no matter how efficient the system components are, if the services provided by the computer system do not meet the needs of its users, the system is a failure: and there have been many such failures.

A university computing environment provides an excellent test bed in which to examine the needs of a varied user population, and to discover the crucial factors determining local user satisfaction. In addition, the New Zealand universities are all similarly equipped and founded, making it possible to compare the different ways of providing similar services, and to postulate the corresponding effects on user satisfaction.

The primary aim of this project is to develop a general tool for use in such a comparative investigation. In this process, a pilot study carried out at the University of Canterbury tested hypotheses about user characteristics, the nature of man-computer interaction, and the overall formulation of the tool.

2. BACKGROUND

User-oriented evaluation must firstly be viewed in relation to the wider concept of "man-computer interaction". Several authors have tried to define this esoteric relationship [Davis 1966; Licklider 1960; Shackel 1969] and formulate possible models [Carbonell 1969]. It is the nature of the link that exists between man and computer that must be clarified, before any valid hypothesis on user satisfaction may be postulated.

Previous literature has tended to consider specialised environments, as "... innovation studies were rampant; evaluation of user effectiveness was virtually non-existent" [Sackman 1970, p. 10]. For example, the comparison of time-sharing versus batch processing has been extensively studied [Gold 1969; Hansen 1976; Sackman 1970; Smith 1967]. The approach has been to measure levels of user performance, rather than satisfaction of user needs. Many have recognised the important role of human factors, but are constrained by lack of experimental measurement methods.

The majority of the research has been in commercial applications. As part of his doctoral dissertation, McKaskill [1977] carried out a comparative organisational survey to investigate factors which influence the effectiveness of computer-based information systems. The objective was to determine characteristics of the user, system, and organisation, and relate them to some measure of system effectiveness. Similarly, the extensive survey of Eason *et al.* [1974], covering 26 computer systems, identified the various user types, work types, and forms of interaction

within each organisation. Four indices (task fit, ease of use, user support, and indirect consequences) were constructed to summarise user responses, and proved useful in job type comparisons, and evaluating individuals and groups. Their most valuable contribution was in identifying the problems to tackle for man-computer interaction.

University computing service applications have concerned the role of university computing and characteristics of university users. Whether university computing is a political process [Wiste 1974], managing critical resources [Mosmann and Stefferud 1971], or part of a formal organisational model [Gross 1968; Varanelli 1978], adequate provision of services is still emphasised. Users may be studied according to their pattern of resource utilisation [Hunt *et al.* 1971; Haralambopoulos and Nagy 1977] or by the rate at which they learn to use the system effectively [Jutila and Baram 1971]. Particular services may be picked out as representing important factors in user satisfaction, such as consultative services [Alty *et al.* 1978] or the level of instructional computing [Mosmann 1977].

However, so far there has been no overall study of university computing services *à la* McKaskill. The essential questions that need to be asked for such a study are:

What is practicable to investigate?

How are the services to be evaluated?

How are the users' needs to be measured?

3. THE NATURE OF THE PROBLEM

The framework of the problem is to assess the extent to which university computing services meet user needs. Thus our primary concern is with effectiveness - how well the services perform, rather than efficiency - how much of the available resources are being used. We believe that the extent to which individual user's needs are satisfied, depends on three components:

(i) Nature of the computing services.

(ii) Nature of the users and their needs.

(iii) Nature of the interaction which exists between them.

A detailed analysis is required to ascertain what are the services, who are the users, and how do they interact with the services. Certain relationships may emerge as being obvious in establishing satisfaction or dissatisfaction of the individual user (e.g. turnaround time is important to students); others may be less direct (e.g. to what extent does previous experience influence present satisfaction). Testing these relationships with a large sample of university users should highlight the sensitive areas on the provision of computing services at Canterbury.

In the broader perspective, the future projection of this analysis into a comparative study of the New Zealand universities could pinpoint the merits of different approaches to these sensitive areas. The current computer configurations and funding structure of the universities are discussed with this basis in mind in Appendix A.

4. THE MAJOR EXPLORATORY AREAS

4.1. Provision of Computing Services

Definition 4.1.1.

We define *computing services* as all the facilities made generally available to assist users in the performance of their tasks.

These would include hardware and software, hours of availability, consultative and documentary services, ancillary services, funding and accounting routines. The term "computing services" is preferred over "computer services" as having a more general connotation, but the distinction is purely arbitrary. Also, in this project the computing services under study are those provided by the Computer Centre of the university.

In order to gauge the satisfaction level of users, one must determine the actual services provided by the Computer Centre. A list of the services provided by the University of Canterbury appears in Appendix B. Questions on the use of these services fall naturally into the following categories: the method of using the computer, from feeding parameters to writing complex programs; the communication method employed, such as batch or on-line; the frequency of use of consultative services, reference manuals and informational media; the methods of input preparation and output distribution.

In addition, the continuing support and development of these services is very important, for ".. computer centres have as a prime consideration, a service function to their

university... support must be responsive to requests thrown at it" [Selfridge 1973]. However, from the Computer Centre's view, it is often a tradeoff between satisfying user needs and meeting certain Centre requirements, e.g. extending the hours of availability may cause security problems. Also, as the range and maturity of facilities increase, so do user expectations, and the Computer Centre must cater accordingly for this.

4.2. The User Population

Definition 4.2.1.

We define a *computer user* as any person who makes use of the computing services in any type of application.

Typically this person will not be an expert in computing, but utilises the computer as a problem-oriented tool. Eason *et al.* [1974, p. 8] define such a person as a "naive computer user".

Within the university environment, the user population is a heterogeneous mixture of academics, students, and researchers. They all have a common aim in their utilisation of the computer, but differing emphases on factors important to their task performance, such as turnaround time, access to facilities, and quality of documentation and consultative services.

It would seem logical to use a behavioural model of the computer user; ".. because nearly all the evaluations are essentially trials with humans, the experimental methods of the human sciences must be used if validity is to be ensured" [Nickerson 1969, p. 155]. However, existing models seem

insufficient and at best only serve ".. as a set of evaluation criteria by which a third party may assess whether a particular system is likely to fulfil the needs of a particular kind of user" [Eason *et al.*, p. 7].

What is required then, is a description of the user profile. This will include his status as a user, purpose for using the computer, the major type(s) of work done (often equated to pattern of resource utilisation), and the level of the user's previous experience in computing. This last factor is especially important in forming the bias (one would hypothesise) for future expectations. The period and place of previous computing instruction and knowledge of various programming languages form some of the building blocks in the profile of a typical university user.

4.3. The Nature of the Interaction

The nature of the link or interface that exists between the user and the computer is highly tenuous and needs to be explained. Firstly we distinguish between the user's *mode* and *medium* of interaction. The mode may be explained as the use of a range of software facilities, whereas the medium is the communication method employed. For example, a statistical package user running batch programs is communicating via the batch medium, but his mode is described as feeding parameters into packages.

The interface as seen by Eason *et al.* [1974] comprises two distinct (sometimes opposing) functions: the interface as a link, relating the physical and psychological aspects of man to the hardware and software of the computer; and the interface as a barrier, protecting the user against

unnecessary complexity not required for his task.

Whatever the function of the interface, certain satisfaction levels are engendered by the users through their interaction with the services. These may be general attitudes to batch use, interactive use, the overall disposition, or particular frustrations with the adequacy of the consultative services, documentation or data preparation.

5. CONSTRUCTION OF THE TECHNIQUE

5.1. Formulation of the Questionnaire

5.1.1. Justification

Why use a questionnaire? We justify its use because of the "value of questionnaire surveys as useful exploratory aids - aids that uncover and highlight key problems and areas based on expressed attitudes and opinions of current and potential users" [Sackman 1970, p. 37]. Social scientists have traditionally used questionnaires for this type of purpose, and it was felt that a general survey of user attitudes was required for the first phase of this project.

5.1.2. Layout of the Questionnaire

On the basis of the features discussed in Section 4 on computing services, user population and the nature of the interaction between them, a table of user characteristics was formulated (Table 5-1). The content of the questionnaire was formulated from this table. The three logical subdivisions within the table represent the three major components under investigation. The questionnaire comprised 31 questions, with two additional comment sections available for user assessment of the computing services, and of the questionnaire itself.

5.1.3. Preliminary Survey

A small sample of forty users were selected at random from the monthly summary of user projects, to participate in the preliminary survey. By making a "dummy run", it was

Table 5-1. User Characteristics

1. Description of the user
   - 1.1 status
   - 1.2 purpose for using the computer
   - 1.3 work (job) type
   - 1.4 previous background in computing
     - 1.4.1 instruction period
     - 1.4.2 instruction place
     - 1.4.3 knowledge of computing languages
   - 1.5 level of computing expenditure

2. Use of computing services
   - 2.1 mode
   - 2.2 medium
   - 2.3 use of consultative services
   - 2.4 use of reference manuals
   - 2.5 use of informational media
   - 2.6 input preparation method
   - 2.7 output distribution method

3. Satisfaction levels
   - 3.1 batch use
   - 3.2 interactive use
   - 3.3 general facility use
     - 3.3.1 assistance with problems
     - 3.3.2 availability of staff
     - 3.3.3 adequacy and quality of ancillary services

hoped that ambiguities and irrelevancies in the questionnaire would be ironed out before the actual pilot study. The feedback from this preliminary survey was of great value in improving the layout and content of the questionnaire. For example, some users found it difficult to distinguish among work type alternatives; they did not consider themselves as belonging exclusively to one category, but to several categories in varying amounts. This question was subsequently modified to allow for more than one alternative. Also, some questions were applicable in some time periods, not in others; there was no allowance for the wide distribution of computing activity over some time period. A small analysis of the results showed interesting results and relationships that needed to be verified and compared with a larger sample.

5.2. Selection of the User Sample

5.2.1. Sample Size Determination

A full-scale study of all the users at Canterbury University would be a time-consuming task, though it would provide a true representation of user attitudes at this university. The problems of determining a significant sample size are well-known [Mace 1964]. Determining exactly who are the users then became particularly evident, when a sample size for the pilot study had to be selected. An inspection of the Computer Centre's user file (consisting of all registered projects, including subaccounts for undergraduate users of the B6718) revealed that much of the information was out-of-date and many users had since left and not closed their accounts. Subsequent editing of the

file and comparing it with the project registration forms, reduced the original figure of 900 users to about 600 current users at Canterbury University. The sample size selected was 295 users (300 were actually chosen, but five had already taken part in our preliminary survey). This seemed large enough to get a representative sample, yet not too large for processing constraints.

5.2.2. Sampling Technique

To increase the reliability of sample results, the technique of proportionate stratified sampling [Butcher 1965; Hansen 1963, ch. 5] was chosen. With this technique the population is divided into various strata, and independent, random selections are taken from each stratum. The proportion of the individuals per stratum in the sample must be the same as the proportion represented by that stratum in the total population, e.g. if students represent 60% of the total population of 1000 users, then for a sample size of 300, 60% or 180 of those selected should be students.

Proportionate stratified sampling tends to produce a more representative sample in the sense that "the sampling error of a mean [from the stratified sample] is nearly always smaller than the standard error in a simple random sample of the same size" [Butcher 1965, p. 7].

The user population was divided into two categories:

(i) External users; and

(ii) Internal users, who were subdivided into departments, and further into categories of staff and students. The population from which the sample was chosen did not include students using the PDP11/34 undergraduate

system, as the survey was primarily aimed at investigating the services provided by the B6700 and its satellites.

A breakdown of the numbers chosen in each category per department is shown in Table 5-2.

5.3. Analysis

After questionnaire collection and data entry, results were analysed using a statistical computer package. The main computer packages available were Basis, SPSS, and Teddybear. SPSS [Nie *et al.* 1970] was chosen mainly for availability of up-to-date documentation and ease of analysis by subprogram control cards.

For each user, various "satisfaction indices" were constructed to represent levels of satisfaction with particular services. These were:

(i) Batch index - an indication of the attitude towards various aspects of the batch service, such as turnaround time, queue structure, location of RJE facilities etc. (refer to Question 21 of the questionnaire in Appendix C).

(ii) Cande index - an indication of the attitude towards aspects of the interactive service, such as response time, assistance, range of facilities etc. (Question 22 in Appendix C).

(iii) Ancillary services index - the attitude towards support facilities such as data preparation, documentation, consultative services etc. (Questions 23-31 in Appendix C).

(iv) Overall index - the general attitude towards all aspects of the computing services represented by the average score for all the responses to batch, Cande, and ancillary

Table 5-2. Breakdown of Sample by Department and Category

Department	Staff	Students	Row total
Accountancy	3	-	3
Botany	1	-	1
Business Adm.	-	5	5
Chemistry	7	4	11
Chem. Eng.	4	5	9
Civil Eng.	10	6	16
Computer Science	3	63	66
Economics	3	4	7
Education	4	1	5
Elec. Eng.	3	8	11
English	1	-	1
Environ. Sci.	-	-	-
E.R.A.U.	-	-	-
Extension Studies	-	-	-
Forestry	2	2	4
French	2	-	2
Geography	5	3	8
Geology	-	1	1
History	-	1	1
Mathematics	5	8	13
Mech. Eng.	4	7	11
Mt. John Observatory	-	1	1
Music	1	-	1
Physics	7	11	18
Political Sci.	-	-	-
Pysch/Socio.	4	4	8
Zoology	3	7	10
Lincoln College	17	32	49
COLUMN TOTAL	89	173	262
EXTERNAL USERS			33
			295

services questions, not the average of the three indices.

The first three indices were calculated as the average of answered questions in the appropriate section. If a user did not use a particular service, such as the interactive service, the appropriate index was set to zero and did not contribute to any subsequent analysis. Each of the four indices could range from 1-5, corresponding to opinions ranging from "highly dissatisfied" to "highly satisfied".

Having established a general feel for user attitudes towards the provision of computing services, cross-tabulation techniques were used to identify the more sensitive interactions. Thses were exposed by looking at variations in satisfaction levels significantly at variance with those in the full sample.

There remains a very large number of interactions to be studied, but this detailed analysis based on the data base obtained from the survey, is not part of this project. Our objective was to develop a technique for exposing and analysing particular interactions, about which particular questions should be asked. The answers to the questions may be provided by the analysis, or further data may need to be obtained from the users concerned. The questions might be like these:

Are, say, FORTRAN users significantly more satisfied with batch services than, say, ALGOL users? If they are, why is this so?

Do users with some or first knowledge of assembler find services easier or more difficult to use? Again, if this is so, why?

Is there a typical growth path for particular types of users? For instance, do package users become FORTRAN users, or vice versa?

There is some dissatisfaction with batch turnaround. A fruitful study that could be carried out quite simply, would be to measure and compare the users' perceptions, expectations, and realisations of turnaround. We believe that users' satisfaction with services may be related at least as much to their feelings about the services, as it is to the absolute nature of the services they receive.

6. RESULTS

6.1. Response Rate

Of the 295 questionnaires sent out, 209 of them were returned. This represents a response rate of 70.85%. However, of those 209 returned, 22 of them were unanswered for such reasons as the user being away on sabbatical leave, having left the university, unable to be contacted, or preferring not to fill in the questionnaire because had not made any recent use of the services. Therefore the effective response rate was $^{187}/_{295} = 63.4\%$.

A copy of the questionnaire used in the survey and a summary of the responses for each question are provided in Appendix C. The percentages of responses for each question will not always add up to 100 as some users omitted various questions. The SPSS program written to analyse the data appears in Appendix D.

6.2. Analysis of Particular Interactions

Appendix E contains some of the analyses done on particular observed relationships. Table E-1 summarises the frequency distributions for the four satisfaction indices explained in Section 5.3. As expected with surveys of this kind, most of the indices indicate a "middle of the road" or "indifferent" attitude. The arithmetic means of the batch, general and overall indices all fall into the category 3.0 - 3.5 ("indifferent" to somewhat "satisfied"), with standard deviations of approximately 1. The Cande index mean is slightly lower at 2.5 - 3.0 (somewhat "dissatisfied" to "indifferent"). This indicates a slight dissatisfaction

with the interactive service, though how significant this indication is, requires further investigation, as only 42 out of the 187 users were Cande users. (Further analysis might reveal for instance, that users of the interactive service tend to be more experienced or otherwise more demanding in their expectations. Or else that the interactive service *per se* is less satisfactory than the batch service).

The breakdown of users into their level of usage of batch and Cande is indicated in Table E-2. The sample chosen is seen to consist predominantly of batch-only users (73.8%) with 20.9% of the users, using both facilities. That is, 94.7% of the respondents made use of the batch services. Due to this high proportion, it seemed beneficial to investigate properties of batch use, such as turnaround, and breakdowns of batch use by interaction medium or user status. Table E-3 is a cross-tabulation of the interaction medium against the batch index. It is interesting to note that the only users in the lowest category 1.5 - 2.0 (tending to "highly dissatisfied" to "dissatisfied") of the batch index, are the local batch users. The spread of the index for local batch users is obviously more on the low satisfaction side than any of the other categories. An investigation into the reasons for this dissatisfaction with local batch would probably involve a follow-up interview to ask the users which aspects of the batch service were causing the dissatisfaction.

One interesting observation from the summary of responses in Appendix C, was the frequency distribution for VARO49, the quality of available documentation. Although

only 12% of the users were highly dissatisfied and the distribution was very normal (mean 3.041, skewness -0.176), nevertheless the 12% represented 20 people who felt very strongly that the quality of documentation was very low. It was decided to find out what type of users were represented in this group of 20. Table E-4 lists the cross-tabulations of the documentation variable against user status, computing expenditure and user work type. It is very apparent that the highly dissatisfied with documentation users come from the ranks of the academic staff (they represent 75% of those highly dissatisfied). The correlation is not so obvious for the expenditure or worktype variables, although we can say that the users spending $20-$50 per month tend to be more dissatisfied (52% fall into categories "highly dissatisfied" or "dissatisfied") than the small or large spenders; and that dissatisfied users tend to do number crunching, data processing and computer modelling. Of the 30.4% of users in categories "highly dissatisfied" and "dissatisfied", these three types account for 72% of "highly dissatisfied" users, and 68% of "dissatisfied" users.

(Note: The statistics provided for the cross-tabulation of status against documentation, substantiate the evidence that academic staff are very dissatisfied with documentation. The chi-square value is a representation of whether any systematic relationship exists between the two variables. A large chi-square value usually implies a systematic relationship, while a small chi-square implies statistical independence. The chi-square value for this table is

38.87 - a fairly large value. To test whether this is significant, we look at the significance value provided, which is 0.0011. This means that the probability of obtaining this chi-square value or larger, with 16 degrees of freedom (the number of cases) is less than 0.0011, i.e. we can conclude that a systematic relationship does exist between user status and the satisfaction (or otherwise) of documentation quality. Roughly speaking, for only 1 time out of 1000 would this be due to chance. Hence the chi-square value is clearly statistically significant at the 0.01 level.)

7. CONCLUSIONS FROM THIS ANALYSIS

7.1. Implications for the Questionnaire as a Tool

The questionnaire has been most useful in providing the essential data required for investigations of user satisfaction with the provision of computing services. The comments made by the users on the format and content of the questionnaire are summarised in Appendix C. It is apparent that some abiguities still exist, the main complaint being that categories are not always mutually exclusive. These expressions of opinion will enable further improvements on the questionnaire to be made for future surveys.

7.2. Implications for the Analysis Technique

There are obviously several more types of interactions that could be studied from the raw data provided by the survey. It was not the objective to carry out a detailed analysis; rather it was wished to expose and analyse particular sensitive areas. In this, the analysis technique has been successful. An extension of the analysis would be to include a follow-up interview technique to obtain clarifications and additional data unobtainable from a general attitude indicator such as the questionnaire.

7.3. Implications for Broader Investigation

It has become obvious that the survey data has provided us with a valuable data base, which is able to be processed in a variety of ways. From this data base, it is possible to carry out analyses of various interactions, in order to gain greater insight in the field of measuring effectiveness

of university computing services. It has been possible to gauge the implications and problems associated with investigations in this area. It is hoped that research will continue to develop in measuring effectiveness of computing services at Canterbury and will extend to a comparative study of services at all the New Zealand Universities. The data we have, can show what are the sensitive areas at Canterbury. The broader study should indicate whether patterns of satisfaction and dissatisfaction observed locally, apply more generally. It also may suggest which of the techniques for providing computing services (in environments which are in many ways very similar) are relatively more effective in meeting users' needs.

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APPENDIX A: A Look at the New Zealand Universities

There are seven universities in New Zealand; their geographical layout and current machine configurations are indicated in Fig. A-1. Computing services are provided by the individual university computer centres. Funding is now based on submission of quinquennial estimates from each university to the government, and the subsequent allocation of block grants. In earlier days, the uneven development of the computing services at the different campuses was very much a reflection of the extent to which those universities were prepared to invest their own funds in computing.

In 1970 the government provided a $3.425M special grant to the universities to purchase computer equipment and facilities for the following quinquennium 1970-1974. This has led to the current configurations of B6700 processors at Auckland, Massey, Victoria, Canterbury and Otago, with on-line access (originally DC1200 equipment, now PDP11/70 and PDP11/40 respectively) for Waikato and Lincoln. There was then a deliberate attempt to provide equivalent computer services to the individual user, whatever his university.

Although the hardware configurations are similar in all universities, the implementation at the computer centres has proceeded very autonomously. This has resulted in different ways of providing services at each university, in areas such as charging policies, queueing and priority structures, hours of availability, range of interactive facilities etc. Hence a unique opportunity has arisen. The universities may be objectively compared to determine the factors relevant to

satisfaction, obtained from different ways of providing similar services on similar equipment.

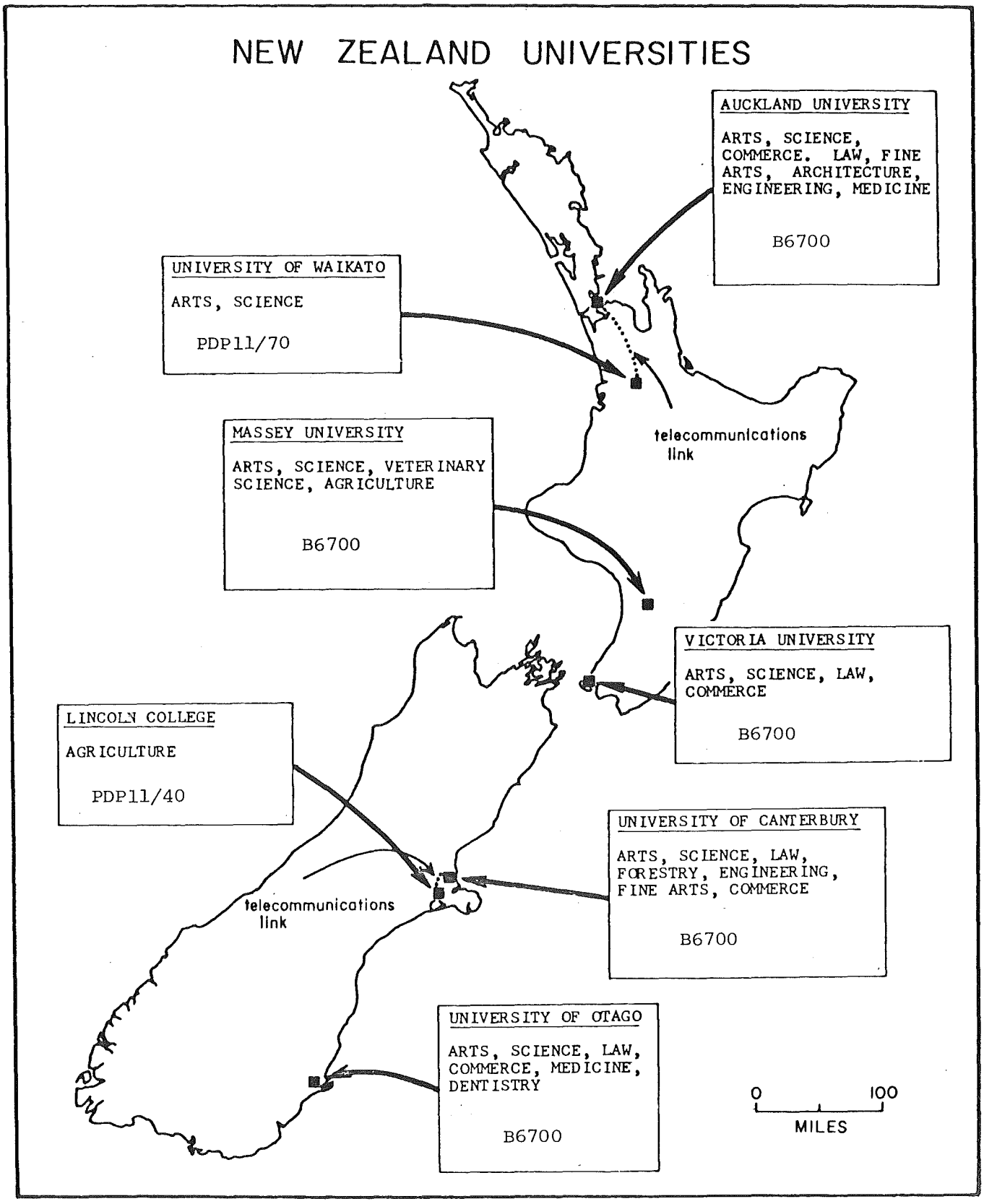

Figure A-1 The New Zealand Universities

APPENDIX B: Computing Services offered at the University of Canterbury

Hardware
- B6718 computer
- 224K words of memory (fast, bulk, planar)
- Various peripherals including card readers, line printers, card punches, paper tape readers, paper tape punches, VDUs
- X-Y plotter
- GT44 Graphics system

Software
- a wide range of language compilers
- statistical and numerical analysis packages

Ancillary support
- professional data preparation facilities
- RJE stations at Lincoln and Engineering
- CANDE interactive services
- accounting routines

Human support
- duty programmer
- Computer Centre staff (28)
- computer users' group
- departmental liaison officer

Informational support
- User's Guide
- Newsletter
- suggestions book
- message of the day
- Ansatel service
- on-line documentation
- Reference manuals

APPENDIX C

Questionnaire used and

summary of the responses

USER PERSONAL EXPERIENCE

1	2	3	4	5	6
5	0	2			

(1) Which one of the following best describes your status as a user?

1. Academic staff member (33%0
2. Postgraduate student (23%)
3. Undergraduate student (26%)
4. External user (13%)
5. Other (please specify) ..... (5%)

7 [ ]

(2) Which one of the following best describes your major purpose for using the computer?

1. Because it would be impossible to undertake the work otherwise (33%)
2. The work would otherwise be limited in scope (14%)
3. To save time and effort (19%)
4. The computer itself is an inherent part of the study (33%)

8 [ ]

(3) Which one of the following best classifies the major type of work you do on the computer. If you cannot decide among alternatives, enter two.

1. Number crunching, i.e. large amount of CPU time
2. Package analysis, i.e. extensive use of statistical and other packages
3. Data processing, i.e. large amount of I/O and information retrieval
4. Developing computer models
5. Teaching, e.g. CAL
6. Learning programming

9 [ ] [ ] 10

* See Note 1

(4) How long a period of instruction in computing have you received?

1.	None	(12%)
2.	Less than one week	(13%)
3.	One week - one month	(16%)
4.	One month - six months	(18%)
5.	Over six months	(41%)

11 

(5) Where did you receive your instruction (if any) in computing?

1.	Not applicable	(9%)
2.	Machine company training course	(2%)
3.	Computer Centre service course	(8%)
4.	Self-taught instruction course	(16%)
5.	University unit	(51%)
6.	Other (please specify)	(15%)

12 

(6) What is your average gross expenditure on computing per month?

1.	Less than $5	(28%)
2.	$5 - $20	(34%)
3.	$20 - $50	(13%)
4.	$50 - $100	(8%)
5.	Over $100	(10%)
6.	Don't know	(7%)

13 

If your use of the computer involves writing programs (as opposed
* o providing data for packages), answer questions (7) and (8).
therwise please leave blank.

* (7) How do you write your programs?

1. In collaboration with others (apart from consultants, etc.) (10%)
2. By yourself (70%)

14 ☐

* (8) Once your typical program is developed, will it:

1. Be used repeatedly with different parameters and/or data? (35%)
2. Have provided the end solution to the problem and will not be run again? (32%)
3. Be run again after modification or incorporation with other programs? (13%)

15 ☐

(9) Please indicate the extent of your knowledge in the following languages, and the percentage of your work done in them.

		No Knowledge		Workable		Capable & fluent	% work done in this language	
1.	FORTRAN	1	2	3	4	5	16 ___ 18	19 ☐
2.	ALGOL	1	2	3	4	5	20 ___ 22	23 ☐
3.	COBOL	1	2	3	4	5	24 ___ 26	27 ☐
4.	PL/1	1	2	3	4	5	28 ___ 30	31 ☐
5.	Assembler lang. (any type)	1	2	3	4	5	32 ___ 34	35 ☐
6.	Statistical & other packages	1	2	3	4	5	36 ___ 38	39 ☐
7.	Other lang. (if applicable)	1	2	3	4	5	40 ___ 42	43 ☐

.....

* See Note 2

(10) Which of the languages in Question 9 did you learn first (indicate one from 1 - 7)?

44 ☐

* See Note 3

USE OF SUPPORT FACILITIES

11) How do you principally use the computer?

1. By feeding parameters/data into given packages (30%)
2. By writing small procedures or sections to be added to a supplied program (5%)
3. By writing entire source programs to solve a problem (54%)
4. By writing batches of programs to solve a major problem (11%)

45 ☐

(12) Through which medium do you usually communicate with the computer?

1. Local batch at Computer Centre (62%)
2. Remote through CANDE terminals (6%)
3. Remote batch at Lincoln College, Engineering batch terminals (30%)
4. Give your requirements to someone else, who interprets them and gives back the desired results (2%)

46 ☐

(13) How would you summarise the distribution of your computing activity over a year?

Very Irregular		Sporadic		Regular
1 (13%)	2 (9%)	3 (35%)	4 (27%)	5 (16%)

47 ☐

(14) Roughly speaking, how often do you consult a Duty Programmer?

Never	Yearly	Monthly	Weekly	Daily or more often
1 (18%)	2 (35%)	3 (37%)	4 (10%)	5 (0%)

48 ☐

(15) How often do you consult reference manuals?

Never		Occasionally		All the time
1 (4%)	2 (12%)	3 (42%)	4 (30%)	5 (12%)

49 ☐

		Yes	No	
(16)	Do you have a copy of the User's Guide?	1 (54%)	5 (46%)	50
(17)	Do you receive regular copies of the Newsletter?	1 (49%)	5 (51%)	51

(18) How many User's Group meetings do you attend per year? 52

0 1 2 3 4 or more

(19) How do you usually prepare the majority of input for your programs and data?

1. Use professional data preparation facilities at the Computer Centre or Lincoln College (51%)
2. Do own keypunching (44%)
3. Explain your needs to someone else (4%)

53

(20) How do you normally receive output for your problems?

1. Pick it up from the Computer Centre or batch terminal yourself (81%)
2. Have it brought to the department by courier (17%)
3. Receive a report prepared by someone else from computer output (1%)

54

USER SATISFACTION

If you have particular comments about any questions in this section, please add them to those in Question 32.

	Highly dissatisfied			Neither satisfied nor dissatisfied		Highly satisfied	
(21) Are you a batch user? If so, how satisfied are you with:							
1. Turnaround time	1	(5%)	2 (28%)	3 (26%)	4 (31%)	5 (10%)	55
2. Hours of availability of batch facilities	1	(5%)	2 (22%)	3 (26%)	4 (28%)	5 (20%)	56
3. Present queue and priority structure	1	(2%)	2 (7%)	3 (37%)	4 (38%)	5 (17%)	57
4. Extent to which you are advised of unscheduled delays (due to breakdowns, etc.)	1	(5%)	2 (16%)	3 (44%)	4 (20%)	5 (14%)	58
5. Location of batch facilities (RJE or Centre)	1	(2%)	2 (10%)	3 (34%)	4 (27%)	5 (27%)	59
(22) Are you a CANDE user? If so, how satisfied are you with:							
1. Response time for editing	1	(17%)	2 (23%)	3 (50%)	4 (10%)	5 (0%)	60
2. Response time for execution of tasks	1	(7%)	2 (21%)	3 (43%)	4 (19%)	5 (10%)	61
3. Hours of availability of CANDE	1	(22%)	2 (37%)	3 (15%)	4 (20%)	5 (7%)	62
4. Range of facilities available	1	(7%)	2 (17%)	3 (20%)	4 (37%)	5 (20%)	63
5. Ease of obtaining assistance in case of breakdown during a CANDE session	1	(8%)	2 (13%)	3 (49%)	4 (23%)	5 (8%)	64

How satisfied are you with:	Highly dissatisfied		Neither satisfied nor dissatisfied		Highly satisfied	
(23) Response of Computer Centre to problems that you experience (e.g. software bugs, hardware breakdowns, supply shortages, etc.)	1 (4%)	2 (8%)	3 (42%)	4 (27%)	5 (18%)	65
(24) Adequacy of the Duty Programmer service	1 (4%)	2 (13%)	3 (41%)	4 (30%)	5 (12%)	66
(25) Availability of Computer Centre staff	1 (1%)	2 (10%)	3 (40%)	4 (32%)	5 (18%)	67
(26) Quality and administration of data preparation facilities	1 (1%)	2 (10%)	3 (35%)	4 (25%)	5 (29%)	68
(27) Quality of available documentation	1 (12%)	2 (19%)	3 (33%)	4 (27%)	5 (9%)	69
(28) Willingness of Computer Centre to make provision for an unusual requirement	1 (2%)	2 (4%)	3 (53%)	4 (25%)	5 (17%)	70
(29) The User's Group as a medium of communicating your needs	1 (2%)	2 (7%)	3 (83%)	4 (5%)	5 (3%)	71
(30) Adequacy of computing funds to support your projects	1 (2%)	2 (8%)	3 (23%)	4 (33%)	5 (34%)	72
(31) Fairness of the charging algorithm	1 (4%)	2 (11%)	3 (33%)	4 (28%)	5 (14%)	73

(2) GENERAL ASSESSMENT

If you have any additional suggestions or criticisms regarding the provision of computing services at present, we would be glad to receive them. It would be helpful if you could list the characteristics of the Burroughs system and its satellites under the following headings:-

Helpful/Good/Supportive Frustrating/Unsatisfactory

Various comments were received. The main points are listed below:-

- too complicated WFL commands
- introductory courses for CANDE and WFL commands would be helpful
- low quality of documentation in general
- not enough primers for new users

(33) GENERAL COMMENT

Any other general comments. In particular, if you have any comments regarding this questionnaire (format, depth, content, etc.), we will be pleased to receive them.

The main faults with the questionnaire format are listed below:-

- non-mutual exclusivesness of questions 2, 8, 9, 11, 12
- question 4 should specify over which time period
- question 5 should perhaps included "overseas" as an alternative
- more specific questions on particular aspects of the service, e.g. plotter quality, use of GT44, etc.

THERE ARE 9 PAGES TO THIS QUESTIONNAIRE. PLEASE CHECK THAT YOU HAVE FILLED OUT ALL THE PAGES. THANK YOU FOR YOUR CO-OPERATION.

Notes on Summary of Questionnaire Responses

1. Question 3 is the major type of work done on the computer. As there could be some overlap of categories, up to two alternatives were allowed. This is handled by SPSS as a multiple response question. The frequency distributions, according to number of responses and number of respondents, are shown in Table C-1.

2. Question 9 is the user's current knowledge and use of various programming languages. This was divided into two sections:

   (i) The extent of knowledge in the programming languages.

   (ii) The percentage of present work done in this language.

   The summaries are represented in Tables C-2 and C-3 respectively.

3. Question 10 is the programming language learnt first by the user. The distributions are summarised in Table C-4.

```
PILOT STUDY ON USER EFFECTIVENESS                                    10/27/78        PAGE    7
LEVEL OF USAGE OF BATCH AND CANDE
CPU TIME REQUIRED..    0.51 SECONDS

                TASK NAME      FREQUENCY OF MAJOR WORK TYPES OF USERS (MORE THAN 1 ALT ALLOWED)
                MULT RESPONSE  GROUPS=WORKTYPE WORK CLASSIFICATION
                                    (VAR003) TO VAR004(0,6))/
                               FREQUENCIES=WORKTYPE)
                STATISTICS     ALL

'MULT RESPONSE' PROBLEM REQUIRES      18 WORDS OF WORKSPACE NOT INCLUDING LABELS.
GIVEN SPACE PROVIDES FOR    1498 LABELS FOR FREQUENCIES
AND   2998 LABELS FOR TABLES.


PILOT STUDY ON USER EFFECTIVENESS                                    10/27/78        PAGE    8
FREQUENCY OF MAJOR WORK TYPES OF USERS (MORE THAN 1 ALT ALLOWED)
FILE   USERS   (CREATION DATE = 10/27/78)   QUESTIONNAIRE REPLIES FROM SURVEY DONE AT CANTERBURY UNIV
GROUP WORKTYPE  WORK CLASSIFICATION

                                                                    PCT OF   PCT OF
CATEGORY LABEL                          CODE      COUNT  RESPONSES  CASES
NUMBER CRUNCHING                           1         60       22.5    32.1
PACKAGE ANALYSIS                           2         53       19.9    28.3
DATA PROCESSING                            3         63       23.6    33.7
DEVELOPING COMPUTER                        4         35       13.1    18.7
TEACHING                                   5         12        4.5     6.4
LEARNING PROGRAMMING                       6         44       16.5    23.5
                                    TOTAL RESPONSES          267      100.0   142.8

     0 MISSING CASES     187 VALID CASES
```

Table C-1 Frequency of Users' Major Work Types

Table C-2. Extent of User Knowledge in Programming Languages

Programming Language	No knowledge	Poor knowledge	Workable knowledge	Good knowledge	Capable & fluent
FORTRAN	19(10%)	20(11%)	45(24%)	51(27%)	52(28%)
ALGOL	89(48%)	23(12%)	24(13%)	28(15%)	23(12%)
COBOL	146(78%)	10 (5%)	14 (7%)	13 (7%)	4 (2%)
PL/1	173(93%)	9 (5%)	4 (2%)	0 (0%)	1 (1%)
Assembler	123(66%)	13 (7%)	28(15%)	7 (4%)	16 (9%)
Statistical Packages	112(60%)	16 (9%)	30(16%)	20(11%)	9 (5%)
Other languages	153(82%)	3 (2%)	10 (5%)	9 (5%)	12 (6%)

Table C-3. Percentage of Present Work Done in Programming Languages

Programming Language	No work done	1-25%	26-50%	51-75%	76-99%	100%
FORTRAN	42(23%)	40(21%)	27(14%)	9 (5%)	24(13%)	45(24%)
ALGOL	113(60%)	21(11%)	15 (8%)	22(12%)	10 (5%)	6 (3%)
COBOL	161(86%)	15 (8%)	8 (4%)	0 (0%)	1 (1%)	2 (1%)
PL/1	185(99%)	2 (1%)	0	0	0	0
Assembler	153(82%)	30(16%)	1 (½%)	2 (1%)	1 (½%)	0
Stats. Packages	126(67%)	26(14%)	6 (3%)	3 (2%)	11 (6%)	15 (8%)
Other languages	170(91%)	10 (5%)	3 (2%)	4 (2%)	0	0

APPENDIX D

The SPSS Program for Data Analysis

SPSS FOR B6700, VERSION H, RELEASE 7.2, LEVEL 72.001.028.005

DEFAULT SPACE ALLOCATION... ALLOWS FOR...
NCRASPACE 17500 WORDS — 50 TRANSFORMATIONS
TRANSPACE 2500 WORDS — 400 RECODE VALUES + LAG VARIABLES
— 600 IF/COMPUTE OPERATIONS

PAGESIZE — 70
RUN NAME — PILOT STUDY ON USER EFFECTIVENESS
FILE NAME — USERS, QUESTIONNAIRE REPLIES FROM SURVEY DONE AT CANTERBURY UNIV
INPUT MEDIUM — CARD
VARIABLE LIST — SVCODE,STATUS,PURPOS,VAR003 TO VAR053
INPUT FORMAT — FIXED (F6.0,9F1.0,F3.0,F1.0,F3.0,F1.0,F3.0,F1.0,F3.0,F1.0,F3.0,F1.0,F3.0,F1.0,F3.0,F1.0,30F1.0)

ACCORDING TO YOUR INPUT FORMAT, VARIABLES ARE TO BE READ AS FOLLOWS

VARIABLE	FORMAT	RECORD	COLUMNS
SVCODE	F 6.0	1	1- 6
STATUS	F 1.0	1	7- 7
PURPOS	F 1.0	1	8- 8
VAR003	F 1.0	1	9- 9
VAR004	F 1.0	1	10- 10
VAR005	F 1.0	1	11- 11
VAR006	F 1.0	1	12- 12
VAR007	F 1.0	1	13- 13
VAR008	F 1.0	1	14- 14
VAR009	F 1.0	1	15- 15
VAR010	F 3.0	1	16- 18
VAR011	F 1.0	1	19- 19
VAR012	F 3.0	1	20- 22
VAR013	F 1.0	1	23- 23
VAR014	F 3.0	1	24- 26
VAR015	F 1.0	1	27- 27
VAR016	F 3.0	1	28- 30
VAR017	F 1.0	1	31- 31
VAR018	F 3.0	1	32- 34
VAR019	F 1.0	1	35- 35
VAR020	F 3.0	1	36- 38
VAR021	F 1.0	1	39- 39
VAR022	F 3.0	1	40- 42
VAR023	F 1.0	1	43- 43
VAR024	F 1.0	1	44- 44
VAR025	F 1.0	1	45- 45
VAR026	F 1.0	1	46- 46
VAR027	F 1.0	1	47- 47
VAR028	F 1.0	1	48- 48
VAR029	F 1.0	1	49- 49
VAR030	F 1.0	1	50- 50
VAR031	F 1.0	1	51- 51
VAR032	F 1.0	1	52- 52
VAR033	F 1.0	1	53- 53
VAR034	F 1.0	1	54- 54
VAR035	F 1.0	1	55- 55
VAR036	F 1.0	1	56- 56
VAR037	F 1.0	1	57- 57
VAR038	F 1.0	1	58- 58
VAR039	F 1.0	1	59- 59
VAR040	F 1.0	1	60- 60
VAR041	F 1.0	1	61- 61
VAR042	F 1.0	1	62- 62
VAR043	F 1.0	1	63- 63

ACCORDING TO YOUR INPUT FORMAT, VARIABLES ARE TO BE READ AS FOLLOWS

VARIABLE	FORMAT	RECORD	COLUMNS
VAR044	F 1.0	1	64- 64
VAR045	F 1.0	1	65- 65
VAR046	F 1.0	1	66- 66
VAR047	F 1.0	1	67- 67
VAR048	F 1.0	1	68- 68
VAR049	F 1.0	1	69- 69
VAR050	F 1.0	1	70- 70
VAR051	F 1.0	1	71- 71
VAR052	F 1.0	1	72- 72
VAR053	F 1.0	1	73- 73

THE INPUT FORMAT PROVIDES FOR 54 VARIABLES. 54 WILL BE READ
IT PROVIDES FOR 1 RECORDS ('CARDS') PER CASE. A MAXIMUM OF 73 'COLUMNS' ARE USED ON A RECORD.

N OF CASES 187

VAR LABELS

SVCODE SURVEY CODE/
STATUS USER CLASSIFICATION/
PURPOS PURPOSE FOR USING COMPUTER/
VAR003 MAJOR WORK TYPE ALT 1/
VAR004 MAJOR WORK TYPE ALT 2/
VAR005 PERIOD OF INSTRUCTION IN COMPUTING/
VAR006 PLACE OF INSTRUCTION IN COMPUTING/
VAR007 AVERAGE COMPUTING EXPEND. PER MONTH/
VAR008 PROGRAM WRITING METHOD/
VAR009 PROGRAM PURPOSE/
VAR010 FORTRAN WORK % /
VAR011 AMOUNT FORTRAN KNOWLEDGE/
VAR012 ALGOL WORK % /
VAR013 AMOUNT ALGOL KNOWLEDGE/
VAR014 COBOL WORK % /
VAR015 AMOUNT COBOL KNOWLEDGE/
VAR016 PL1 WORK % /
VAR017 AMOUNT PL1 KNOWLEDGE/
VAR018 ASSEMBLER WORK % /
VAR019 AMOUNT ASSEMBLER KNOWLEDGE/
VAR020 STATS PACKAGE WORK % /
VAR021 AMOUNT STATS PACKAGE KNOWLEDGE/
VAR022 OTHER LANGS % /
VAR023 AMOUNT OTHER LANG KNOWLEDGE/
VAR024 LANGUAGE LEARNT FIRST/
VAR025 MODE OF COMPUTER USE/
VAR026 MEDIUM OF COMMUNICATION/
VAR027 DISTRIBUTION OF COMPUTING ACTIVITY/
VAR028 DUTY PROGRAMMER USE/
VAR029 REFERENCE MANUAL USE/
VAR030 CMN USERS GUIDE/
VAR031 COPIES OF NEWSLETTER/
VAR032 ATTEND USERS GROUP MEETINGS/
VAR033 INPUT PREPARATION MODE/
VAR034 OUTPUT COLLECTION MODE/
VAR035 BATCH TURNAROUND TIME/
VAR036 HOURS OF BATCH AVAILABILITY/
VAR037 BATCH QUEUE & PRIORITY/
VAR038 UNSCHEDULED BATCH DELAYS/
VAR039 LOCATION OF BATCH FACILITIES/
VAR040 CANDE EDITING RESPONSE TIME/
VAR041 CANDE TASK EXECUTION TIME/
VAR042 HOURS OF CANDE AVAILABILITY/
VAR043 CANDE RANGE OF FACILITIES/
VAR044 EASE OF OBTAINING CANDE ASSISTANCE/
VAR045 RESPONSE OF CC TO PROBLEMS/
VAR046 ADEQUACY OF DUTY PROG SERVICE/
VAR047 AVAILABILITY OF CC STAFF/
VAR048 DATA PREPARATION FACILITIES/

```
                                VAR049 QUALITY OF AVAILABLE DOCUMENTATION/
                                VAR050 UNUSUAL REQUIREMENT PROVISION/
                                VAR051 USER NEEDS VIA USERS GROUP/
                                VAR052 ADEQUACY OF COMPUTING FUNDS/
                                VAR053 FAIRNESS OF CHARGING ALG
                    VALUE LABELS STATUS (1) ACADEMIC STAFF (2) POSTGRAD STUDENT
                                (3) UNDERGRAD STUDENT (4) EXTERNAL USER (5) OTHER/
                                PURPOS (1) IMPOSSIBLE OTHERWISE (2) LIMITED IN SCOPE
                                (3) SAVE TIME & EFFORT (4) STUDY THE COMPUTER ITSELF/
                                VAR003 ,VAR004 (1) NUMBER CRUNCHING (2) PACKAGE ANALYSIS
                                (3) DATA PROCESSING (4) DEVELOPING COMPUTER MODELS
                                (5) TEACHING (6) LEARNING PROGRAMMING/
                                VAR005 (1) NONE (2) < 1 WEEK (3) 1 WK - 1 MTH (4) 1 MTH - 6 MTHS
                                (5) > 6 MTHS/
                                VAR006 (1) NOT APPLICABLE (2) MACHINE COMPANY (3) COMPUTER CENTRE
                                (4) SELF-TAUGHT (5) UNIVERSITY UNIT (6) OTHER/
                                VAR007 (1) <$5 (2) $5-$20 (3) $20-$50 (4) $50-$100 (5) >$100
                                (6) DONT KNOW/
                                VAR008 (1) IN COLLABORATION WITH OTHERS (2) BY YOURSELF
                                (5) DON'T WRITE PROGRAMS/
                                VAR009 (1) RUN WITH DIFF PARAMS (2) END SOLUTION
                                (3) WITH MODIFICATIONS (5) DON'T WRITE PROGRAMS/
                                VAR010,VAR012,VAR014,VAR016,VAR018,VAR020,VAR022
                                (1) NO WORK DONE (2) 1-25% WORK DONE (3) 26-50% WORK DONE
                                (4) 51-75% WORK DONE (5) 76-99% WORK DONE (6) 100% WORK/
                                VAR011,VAR013,VAR015,VAR017,VAR019,VAR021,VAR023
                                (1) NO KNOWLEDGE (2) POOR KNOWLEDGE (3) WORKABLE KNOWLEDGE
                                (4) GOOD KNOWLEDGE (5) CAPABLE & FLUENT/
                                VAR024 (1) FORTRAN (2) ALGOL (3) COBOL (4) PL1 (5) ASSEMBLER
                                (6) STATS PKGES (7) OTHERS /
                                VAR025 (1) DATA INTO PACKAGES (2) SMALL PROCEDURES
                                (3) SOURCE PROGRAMS (4) BATCHES OF PROGRAMS/
                                VAR026 (1) LOCAL BATCH (2) REMOTE THRU CANDE (3) REMOTE BATCH
                                (4) HUMAN INTERMEDIARY/
                                VAR027 (1) VERY IRREGULAR (2) IRREGULAR (3) SPORADIC
                                (4) FAIRLY REGULAR (5) REGULAR/
                                VAR028 (1) NEVER (2) YEARLY (3) MONTHLY (4) WEEKLY (5) DAILY/
                                VAR029 (1) NEVER (2) RARELY (3) OCCASIONALLY (4) FREQUENTLY
                                (5) ALL THE TIME/
                                VAR030,VAR031 (1) YES (5) NO
                                VAR033 (1) DP FACILITIES (2) OWN KEYPUNCHING
                                (3) EXPLAIN NEEDS/
                                VAR034 (1) PICK UP PERSONALLY (2) VIA COURIER
                                (3) RECEIVE A REPORT/
                                VAR035 TO VAR053 (1) HIGHLY DISSATIS (2) DISSATIS
                                (3) INDIFFERENT (4) SATISF (5) HIGHLY SATISF
                    ALLOCATE    TRANSPACE=5000

SPECIFIED SPACE ALLOCATION..  ALLOWS FOR..   100 TRANSFORMATIONS
WORKSPACE     15000 WORDS                    800 RECODE VALUES + LAG VARIABLES
TRANSPACE      5000 WORDS                   1200 IF/COMPUTE OPERATIONS

                    RECODE      VAR008,VAR009 (BLANK=5)/
                                VAR011,VAR013,VAR015,VAR017,VAR019,VAR021,VAR023 (BLANK=1)/
                                VAR010,VAR012,VAR014,VAR016,VAR018,VAR020,VAR022
                                (BLANK,0=1) (1 THRU 25=2) (26 THRU 50=3) (51 THRU 75=4)
                                (76 THRU 99=5) (100=6)
                    COMMENT     INITIALISE REQUIRED VARIABLES
                                THERE WERE 5 BATCH, 5 CANDE, AND 9 GENERAL QUESTIONS
                                ON USER SATISFACTION
                    COMPUTE     NUMBQN=5
                    COMPUTE     NUMCQN=5
                    COMPUTE     NUMGQN=9
                    COMMENT     CALCULATE EFFECTIVENESS INDICES FOR BATCH,CANDE,GENERAL,TOTAL
                    DO REPEAT   VB=VAR035 TO VAR039/
                                VC=VAR040 TO VAR044/
                    IF          (VB EQ 0) NUMBQN=NUMBQN - 1
                    IF          (VC EQ 0) NUMCQN=NUMCQN - 1
                    COMPUTE     BINDX=BINDX+VB
```

```
                COMPUTE         CINDX=CINDX+VC
                END REPEAT
DO REPEAT REQUIRED  96 WORDS OF WORKSPACE.

                DO REPEAT       VG=VAR045 TO VAR053/
                IF              (VG EQ 0) NUMGWN=NUMGQN + 1
                COMPUTE         GINDX=GINDX+VG
                END REPEAT
DO REPEAT REQUIRED  56 WORDS OF WORKSPACE.

                COMPUTE         TINDX=(BINDX+CINDX+GINDX)/(NUMBQN+NUMCQN+NUMGQN)
                IF              (NUMBQN NE 0) BINDX=BINDX / NUMBQN
                IF              (NUMCQN NE 0) CINDX=CINDX / NUMCQN
                IF              (NUMGQN NE 0) GINDX=GINDX / NUMGQN
                COMMENT         CALCULATE THE NUMBER OF USERS WHO USE:
                                (1) BOTH BATCH AND CANDE
                                (2) BATCH ONLY
                                (3) CANDE ONLY
                                (4) NEITHER
                                THE TOTAL NUMBER IN EACH CATEGORY IS REPRESENTED BY THE FREQUENCY
                                OF THE VALUES 1,2,3,4 OF THE VARIABLE LEVUSAGE
                IF              (BINDX NE 0 AND CINDX NE 0) LEVUSAGE=1
                IF              (BINDX NE 0 AND CINDX EQ 0) LEVUSAGE=2
                IF              (BINDX EQ 0 AND CINDX NE 0) LEVUSAGE=3
                IF              (BINDX EQ 0 AND CINDX EQ 0) LEVUSAGE=4
                RECODE          BINDX,CINDX,GINDX,TINDX (0.5 THRU 1.0=1) (1.0 THRU 1.5=2)
                                (1.5 THRU 2.0=3) (2.0 THRU 2.5=4) (2.5 THRU 3.0=5)
                                (3.0 THRU 3.5=6) (3.5 THRU 4.0=7) (4.0 THRU 4.5=8) (4.5 THRU 5=9)
                VAR LABELS      BINDX BATCH HAPPY INDEX/
                                CINDX CANDE HAPPY INDEX/
                                GINDX GENERAL HAPPY INDEX/
                                TINDX OVERALL HAPPY INDEX/
                VALUE LABELS    LEVUSAGE (1) BOTH BATCH AND CANDE (2) BATCH ONLY (3) CANDE ONLY
                                         (4) NEITHER/
                                BINDX,CINDX,GINDX,TINDX (1) 0.5=1.0 (2) 1.0=1.5
                                (3) 1.5=2.0 (4) 2.0=2.5 (5) 2.5=3.0 (6) 3.0=3.5
                                (7) 3.5=4.0 (8) 4.0=4.5 (9) 4.5=5.0
                MISSING VALUES  STATUS TO VAR009,VAR024 TO VAR031,VAR033 TO VAR053 (0)
                                BINDX,CINDX,GINDX,TINDX (0)
                TASK NAME       FREQUENCY OF LANGUAGES LEARNT FIRST
                FREQUENCIES     INTEGER=VAR024 (0,7)
                OPTIONS         3
                STATISTICS      ALL
FREQUENCIES PROBLEM REQUIRES  49 WORDS OF SPACE

                READ INPUT DATA
```

Running a SPSS Program

SPSS provides options for associating labels with variables and values, for recording variables to values other than the input value, for adjusting for missing values, selecting cases according to conditional expressions, and many other features. Once all the variables and transformations are defined, they provide a data base file for any subsequent processing. Frequency distributions, cross-tabulations and Pearson's correlations are just a few of the many statistical analysis methods available with SPSS. Each of these methods is generated by subprogram control cards, the general format of which is:

col. 1	col. 16
:	:
<name of method>	<variable parameters>
OPTIONS	<required options>
STATISTICS	<required statistics>

The reader is referred to Nie *et al.* [1970] for a detailed description on how to run SPSS programs.

WFL for Running SPSS programs

The following WFL cards are required to run a SPSS program. In the initial run to create a file from the questionnaire data, FILE4 is the system output file that is generated on a SAVE FILE command.

```
? JOB SURVEY/ANALYSIS
? CLASS=2
? USER <usercode>/<password>
? BEGIN
? RUN CRYPTO/SPSSV7
? FILE FILE4 (KIND=PACK, PACKNAME=CANDEPACK, TITLE=<title>)
? DATA IOCR
  <SPSS program deck>
? END JOB
```

For subsequent runs, the file created can be retrieved by a GET FILE filename command within the SPSS program. The system input file is FILE3, so the WFL required is:

```
  ? JOB SURVEY/ANALYSIS
  ? CLASS=2
  ? USER <usercode>/<password>
  ? BEGIN
* ? RUN SYSTEM/NEWFAMILY ("DISK=CANDEPACK OTHERWISE PACK")
  ? RUN CRYPTO/SPSSV7
  ? FILE FILE3 (KIND=PACK, PACKNAME=CANDEPACK, TITLE=<same title>)
  ? DATA IOCR
    <SPSS further analyses>
  ? END JOB
```

If changes are made and the user wishes to save them and update the file, the WFL card with FILE4 should also be included.

* This card is necessary only at present, due to the pecularities of SPSS and Candepack.
Check with the SPSS co-ordinator for its necessity when running future SPSS programs.

APPENDIX E

Statistical analyses for some interactions

DEFAULT SPACE ALLOCATION.. ALLOWS FOR.. 50 TRANSFORMATIONS
WORKSPACE 17500 WORDS 400 RECODE VALUES + LAG VARIABLES
TRANSPACE 2500 WORDS 600 IF/COMPUTE OPERATIONS

```
GET FILE    USERS

FILE USERS    HAS  65 VARIABLES
THE SUBFILES ARE..
                  NO OF
NAME              CASES
USERS              187

CPU TIME REQUIRED..    0.57 SECONDS

TASK NAME      FREQUENCIES OF COMPUTED EFFECTIVENESS INDICES
FREQUENCIES    INTEGER=BINDX,CINDX,GINDX,TINDX (0,9)
OPTIONS        3
STATISTICS     ALL
FREQUENCIES PROBLEM REQUIRES    91 WORDS OF SPACE
```


BINDX BATCH HAPPY INDEX

CATEGORY LABEL	CODE	ABSOLUTE FREQUENCY	RELATIVE FREQUENCY (PERCENT)	ADJUSTED FREQUENCY (PERCENT)	CUMULATIVE ADJ FREQ (PERCENT)
1.5-2.0	3	4	2.1	2.3	2.3
2.0-2.5	4	13	7.0	7.3	9.6
2.5-3.0	5	50	26.7	28.2	37.9
3.0-3.5	6	42	22.5	23.7	61.6
3.5-4.0	7	40	21.4	22.6	84.2
4.0-4.5	8	13	7.0	7.3	91.5
4.5-5.0	9	15	8.0	8.5	100.0
	0	10	5.3	MISSING	100.0
	TOTAL	187	100.0	100.0	

MEAN	6.130	STD ERR	0.108	MEDIAN	6.012
MODE	5.000	STD DEV	1.434	VARIANCE	2.057
KURTOSIS	-0.366	SKEWNESS	0.283	RANGE	6.000
MINIMUM	3.000	MAXIMUM	9.000		

VALID CASES 177 MISSING CASES 10

Table E-1 Frequencies of Obtained Satisfaction Indices

10/26/78 FILE = USERS = CREATED 10/26/78 PAGE 3

GINDX GENERAL HAPPY INDEX

CATEGORY LABEL	CODE	ABSOLUTE FREQUENCY	RELATIVE FREQUENCY (PERCENT)	ADJUSTED FREQUENCY (PERCENT)	CUMULATIVE ADJ FREQ (PERCENT)
1.5-2.0	3	3	1.6	1.6	1.6
2.0-2.5	4	5	2.7	2.7	4.4
2.5-3.0	5	41	21.9	22.5	26.9
3.0-3.5	6	55	29.4	30.2	57.1
3.5-4.0	7	51	27.3	28.0	85.2
4.0-4.5	8	16	8.6	8.8	94.0
4.5-5.0	9	11	5.9	6.0	100.0
	0	5	2.7	MISSING	100.0
	TOTAL	187	100.0	100.0	

MEAN	6.308	STD ERR	0.093	MEDIAN	6.264
MODE	6.000	STD DEV	1.254	VARIANCE	1.573
KURTOSIS	0.046	SKEWNESS	0.130	RANGE	6.000
MINIMUM	3.000	MAXIMUM	9.000		
VALID CASES	182	MISSING CASES	5		

10/26/78 FILE = USERS = CREATED 10/26/78 PAGE 4

TINDX OVERALL HAPPY INDEX

CATEGORY LABEL	CODE	ABSOLUTE FREQUENCY	RELATIVE FREQUENCY (PERCENT)	ADJUSTED FREQUENCY (PERCENT)	CUMULATIVE ADJ FREQ (PERCENT)
1.5-2.0	3	2	1.1	1.1	1.1
2.0-2.5	4	4	2.1	2.2	3.2
2.5-3.0	5	44	23.5	23.7	26.9
3.0-3.5	6	66	35.3	35.5	62.4
3.5-4.0	7	45	24.1	24.2	86.6
4.0-4.5	8	14	7.5	7.5	94.1
4.5-5.0	9	11	5.9	5.9	100.0
	0	1	0.5	MISSING	100.0
	TOTAL	187	100.0	100.0	

MEAN	6.258	STD ERR	0.088	MEDIAN	6.152
MODE	6.000	STD DEV	1.198	VARIANCE	1.436
KURTOSIS	0.212	SKEWNESS	0.366	RANGE	6.000
MINIMUM	3.000	MAXIMUM	9.000		
VALID CASES	186	MISSING CASES	1		

10/26/78 FILE = USERS = CREATED 10/26/78 PAGE 2

CINDX CANDE HAPPY INDEX

CATEGORY LABEL	CODE	ABSOLUTE FREQUENCY	RELATIVE FREQUENCY (PERCENT)	ADJUSTED FREQUENCY (PERCENT)	CUMULATIVE ADJ FREQ (PERCENT)
1.0-1.5	2	1	0.5	2.4	2.4
1.5-2.0	3	2	1.1	4.8	7.1
2.0-2.5	4	8	4.3	19.0	26.2
2.5-3.0	5	8	4.3	19.0	45.2
3.0-3.5	6	9	4.8	21.4	66.7
3.5-4.0	7	11	5.9	26.2	92.9
4.0-4.5	8	2	1.1	4.8	97.6
4.5-5.0	9	1	0.5	2.4	100.0
	0	145	77.5	MISSING	100.0
	TOTAL	187	100.0	100.0	

MEAN	5.619	STD ERR	0.236	MEDIAN	5.722
MODE	7.000	STD DEV	1.529	VARIANCE	2.339
KURTOSIS	-0.359	SKEWNESS	-0.172	RANGE	7.000
MINIMUM	2.000	MAXIMUM	9.000		
VALID CASES	42	MISSING CASES	145		

Table E-1 (contd)

```
PILOT STUDY ON USER EFFECTIVENESS

TRANSPACE REQUIRED..1275 WORDS
     51 TRANSFORMATIONS
     22 RECODE VALUES + LAG VARIABLES
    242 IF/COMPUTE OPERATIONS

CPU TIME REQUIRED..   18.47 SECONDS


                    TASK NAME      LEVEL OF USAGE OF BATCH AND CANDE
                    FREQUENCIES    INTEGER=LEVUSAGE (1,4)
                    OPTIONS        3
                    STATISTICS     ALL

FREQUENCIES PROBLEM REQUIRES     25 WORDS OF SPACE


10/27/78          FILE = USERS     = CREATED 10/27/78          PAGE    1

LEVUSAGE

                                                 RELATIVE    ADJUSTED    CUMULATIVE
CATEGORY LABEL          CODE   ABSOLUTE FREQUENCY  FREQUENCY (PERCENT)  FREQUENCY (PERCENT)  ADJ FREQ (PERCENT)
BOTH BATCH AND CANDE       1                  39        20.9                 20.9                 20.9
BATCH ONLY                 2                 138        73.8                 73.8                 94.7
CANDE ONLY                 3                   3         1.6                  1.6                 96.3
NEITHER                    4                   7         3.7                  3.7                100.0
                       TOTAL                 187       100.0                100.0

MEAN          1.882     STD ERR        0.044     MEDIAN          1.895
MODE          2.000     STD DEV        0.602     VARIANCE        0.362
KURTOSIS      4.100     SKEWNESS       1.098     RANGE           3.000
MINIMUM       1.000     MAXIMUM        4.000

VALID CASES     187     MISSING CASES      0
```

Table E-2 Level of Usage of Batch and Cande

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES 10/27/78 PAGE 4

FILE USERS (CREATION DATE = 10/27/78) QUESTIONNAIRE REPLIES FROM SURVEY DONE AT CANTERBURY UNIV

* * * * * * * * * * * * * * * * * * * C R O S S T A B U L A T I O N O F * * * * * * * * * * * * * * * * * * *

VAR026 MEDIUM OF COMMUNICATION BY BINDX BATCH HAPPY INDEX

* PAGE 1 OF 1

VAR026	BINDX 1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	ROW TOTAL
1 LOCAL BATCH	4	6	31	28	24	8	10	111
	3.6	5.4	27.9	25.2	21.6	7.2	9.0	64.2
	100.0	46.2	66.0	66.7	61.5	61.5	66.7	
	2.3	3.5	17.9	16.2	13.9	4.6	5.8	
2 REMOTE THRU CAND	0	2	2	1	2	1	0	8
	0.0	25.0	25.0	12.5	25.0	12.5	0.0	4.6
	0.0	15.4	4.3	2.4	5.1	7.7	0.0	
	0.0	1.2	1.2	0.6	1.2	0.6	0.0	
3 REMOTE BATCH	0	5	12	13	13	4	5	52
	0.0	9.6	23.1	25.0	25.0	7.7	9.6	30.1
	0.0	38.5	25.5	31.0	33.3	30.8	33.3	
	0.0	2.9	6.9	7.5	7.5	2.3	2.9	
4 HUMAN INTERMEDIA	0	0	2	0	0	0	0	2
	0.0	0.0	100.0	0.0	0.0	0.0	0.0	1.2
	0.0	0.0	4.3	0.0	0.0	0.0	0.0	
	0.0	0.0	1.2	0.0	0.0	0.0	0.0	
COLUMN TOTAL	4	13	47	42	39	13	15	173
	2.3	7.5	27.2	24.3	22.5	7.5	8.7	100.0

RAW CHI SQUARE = 13.87933 WITH 18 DEGREES OF FREEDOM, SIGNIFICANCE = 0.7369
CRAMER'S V = 0.16353
CONTINGENCY COEFFICIENT = 0.27252
LAMBDA (ASYMMETRIC) = 0.00000 WITH VAR026 DEPENDENT, = 0.00794 WITH BINDX DEPENDENT,
LAMBDA (SYMMETRIC) = 0.00532
UNCERTAINTY COEFFICIENT (ASYMMETRIC) = 0.05012 WITH VAR026 DEPENDENT, = 0.02444 WITH BINDX DEPEN
UNCERTAINTY COEFFICIENT (SYMMETRIC) = 0.03286
KENDALL'S TAU B = 0.00500, SIGNIFICANCE = 0.4700
KENDALL'S TAU C = 0.00419, SIGNIFICANCE = 0.4700
GAMMA = 0.00792
SOMERS'S D (ASYMMETRIC) = 0.00394 WITH VAR026 DEPENDENT, = 0.00634 WITH BINDX DEPENDENT,
SOMERS'S D (SYMMETRIC) = 0.00486
ETA = 0.13349 WITH VAR026 DEPENDENT, = 0.11448 WITH BINDX DEPENDENT,
PEARSON'S R = 0.01259 SIGNIFICANCE = 0.4347

NUMBER OF MISSING OBSERVATIONS = 14

Table E-3 Cross-tabulation of Batch index against medium of communication

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES 10/27/78 PAGE 4

FILE USERS (CREATION DATE = 10/27/78) QUESTIONNAIRE REPLIES FROM SURVEY DONE AT CANTERBURY UNIV

* C R O S S T A B U L A T I O N O F *

STATUS USER CLASSIFICATION BY VAR049 QUALITY OF AVAILABLE DOCUMENTATION

* PAGE 1 OF 1

STATUS	VAR049 1 HIGHLY DISSATIS	2 DISSATIS	3 INDIFFER ENT	4 SATISF	5 HIGHLY SATISF	ROW TOTAL
1 ACADEMIC STAFF	15 26.3 75.0 8.8	12 21.1 37.5 7.0	13 22.8 23.2 7.6	15 26.3 31.9 8.8	2 3.5 12.5 1.2	57 33.3
2 POSTGRAD STUDENT	2 5.1 10.0 1.2	7 17.9 21.9 4.1	12 30.8 21.4 7.0	14 35.9 29.8 8.2	4 10.3 25.0 2.3	39 22.8
3 UNDERGRAD STUDEN	2 4.5 10.0 1.2	8 18.2 25.0 4.7	21 47.7 37.5 12.3	10 22.7 21.3 5.8	3 6.8 18.8 1.8	44 25.7
4 EXTERNAL USER	0 0.0 0.0 0.0	3 12.5 9.4 1.8	9 37.5 16.1 5.3	5 20.8 10.6 2.9	7 29.2 43.8 4.1	24 14.0
5 OTHER	1 14.3 5.0 0.6	2 28.6 6.3 1.2	1 14.3 1.8 0.6	3 42.9 6.4 1.8	0 0.0 0.0 0.0	7 4.1
COLUMN TOTAL	20 11.7	32 18.7	56 32.7	47 27.5	16 9.4	171 100.0

RAW CHI SQUARE = 38.86926 WITH 16 DEGREES OF FREEDOM, SIGNIFICANCE = 0.0011
CRAMER'S V = 0.23038
CONTINGENCY COEFFICIENT = 0.43036
LAMBDA (ASYMMETRIC) = 0.11404 WITH STATUS DEPENDENT, = 0.05217 WITH VAR049 DEPENDENT,
LAMBDA (SYMMETRIC) = 0.08297
UNCERTAINTY COEFFICIENT (ASYMMETRIC) = 0.07514 WITH STATUS DEPENDENT, = 0.07275 WITH VAR049 DEPENDENT,
UNCERTAINTY COEFFICIENT (SYMMETRIC) = 0.07393
KENDALL'S TAU B = 0.18375, SIGNIFICANCE = 0.0018
KENDALL'S TAU C = 0.17339, SIGNIFICANCE = 0.0018
GAMMA = 0.24648
SOMERS'S D (ASYMMETRIC) = 0.16240 WITH STATUS DEPENDENT, = 0.18503 WITH VAR049 DEPENDENT,
SOMERS'S D (SYMMETRIC) = 0.16375
ETA = 0.30111 WITH STATUS DEPENDENT, = 0.32324 WITH VAR049 DEPENDENT,
PEARSON'S R = 0.23150 SIGNIFICANCE = 0.0012

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES 10/27/78 PAGE 5

NUMBER OF MISSING OBSERVATIONS = 16

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES 10/27/78 PAGE 6

FILE USERS (CREATION DATE = 10/27/78) QUESTIONNAIRE REPLIES FROM SURVEY DONE AT CANTERBURY UNIV

* C R O S S T A B U L A T I O N O F *

VAR007 AVERAGE COMPUTING EXPEND, PER MONTH BY VAR049 QUALITY OF AVAILABLE DOCUMENTATION

* PAGE 1 OF 1

VAR007	VAR049 1 HIGHLY DISSATIS	2 DISSATIS	3 INDIFFER ENT	4 SATISF	5 HIGHLY SATISF	ROW TOTAL
1 <$5	1 2.1 5.0 0.6	6 13.6 18.8 3.5	16 40.9 32.7 10.6	14 31.8 29.8 8.2	5 11.4 31.3 2.9	44 25.9
2 $5-$20	8 13.8 40.0 4.7	10 17.2 31.3 5.9	18 31.0 32.7 10.6	16 27.6 34.0 9.4	6 10.3 37.5 3.5	58 34.1
3 $20-$50	5 20.0 25.0 2.9	8 32.0 25.0 4.7	2 8.0 3.6 1.2	6 24.0 12.8 3.5	4 16.0 25.0 2.4	25 14.7
4 $50-$100	2 14.3 10.0 1.2	5 35.7 15.6 2.9	3 21.4 5.5 1.8	4 28.6 8.5 2.4	0 0.0 0.0 0.0	14 8.2
5 >$100	3 17.6 15.0 1.8	1 5.9 3.1 0.6	7 41.2 12.7 4.1	5 29.4 10.6 2.9	1 5.9 6.3 0.6	17 10.0
6 DONT KNOW	1 8.3 5.0 0.6	2 16.7 6.3 1.2	7 58.3 12.7 4.1	2 16.7 4.3 1.2	0 0.0 0.0 0.0	12 7.1
COLUMN TOTAL	20 11.8	32 18.8	55 32.4	47 27.6	16 9.4	170 100.0

RAW CHI SQUARE = 26.42486 WITH 20 DEGREES OF FREEDOM, SIGNIFICANCE = 0.1522
CRAMER'S V = 0.19711
CONTINGENCY COEFFICIENT = 0.36678
LAMBDA (ASYMMETRIC) = 0.00000 WITH VAR007 DEPENDENT, = 0.06957 WITH VAR049 DEPENDENT,
LAMBDA (SYMMETRIC) = 0.03524
UNCERTAINTY COEFFICIENT (ASYMMETRIC) = 0.05696 WITH VAR007 DEPENDENT, = 0.06121 WITH VAR049 DEPENDENT
UNCERTAINTY COEFFICIENT (SYMMETRIC) = 0.05901
KENDALL'S TAU B = -0.12849, SIGNIFICANCE = 0.0202
KENDALL'S TAU C = -0.12318, SIGNIFICANCE = 0.0202

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES 10/27/78 PAGE 7

GAMMA = -0.16620
SOMERS'S D (ASYMMETRIC) = -0.12954 WITH VAR007 DEPENDENT, = -0.12745 WITH VAR049 DEPENDENT,
SOMERS'S D (SYMMETRIC) = -0.12849
ETA = 0.15081 WITH VAR007 DEPENDENT, = 0.19372 WITH VAR049 DEPENDENT,
PEARSON'S R = -0.14197 SIGNIFICANCE = 0.0324

NUMBER OF MISSING OBSERVATIONS = 17

Table E-4 Cross-tabulation of Documentation against user status, expenditure and work type

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES 10/27/78 PAGE 19

FILE USERS (CREATION DATE = 10/27/78) QUESTIONNAIRE REPLIES FROM SURVEY DONE AT CANTERBURY UNIV

* * * * * * * * * * C R O S S T A B U L A T I O N * * * * * * * * * *

WORKTYPE (GROUP) WORK CLASSIFICATION
BY VAR049 QUALITY OF AVAILABLE DOCUMENTATION

* PAGE 1 OF 1

WORKTYPE	VAR049 1 HIGHLY DISSATIS	2 DISSATIS	3 INDIFFERENT	4 SATISF	5 HIGHLY SATISF	ROW TOTAL
1 NUMBER CRUNCHING	6 10.9 30.0 3.5	11 20.0 34.4 6.4	21 38.2 37.5 12.3	15 27.3 31.9 8.8	2 3.6 12.5 1.2	55 32.2
2 PACKAGE ANALYSIS	5 10.6 25.0 2.9	3 6.4 9.4 1.8	13 27.7 23.2 7.6	21 44.7 44.7 12.3	5 10.6 31.3 2.9	47 27.5
3 DATA PROCESSING	9 15.3 45.0 5.3	9 15.3 28.1 5.3	19 32.2 33.9 11.1	14 23.7 29.8 8.2	8 13.6 50.0 4.7	59 34.5
4 DEVELOPING COMPUTER	8 24.2 40.0 4.7	7 21.2 21.9 4.1	9 27.3 16.1 5.3	5 15.2 10.6 2.9	4 12.1 25.0 2.3	33 19.3
5 TEACHING	2 20.0 10.0 1.2	4 40.0 12.5 2.3	1 10.0 1.8 0.6	1 10.0 2.1 0.6	2 20.0 12.5 1.2	10 5.8
6 LEARNING PROGRAMMING	2 4.8 10.0 1.2	9 21.4 28.1 5.3	16 38.1 28.6 9.4	12 28.6 25.5 7.0	3 7.1 18.8 1.8	42 24.6
COLUMN TOTAL	20 11.7	32 18.7	56 32.7	47 27.5	16 9.4	171 100.0

PERCENTS AND TOTALS BASED ON RESPONDENTS

171 VALID CASES 16 MISSING CASES

Table E-4 (contd)