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ABSTRACT

This handbook describes and documents the measurement system employed by the Educational Facilities Laboratory Project at Duke University for gauging the level of space-demanding activities. It offers detailed information regarding procedures for assessing space-demanding activity levels. The first part deals with procedures which have been developed for collection of data regarding space-demanding activities and for preparing these data for analysis. The second part describes preliminary steps in analysis and some of the techniques used. Sample forms are included in the appendices. (FS)

INFORMATION NEEDS:

for planning physical facilities in colleges and universities

Space-Demanding Activities

November 1969

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Educational Facilities Laboratories, Inc.
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FOREWORD

This volume is volume three of a four volume set published by Educational Facilities Laboratories dealing with physical facilities planning in institutions of higher education. The other volumes are:

Volume 1: Overview

Volume 2: Room Inventory

Volume 4: Space Planning: A Technique for Evaluating Alternative Campus Building Programs

Volume 2 deals with methods for developing an inventory of the existing space on a given campus. To talk about an inventory or supply of space is to discuss only half the process. To analyze and estimate future requirements for space we need an additional measurement system for gauging the level of activities which demand space. Such a system must be compatible with the system used for recording data on space. The planner must be able to infer from statements of planned activity levels the amount and types of space which shall be needed, i.e., the room space which must be budgeted and planned.

This handbook serves two purposes:

- To describe and document the measurement system employed by the Educational Facilities Laboratory Project at Duke for gauging the level of space-demanding activities
- To serve as a guide from which investigators at other colleges and universities can derive the requisite detailed information regarding procedures for assessing space demanding activity levels at their own institutions. In other words, this document tells the specifics of what we have done to measure the level of space-demanding activities and shows the reader how he can measure these activity levels in his own setting.

It should be noted at the outset that the procedures detailed herein may be subjected to modification in other settings according to the requirements of the user. These procedures were designed to interface with the system employed for recording data on existing space. Variations in space recording systems provide one possible basis for modification in activity measurement procedures. Another basis for possible modification lies in the applications with respect to planned activity levels under study. If, for example, the user is interested in some specific type(s) of activity, such as student union use, considerable parsimony could be affected through limiting data collection to relevant activities. We shall not attempt to offer specific suggestions, but rather leave such modifications to the discretion of potential users.

The volume is divided into two main parts. Part One deals with the procedures which we have developed for collection of data regarding space-demanding activities and preparing these data for analysis. Part Two describes preliminary steps in analysis, devoted to assessing the representativeness of the *working sample*[1]; and some of the techniques by which the data may subsequently be analyzed. Appendices provide

[1] By "working sample" we mean the actual respondents, as distinct from the sample originally selected. In all investigations such as ours, some members of the originally representative sample fail to complete the task, thus introducing some unknown reduction in representativeness. Those respondents who do provide usable data, the working sample, should therefore be examined for representativeness in so far as is possible before any generalizations to population parameters are made. Thus, this task is logically the first stage of analysis, and is treated separately as Chapter Seven in Part Two.

materials which are discussed in Chapters One and Four, and which were too lengthy to include in the text. Detailed documentation for all of the computer programs developed in this study is available through the EFL Library.

There have been a large number of consultants and others who have contributed to the project as a whole and indirectly to this volume. It is impossible to thank all of the people by name — in part because the list is so long, and in part because the writer has not had the opportunity of working with all of them.[2]

Particularly, I should like to thank Miss Judith E. King, who wrote Chapters Four and Five and contributed heavily to Chapter Seven. Her programming skills, reflected in many of the computer programs for analysis, together with her grasp of the problems involved in coding and checking the data and machine processing and analysis, have been a major contribution to the entire project and to this volume. Editorial responsibility for her contributions to the text of this volume, of course, is mine.

Walter Matherly, Principal Investigator, also deserves a special note of thanks for his ever helpful comments and suggestions on draft versions of this volume. Robert W. Chamberlin, who served as project manager, provided notes and records which were of great help in writing sections of this volume dealing with aspects of the project with which the writer was not directly concerned in his capacity as sociological consultant.

Jeffery S. Lazarus and Neal L. Paris, the latter of the Duke University Computing Center staff, should also be thanked for their contributions to programming for analysis and sample selection.

Finally, I should like to thank Mrs. Clem B. Fox for her patient labors in typing the original manuscript.

R. Bruce W. Anderson
Duke University
July 1969

[2]The writer's lack of personal contact with many members of the project team results from the fact that he was originally engaged as a sociological consultant and methodologist. There is a certain poetic justice in subsequently being asked to edit this volume, thereby becoming more visably accountable for many of the recommendations which he made while serving in that original capacity.

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FIGURES

INSTRUMENTS FOR DATA COLLECTION

This chapter describes the primary data collection instruments which we have developed. First, it is essential to define the nature of the data to be gathered, and to delineate from whom they will be sought. The general objective has been to gather data which provide accurate, detailed descriptions of space-demanding activities on campus: Potentially, *any activities which use campus facilities.* In fact, the investigation focused upon some, but not all, users of campus space, thereby reducing the range of activities about which data were gathered.

Figure 3.1 illustrates the ways in which six more or less mutually exclusive groups of users of campus space differ with respect to the types of space which they employ. To be sure, these are only rough categories of *actors,* and equally imprecise spatial classes. It is also true that the illustrated patterns may be at odds with the realities of some campuses. For example, on some campuses *Town People* frequently use classroom or laboratory space while on others no residence facilities are provided for any members of the college community. At Duke, and we suspect at many other colleges and universities throughout

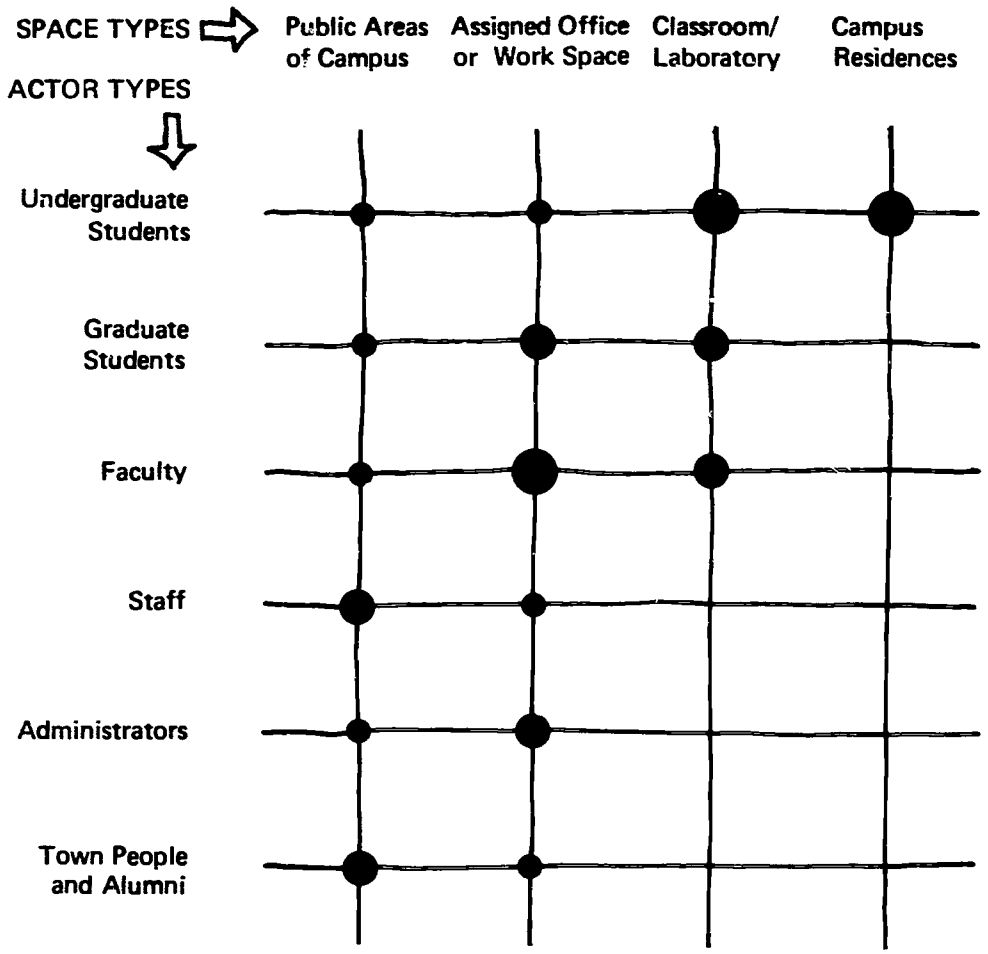

Figure 3.1: *Space types used by Various Types of Actors.* A dot occurring at the intersection of actor and space type denotes an interaction, and the size of the dot, the relative use. The larger the dot, the greater the use.

4 the United States, Figure 3.1 provides a reasonable accurate picture of campus space demanding activity patterns.

Note that, for the undergraduate student, the university is in effect a *total institution* within which most of his daily activity takes place and most of his basic needs are met. The undergraduate is the only actor with a high probability of being a resident of the institution per se. For this reason alone it is likely that he will generate more activity and demand more varied space on the campus per unit of time than any other type of actor. Further, a greater proportion of these activities are likely to be unscheduled[3] than are the activities of other groups of actors. Undergraduates will generate a greater proportion of unscheduled activities on the campus, in part because they are residents of the campus and more likely to be on campus when the desire or need arises for such unscheduled activities as sleeping, studying, eating and watching TV. Unscheduled activities are, by definition, not measurable by current institutionalized data gathering procedures. They merit special attention in developing instruments for the study of space demanding activities. While data regarding classes, lectures, athletic events, and other scheduled activities are readily available, knowledge about unscheduled space demanding activities is generally unavailable to the planner. Educational Facilities Laboratories, therefore, charged us to exert a major effort upon developing means for gathering such data.

For reasons described, our attention has focused primarily upon the space-demanding activities of *undergraduate students*. In addition to undergraduates, some effort was devoted to exploring means by which comparable data could be gathered from faculty and graduate students. These two groups of campus actors presented special data gathering problems which have not yet been resolved entirely. At this point, it is appropriate to discuss the criteria employed in developing an instrument for use with undergraduates and to describe the instrument itself.

Criteria for instrument development

The objective was to develop means for measuring non-scheduled activities; therefore, use of existing university data was closed to us except for possible cross-checking purposes. Six criteria were formulated for a suitable instrument in gathering data regarding non-scheduled activities.

COMPLETE

While non-scheduled activities constituted the problem, neither scheduled activities nor any significant subcategory of non-scheduled activities could be ignored. The intention was to gather data which would permit analysis of activity pattern changes. Completeness demands consideration of all activities of any given actor or group of actors as interrelated in discernable

[3] On the distinction between scheduled and unscheduled activities, and its importance in this investigation, see Volume 1.

ways. If the amount of time devoted to one activity such as sleep or study is modified, modifications will necessarily follow at other point or points in the system. The simple truth is that, if one sleeps more, he *must* do something else less; or if he studies less, he *must* do something else in the time gained. Without an exhaustive accounting of people's time we would simply be unable to assess the effect of changes in activity patterns. Thus, the instrument must account for all significant activities throughout a continuous and fairly extended time span.[4] Operational definitions of "significant activities" and "continuous, extended time span" which evolved and were employed will be discussed in some detail below.

LOCATIVE

Our concern with activity patterns, and the characteristics of an activity which define its significance, is rooted in the space-demanding nature of many activities. To provide data which will aid campus planners requires that the activities of any actor be locatable in time and space as well as being linked to the actor himself. On most campuses, facilities are consciously provided for some unscheduled activities as well as for classes and other scheduled activities. For example, dormitory study halls and library desks or tables are commonly provided for student study. At examination time, and other periods of peak load, however, these facilities are rarely adequate to meet demand, while they may be virtually empty between semesters and at other periods of low demand. In designing facilities, it would be helpful to know how students adjust to problems of peak-load crowding of study space. Existing load/space relationships need to be analyzed in order to anticipate future demands created by student body growth or changes in admissions policies.[5] To be useful to the planner, the instrument must provide complete activity records. Those activities must also be located with respect to the following:

- Existing facilities employed for any given activity
- Times at which a given facility enjoys a particular activity load
- Characteristics of the actors involved.

The primary emphasis of the criterion of locatability is upon the spatio-temporal dimensions. The third factor, characteristics of actors, would prove necessary in projections involving modified admissions policies. This dimension of locatability played only a small role in our consideration of potential instruments to gather the basic behavioral data. It was, however, of central concern in developing the Student Information Questionnaire, and will be discussed at some length in that context.

[4]The phrase "significant activities" is employed here to aid in making it clear that the time-and-motion study attention to detail is not at issue. Rather, our concern is with activities which are adjudged significant by the fact that they demand some particular configuration of physical space. Thus, we are not concerned with the fact that a given respondent shifts from washing his face to combing his hair to brushing his teeth within a 10-minute interval. Rather, the significant facts for our purposes are that he is engaged in personal hygiene for 10 minutes in a location equipped with (i.e., requiring) running water, waste disposal, plumbing, mirror, and adequate lighting.

[5]Simulation is but one of the many ways in which such projection of fu[illegible] requirements mightbe accomplished. The criterion of loca[illegible]ty is essential to any predictive uses which might be made of the data gathered regarding space-demanding activities on campus.

6 RESPONSIVE

The two criteria previously discussed refer to the nature of the data necessitated by research goals. It is obvious from the discussion of these criteria that a large mass of detailed information about each respondent's activities must be gathered. Clearly, the means of data gathering must not impose an undue burden upon the respondents for two reasons:

The more effort the respondent must devote to providing data for such an investigation, the less realistic those data will be. Time and effort expended in answering questions is time and effort taken from the daily routine about which we seek information.

Extensive effort expended in responding to questions about activity patterns tends to subvert the university's goals. Thus, any instrument developed must provide maximum data with minimum respondent effort.

ECONOMICAL

All data collection instruments which came under review were judged with respect to economy. From the planning point of view it would be highly desirable to make repeated studies of space-demanding activity patterns to assess the effectiveness of modifications in facilities. Such replication would seem appropriately undertaken on an annual basis by small to medium sized institutions with average building and remodeling programs — perhaps more often for universities undergoing large scale change or rapid growth. It was thought that a maximum of $3000 per year could be budgeted by the average small to medium sized institution for this purpose. An objective was to develop an instrument which could be employed for less than this amount.

ADMINISTRABLE

A clear corollary of economy is ease of administration. The more complex the problems of administration the larger the staff required to do the job and the greater the expense. Hence, it was necessary to consider the requirements of administration in designing our research instrument.

ANALYZABLE

The sixth and final criterion considered is ease of analysis, another corollary of economy. An instrument was sought which facilitates translation of responses into appropriate form for computer analysis with minimum time and effort.

The first two criteria refer to the types of data which the instrument should provide. The third criterion, in contrast, specifies conditions under which acceptable data quality might be obtained within the college or university frame of reference. The last three criteria all relate to the economy of the undertaking as a whole; the fifth and sixth criteria specify that attention must be paid to administrative and analysis requirements to insure that the overall project comes within the range of economic feasibility.

Types of instruments considered and application of criteria

Four types of data collection instruments were considered for possible use. Figure 3.2 summarizes these four general types in relation to the six criteria established. The following paragraphs elaborate some of the aspects of these relationships.

One of the first methods of data collection considered was the *periodic traffic count* or *occupant count*. This approach involves the use of one or more research assistants who observe. These observers are assigned to specific locations to record the occupants or traffic flow at predetermined observation times. A major drawback of this method is the fact that it is impossible to obtain complete records of traffic or occupants for all locations or all time periods. Sampling of both location and time is necessary in the use of human observers and may be frustrated by inaccessability at certain times or

	Traffic/Occupany Counts	Mechanical Counters	Secondary Indicators	Time Budgets	Diary
Complete	−	+	−	o	+
Locative	o	o	o	o	+
Responsive	+	+	+	o	o
Economical	−	−	+	o	+
Administratable	−	+	+	+	+
Analyzable	+	+	−	o	+

Figure 3.2: *Rating of Proposed Data Collection Instruments by Criteria.* Plus indicates that the criterion is unambiguously met; zero indicates that it is partially met; and minus indicates that the criterion is not met.

places due to existing regulations.[6] In addition to weakness with respect to completeness, traffic or occupant counts are expensive to administer due to the large number of observers necessary and the resulting supervisory and training expenses involved. Finally, these techniques do not permit recording the data in terms of actor characteristics except where those characteristics are immediately observable as in the case of sex.

Substitution of *unobtrusive mechanical counters,* such as hidden photoelectric cells, provides solutions to the problems of administration and, when used in sufficient numbers, completeness. Unfortunately such equipment, if employed on a large enough scale to provide the requisite level of completeness, represents a considerable capital outlay. The difficulty of identifying actor characteristics is greater with mechanical devices in general (television cameras being the exception) than with human observers, and this is not resolvable even with the most highly sophisticated equipment. Since it was deemed important to gather data regarding actor characteristics for use in anticipation of space demands raised by modification in recruitment policies, this difficulty loomed large.

Secondary indicators, such as the volume of water per unit of time used in dormitories, the number of coffee cups in conference room wastebaskets, or the amount of wear exhibited by campus paths and walkways were also considered for use. These techniques[7] are appealing for their novelty but suffer extreme weakness when used as means of primary data collection. For our purposes the difficulties of low completeness, inability to relate the data to actor characteristics, and problems of analysis introduced by the use of many varied data sources were sufficient to lead us to abandon this lead.

At this point in our deliberations two related data gathering techniques came to our attention: the *diary* and the *time budget*.[8] The former involves a paper and pencil response on the part of individual actors who are asked to record their actual behavior as it occurs. The time budget is also a paper and pencil task in which the respondent is asked to indicate how, and where, he would spend his time under a set of predefined hypothetical conditions. These conditions may, of course, closely reflect reality, or they may include specification of various facilities not presently available on the campus. These two techniques are treated together because the data which they provide *appear* similar, and because we originally considered using both techniques during successive phases of the investigation. However, formal similarities between data produced by a diary and those produced by the time budget technique are misleading.

Special emphasis should be placed on the difference in the way in which these two

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[6] Such regulations include institutionally imposed dormitory hours, subinstitutional restrictions like "closed meetings" of social groups, and broader restrictions founded in basic rights of privacy.

[7] Techniques of this sort have been suggested by Eugene J. Webb, *et.al.,* primarily as a means for validation of data gathered through more traditional questionnaire and observational techniques. As validation techniques they merit consideration, although we can see little utility for them as sources of basic data when other techniques are available. See: Eugene J. Webb, *et.al., Unobtrusive Measures: Nonreactive Research in the Social Sciences,* Rand McNally and Co., Chicago, Illinois, 1966.

[8] On time budgets see Pitirim A. Sorokin and Clarence Q. Berger, *Time-Budgets of Human Behavior* (Cambridge, Mass.: Harvard University Press, 1939). Cf. Kaare Svalastoga, "The Measurement of Desirability: The Time Token Method," *Sociologiske Meddelelser, 4,* pp. 83-98.

techniques require the data to be provided. The diary requires that each activity be noted as closely after its completion as possible. In contrast, the respondent notes activities for the time budget without having necessarily engaged in them at all. Thus the former instrument appears well suited to providing self-reported data concerning actual behavior. Resulting data are likely to reflect the respondent's *true* activity patterns rather closely. In the case of the time budget, on the other hand, there is no necessary relationship between actual behavior and the data reported. Whatever degree of relationship actually obtained will, of course, be partly a function of the instructions under which respondents operate; but the number of unknowns is likely to be disappointingly large in any event. At best, the time budget appears to have utility as a sort of simulated diary, and this is how we originally thought to employ it.

Preliminary consideration of these two data collection techniques led us to conclude that some form of the diary was best suited to our needs for gathering information about existing patterns of space demanding activity on the campus. We judged the time budget's potential utility to lie in the area of subsequent simulation of activity patterns where a variety of hypothetical modifications in the campus spatial configuration were to be explored. Specifically, we thought to ask some of the respondents who had previously completed diaries describing their activities to provide time budget information regarding how they would distribute their activities after the completion of various facilities (such as a new library or chemistry building) which were currently in planning or construction stages. We hoped these data, together with the knowledge of existing activity patterns from which to simulate the activity patterns which could be expected after completion of the planned facilities. As we examined this approach more carefully, certain weaknesses of the time budget became apparent which convinced us not to pursue that aspect of the undertaking further. These weaknesses included the following:

Faulty Impressions. Each individual obtains his own impressions of the new facility. Since these impressions must necessarily be subjective, there is no assurance that each respondent has an accurate impression of the new environment. Basing a simulation model upon such subjective impressions would at best be a risky business. Planning decisions made on the basis of such simulations would be highly suspect.

Fad Effect. Related to the problem of faulty impressions is the possibility of collecting time re-allocations which would reflect an activity pattern the first week after the new facility is put into use. In other words, the sheer newness of the facility may cause an atypically high usage pattern. This fad effect would be expected to wear off with time in the case of an actual facility, but could not be expected to do so under simulated conditions.

Hidden Variables. Many variables other than building construction and design result in changed patterns of activities and space-type usage. This model unrealistically assumes that other sources of activity pattern changes are unimportant. This assumption might lead to overlooking useful policy variables simply because they were not accounted for (e.g., scheduling changes or modifications in teaching methods).

Fluctuating Levels. Activity patterns change significantly in the course of a semester due to

10 the instructional cycle, the weather, registration, and vacation schedules. Since there is no truly representative week, these fluctuating activity levels introduce a serious form of unreality into the time budget simulation.

Ex-post Re-allocation. The time budget may reflect the respondent's *ex-post* desires to re-allocate his time, regardless of environment, rather than the effects of a new facility. Thus, if a new library is added to campus facilities for simulation purposes, the time budget approach may attribute increased library usage to its presence when in fact this re-allocation simply reflects the respondent's desire (or felt need) to spend more time studying.

For these and other less noteworthy reasons we conclude that the *state of the art* is not yet able to support full-scale simulation research of the kind necessary to yield practical results using the time budget. Thus, we decided to gather data describing existing patterns of space demanding activities by means of a diary type instrument, but not to pursue the use of time budgets in simulation at this time. The following section describes the diary instrument, which was developed.

Student activity diary

The Student Activity Diary, which appears as Appendix A1[9] represents the end process of a lengthy series of revisions. In February 1967, a random sample of 100 Duke undergraduates was asked to log their activities by time and location throughout an entire week. These respondents were given open-ended forms. The resulting pre-test data were examined to derive a set of efficient coding categories. Eighty-six students completed the pre-test and also engaged in several small discussion groups which focused on problems of university planning from the undergraduate's perspective and student activity patterns in general. Results of this pre-test provided the basis for later decisions with respect to structuring the time dimension and activity categorization procedures.[10] It also informed our sample selection procedures (discussed in Chapter Two) and administration techniques (described in Chapter Three) to a considerable extent.

By April 1968, the pre-test had been reviewed and a diary instrument essentially similar to the present Student Activity Diary had been developed. With this instrument a full-scale survey of 550 undergraduates, selected by the stratified random sampling procedures discussed in the next chapter, was launched. Respondents were to provide detailed information throughout an entire week, which had been carefully selected to avoid anticipated unusual events such as major sports events and large scale mid-term examinations. Shortly after the students began keeping their diaries, Dr. Martin Luther King was assassinated and both the campus and the Durham community were thrown into turmoil. The disruption of normal campus activities which was precipitated

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[9] Each respondent was presented with a spiral bound booklet which included both the Student Activity Diary and the instrument used to gather supplementary data about respondent characteristics. The sample copy of the Student Activity Diary included in Appendix A1 has been shortened by omission of the pages which were provided for recording activities occurring after the first day. Respondents were asked to record their activities for seven days and, since the recording forms were identical from day-to-day, this omission reduces bulk, but not content. The Student Information Questionnaire is included as Appendix A2.

[10] Analysis and findings from this pre-test are reported in part in *Computer Aided Campus Planning For Colleges and Universities, Interim Report,* published in August 1967 by EFL.

by Dr. King's death made it impossible for us to employ these data in planning-oriented analyses. The data, or more particularly the comments we received, did allow further improvement of the diary. In addition, this unanticipated pre-test proved useful by bringing into the open some problems of large scale administration.[11]

A full-scale survey was again mounted in October 1968, and the research instruments and procedures were all in the form presented in this volume. The Student Activity Diary consists of two parts: the basic diary forms printed especially for use with a Digitek mark-sensing unit, and various supporting materials and instructions.

The diary forms are essentially 21 identical pages, one for each eight-hour period during the week under study.[12] Since the instructions to respondents regarding use of the diary required four printed pages, it is clear that this basic diary form is somewhat more complex than it appears. The supporting materials and instructions, which the respondent encounters first when reading through the booklet, are as follows:

Introductory letter: The first item which the respondent encounters is a letter, signed by the principal investigator, describing the objectives of the project, the nature of the information sought in general terms, and the guarantees of respondent anonymity. This letter is the basic appeal for cooperation.

Map of the campus and lists, keyed to the map, of all buildings owned by the university: Since Duke has two campuses, two maps and associated building lists were required. These maps incorporate the building numbering system employed consistently throughout the investigation and are provided for the convenience of the respondents. In keeping their diary records, the respondents are asked to enter the number of the building in which each activity takes place. Since most buildings are commonly referred to by informal names, such as "Physics Building," "the gym," it is essential that the numbers be provided in convenient, accessible form. The maps and buildings lists constitute one of the two methods we have attempted for facilitating the respondent's task in this regard.

Instructions for use of activity diary forms: These instructions include a general statement of the four types of information which each diary entry should provide (what, when, where, and how many people were involved), definitions of the activity and group size categories, specification of procedure for entering

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[11] The administration procedures discussed in Chapter Three reflect modifications made as a result of this experience. Noteworthy is the reduction in number of respondent supervisors from 50 in April 1968 to 12 in October 1968, which was in part a result of the decision to spread data gathering over four consecutive weeks in order to reduce the hazard of inadvertent choice of a grossly unrepresentative week.

[12] Actually there is slight variation among the three pages designated for recording each day's activities, since only the appropriate time intervals for each eight-hour period are printed along the left hand margins, and pages are numbered sequentially within days. The three diary pages included in Appendix A1 would be used by a respondent to record one entire day's activities, and his diary booklet would include as many sets of three pages as there were days under investigation (in our case, seven). Pages for the first eight hour period were printed in blue, those for the second in green, and those for the third in brown for the convenience of the respondent and later facilitation of coding and checking.

12 location data, guidelines for using the time-span records, an example, general notes on what to do during the week and at the end of the week before returning the booklet to supervisors.

Definition of activity categories presented one of the most difficult problems encountered in working out an instrument which met the criteria of completeness and responsiveness. The criterion of responsiveness leads to a set of predefined categories which could be examined quickly and easily by the respondent. The criterion of completeness, however, demanded that all of the activities which respondents might undertake could be classified within whatever list of activities provided. The task was further complicated by the decision to use Digitek mark-sensing equipment in the interests of economy and analysis.[13] The list of 23 activity categories was developed which, through careful definition, made it possible for more than 99% of the student-hours for which pre-test data were available to be reliably classified with less than one percent of all reported activities falling into the *other* category. The inadvertent pre-test in April 1968 elicited few student complaints regarding the category system, and several definitions were modified in order to reduce the likelihood of subsequent complaint in several instances. For example, several students objected to the original definition of *bull sessions* which led to subsequent definitional emphasis on *informal conversation* regardless of topic. The reader is invited to examine the resulting definitions carefully and note the various ways in which specificity and elimination of ambiguity were sought.[14]

The group size item is included to check data used in generalizing from the sample studied to the undergraduate population as a whole and to assess student perceptions of the number of persons which on the average constitute various types of activity groups. The group size classes employed, while somewhat arbitrary, have some special significance with respect to the patterns of interaction which they permit. A paired relationship, involving the respondent and one other, implies qualitatively different interaction patterns and, probably, affectual relations. Ten persons tend to approximate the largest group size in which continuous, extensive face-to-face interaction among all participants is feasible, while 20 or less seems to cover the range of groups in which face-to-face interaction among all pairs can reasonably be obtained, assuming circulation of group members. The category including groups of from 21 to 50 members is somewhat ambiguous with respect to interaction potential since the characteristics of smaller groups might be present under special circumstances. Usually these groups, and all groups with more than 50 members, will be characterized by highly impersonal behavior patterns and limited interpersonal interaction. In

[13] The problems of adaptation to the Digitek requirements will be discussed later in this section when our attention is focused upon the diary pages per se. Further discussion of these problems from the perspectives of the coder and machine processor may be found in Chapters Five and Six, respectively. Optical scanning devices available from other manufacturers could be employed. Computer programs could be written to put the data into the format required by the other programs developed in this study.

[14] For example, "sleeping" is carefully specified in order to discourage the respondent from using this code in the event that he inadvertently dozed off during a lecture or while studying. "Movie/game" is illustrated by several examples which are intended to make it clear that this category is to be used whenever the respondent attends an event in which his role is primarily as a member of an audience.

addition to these factors, it should be noted that 20 persons are about the maximum number that can be grouped conveniently around most conference tables, and groups larger than 50 tend to require auditorium seating if all group members are to focus their attention upon a speaker or other center of interest.

For each activity the respondent was asked to indicate the building and room numbers identifying its location. The abortive survey of April 1968 indicated that many rooms on the campus were poorly identified, often by numbers obscurely placed on the outside of the room. To facilitate the respondent's task in identifying rooms by number, cards like the one shown in Figure 3.3 were placed conspicuously inside each room in the more heavily trafficked buildings. These cards provided both building and room numbers for respondents in the October survey, resulting in considerable improvement in data quality. Building numbers were also provided on campus maps, and facing each diary page. Location cards were not placed in dormitory rooms, bathrooms, or certain other inaccessible locations. This factor, coupled with an unfortunate choice of illustrative materials in the example (discussed below), led to relatively poorer data quality for these locations.

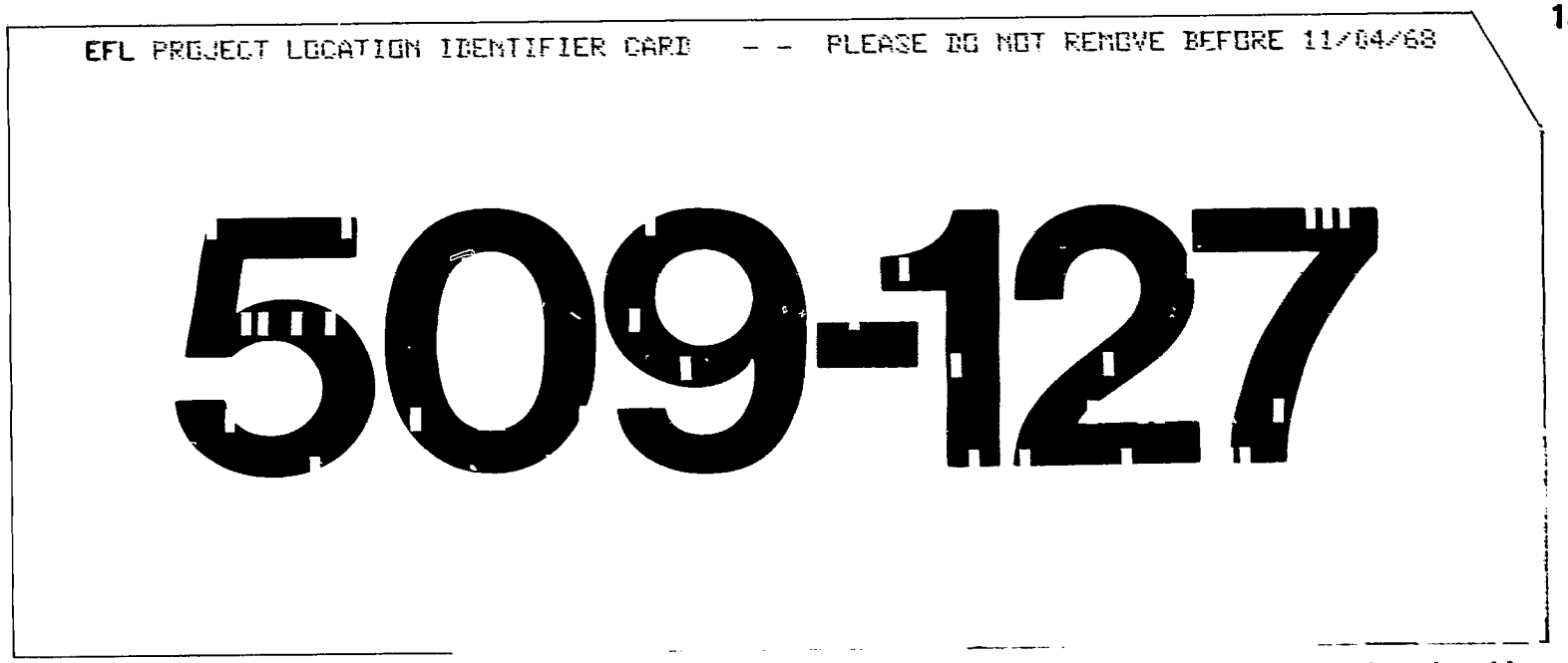

Figure 3.3: *Sample Location Identifier Card, showing Building and Room Number.* Building and room number placed in Academic Facilities.

The open-ended pre-test indicated that the 10-minute time interval was the closest practical approximation to a continuous record which could be obtained. Most activities which are undertaken in less that 10 minutes are insignificant for planning purposes, and the attention to detail required for recording data for smaller time intervals was adjudged undesirable because it would over burden respondents. It also would tend to introduce instrument effects of considerable magnitude by making diary keeping a disproportionately significant activity, *vis-a-vis*

the activities which normally involve the respondent's time. Even 10-minute intervals were chosen both because they are easy to work with and, more importantly, because they coincide with all normal class beginning and ending times at Duke.[15]

The diary example consists of a description of a set of hypothetical activities and two sample diary pages on which these activities are recorded. The sample diary pages appeared immediately after the instructions section of our booklet. The discussion contained in the instructions section is quite straightforward. The sample diary pages, however, list *bathroom* and *bedroom* as room locations which was a mistake. Many students seem to have taken this as the correct way of providing these data, which resulted in infrequent entry of bedroom and bathroom *room numbers*, thus lowering data quality. In contrast, the *post office* and *dope shop* entries, on the second sample diary page refer to unique locations and the appropriate numbers are easily supplied by editors during the data coding and checking phase of the investigation.[16]

The two final sections of the instructions are self-explanatory. It should be noted that we *did not* instruct the respondents to make diary entries with a soft pencil. A large number of entries were made in ink which are not read well by the Digitek machine. Wisdom of hindsight suggests that the admonition to use a number two pencil should appear in the instructions under *During the Week,* and possibly somewhere on the diary pages as well. This simple improvement would reduce the editing task considerably.

Following these instructions, the respondent encounters the two sample diary pages discussed above, and then the actual diary pages on which he is to record his activities. Since the alphabetical listing of buildings (with associated numbers) is printed on the back of each diary page, including the sample pages, the respondent will have these data available opposite each page on which he is to keep his diary records. The three different "off campus" locations (together with "residence, private," which is also out of alphabetical sequence) are anomalously included under the heading "Duke University, West Campus." We do not know to what extent this error on our part (which is repeated on the West Campus map, but not on the East Campus map) contributed to incorrect responses for off campus locations.[17] Clearly the editing task, discussed in Chapter Four, is potentially complicated by any such incorrect responses.

The Diary. The diary pages themselves may be viewed as a matrix. The rows of this matrix represent the 10-minute time intervals, each page covering eight hours, or 48 intervals. The columns of the matrix are divided into four fields, two of

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[15] Clearly some adaptation of the time intervals would be necessary on campuses where classes begin and end on the quarter hour.

[16] See Chapter Four for further discussion of the editing and checking process and the problems resulting from non-numerical location entries.

[17] Since these items were listed under "West Campus," we might expect a higher error rate among female students, all of whom are housed on the East Campus. Such an index of the influence of this anomaly is, at best, weak since most female students have some classes on the West Campus and could therefore be expected to peruse that list as well. For this reason we have not attempted to pursue this matter further.

which are directly machine readable. The machine readable fields are the *activity field* which includes 23 columns (one for each activity, grouped for the respondent's convenience according to type to correspond with the grouping employed in the instructions section of the booklet), and the *group size field.* The remaining fields, in which the respondent is to write the building number and room number, respectively, must be coded for machine reading according to the procedure described in Chapter Four. It would have been preferable to have all data directly machine readable, but technical limitations of the Digitek equipment require the present, more cumbersome, layout.

For most activities, the respondent makes four simple entries, one in each field, in the row corresponding to the time interval in which he began that activity.

- The first entry will be in the column of the activity field which identifies the activity in question.
- The second will indicate the group size in the appropriate column of that field.
- The third will be the building number, or appropriate off-campus designation.
- The final entry will be the room number, except in those instances where the activity was engaged in off-campus or out of doors.

Note that this task requires two vertical pencil marks in the machine readable field and the entry of two numbers in the location fields.

In the upper right-hand corner of each diary page there are three small machine readable fields which identify the following:

- The respondent's sample number,
- The day of the week in which the diary page in question was completed, and
- The page number within days.

These three fields provide the basic data which is employed during machine processing (see Chapter Five) to place the data in proper sequence and to bring these data together with the other available information regarding each respondent, such as his responses to Student Information Questionnaire items.

Student information questionnaire

Included in the booklets received by each respondent was a *Student Information Questionnaire* designed to augment model building capabilities by providing data regarding his background and his attitudes toward certain university functions. These data provide a means by which planning officers and other administrators can better understand the behavior and attitudes of the students whose activities have come under investigation. The background data permit classification of respondents along several dimensions, allowing users of these data to better avoid fallacious interpretations based on some *average student.* The attitude items provide both a means for assessing overall student satisfaction with the university's fulfillment of various functions and the data necessary to evaluate the relative importance of the several functions to the various groups of students responding.

Further, in building a computer-oriented planning model, it is essential to be able to modify the various forms of input data. One basic form

16 which such modifications might take is changes in the student mix. For example, Duke presently has an excess of male over female undergraduates. Planners employing a computer-aided model might wish to consider what adaptations might prove necessary if the campus ratio were brought to a different balance through admission of increased numbers of female students. Data gathered through the Student Information Questionnaire provide a basis for this type of hypothetical modification within the model. The procedure in this example would be to increase the use-hours of facilities employed by female students, while holding use-hours of facilities employed by male students constant. Thus, if facility A is used m hours by male students under present conditions, and n hours by female students (total present use = $m + n$), doubling the female enrollment in the model would result in total use of $m + 2n$. Dimensions other than sex could be employed to make similar modifications in the student mix, providing the planner with data which could anticipate a variety of consequences of administrative policy changes.

Questions in the Student Information Questionnaire (Appendix A2) attempt to gather information which would be relevant to the potential uses discussed above. The intent is to structure the questions to maximize the ease and accuracy with which responses can be provided. Many of the items are standard background questions of the sort commonly found on college and university application forms, and all of the items could be adapted for use in admissions screening. In addition to background items, there are items which tap several dimensions of the respondent's current status on and off campus, his educational and occupational aspirations, and his attitudinal orientations toward a number of potentially significant aspects of college or university life.

Most of the items included in the Student Information Questionnaire are quite straightforward and do not require comment here. These items, dealing with the student's background, his current status, and his aspirations, have high potential as determinants of his activity patterns. Remarks about each of the background questions (items 1-12 and 17) are presented in Figure 3.4. The remainder of this section will discuss in detail the rationale underlying items 13-16, and items 18 and 19.

Items 13-16 of the Student Information Questionnaire refer to a list of 27 *functions* which a college or university *may* sometimes be called upon to fulfill.[18] By a function, we mean simply the consequence (or output) of a given institutional structure. Clearly not all of these 27 functions are fulfilled by all colleges or universities equally well in the eyes of their constituencies. Similarly, the several functions may be differently fulfilled by a given institution. Some students may choose not to pursue some of these goals, while others may be excluded from their pursuit for a variety of reasons beyond their own control. Thus, on many campuses, some students may choose to provide their own

[18] The list of university functions has been adapted from a list of fraternity functions employed by Robert F. Winch in conjunction with an ongoing investigation of the identification process. See his preliminary monograph dealing with identification: *Identification and its Familial Determinants*, Bobbs-Merrill, Indianapolis, Indiana, 1962.

QUESTION NUMBER	BRIEF ITEM DESCRIPTION	REMARKS/RATIONAL*
1	Sex	High probability of differential facilities use.
2	Marital Status	Married students are likely to use different facilities than unmarried. Other categories included on exploratory basis.
3	Age	Anticipated utility in varying student mix for modeling purposes.
4	Class in School	Differential use likely.
5	Academic Aspiration Level	Exploratory. May be factor in differential use.
6	Major Field of Study	Differential use likely.
7	Declared Major	Declared majors more likely to adopt "major type" facilities use patterns than undeclared.
8	Occupational Aspirations**	Exploratory. May be factor in differential use.
9	Residential Status	High probability of differential use.
10	Father's Occupational Status**	Exploratory in this context. Demonstrated utility in wide range of other contexts, especially relating to aspirations.
11	Parental Educational Status	Same as item 10.
12	Sources of Support	High probability of differential facilities use — especially for employed students.
17	Organizational Participation	High probability of differential use — correlated with involvement.

*In general, it is safe to say that these items were included primarily because we anticipated that they would correlate with variation in patterns of use of space-demanding facilities. The entries in this column are intended to suggest the extent of our confidence in the individual items as probably correlated to use patterns, and where it is not entirely obvious, the type of relationship(s) we expect will exist.

**Questions 8 and 10 are coded in terms of the Socioeconomic Index, which provides a hierarchical scale for detailed occupational listings from the US Census. Coding Procedures are discussed in Chapter Five, and the classification system and Socioeconomic Index scores are presented as Appendix A4.

Figure 3.4: *Summary Listing of Background Information Questions*

housing, others may be excluded from university run housing for reasons of finances or marital status. Considerations of this sort appear to be relevant to all 27 of the functions, and the several questions dealing with these functions seek to provide data pertaining both to the respondent's evaluation of the relative importance of each function and to his assessment of Duke's relative success in their fulfillment.

Question 13 lists the 27 functions as "objectives which have been suggested as important for the college student." Each respondent is asked to assess the degree of importance of each of the 27 items to him, personally. For each function a scale, consisting of the following four classes, is provided for rating the degree of importance of the item in question: none, somewhat, considerable, high.

Question 14 asks the respondent to reconsider the list of 27 items and to indicate which three he considers most important for college students in general. Thus, we have data indicating the respondent's judgment regarding the importance of these items to him and also his assessment of the items which are most salient for the college

population as a whole. Responses to questions 13 and 14 merit comparison and also may be employed as alternative bases for contrasting analyses employing the following two questions. Questions 15 and 16 ask the respondent to indicate the three items which Duke *best* facilitates and the three which Duke *least* facilitates. It becomes possible, with the addition of these data, to explore the extent to which functions adjudged important are viewed as being among the best provided for, among the worst provided for, or neither. Either way of assessing importance might be profitably employed. These data might also be usefully juxtaposed with some of the basic behavioral data described in the previous section, and with the various background items discussed above.

The last two questions included in the Student Information Questionnaire are essentially self explanatory. Question 18 was included to provide us with some indication of student opinion regarding participation in the study. To the extent that responses to this item are largely favorable, it is felt that the validity of the data obtained is likely to be relatively adequate. A predominance of favorable responses also suggests that similar studies conducted elsewhere are likely to meet with success. Question 19 requests that the student release his SAT scores and his grade point average, both of which are ordinarily classified information. These data, if obtained, have numerous interesting possibilities as they relate to activity patterns attitudinal items discussed above.

Exploratory studies of faculty and graduate students

The previous sections of this chapter have dealt with the problems of gathering data about the activities and characteristics of undergraduate students. While the efforts of this study have been focused upon undergraduates, largely because of their greater numbers than other campus groups, other groups have also been considered. In this section we shall review some of the considerations involved in collection of data from faculty and graduate students. These categories of actors present special and differing problems, yet they must be considered in developing an adequate planning model of campus activities.

Graduate students, depending in part upon their age, marital status, and career commitment (which is in turn a function of the extent of professional training completed), may be expected to behave quite differently from undergraduates. Indeed, their activity patterns are likely to reflect their transitional status rather well, showing some characteristics that are quite similar to undergraduate activity patterns and others which are more in line with faculty norms. Figure 3.5 indicates a number of dimensions of difference and the usual directions of difference among undergraduates, graduate students and faculty. Each of these dimensions is related to activity patterns in a predictable manner, and in all cases the graduate student falls somewhere in between. Whatever the dimension of difference, it appears that the undergraduate is likely to spread his activities over a larger number of campus facilities with the consequence that most facilities are used less intensively by any single student. The faculty member, in contrast, tends to confine

DIMENSION	UNDERGRADUATES	GRADUATE STUDENTS	FACULTY
Age	Most under 21	Most 21 or over	All over 21
Marital status	Few married	Many married	Most married
Residence	Most on campus	Most off campus	All off campus
Courses in which a participant	Various and numerous fields	Few fields; major, minor, languages	One field
Extracurricular campus group participation level	High — many memberships	Low — few or no memberships	Low — occasional advisory role only
Professional orientation	Low	Moderate or minimal	High
Community involvement outside university	Some	Little or none	High or moderate
Most commonly assigned space type	Dorm room	Library carrel	Office and/or laboratory
Weekly hours committed to scheduled activities (classes)	15-20 average about 15	3-15 average about 9	3-9 average about 6
Presence of supervisors (secretaries, assistants, etc.)	Rarely if ever	Occasionally	Often, sometimes several
Library holding usually used.	General	Specialized and general	Highly specialized

Figure 3.5: *Selected Dimensions of Difference Among Faculty, Graduate Students and Undergraduates*

his activities to fewer locations with the result that his usage patterns are more intense. For these reasons it is necessary to develop rather different instruments for gathering data regarding the faculty and graduate student activity patterns. A special Senior Personnel Questionnaire (Appendix A3) aimed at the problems of collecting data from the faculty was designed and tested on an exploratory basis.

As noted above, faculty are likely to utilize fewer campus facilities than either undergraduate or graduate students. They are also less likely to respond to a detailed activity inventory of the sort employed for undergraduate students because they are likely to have real, or perceived, time pressures which militate against such a task. They also are apt to view such an inquiry as an infringement of their perquisites of activity independence and self determination. Academicians traditionally reject any suggestions that their lives be regulated by any time-clock-like scheme.

Largely in response to these considerations we developed the short, location-oriented form reproduced as Appendix A3. It will be noted that

the respondent is asked to provide the *proportion* of time spent each day in a number of locations, rather than the exact times spent at each place. He is also asked to indicate the total number of hours each day which he spent on campus (i.e., the number of hours represented by 100%). Finally he is requested to indicate as precisely as possible the locations to which these various percentages refer. These data are supported by 13 supplementary items.

Most of the supplementary items are self explanatory. Several of these items are concerned with the extent and nature of interdisciplinary activities. This is a dimension of academic life which is often the result of circumstance and is poorly understood. For the university planner interdisciplinary activities have special significance since they imply co-use of space by members of different disciplines and appear to require spatial planning and assignment to facilitate certain types of interdisciplinary contact. The typology of interdisciplinary activities included in questions seven and eight was derived from *Systems for Measuring and Reporting the Resources and Activities of Colleges and Universities.*[19]

The faculty questionnaire described above was applied in two ways, each application with a subsample of 25 faculty members. One subsample received the instrument with a cover letter through the campus mail and was asked to return it through the mail. This is clearly the least expensive means of administration and the one with the highest risk of non-response especially when only one mailing is undertaken. The other subsample was interviewed by an attractive female student using the instrument as a guide. While more costly, the return rate for the latter approach might justify the additional expense.

The tabulation of responses to these two approaches for gathering data from Faculty, presented in Figure 3.6, indicates that neither method was particularly successful. The surprisingly higher rate of responses to the mailed questionnaire suggests that it might be wise to use this less expensive approach for a full scale inventigation of faculty activity patterns. This conclusion must be tempered by the note that our use of a single part-time interviewer may have unduly complicated the problem interview scheduling. On the basis of this small test, we would recommend a two-wave mailing followed by interviews with those faculty members who had still not responded to the mailed questionnaires.

The Senior Personnel Questionnaire has not been subjected to the extensive pretesting undertaken in developing the Student Activity Diary. Part of the plan was to obtain additional data which would allow comparison of the responses of two samples of graduate students, one of which would be sent the Senior Personnel Questionnaire by mail and the other of which would be asked to complete the Student Activity Diary. This approach, in keeping with the highly exploratory orientation toward the faculty and graduate student populations, would have allowed some tentative conclusions to be drawn about the relative utility of the data provided by the two instruments. It would also have provided some indication as to which instrument is better suited to gathering data from graduate students. Unfortunately, budgetary and other exigencies required that this phase of the original plans be

[19] National Science Foundation, NSF 67-15.

Method of Administration	Number Attempted	Number Completed*	Response Rate
Interviews. Non-response reflects difficulties of scheduling. Interviewer was a student employed part-time.	25	9	36%
Mailed Questionnaire. Non-response reflects respondent reluctance.	25	12**	48%

*These data have not been subjected to systematic analysis as of this writing. Visual inspection of the completed questionnaire suggests that the overall quality of the data does not vary with the method of administration. In either case the responses to structure questions is excellent, and the open-ended questions elicit about the same number and quality of comments. With respect to open-ended items, the remarks tend to point to similar issues — such as the absence of an adequate "faculty club."

**One of these twelve returned questionnaires was not completed. A note attached to it indicated that the respondent was in the process of moving, and judged his present activity patterns to be too atypical for use. His apparent willingness to respond under more "normal" circumstances led to our inclusion of his questionnaire in this tabulation.

Figure 3.6: *Comparison of Return Rates for Senior Personnel Questionnaire by Method of Administration*

dropped. In spite of the fact that we are unable to make any clear cut recommendations regarding the utility of the Senior Personnel Questionnaire, this discussion is included here and the questionnaire among the appendices in the hope that the limited experience in gathering data regarding faculty activity patterns might be of some use to other investigators. The following chapters will not discuss faculty or graduate student data gathering or analysis, since our experience in this regard has been negligible.

Summary

This chapter has summarized the major considerations in developing research instruments. Six criteria for instrument development were discussed: the instrument must be complete, locative, responsive, economical, administrable, and analyzable. Various approaches to collecting data from undergraduate students considered were discussed, and the more salient reasons for choosing the diary were stated. The last three sections of the chapter have described the three instruments developed: the Student Activity Diary, the Student Information Questionnaire, and the Senior Personnel Questionnaire, for use with faculty and graduate students.

SAMPLE SELECTION PROCEDURES

This chapter presents the method for choosing respondents. Our major emphasis upon undergraduates, who number approximately 4700, required us to develop procedures for obtaining a representative sample since economic considerations precluded studying the entire population. As noted in the previous chapter, various research instruments were tested on three separate occasions, each time employing somewhat different sampling procedures. In the case of the pre-test, selection procedures were quite simple, and the sample rather inelegant. The abortive survey of April 1968 employed a more sophisticated sample of students and served as a forceful reminder that time sampling as well as respondent sampling was problematic. The third survey, in October 1968, included respondents selected by the same procedures which were employed in April, with the addition of a quasi-panel aspect to the design. This addition was an effort to gain control over the time factor. Details of these three approaches to sample selection are described in the following sections of this chapter.

The pretest: a simple random sampling procedure

The pretest was conducted with a total of 100 potential respondents, 86 of whom actually completed the task. A sample size of 100 was selected, arbitrarily, in order that there be an adequate number of respondents to provide data from students with varying backgrounds and orientations, yet few enough that the volume of open-ended data would be of manageable size. At that stage of the project relevant background dimensions for stratification purposes were not known; therefore, a simple random selection procedure was used. The steps involved in this procedure are as follows:[20]

Population listing. A computer generated list of the names and addresses of all currently enrolled undergraduate students was obtained from the university registrar. The total number of entries in this list, *N*, was printed out.

Sampling interval. The sampling interval, *i*, was calculated using the following equation: $i = N/100$.

Drawing the sample. One of the first *i* entries on the population list was selected with the aid of a table of random numbers, and this entry and every *i*th individual thereafter was included in the sample. This resulted in the required sample of 100 undergraduates.

[20] Essentially the same procedure was followed for our limited explorations of faculty activity patterns. The two differences were that only a total of 50 faculty members were chosen, and the faculty sample was divided into two groups of 25 (one for mail administration, the other for interviewing) by taking every second member of the sample for one group and the remaining members for the other. The university payroll department provided the population list employed for faculty selection.

April 1968: a stratified sample and replication

By the time of the first full-scale survey, it was evident that some stratification procedures might be usefully employed to be more certain that crucial background differences were adequately represented. Since one of the major dimensions of this project was to provide data which would allow planners to project activity patterns under varying conditions of student body composition, stratification should be along some relevant dimensions. Had special interest been, for example, in the effects of dormitory locations upon activity patterns, stratification might have been on the basis of residential status.[21] The initial problem was to choose the appropriate dimensions for stratification from among the variables for which the registrar maintains data on the undergraduate student population.

In discussing the background items chosen to measure by the Student Information Questionnaire (Chapter One) it has already been indicated that they are expected to correlate highly with different activity patterns, and therefore with differences in facilities utilized. This criterion is also basic for choosing among alternative dimensions of stratification. An additional criterion was that dimensions of stratification be chosen where possible so that the likelihood of excluding small but important strata be smaller than would be the case with a simple random sample. For instance, the ratio of males to females in the undergraduate population is approximately 2:1; a simple random sample of reasonable size would include a significant proportion of the 1500-plus female students by chance alone. Thus, sex did not appear to be a particularly useful sampling dimension, even though a high correlation between sex and activity pattern could be expected.

One dimension for stratification chosen was the college in which the student is registered.[22] This variable is highly correlated with sex at Duke, as is evident from examination of Figure 3.7; hence, two relevant variables are taken into account at once. The college in which an undergraduate is registered is also related, albeit imperfectly, to residential status. More students registered in Trinity College and the School of Engineering reside on West Campus, most of those registered in the Women's College live on East Campus, and most students in the School of Nursing live in two special dormitories located near the medical school. Had not "college" been taken as a stratification variable, students enrolled in engineering and nursing programs might have been under-represented by chance, since their numbers are relatively few.

The second dimension of stratification chosen was undergraduate class-in-school. In this case there was little concern about the problem of inadvertently omitting any category except for fifth-year undergraduates, since all other groups

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[21] The computer program, available through EFL, which we employed in selecting our sample has been generalized so that it can be employed with any three stratification dimensions for which population data are available.

[22] It should be emphasized that the range of potential stratification dimensions is strictly limited by the availability of data regarding the entire population from which the sample is to be drawn. Thus, the registrar could not provide data regarding "father's occupation" and declined to release "grade point averages" to us, eliminating any possibility of stratifying along these dimensions.

Stratum 1. COLLEGE	Population	Expected Sample Size
Trinity (Undergraduate, Men)**	2377	262
Engineering (Undergraduate, 2F)	402	44
Woman's College**	1343	147
Nursing (2 Men)**	260	29
Undergraduate Subtotals	4382	482
Stratum 2. UNDERGRADUATE CLASS		
Freshmen	1248	138
Sophomores	1201	132
Juniors	1021	112
Seniors	977	108
5th Year	76	9
Totals	4523	499
Stratum 3. MAJOR		
Undecided	1613	177
Humanities (Undergraduate)	750	83
Social Science (Undergraduate)	776	86
Science (Undergraduate, including Engineering and Nursing)	1243	136
Totals	4382	482

*Data for Fall Semester 1967-68, provided by Duke University Registrar

**Does not include the following in population: Trinity, 42 "special students"; Woman's College, 28 "special students"; and Nursing, 10 graduates.

Figure 3.7: *Definition of Strata and Sample Size**

are about the same size. The primary reason for including class as a basis for stratification sampling was to insure proportionate representation across the four normal categories. This dimension, unlike the others, has the property of order and one would expect systematic, progressive changes in activity patterns to occur as students matured academically. If this assumption is true, proportional representation will be more likely to reveal it than comparisons based on samples reflecting random disproportions.

The third dimension, "major group," also meets the criterion of being related to activity patterns. As will be seen from the data presented in Figure 3.7, there is some risk that humanities and/or social science majors might be under-represented if simple randomization were employed in sample selection. Since a student's choice of major is associated with his choice of courses, and hence with the academic facilities which he is likely to utilize, it is considered especially important that no significant category of majors be under-represented among our respondents. Figure 3.8 shows the way in which the various individual

STRATUM:	MAJORS INCLUDED IN STRATUM GROUPING:	
Humanities	Art	Languages (all)
	Classics	Music
	Education	Philosophy
	English	Religion
	History*	
Social Sciences	Anthropology	Political Science
	Accounting	Psychology**
	Business Administration**	Sociology
	Economics	
Sciences	Anatomy	Geology
	Bio-Chemistry	Mathematics
	Chemistry	Nursing
	Engineering	Physics
	Forestry	Zoology

*History is included among the humanities on the grounds that teaching and research in history tend to be more similar to teaching and research in English than to teaching and research in Sociology — hence the facilities used and the activity patterns of majors would tend to "fit" better under this classification.

**Accounting, Business Administration, and Psychology, for various reasons, are difficult to classify. In our judgment, they are better classified under Social Sciences than elsewhere.

Figure 3.8: *Grouping of Majors into Three Classes for Stratified Sampling*

majors were grouped into strata for major group classification.

The procedure by which the basic sample of 500 undergraduates was drawn,[23] utilizing the three dimensions of stratification discussed in the preceeding paragraphs of this section was quite simple. The program SELECT was developed to perform the actual operations. The basic steps in sample selection were:

Population listing. A machine-readable tape, including the data relevant for stratification as well as names and addresses of all currently registered undergraduates, is obtained from the registrar. This tape provides the input data for program SELECT, which performs the remaining steps.[24]

[23] The decision to use a 500 member sample reflected budgetary considerations and judgment that, assuming a response rate of close to 80%, it would provide data adequate for all anticipated analyses.

[24] It should be noted that these steps are listed in the sequence in which a human, working with a list or card file, would be expected to operate. Program SELECT performs the tasks in essentially the same sequence.

Grouping by college. All students in the population are divided into four groups corresponding to the groups listed under "college" in Figure 3.7.

Grouping by class. Within each of the four groups obtained in the previous step students are subdivided into five groups, by class, corresponding to the categories listed under "college" in Figure 3.7. This results in 4x5 = 20 cross-classified groups.

Grouping by major. Within each of the 20 groups resulting from step three all students are further classified with respect to major, again corresponding to the four relevant categories of Figure 3.7. This results in 4x20 = 80 cross-classified groups, as represented by the cells of Figure 3.9.

Drawing the sample. Eleven percent[25] of the members of each of the 80 groups from the previous step are randomly chosen and constitute the basic sample. The computer prints and punches out the relevant data regarding each sample member. These data include his name, address and status with respect to each stratification dimension.

STRATUM 1 – SCHOOL:		Trinity	Women's College	Engineering	Nursing
STRATUM 2 – CLASS:	STRATUM 3 – MAJORS:				
Freshmen	Undecided				
	Humanities				
	Social Sciences				
	Sciences				
Sophomores	Undecided				
	Humanities				
	Social Sciences				
	Sciences				
Juniors	Undecided				
	Humanities				
	Social Sciences				
	Sciences				
Seniors	Undecided				
	Humanities				
	Social Sciences				
	Sciences				
Fifth year	Undecided				
	Humanities				
	Social Sciences				
	Sciences				

Figure 3.9: *Sample Design Matrix — Stratification*

In addition to the basic sample, derived by the stratified random procedure just described, data was sought from a special group of 50 students. This group consisted of all members of the pilot study sample (February 1967) who were currently enrolled at Duke and had not been included by chance in the basic sample. As it turned out, 11 of the original pilot study sample members were included in the new sample. There were also, of course, a number who had graduated or were not currently in residence for other reasons. The purpose in seeking data from this special group was to develop an estimate of the stability of individual activity patterns over time (approximately one calendar year). As it turned out, responses were low and activity patterns were too obviously disrupted by the events (discussed in Chapter One) which led us to pursue this phase of the analysis in the field again.

[25] Since a sample of 500 was chosen previously, it was simple to determine the sampling proportion as follows: Let N = the size of the population from which the sample is to be drawn (in this case $N = 4500$), and s = the desired sample size ($s = 500$). Then the sampling proportion, P equals s/N, or in the present instance, $P = 11\%$.

30 October 1968: a four-wave quasi-panel design

At the outset of the fall semester 1968, it was decided to make a simple modification in the design which, hopefully, would produce a higher proportion of useful data in the event of another significant campus disturbance. The decision was made to spread data collection over a longer period of time, rather than concentrating efforts in a single week, possibly highly atypical. The risk increased that some outside forces might reduce the utility of some of the data. On the other hand, the likelihood of gathering entirely useless data would be reduced to a sufficient extent to warrant the strategy change.

The basic sample for the new strategy was derived exactly as was the sample for the April survey. Once the 500 subjects had been selected, they were divided at random into four groups of equal size. These four groups of 125 students were then randomly assigned to four consecutive weeks in October. Thus, a different group responded to our instruments in each full week of the month.[26] Aspects of the October survey are presented in the next chapter, which deals with administration procedures.

It should be noted that this design has some added advantages. a "four-wave quasi-panel" provides data which, like a true panel design, permits analyses directed at discovering change and stability factors over time. Random assignment of subjects to each of the four groups provides considerable assurance that the four groups were initially comparable. This comparability, of course, can be tested either according to previously available data such as the sampling criteria, responses to background items on the Student Information Questionnaire, or both. Since all four groups responded to the same instruments, the sources of between-groups variation which are not attributable to chance are time-correlated. Among these sources, only the increased experience of the respondent supervisors may be reasonably assumed to contribute error variance. Thus, comparison of the activity patterns of the four groups will provide indicators of change and stability over time that are quite similar to those which are rendered by a true panel design. Averaging over the four groups, in contrast, will provide a more stable index of the typical activity pattern than would be provided by the one-week design employed in April. It therefore becomes possible, through this simple modification in design, to concomitantly provide data of a sort previously unavailable and to offer the planning officer a better, more stable, picture of typical activity patterns.[27]

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[26] The possibility of disruptive events, such as the massive sit-in which occurred on campus during the previous April, was anticipated by maintaining scheduling flexibility. If such events had occurred during the second week of the survey, distribution of the material to subsequent groups would have been delayed until more normal conditions were obtained. Fortunately, this was not necessary.

[27] This will be true both for the sample as a whole and for various subgroups defined in terms of background or stratification variables, except for the caution that subgroups should be sufficiently large for any given week to allow generalization. A minimum of 20 subgroup members is a widely accepted rule of thumb definition of *sufficiently large*. Clearly, the larger the group, the greater confidence one will have in generalizations based upon it.

ADMINISTRATION, MANPOWER & MONEY

Up to this point, attention has been focused upon descriptions of things which were done, the ways in which they were done and, in some cases, how they might have been done better. This chapter describes the steps which intervened between sample selection and coding and checking the completed instruments. The number and qualifications of persons required to staff such a project and cost estimation procedures are discussed. This juxtaposition seems appropriate since the activities described thus far, with the exception of programming for sample selection, largely have been accomplished by the principal investigator and the project director with the occasional assistance of various consultants. If we assume that the guidelines set forth in this handbook, based upon the experience of this study, are sufficient to allow others to initiate a comparable investigation in their own environments, it would appear that the major personnel costs of such a study will come during, and after, administration of the survey.

Organizational requirements for survey administration

The major burden of the diary project was carried by two people: the principal investigator, who devoted varying portions of his time to this investigation, and a full-time project director. The project director had the major responsibility for recruiting, training, and supervising other personnel.[28] Most of these other people who worked on the project were students engaged on a part-time basis. Advantages of utilizing this readily available labor pool are noteworthy:

- Students are more familiar than anyone else with undergraduate activity patterns, hence their critical abilities proved vary useful in developing instruments and procedures, particularly during the pre-test and the April 1968 survey.
- Students tend to be more familiar with both the campus and their fellow students (i.e., sample members), facilitating the tasks of contacting and supervising respondents.

In editing, coding, and checking various items, student familiarity with the campus scene allowed resolution of ambiguities which would not be possible if non-students had been employed on a full-time basis. For example, the Student Information Questionnaire item dealing with organizational participation elicited responses indicating membership in a variety of organizations which were not listed on official records. The student staff members were able to provide necessary information about these organizations to allow appropriate coding and classification.

Early experiences with training and supervising student personnel helped to do so at later stages of the investigation. Much of the knowledge gleaned from these early experienes resulted in subtle shifts in approaching these tasks, and is virtually impossible to translate into written form

[28] These tasks were occasionally shared by other members of the research team including the principal investigator, some consultants, and some previously trained student personnel.

September

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
15	16	17	18	19 Classes Start	20	21
22	23 Hire Student Personnel	24 Begin "Location Identification"	25	26	27	28
29	30					

October

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 Meet the monitors	2 Monitors get booklets for Group I	3 Group I Booklets	4 Distributed	5
6 Group I begins booklets	7	8	9 Monitors get booklets for Group II	10 Group II Booklets	11 Distributed	12
13 Group II begins booklets	14 Collect Group I booklets	15	16 Monitors get booklets for Group III	17 Group III Booklets	18 Distributed	19
20 Group III begins booklets	21 Coilect Group II booklets	22	23 Monitors get booklets for Group IV	24 Group IV Booklets	25 Distributed	26
27 Group IV begins booklets	28 Collect Group III booklets	29	30	31		

November

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4 Collect Group IV booklets	5 Begin editing and	6 coding all booklets	7	8	9
10	11	12	13	14	15	16

Figure 3.10: *Timetable for Survey — October 1968 Diary*

for other investigators. Other experiences are reflected in the instruments as they presently appear, and in the procedures described here.

The organization which was assembled to handle the survey administration, and to a lesser extent the coding and checking group, varied among the three ventures into the field. Since the October 1968 survey reflected prior experience, it seems appropriate to center attention on the procedures and organizational features which were employed at that time. The discussion will follow the chronology of operations from late September when the first student helpers were hired through early November when editing, coding and checking got under way. Figure 3.10 shows this

sequence of events and may prove useful for other investigators wishing to estimate timetables for their own research.[29]

Location identification. Experience with the April 1968 survey called attention to the difficulty which respondents encountered with identifying correctly their locations by room number. At Duke a given room number is located outside, usually on or near the entrance. Exterior identification is useful in finding rooms, but it does not help the person inside the room to identify his location. The location of room numbers on the outside varies depending on the time the building was built or remodeled. Also, the respondent was frequently faced with the problem that some locations simply are not numerically identified inside or outside. (This most commonly occurs with restrooms and rooms which have been created as a result of remodeling, though some multi-entrance rooms are numbered on *one door only.*) Ideally *all rooms* should be permanently, conspicuously and consistently identified by number both inside and outside. It was impossible for our research group to provide such identification. As a partial effort, cards like the one reproduced as Figure 3.3, were placed in conspicious locations inside many of the more heavily used rooms on campus.

Assistants were provided with a supply of bright pink data cards, which had been pre-punched and interpreted to read "EFL PROJECT LOCATION IDENTIFIER CARD – PLEASE DO NOT REMOVE BEFORE 11/04/68." They were also given a set of number stencils, a black felt-tipped marker, masking tape, and floor plans of the buildings assigned to them with the numbers of all rooms in the building identified thereon. Their task was to find all rooms shown on the floor plans to which they could obtain access (excluding private offices), stencil the room number on one of the pre-punched cards, and affix it conspicuously inside the room.

Diary preceding. During the same period that room identification cards were being placed around the campus another group of students was preparing the booklets for distribution to respondents. These students wrote a sample number on the outside of each booklet, entered it in the appropriate field of each diary page in the booklet, and wrote it on the Student Information Questionnaire and the tear-out card which the respondent was asked to use in requesting that his SAT scores and grade point average be released. They also precoded the day and page number entries on all diary pages. This effort was made to reduce editing time and to help insure higher data quality.

Organization for administration. While the preparations described above were underway, a team of students was being trained to act as supervisors during administration of the survey. During the pretest 10 volunteers contacted sample members, gave them the pretest

[29] Figure 3.10 omits both the instrument preparation phase and final stages of coding and checking, machine processing, and analysis. The reason for these omissions is simply that each of these aspects of the total project may require widely varied amounts of time, depending upon a host of circumstances. For example, printers who are able to produce Digitek forms within the required tolerance limits may require greater or lesser amount of time to prepare the instruments once layout and design are finalized. Again, the post-data-collection phases of the undertaking may be expected to require differing amounts of time depending on such factors as: the total amount of data collected, the number of coder hours available per week, the amount of special computer programming required, or computer turn-around time.

instrument, collected it at the end of the week, and in general kept this phase of the project running smoothly. Each of these individuals, recruited from the ranks of acknowledged student leaders, took responsibility for administration in the pretest of ten respondents. The relatively successful pretest led to a similar approach in administration in April 1968. Because of the large sample, it was necessary to secure 50 volunteers to serve as supervisors. It is extremely difficult to supervise so many volunteers as carefully as seems to be necessary to maintain their motivation and performance levels.

The most recent survey involved approximately the same number of respondents as the April 1968 survey. They were studied, however, in four smaller groups over as many successive weeks, rather than all at once. This schedule provided the opportunity to work with fewer supervisors, twelve in all, and to maintain closer contact with them. To help maintain their motivation, these twelve supervisors were paid an hourly wage, and were given a bonus of 25 cents for every acceptable booklet which they returned. In addition, a student who had previously worked on the project, was hired to serve as supervisory coordinator during this period.

Supervisory coordinator. The role of the coordinator was pivotal. He made initial contacts with potential supervisors, and made recommendations as to who should be hired. He took the major responsibility for pre-survey training sessions, coordinating booklet distribution and collection and answering any questions which might arise, among the supervisors during the four-week survey period. He required no special training, since his previous experience in coding the data in the April 1968 survey had sensitized him to the range of problems which might arise and had familiarized him with the decisions which senior staff members had made regarding problem disposition. During the four weeks of data collection the supervisory coordinator was in daily contact with the project director, and frequently appraised the principal investigator and members of the consulting staff of progress. He inspected the booklets which were returned for adequacy and served as *bonus paymaster* for the supervisors.

Supervisors. These students began their jobs by attending an introductory training session, conducted by the coordinator, in which members of the senior staff briefed them regarding the nature and significance of the project as a whole and the importance of their roles. At this meeting they were given general instructions on their task, and given a twenty-four-hour version of the diary with instructions identical to those the actual respondents would receive. During the following day the supervisors logged their own activities, as a means of preparing themselves for any difficulties which their respondents might uncover and insuring familiarity with the details of diary keeping. At a meeting, held the following evening, the coordinator discussed the problems which arose as the supervisors kept their short diaries. This session was the real working session, in which supervisors received detailed instructions on contacting respondents, encouraging reluctant respondents, answering questions, or obtaining answers, and distributing and collecting booklets. Weekly supervisor meetings were held with the coordinator and project supervisor. The coordinator contacted each supervisor individually at least once each week to check on progress and to resolve any difficulties.

Each supervisor administered the diary to an average of 10 respondents[30] each week during the data gathering period. At the weekly meetings supervisors were given names and addresses of respondents whom they were to supervise during the following week, together with the proper number of booklets. To insure respondent anonymity, there were no records to note which booklets were given to particular individuals.[31] Only booklet numbers were used by the coordinator in keeping track of the number of acceptable booklets returned by each supervisor.

When each supervisor made initial contact with the respondents assigned to him, he was instructed to remind the student that his cooperation had been solicited previously by means of a letter and to explain in detail the instructions and example. Some respondents were reluctant and the supervisor's most difficult task was determining how much persuasion could be applied without alienating respondents. The relatively small number of outright refusals suggests that supervisors were reasonably successful.

At the end of each week supervisors were instructed to collect the booklets individually. At this time they were to give each booklet a preliminary inspection for completeness, preferably in the respondent's presence. In the event that the Student Information Questionnaire had not been completed, or the request card had not been removed and, presumably, sent to the registrar, supervisors were encouraged to use this opportunity to urge the respondent to complete the task at once. We do not know to what extent supervisors may have used this opportunity to ask respondents to fill out incomplete diary entries by *post hoc* reconstruction of activities which were omitted. The bonus payments were purposely set at a low figure of 25 cents per booklet to discourage this form of faulty reporting. Most of the unacceptable booklets returned were rejected because the respondent had not completed the task, which suggests that this practice was uncommon.

Criteria for selection of student employees

This section will not discuss the qualifications appropriate for senior staff members for a project such as this one, nor the consulting or

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[30] Sample numbers were pre-entered in the booklets and were unable to be related to respondent names. Arrangement with the registrar regarding SAT scores and grade averages ("quality point ratio" is the commonly accepted term for "cumulative grade point average" at Duke; hence the phrase used in the booklet) was such that students sent him authorization to release this information to us via campus mail, the authorization form included both the respondent's signature and the sample number, and the registrar provided us with data which included *only* the sample number as a means of identification. Thus anonymity was preserved even at this step. Since printed instructions did not describe this procedure explicitly, the supervisors were instructed to clarify it to all respondents at the time of initial contact and to further remind them of the arrangements and urge them to send the cards to the registrar, if they had not previously done so, at the time when booklets were collected.)

[31] In fact, two supervisors were responsible for fewer respondents - all of whom lived off campus, complicating the task of initiating contact with them.

programming talents which are required.[32] Rather, attention will be directed to the salient characteristics to be sought in hiring people to fill the roles for which students were employed. The possibility of securing other full-time personnel for these tasks is not ruled out. Since students undoubtedly will constitute a ready pool of available labor wherever similar investigations are undertaken, since these tasks are well suited to part-time or short-term employment, and in the light of the advantages of employing students outlined in the previous section, bias is toward the hiring of students.

The next several paragraphs will summarize the important criteria for selecting student-employees. How one makes contact with likely candidates, or determines if they have the requisite abilities for a particular task is likely to present a problem. We operated quite informally in securing personnel, and in most cases relied heavily upon the recommendations of other students who were personally acquainted with the potential recruits. During the pilot study, several leaders of student government served as supervisors and suggested others. The president of the Interfraternity Council assembled the 50 volunteer supervisors who worked on our first full-scale survey and helped coordinate their efforts; the supervisory coordinator nominated potential supervisors for the most recent diary. Other student-employees were frequently hired on the recommendations of members of the several supervisory groups. This informal approach worked rather well, since fellow students with long acquaintanceships involving contact in a variety of situations are better able to assess many of the desired traits than would otherwise be possible without resorting to some sort of formal testing procedures.[33]

The supervisory coordinator, above all, should be a leader who has the respect of his supervisors. Acknowledged student leaders were chosen to fill this role. He should also be able to work independently and be able to cope with the cross pressures inherent in the *middle man's role.*

Supervisors, also must be able to hold the respect of respondents. They should be able to persuade reluctant respondents in a diplomatic fashion, and be conscientious, since it will be impossible for the coordinator to monitor their efforts continuously.

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[32] Prior experience with survey research and some familiarity with automated data processing are highly desirable characteristics of senior staff members. If the senior staff members are not equipped with these sorts of experience, the council of appropriately selected consultants should be sought. Similarly, someone associated with a project such as this one should be able to provide the perspective of the planner and architect. Again, a consultant may be usefully engaged. The point is that, although this combination of talents is rarely, if ever, encountered in a single individual, they are useful in mounting a project such as ours. The more familiarity the principal investigator has with these several aspects of the undertaking, of course, the better able he will be to assess the recommendations of consulting specialists.

[33] Personnel psychologists have developed a variety of sophisticated tests for assessing these traits. An alternative approach would have been to work through the university guidance and employment offices to recruit our necessary staff members. The investment in testing and selection procedures which this approach would involve would seem better suited to a project which was designed to use a true panel with repeated surveys on several occasions during each of several successive academic years. With a research design of that sort a small number of full time employees could be engaged to serve as respondent supervisors and, subsequently as coders, shifting from one role to the other and back again with each new wave of the panel study.

Interviewer(s) for faculty and/or graduate student studies should be neat, attractive and polite. Female students generally perform better than males in this capacity.

Coders, who usually double as editors, unlike the other personnel, do not need any high degree of interpersonal skills. Rather, they should have the capacity to work with intrinsically uninteresting materials and to pay meticulous attention to neatness, accuracy and detail.

Guidelines for cost estimation

Concern has been uppermost for developing instruments, administration procedures, and analytic techniques which could be used for similar investigations on small to medium sized campuses. An initial and somewhat arbitrary estimate was that such institutions might reasonably budget $3000 annually to develop and maintain an activities data base for use in facilities planning. Needless to say, development of the instruments, procedures, and techniques described in this volume was not an inexpensive undertaking. The "handbook" format, and extensive appendix documentation, of this volume is intended to save others as much of the developmental expense as possible. Presumably, some investigators might wish to replicate this study exactly in their own environments, and this volume should facilitate such replication. Others will feel that various modifications are necessary for application to their campuses. These modifications will cost money, and we are unable to offer any suggestions as to how much expense will be involved in making such changes. The discussion of cost estimating which follows is based upon experience in the post-developmental phases of this investigation. The detailed item expenses may be somewhat at odds with the costs for identical services in other college communities and may be expected to change over time. These figures should be checked against prevailing locat rates before committing a specific budget.

Figure 3.11 summarizes the major items of expense, and provides an illustration of budget items based upon this project experience.

Booklet preparation. The figures entered in Figure 3.11 assume that the diary pages are prepared by Optical Scanning Corporation, and are based on their March 1968 prices. Other printers might be engaged to do this task, but the reader is cautioned to make certain that the tolerance limits and other Digitek specifications are carefully observed. Specific items in preparing machine-readable pages are as follow:

- A total of six plates are required for printing, one for the back of the Digitek sheet, two for the sample pages, and three for the actual diary pages.
- Color shading is required for each of the five different front pages to make it easier for respondents to distinguish one row from the next. Alternate rows are shaded.
- Each plate requires a new press setup. These setup charges will be made for preparing to run the location list (back of pages) in additional colors. Thus a total of eight press setups will be required.
- Printing is charged per 1,000 sheets. Since 500 booklets were required plus 20 extras, with 23 pages in each, 12,000 pages were ordered.

The other portions of the booklet were printed, and assembled together with the diary pages by

ITEM	NUMBER OF UNITS @ UNIT COST	ITEM COST	TOTAL
Booklet			
Diary Pages: Digitek plates	6 plates @ $35.00	$ 210	
Color shading	5 plates @ $20.00	100	
Press set-up	8 runs @ $15.00	120	
Printing	12,000 pages @ $15.10/M	180	
Instructions, Questionniares, Cover and Binding	520 books @ $ 1.00	520	$1130
Junior Staff			
Three (3) Assistants	200 hours @ $ 1.75	$ 350	
One (1) Coordinator	6 weeks @ $20.00	120	
Twelve (12) Supervisors	4 weeks @ $12.00	480	
Bonus*	500 books @ $ .25	125	
Four (4) Staff** (editing, coding, checking)	500 books @ $ 4.40	2200	
Five (5) Programmers***	100 hours @ $ 2.00	200	
			$3475
Machines			
Digitek**	8.5 hours @ $15.00	$ 127	
Computer			
Sample Selection	4 minutes @ $ 6.00	24	
Processing***	30 minutes @ $ 6.00	180	
Analysis***	30 minutes @ $ 6.00	180	
			$ 511
Miscellaneous			
Printing and Postage	500 books @ $ .10	$ 50	
Digitek Utility Forms	10,000 sheets @ $16.85/M	169	
			$ 219
TOTAL			$5335

NOTES:

*In all cases, estimates based upon the maximum possible number of units should be used to allow for unanticipatable expenses. Thus, total booklet costs, supervisor bonuses, and coding costs are figured *as if* all booklets were used and were acceptable — although this is not likely.

**Estimates for number of units for these items represent maximum possible numbers. Similarly, cost figures for editing, coding, and checking represent an average for booklets in need of considerable editing. If fewer than 500 unacceptable booklets are returned, which is quite likely, these figures will be reduced proportionately. Similarly, though less likely, if little editing is required, the cost per booklet will be less if editor/coders are payed on an hourly basis.

***Programming, processing, and analysis are estimated on the assumption that the programs documented in the appendices to this volume are used without modification. Such costs will vary with computer, programming, and number of booklets to be processed, and the investigators' requirements with respect to analysis.

Figure 3.11: *Estimate of Direct Costs for Student Diary Preparation and Processing*

the same printer at a cost of one dollar per booklet.

Staff, wages. Various types of junior staff personnel and their duties have been discussed previously. Assistants undertook all the pre-marking of diary pages and posting of *location identifier cards.* Their hourly wage was $1.75. The coordinator averaged 10 hours per week over six weeks at a rate of $2.00 per hour. Supervisors were payed $10 per week, plus the bonus for acceptable booklets. Editing and coding staff received $1.75 per hour and required about 2.5 hours to edit, code and check each booklet. We were able to hire an able student programmer at $2.00 per hour, and feel that this relatively low wage should be sufficient to hire someone capable to run packaged programs.

Machine costs. The figures which have been used represent actual unit costs as charged to users of the Duke University Digitek machine and the Triangle Universities Computing Center IBM 360/75. The Digitek machine reads 2,400 sheets per hour, and since each booklet may require as many as 40 sheets (for diary, location and

questionnaire data),[34] eight and one-third hours are estimated to read the data from 500 booklets. Computer costs for sample selection, using SELECT, represent maximum compile and run times on the 360/75. Other computer costs are estimates subject to several sources of variability, as noted in the third footnote to Figure 3.11.[35]

Miscellaneous costs. The first item under this heading accounts for the expense involved in multilithing and mailing letters to sample members enlisting their cooperation. The Digitek utility forms, shown as the second item, are used during coding and checking for entry of the location data and the questionnaire. These forms constitute a different press-job for Optical Scanning Corporation using one of their standard plates. The total cost figure represents a $15.00 charge for press setup plus the same printing rate, $15.10/1,000.

The data in Figure 3.11 shows that the target figure of $3,000 was exceeded by a rather wide margin. Indeed, labor costs alone are in excess of the desired total budget. It should be emphasized that two of the labor items, the supervisor's bonuses and the coding, are purposely high estimates. In addition, the total cost of wages might be reduced considerably if assistants were not needed to post location identifier cards, if the coordinator's role were absorbed by a senior staff member, or if the limited programming needs could be handled without expense to the project by some member of the computation center's regular staff. These considerations are raised to make it clear that, for various reasons, we have not been too economical in hiring or paying support personnel. Through judicious trimming of personnel and other expenses, it should be possible to lower costs sufficiently to bring the overall budget in line with the $3,000 which we originally assumed.

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[34] These 40 sheets are: 21 for diary activities data, 1 for questionnaire data, and as many as 18 for location data from the diary. See Chapter Four regarding coding of the questionnaire and location data.

[35] Computer Programs were written and compiled on an IBM 360/75. Source listings are available through the EFL Library.

PROCEDURES FOR CODING & CHECKING

43/44

This chapter outlines in detail the precedures employed by our research group in coding and checking the data regarding space demanding activities. Many of these procedures were developed on an *ad hoc* basis, and most of them are the result of *ad hoc* modifications of the coding and checking procedures originally anticipated. They are presented to document this phase of investigation and to provide a base for future investigators to use in developing procedures for their own research.

Procedures for coding and checking the diary

After the booklets have been returned, editing and coding begin. Although these jobs require no special training, it is well to use only a few people to do them; it's the old problem of too many cooks. However, these people should be meticulous about their work, for mistakes made during this phase are very costly, and if they remain undiscovered they may well be compounded during analysis. Interpretability of findings will vary inversely with the magnitude of latent error.

Before the diary booklets were sent out, each was assigned a unique sample number which was then coded on each page of the booklet as explained in Chapter Three. The day and page number were also pre-coded to minimize mistakes. There are machines which will do the pre-marking, and these should be used when available. Each returned booklet should be checked for completeness, neatness (so that an editor can decipher what was intended), and penciled response entries. While there is a 50% chance that the Digitek machine will be able to read ink marks, there is also a 50% chance that it will not. Any marks in other but the location columns should be gone over with a pencil to insure readability. Also, all coding should be done with a number 2 pencil.

The editor will be given a line indicator overlay, a plastic or hard paper template leaving exposed coded fields and bearing coder instructions (see Figure 3.12). After double-checking the sample number, day number and page number fields to insure that they are correct, and further checking to see that the sample number blank on the questionnaire has been filled in, the editor tears out all the diary sheets and the questionnaire and throws away the cover. The questionnaires should be kept together for future coding.

The editor slips the diary sheets under the line overlay, one at a time, and notes beside each entry the page and line number of that entry. This task could be obviated by printing line numbers on all diary pages, with added benefits of error reduction. He should check that each location entry is directly opposite its activity and group size marks. Frequently these items can be misaligned by the students. Finally, all locations should be made as explicit as possible. For instance, if the student indicates only that he studied in the *Undergraduate Reading Room of the East Campus Library,* the editor should refer to a floor plan of the East Campus Library to ascertain the number of the room in question.

Transportation records, (i.e., entries involving transportation from one location to another) are handled in a special manner. How the location for

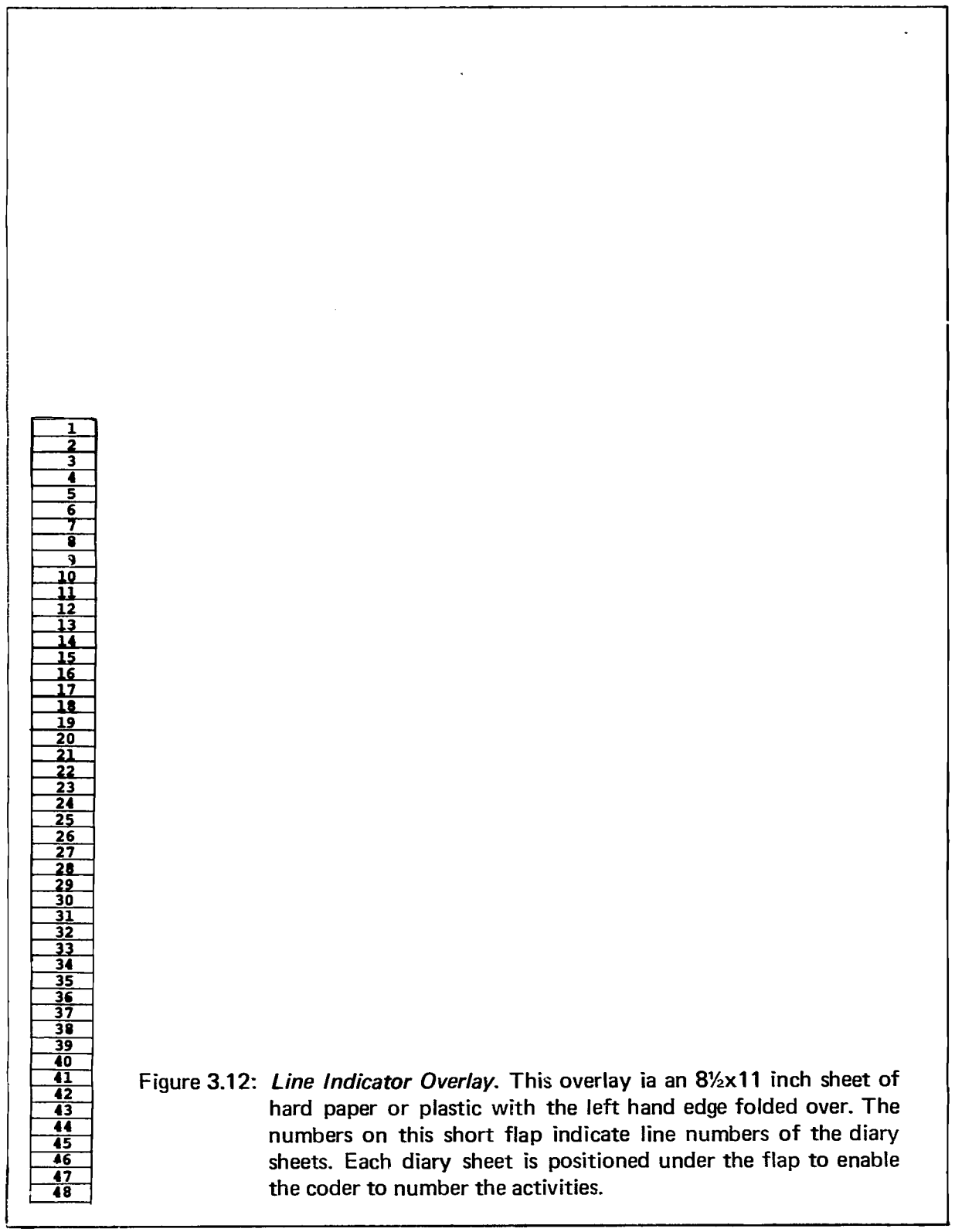

Figure 3.12: *Line Indicator Overlay.* This overlay ia an 8½x11 inch sheet of hard paper or plastic with the left hand edge folded over. The numbers on this short flap indicate line numbers of the diary sheets. Each diary sheet is positioned under the flap to enable the coder to number the activities.

transportation is recorded (that is, whether to record origin or destination) is a matter of preference, convenience, and, in some instances, research requirements. For this reason, we have found it better not to record locations at all for transportation records. During analysis, the location information for transportation records may be taken from origin or destination, the record previous to or the record following the transportation record. Hence the editor should delete all locations given for transportation.

After a booklet has been edited, the coder takes over. On location data forms he will write the following information for each entry in the diary:

The Sample Number: This number is recorded as it appears on the diary sheets.

The Day: Coding Monday as 1 through Sunday as 7, this number is also taken directly from the diary sheets.

Building and Section Number: The building numbers and the section letter (if it exists) are recorded here. Sections apply only to dormitory buildings at Duke, but were necessary to distinguish among buildings. If a student has erred by coding an activity other than transportation

without indicating location, the code 999 is used for the building number. If the editor can be reasonably certain that the activity took place on campus but not in a building, code 593 is used. If the student indicated the location of the activity but did not indicate what he was doing, the space between *car* and *wait* is marked to indicate *unspecified other activity*. This special mark is also used when a student stopped filling out his diary before the end of the week. Then, after letting a reasonable amount of time elapse after the last coded activity, the special mark and 999 are coded in for the duration of the period not coded. Finally, code 593 is used for all on-campus activities not taking place in a building, such as rallies on the quadrangle.

Room Number: The room number, as recorded on the diary sheet by the student or the editor, is filled in here. If the student filled in *bedroom, bathroom, commons or chapter room,* or *hallway,* the codes 9001-9004 respectively were used in hopes of being able later to match the student with his questionnaire. With the information on our sample we could determine his actual bedroom number and the numbers of the nearest bathroom, the nearest commons or chapter room, and the nearest hallway. However, when the students are being given their diaries, care should be taken to emphasize the need for room *numbers.*

Suffix Code: Some rooms are numbered 232S, 224P, etc. For these rooms, the letters A, S, P, etc., are transferred to the location data form.

Page and Line Number: These numbers correspond to the page of the entry and the line on which the entry is coded, as recorded on the diary sheets by the editors. Particular care should be taken to insure that these numbers correspond exactly to the line on which the marks for that activity have been filled in.

Coder's Initials: This is for administrative purposes only.

Figure 3.13 shows an edited diary sheet and Figure 3.14 the location data form completed for this diary sheet. Notice the manner in which (A) bedroom, (B) bathroom, (C) the mis-alignment for line 3-17 (it should be 3-16), and the inserted room numbers for the (D) Reference Room of the library and the (E) East Campus Union have been coded. Notice that (F) line 3-28 has the special activity mark coded since that activity was not specified by the student. Line 3-41, (G), was given location 999 because the student left out the location data. The information for Wednesday morning will be found beginning directly after these data on the same sheet.

After all of the location data forms have been coded, checking begins. No one checks the diaries he coded. Hence, person A takes all of the diaries coded by person B, checking the first and second booklets completely, and correcting any mistakes found. If the first two booklets were done well, the coder, turned checker, can begin looking at every fifth booklet. If the mistake rate is high he will have to continue checking every booklet. Diary booklets and data forms should be initiated by the checker upon completion of this task.

The data forms are now ready to be submitted to a key punch operator for punching and verification. Each line of the forms should be on a separate card for sorting purposes. The format of the card may be left to the programmer in charge of this project.

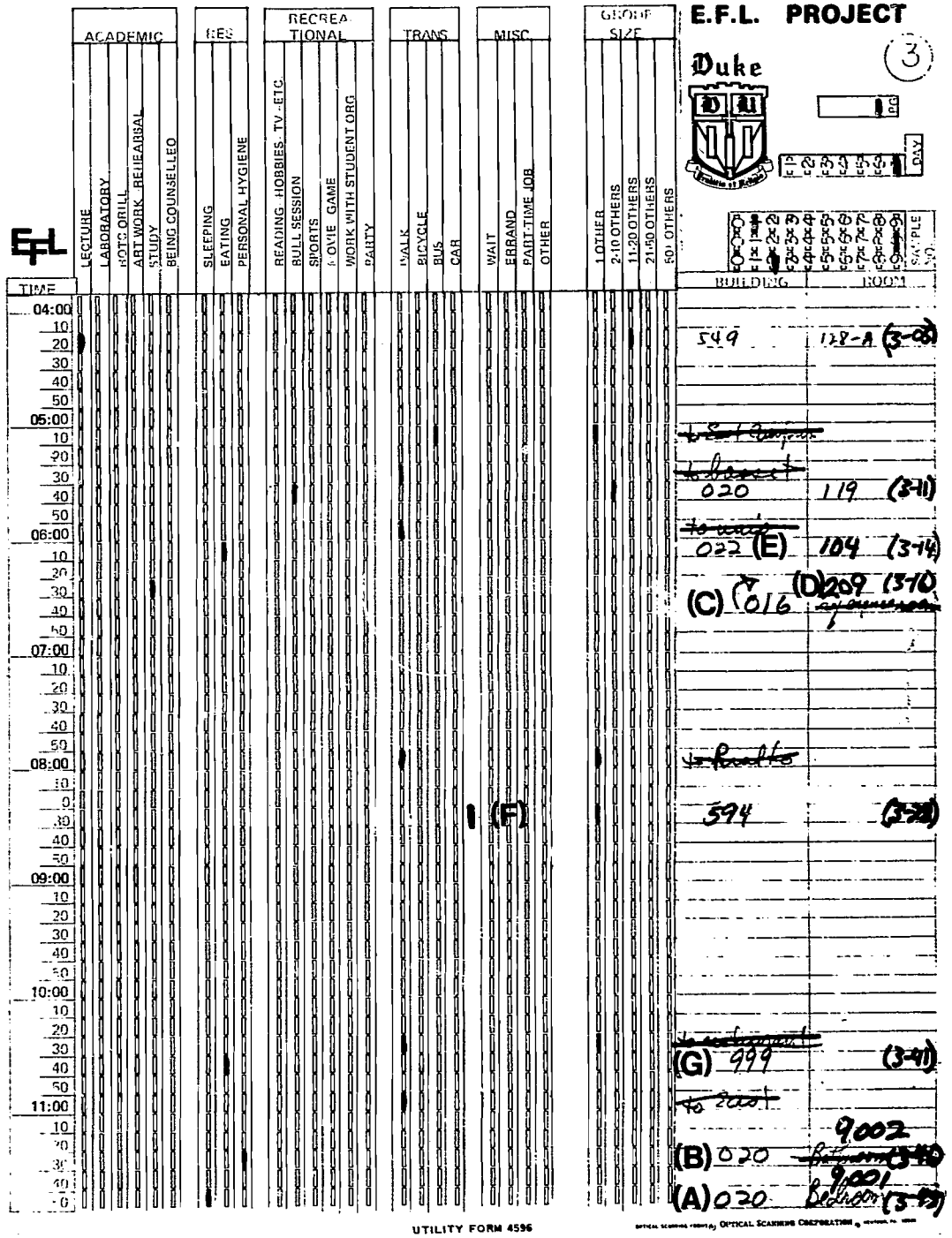

Figure 3.13: *Edited Diary Sheet*

LOCATION DATA FORM

Initials:

	Sample Number	Day	Building & Section	Room	Suffix	Page & Line
	201	7	* 549	128	A	303
	201	7	020	119		311
(E)	201	7	022	104		314
(C) (D)	201	7	016	209		316
(F)	201	7	594			328
(G)	201	7	999			341
(B)	201	7	020	9002		346
(A)	201	7	020	9001		348

3.14 Location Data Form

Procedures for coding and checking the student information questionnaire

The coding of the questionnaire is in many ways much more straightforward, but certain rules and conventions must be observed.

The questionnaire editing need only be a check for the correct sample number on the space provided. That done, the questionnaire can be filed until it is time for it to be coded.

The coder uses the overlay for the *Questionnaire Utility Form* in coding the questionnaires. Figure 3.15 represents the overlay superimposed over a fully coded *Questionnaire Utility Form*. The raw data from which the coding is drawn appears in the appendix. Most of the questions are very easy to code with one rule of thumb: if the question has been left unanswered, leave the field blank.

In question number 3 the last two digits of the birth year are coded.

In question number 5, "Other 1" is used for M.D. and LL.B degrees and, in general, the first professional degree. "Other 2" is used for the second professional degree, and "Other 3" for the third professional degree. "Don't know" is coded as "Other 4."

In questions 8 and 10, "Socio-economic Index for Occupations in the Detailed Classification of the Bureau of the Census: 1950"[36] is used to generate the occupation codes. The first two digits of the four-digit code are taken from the Socio-economic Index column of this table and the second two digits are the assigned codes for the major occupation groups, as shown in Figure 3.16.

Questions 14 through 16 are coded with the letters represented as two-digit numbers.

Question number 17, "organizational membership," presents special problems since an exhaustive list of the names and classifications of student organizations are not always likely to be 49 available from official sources.

Before coding organizational membership, a deck of data cards was generated in which three-digit numbers are punched sequentially. As each new organization appears on a questionnaire, the coder assigns a number to it and records the assignment on the corresponding data card. This number should always be used for its corresponding organization every time the organization appears. These cards are then ready to have the organization names punched into them for later use in computer processing of the questionnaire. These numbers, and their corresponding organizations, should also be listed for subsequent use by the coder. This three-digit code is then filled into the question 17 answer group. Note that there are then question 17 answer groups, each consisting of a three-column

[36] Appendix A4 in this volume has been reproduced from Albert J. Feiss, Jr., *Occupations and Social Status* (Glencoe, Illinois: The Free Press, 1961, pp. 263-275.) Permission of the author has been requested.

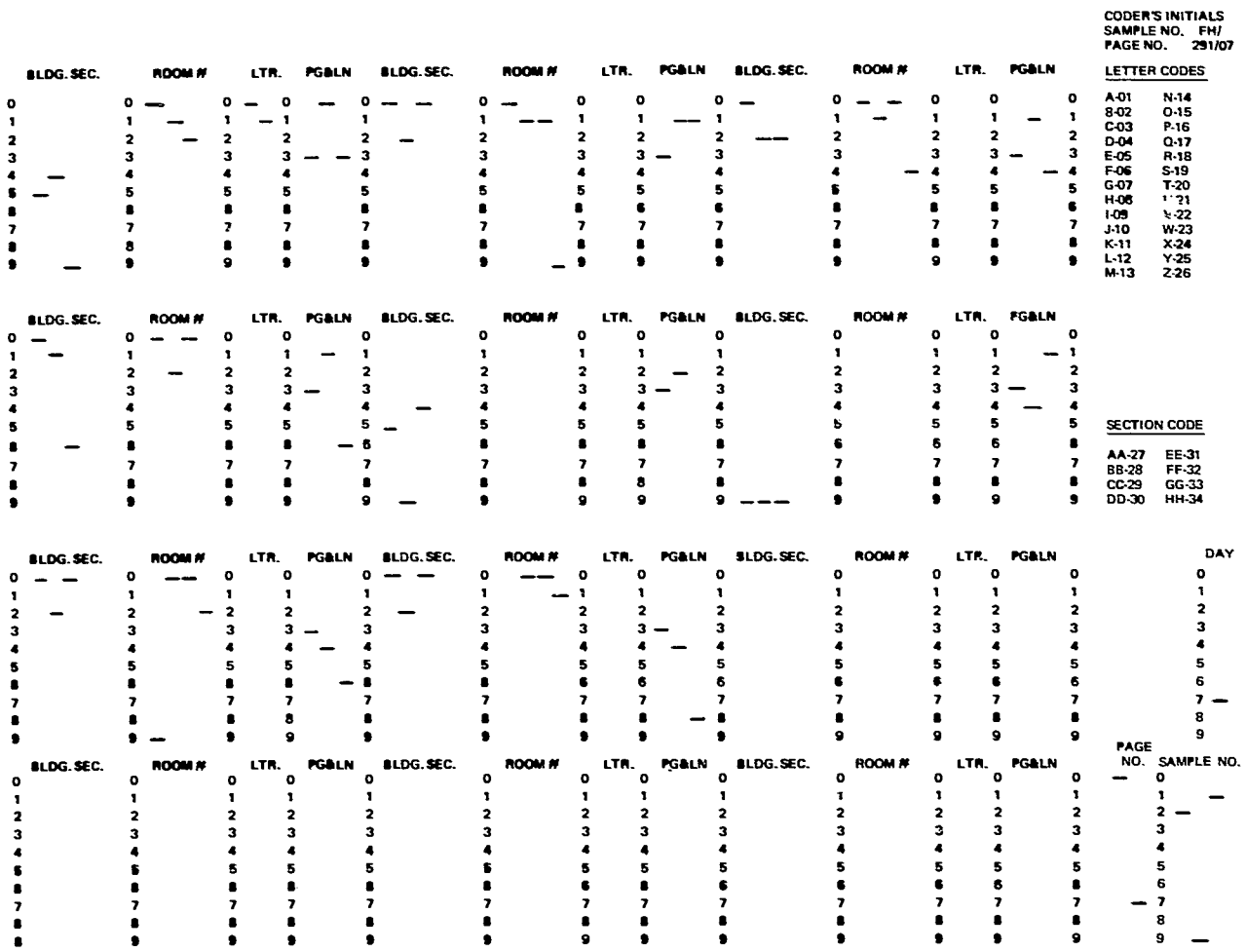

Figure 3.15: *Overlay Superimposed over Coded Questionnaire Utility Form.* The horizontal dashes are pencil marks edited by the coder.

CODE	OCCUPATIONAL GROUP THERAPY
01	Professional, technical, and kindred workers
02	Farmers and farm managers
03	Managers, officials, and proprietors, nonfarm
04	Clerical and kindred workers
05	Sales workers
06	Craftsmen, foremen, and kindred workers
07	Operatives and kindred workers
08	Operatives and kindred workers, not classified elsewhere
09	Private household workers
10	Service workers, except private household
11	Farm laborers and foremen
12	Laborers, not classified elsewhere

Figure 3.16: *Detailed listings of occupations,* partially presented in Appendix A4, are grouped under these headings. The four-digit code is structured so that either general class or the detailed occupational codes from Appendix A4 may be used.

field for the organization code, a "yes-no" field for "office of organization", and a level of participation field. Usually only three to five of these fields are coded for any particular questionnaire. Care should be taken to see that no number is used for more than one organization.

It is not necessary that the organizations be sequentially numbered under each organization type. During computer processing, the organizations will be renumbered so that they can be grouped by type using these numbers as keys.

If the student indicates participation in an organization type, but fails to specify the particular organization, an *unspecified* code, corresponding to that type, is used: 501 for "unspecified academic honorary" through 520 for "unspecified other organization."

The "member" blank on the questionnaire turns out to be superfluous, since the student would not have filled in the organization blank at all unless he were a member. Hence, this item need not be coded. Coding for the remaining items of the Student Information Questionnaire is quite straightforward, and does not merit special comment. Comparison of the marked *Questionnaire Utility Form* presented as Figure 3.15 and the marked questionnaire included as Appendix A2 which corresponds to it will clarify any doubts regarding these procedures.

After the coding has been completed, the questionnaires should be checked, using the same procedure employed for the diaries. The questionnaires are now ready for the Digitek Machine.

MACHINE PROCESSING OF DATA

We originally used the Digitek forms for both the location information and the questionnaire information. Experience has shown that the coding of location data on Digitek forms is far too inaccurate and mistake-laden. The cost of keypunching that information seems to be worth the price in terms of accuracy. Thus the location data after keypunching is ready for processing. The activity and questionnaire data needs further machine processing before it is ready to be matched with the location information. This is due to the fact that the Digitek machine scrambles the data as it reads it, and so the data must be unscrambled. The jobs of machine processing, then, are three-fold:

- Unscrambling activity and questionnaire data
- Matching activity data with location cards
- Adding supplementary data (e.g., SAT scores and space inventory information)

Digitek processing: a hypothetical example

The following simplified hypothetical example may help explain the Digitek process from the above. Assume we are conducting a survey which asks for the following data:

1) How many members are in your family besides you?
   (a) none others; (b) one other; (c) two others; . . . ; (i) eight others; (j) more than eight others.
2) For each of the following food items indicate your preference: (a) enjoy it; (b) tolerate it; (c) dislike it; (d) never had it, so don't know.
   spinach
   hot dogs
   rice
   lobster
   chocolate mousse
3) Did you enjoy this survey? Yes or no.

Assume that the answers to this survey were coded in a manner similar to that discussed in Chapter Four, on a foods utility form (see Figure 3.17), read onto a computer tape by the Digitek machine. Notice in Figure 3.17 that each column is numbered. This series of numbers indicates the order in which we would like to have the columns stored on the tape. Thus we would like the sample number first, in logical order (i.e., hundreds digit, tens digit, and units digit), then the answer to question number 1, followed by all the answers to question number 2, and lastly, the answer to question number 3. Notice also that we have coded the questionnaire for sample number 725, who has two other people in his family, dislikes spinach and rice, tolerates hot dogs, enjoys lobster, has never had chocolate mousse, and who did not enjoy this survey. Let us symbolically represent column 1 by a train car on which is painted a number 1, and which contains seven people, to correspond to the seven coded in column 1. Thus, the car numbered 1 will have seven people in it, and the car numbered 3 will have five people in it and so on (refer to diagram on page 57).

The Digitek machine, does not put our cars in their proper order, with the car numbered 1 in

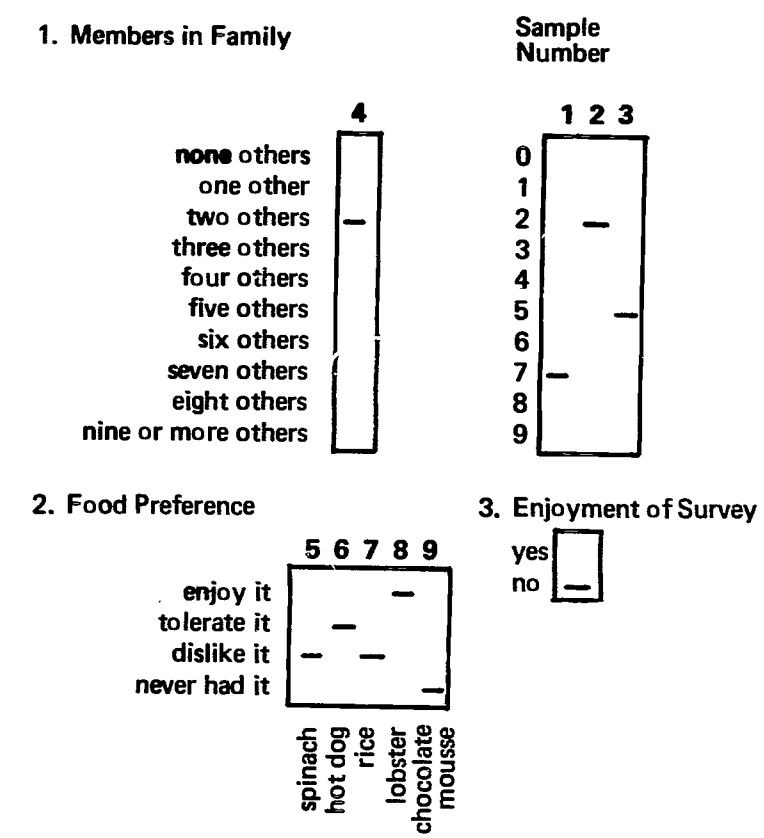

Figure 3.17: *Foods Preference Utility Sheet*

the first place, the car numbered 2 in the second place and so forth. Rather the car numbered 1 is in the fifth place, the car numbered 3 is in the first place. For mechanical reasons, the Digitek machine puts an empty car in the fourth place. The next to last car on every Digitek train has a Q in it, which is the quality mark to show that the machine had no trouble reading that piece of paper, and the caboose always has a record mark (≠) in it. Figure 3.18 shows the Digitek train made from our coding sheet with the people representing the numbers coded on the sheet.

We have written a generalized computer program, SCRAM, which may be used to unscramble any Digitek tape. In order to use SCRAM a number series must be concocted to tell the computer how to rearrange the cars on the train. This must be done carefully so that people remain in the cars in which they started.

Of course, the computer has no way of reading the numbers painted on the cars, so we must tell it in what position the car is currently located. The car numbered 1 is in the fifth position and the car numbered 2 is in the third position, so the first two numbers in our new order for the cars will be: 5 - 3 . Putting in the rest of the numbers for the order of our new train, we get: 5 - 3 - 1 - 9 - 13 - 12 - 10 - 8 - 7 - 2 - 16. This number series instructs the computer, using SCRAM,[37] to put the fifth car in the first position, the third car second, the first car third, the ninth car fourth, etc., and the caboose (the sixteenth car) last. Now our SCRAM train is in the order we previously decided we wanted.

[37] In the following paragraphs we refer to a number of computer programs which have been prepared for machine processing of our data. SCRAM is one such program. All of these programs are identified by a mnemonic code name in capital letters. Detailed documentation of these programs is available through the EFL Library.

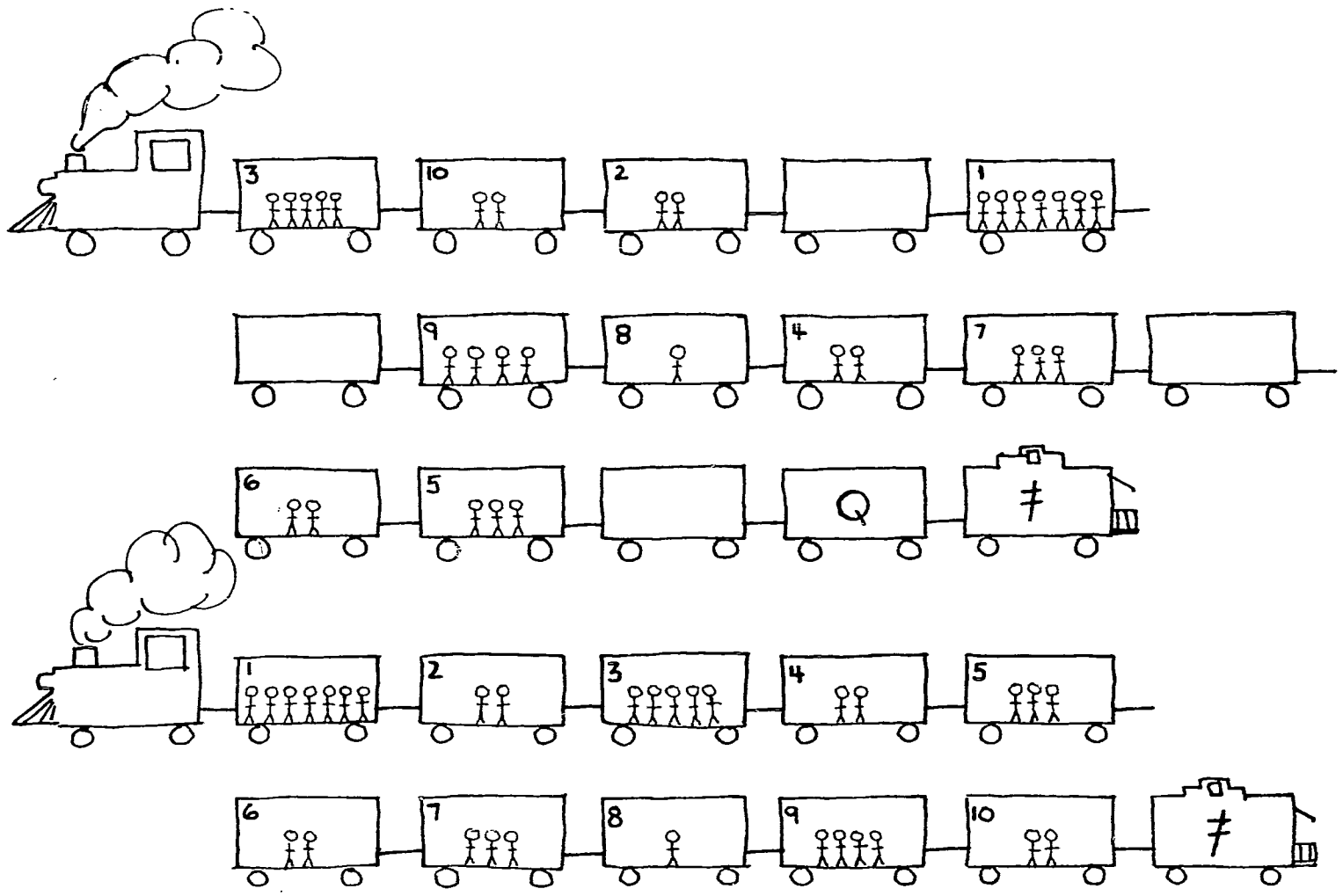

Figure 3.18: *Digitek Sample Problem*

Overview of Digitek processing of activities and related data

In Chapter Four we described the coding and checking procedures which resulted in three sets of machine-readable forms. One set of these forms contains all the data regarding "space demanding activities," the second set contains the data regarding the "locations" of these activities, and the third set contains the supplementary data regarding the respondents which was derived from their responses to the "Student Information Questionnaire." Our edited and coded information from two sets of machine-readable forms is ready to be read by the Digitek machine and the location cards are ready to be put on tape. All the diary sheets will be read on to one tape, which will be called the "activity tape," and from which "activity records" will be formed. The location cards will be read on to the "location tape," each card constituting one "location record." Finally, the Digitek machine will create the "questionnaire tape."

58 Since the two forms are different, two different number series are needed. The generalized SCRAM program can accommodate both forms by insertion of appropriate control cards. Procedures for preparation and use of these cards are described as a part of the program writeup available through the EFL Library.

Before the computer program UNSCRAM is run, the two Digitek tapes and the location cards should be put through a general SORT program (available on most computers) to insure that all the records are in correct order. For the diary sheets, the sample number, day, and page will order and uniquely identify each record. The sample number, day and page and line numbers will order and identify the location data forms and the sample number alone will order and identify the questionnaire utility forms. To avoid confusion we will not discuss the IBM 360/75's version of SORT, but suggest that the user consult with his computer center people for information.

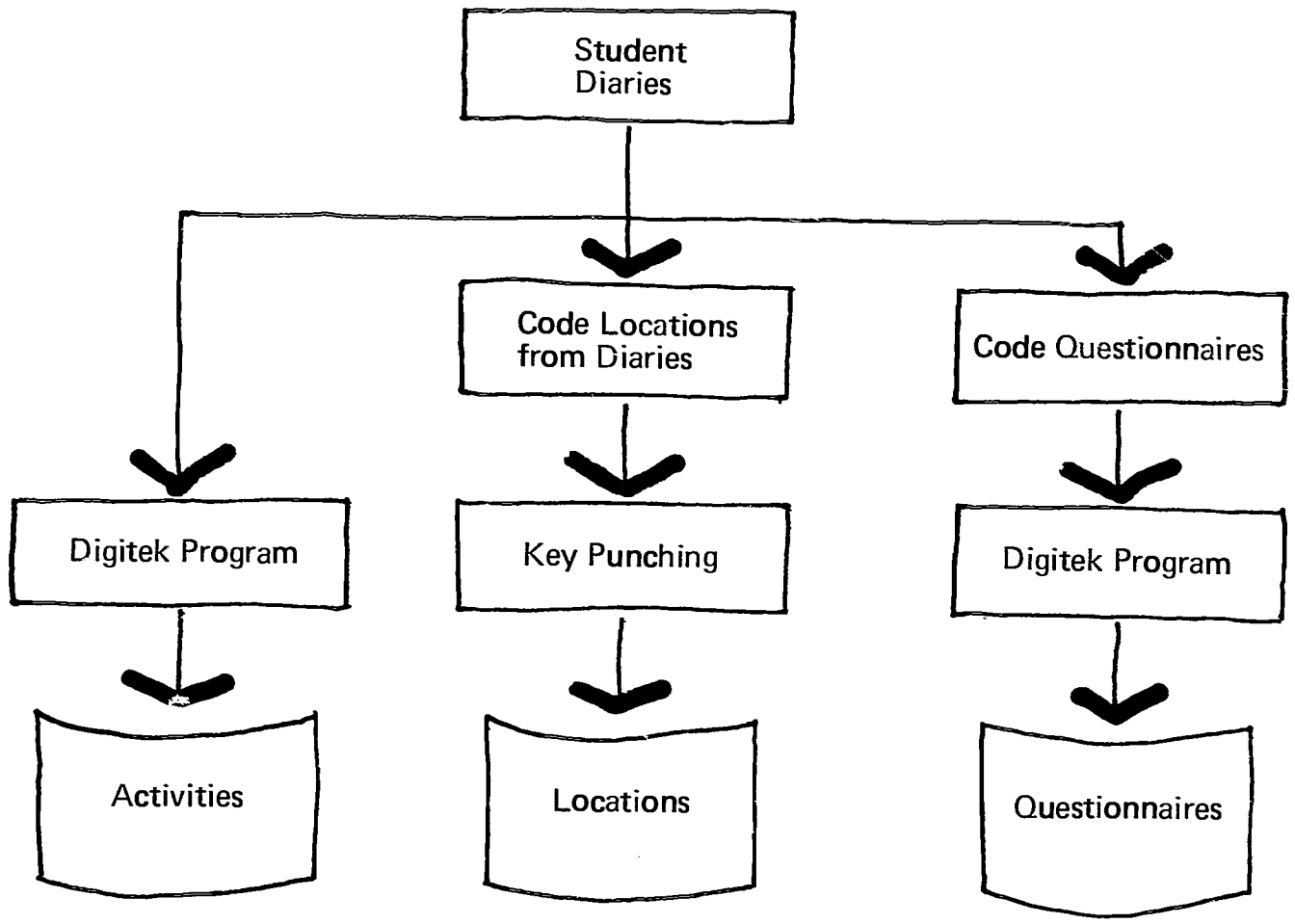

Figure 3.19: *Digitek Processing.* Digitek is an optical scanning device which interprets sense-marked forms and produces computer readable files. Locations from the diaries and responses to student questionnaires are coded on such sheets before submitting them to the optical scanner.

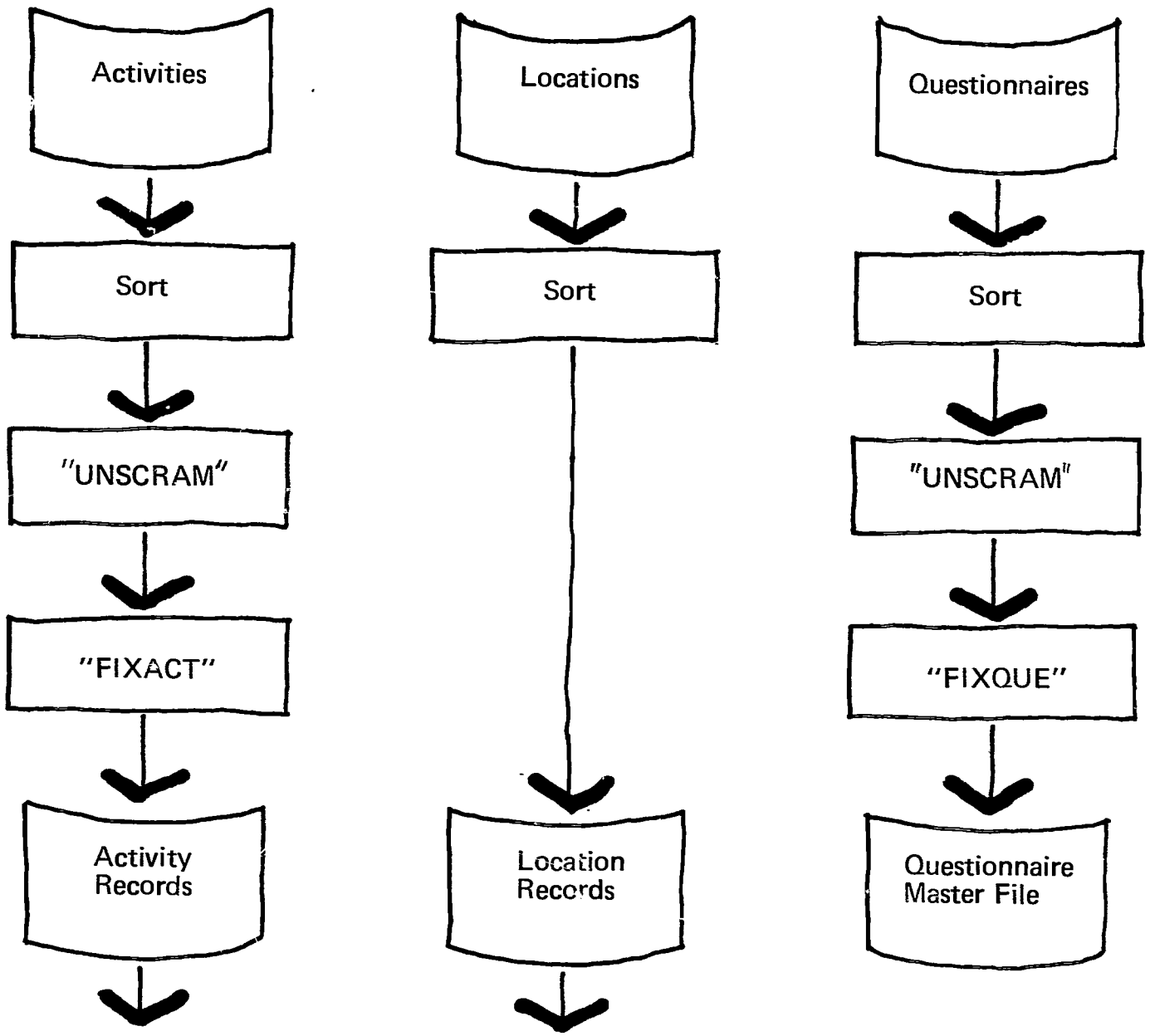

Figure 3.20: *System Flow for Processing Diary Data.* Names of computer programs are indicated by quotation marks.

After the two tapes have been through the unscramble programs, they must be further processed by FIXACT and FIXQUE, respectively.

FIXACT takes the information from one sheet of the diaries at a time and:

- Changes the activity letters to numbers
- Generates the times on a 24-hour clock
- Adds 2 to each group size field to accommodate the blanks which otherwise would be read as zeros
- Deletes the blank activities
- Forms activity records each of which contains the identifying information, the page and line number, the time, the activity, and the group size for one activity.

FIXQUE classifies the major indicated on the questionnaire into its major group category: undecided, humanities, social science, and physical science. As we had no occasion to use the academic scores or organizational data, no programs were developed to handle them.

60 After running FIXACT the activity and location tapes are ready to be matched by a program entitled MATCH. Using the sample number, day, page number, and line number for a given activity, MATCH correlates the location records with the corresponding activity. (Transportation activity records are not matched with any location records as explained above.) Any activity or location records which are unmatchable are deleted from the tape and punched out on cards as well as written out on the printer for use in error correction procedures. Each pair of matched records are then combined into one record and written on the diary tape.

Bad record cards are punched and interpreted so that they can be looked up and compared against their original diary sheets to obtain correct activity or location information. This information can be punched directly onto the error cards and the cards then used as input to the KORECT program. Most frequently, line numbers will be wrong or mis-alignment situations which will result in mismatching of location records and activity records. Hence, two cards, one for the activity record and one for the location record,

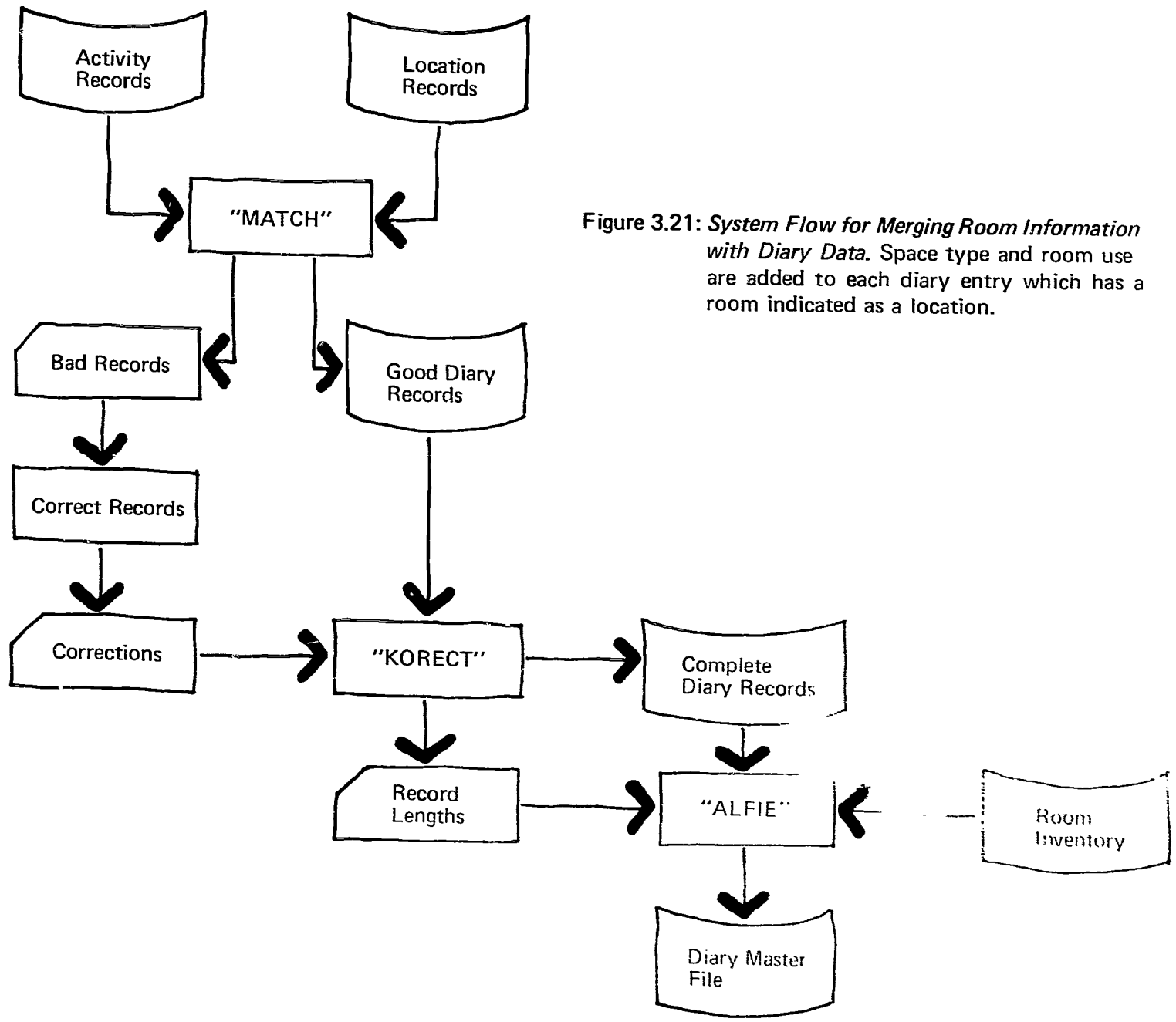

Figure 3.21: *System Flow for Merging Room Information with Diary Data.* Space type and room use are added to each diary entry which has a room indicated as a location.

will be punched out. Only one should have its information completed; the other should be thrown out so that duplicate records will not result.

The KORECT program is based on an IBM 360 system MERGE program (frequently packaged with the previously mentioned SORT program) and is used to incorporate the corrected records with the previously accepted diary records. KORECT also punches out a deck of cards containing sample numbers and the number of diary records pertaining to each.

The final stage of the machine processing is the running of ALFIE. ALFIE takes the space type and incorporates it into the diary records so that each room listed on the diary page has its room use and space type codes entered in the same record. After ALFIE the data set may now be called the master diary tape and put to use in analysis.

All through this discussion many sources of possible error have been ignored. Respondent or coder errors in such fields as activity, group size, building number, and room number are virtually undetectable without going back to the raw data. In general, coding should be desk checked very carefully prior to machine processing so as not to get erroneous information on any of the tapes.

There are several ways in which these tapes may be reformatted. One way might be to calculate the number of hours each person spends in each of the various activities and record these totals. The resulting data set would be more compact and easier to use for certain applications. For most applications, however, the master diary tape represents the data in analyzable form.

ASSESSING SAMPLE REPRESENTATIVENESS

63/64

Chapter Two described the manner in which a stratified random sample of 500 undergraduates was selected. Intervening chapters have explained the remaining steps which characterized the investigation until data were ready for analysis. The sample was selected as carefully as possible to enable generalization to the entire undergraduate student body. Stratification procedures were designed to produce a representative sample from which to generalize.

As in most surveys, some sample members failed to respond. Others were careless in their responses, or failed to provide data for the entire period. For these reasons the size of the working sample, those who responded and whose responses were usable, is somewhat smaller than the original sample.[38] This chapter is concerned with the representativeness of this working sample.

Problems of working sample representativeness

Assuming that the sample of 500 undergraduates originally drawn was adequately representative of the undergraduate student population, why would some of these persons fail to respond? The only way this question could be answered would be through a followup study involving interviews, or other data gathering procedures, with the non-respondents. In the absence of such a study one only can speculate as to the reasons for failure to complete the diary and questionnaire. Among the possibilities opened by such speculation are:

- That non-respondents differed from respondents with respect to personality variables. Perhaps they were more readily antagonized, more defensive about their actions, or more averse to serving as research *guinea pigs*. Psychological variables of this sort may, or may not be associated with the variable of primary interest, activity patterns. To the extent that these variables are the reasons for non-response and that they are also correlated with activity patterns, a possibly serious bias has been introduced into the sample by the fact that these persons are not included in the working sample and hence will not be represented in generalizations based upon it. A likely hypothesis, for example, is that persons who are not particularly gregarious will be both less likely to respond to the urgings of our *respondent supervisors* and less likely to engage in activities involving extensive interaction with others. This untestable (insofar as these data are concerned, not in any ultimate sense) hypothesis would imply an under-representation of solitary and small-group activities. Thus, under this hypothesis, one would expect relatively fewer *poets* as opposed to *journalists,skiers* as opposed to *team sporters*, or *independents* as opposed to *joiners*.

[38] Originally a sample of 500 was drawn to allow room for *dropouts*. for most anticipated analyses, a working sample of about 400 would provide data adequate for estimation of population means within .1 with a probability of .95. See Hayes, William L., *Statistics for Psychologists*, (New York: Holt, Rinehart and Winston, 1964), p. 206.

- That non-respondents differed from respondents with respect to structural variables. Perhaps members of some particular group within the university structure failed to respond due to shared alienation or antagonism toward the project. Student *activists,* for example, might view the project as *irrelevant* and, hence, decline to respond. A fraternity, to offer another example, might collectively feel that it was under pressure from officials of the university (due to probationary status resulting from *wild* parties and the like) and therefore view the project with hostility.
- That non-respondents differed from respondents with respect to activity patterns. It may be the case that some people chose not to respond simply because they felt that they were too busy to do so. For example, students who are heavily involved in a large number of extracurricular activities, have an active social life, *and* maintain good grades with full course loads may have felt that the time required to complete our survey, however minimal, was too much to undertake in addition to their prior commitments.

To the extent that these, or other, reasons for non-response actually obtained and are concommitantly correlated with activity patterns, the working sample will provide an inadequate basis for generalizations regarding the activity patterns of students at large. Since these data do not provide direct answers regarding the presence of these factors, or their correlations with activity patterns, the problem of representativeness can only be approached indirectly. The degree to which non-response introduced real biases into the picture of student activity patterns is not known. Approaches to solution of this problem are presented in the following section of this chapter.

The working sample and the problem: logic of comparison

Chapter One stated that the items for which data was gathered through the Student Information Questionnaire are likely to be correlated in varying degrees with activity patterns. Chapter Three asserted that the three strata employed in sampling are expected to correlate with activity patterns. For the stratification variables complete data are available regarding each member of the undergraduate population included on the tape from which the sample was originally selected. Data are also available relating to some of the questionnaire items, such as sex, marital status, and residential status.[39] Since population data regarding activity patterns is not available, hypothesized relationships between variables for which requisite data is available and activity patterns must be used in order to make inferences regarding the representativeness of the activities data.

[39] It should be emphasized that, where status may change — such as through marriage or moving — within a relatively short time period, official records tend to be outdated in some degree. Thus, comparison of population distributions based on official records with working sample distributions based on more timely questionnaire responses is almost certain to reveal some incongruities as a result of short term changes. Since, in this case, the official data were compiled during September registration, the time lag is quite short and the impact of these changes is apt to be quite small.

The hypothesized relationships indicate that, in general, people who are classified similarly with respect to a given variable, say sex, will exhibit similar activity patterns. This expectation holds whether such variables are considered one-at-a-time, or several at once. Thus, if the working sample does not differ significantly from the undergraduate population with respect to the variables for which there is sufficient data to allow such comparisons, it can be inferred that the working sample does not differ from the population with respect to activity patterns.

To demonstrate that the working sample does not differ significantly from the population with respect to one or more of the dimensions in which data exists, an appropriate *goodness-of-fit* test is required. These tests are typically employed when one wishes to know whether a particular sample could have come from some given population: exactly the problem of representativeness.[40] The first, and most general test involves the stratification variables. For this test, the population data are cast in the 60 categories shown in Table 3.3, which were employed in sample selection, and the proportion of population members falling into each cell is calculated. If the working sample is representative of the population, these same proportions of its members would be expected to fall in the corresponding categories. Multiplication of the total number of members of the working sample by the proportion in each category derived from the population data will give the *expected frequency* for that category. These expected frequencies, together with the *observed frequencies*[41] (the actual numbers of working sample members falling in each of the categories) provide the necessary data for calculating the Chi-square goodness-of-fit test, which is appropriate for these data.

Since there are 60 cells hence 59 degrees of freedom, the obtained value of Chi-square must not exceed 77.9[42] if the working sample is reasonably representative. In general, the smaller the obtained value of Chi-square for such a test, the greater is the confidence in the representativeness. In the event that the test just summarized leads to the conclusion that the expected and the observed frequencies are not significantly different, one may be reasonably comfortable about generalizing to the population on the basis of the entire working sample.

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[40] The following discussion of goodness-of-fit tests relies heavily upon Chapter Four in Siegel, Sidney, *Nonparametric Statistics for the Behavioral Sciences* (New York: McGraw-Hill, 1956) pp. 35-60. The reader is referred to Siegel for computational procedures and examples.

[41] It will be recalled that respondent anonymity has been guaranteed. This complicates the analysis at this point, since it thereby becomes impossible to employ official data, derived from the master tape used in sample selection, for grouping working sample members into the 60 categories. Grouping must be based upon questionnaire responses. One can use "class in school" and "major" directly, however "college" must be derived from the known relationships between sex and major. At Duke any female student *not* enrolled in nursing was assumed to be registered in Women's College; and any male respondent *not* majoring in engineering was assumed to be registered in Trinity College.

[42] This is the Chi-square value with $df = 59$ and $\alpha = .05$ found in Table V: "Fractiles of the χ^2 distribution," p. 43, in A. Hald, *Statistical Tables and Formulas,* (New York: John Wiley and Sons, 1952).

68 Suppose, however, that for some particular analysis focus is brought upon a sub-group of the working sample. For example, the university may be considering expansion of the social sciences offerings, and expanding recruitment of both undergraduate and graduate students throughout the social sciences. The university planner might be asked to estimate the impact of such expansion upon the existing facilities and to make recommendations regarding the necessity of additional space.[43]

In deriving the appropriate estimates, the planner would focus his attention only upon those respondents who indicated, in the "Student Information Questionnaire," that they intended to major in one of the social sciences. This sub-sample could be defined either in terms of expressed intent alone (question six), or in terms of formal declaration (depending upon both questions six and seven). The latter definition, of course, will correspond more closely to population data obtained from official sources, while the former will provide a larger, though less firmly committed, sub-sample.

Once the sub-sample has been isolated, by whatever definition, the investigator would want to know how representative it was of all social science majors currently in residence. Notice that, not only does this hypothetical example focus upon a sub-sample selected from the total working sample, it also seeks to generalize to a sub-population. Thus, in testing representativeness. the expected values for Chi-square tests will be derived from data regarding the subpopulation of social science majors only. The tests undertaken will be similar to the general test described above, except that they will involve a different set of variables. The representativeness of the distribution of specific majors, within the social sciences group would be of major interest in such a study. Class-in-school and sex distributions would also be of interest here.

One additional set of goodness-of-fit tests should be mentioned. It will be recalled that the original sample was randomly divided into four groups, each responding during a different week. Thus far representativeness has been discussed in terms of a *pooled* working sample which included *all* actual respondents, regardless of the week in which they were studied. Strictly speaking, such pooling is legitimate only if the respondents are comparable from week to week. Similarly, comparison of activity patterns between weeks may be properly undertaken only if one is reasonably sure that respondent characteristics do not differ greatly from week to week. In the event that respondent characteristics do differ from week to week, these differences, rather than differences in campus environment (such as between a week in which examinations were being given and a week in which they were not) may explain observed variations in activity patterns. Thus analogous Chi-square tests should be conducted comparing all pairs of weekly

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43. The data can speak only to the matter in so far as increased numbers of undergraduate social science majors are concerned, however, the procedures — especially with respect to checking on representativeness — are perfectly general.

subsamples. For these tests the expected frequencies will be determined on the basis of data provided by one weekly subsample, and observed frequencies will be based upon the data gathered from the other weekly subsample under study. It is of no importance which subsample is used as the criterion group in these tests.[44]

[44] Another, more sophisticated approach to this problem involves the use of the Friedman two-way analysis of variance, discussed by Siegel in Chapter Seven, pp. 166-172. The reader may wish to consult Siegel before deciding upon a strategy in this regard. We shall not complicate the present discussion by elaborating the details of the Friedman procedure.

APPROACHES TO DATA ANALYSIS

71/72

In this chapter, analyses are described which utilize specially prepared computer programs, CHLOE and EFLRED. Discussions of these programs and of the traffic flow and related analyses, together with appropriate program documentation, are available through the EFL Library. The final section of this chapter discusses additional possible analyses. In most instances these analyses involve well known statistical methods employed in standard fashion. Thus the fact that program documentation is not included for the analyses discussed in the concluding section of this chapter should not work any hardship on other investigators since programs to accomplish those tasks are commonly available.[45]

Chloe analyses: time, activity, location, and space types

CHLOE is the name of a general computer program capable of a wide variety of analyses involving distributions of student time as a function of activity and space type or as a function of activity and room use. In order to use CHLOE, the sub-routine EFLRED, and the main program which controls the option-selection switches for CHLOE, are required. Detailed documentation, available through the EFL Library, will guide the user in employing these programs for any desired analysis employing his own data.

EFLRED reads the records for each sample member, calculates the elapsed times between activity changes, and reads the questionnaire data pertaining to that sample number. This information is then available for use by the calling program.

CHLOE's strength lies in its variability. The user must, in the main program, specify what subsets of data are to be considered by CHLOE. The specifications must include the restrictions to be placed on day of the week, time span during the day, sex, class, major group, college, and survey week of the respondent, and whether the table is to be concerned with space type or room use codes. The user should indicate whether he wants one set of tables with the data specified, or two tables, involving differing restrictions on the data. If the latter option is specified, a difference table which shows the raw and percentage difference between the preceding two sets of tables will also be generated. In this way the user can make many varied comparisons of his data, and carefully analyze the students' activity patterns.

By appropriate specification of comparisons one can study the various weeks according to the events he knows were taking place at that time. For instance, in the Duke sample there were weeks which included mid-term examinations, the homecoming football game and celebration weekend, and a slack week which did not include any major campus events. One phenomenon which is important for several different reasons is that during the last week of data collection, an article in the campus newspaper appeared which

[45] It is suggested that the reader consult with members of the computing center staff at his own institution for guidance regarding local availability. The Biomedical Computer Programs (BMD) available from the Health Sciences Computing Facility at UCLA, and widely used elsewhere, include the necessary routines.

discussed the survey and its implications for future campus planning. The response rate that week was markedly higher than it had been before.

CHLOE produces two basic types of tables, disregarding the minor variations caused by the space-type/room use choice.

- The first type of table is a summary using the aggregate activity types: academic, residential, recreational, transportational, and miscellaneous. This table also gives row and column totals, row and column percentages for each entry, row totals for each entry, and the total number of data blocks for each entry. To facilitate reading, this information is displayed in two subtables, rather than as a single complex table.
- The second type of table shows the individual break-downs for each activity type, specifying the particular activities. The same kinds of information as were given for the summary table are given in these tables for the individual activities. These tables have no column totals, however, and the column percentages are based on the totals over all activities.

Much information can be derived from CHLOE's output. Of course the row totals for a run on the entire sample will give a distribution of activity time for individual activities and aggregate activity groups. By restricting the day and time parameters, students' activities can be examined on a day-by-day basis throughout the week. Furthermore the program may be used to compare various subgroups of respondents. For example, one may compare the activity patterns of female and male respondents, of freshmen and sophomores (or any other *class* comparison), or of science majors and respondents majoring in the social sciences or humanities.

In sum, CHLOE is designed to summarize the data and present tabular displays which involve varying configurations of variables. The comparisons described above involve pairs of tables which are similar in all respects save one, and which have identical form. From these two tables a difference table is calculated, the cell entries of which summarize the effects of the lone variable which distinguished the two original tables. This difference table provides an intuitively interpretable overview of the comparison in question.

The following pages show sample output of "Distribution of Students' Time by Activity and Room Use." This output is an example of the product possible from the programs just described, using the data from student diaries.

DISTRIBUTION OF STUDENTS' TIME BY ACTIVITY AND ROOM USE

THIS SERIES OF TABLES SHOWS THE DISTRIBUTION OF THE STUDENTS' TIME BY THE ACTIVITY ENGAGED IN AND THE DESIGNATED ROOM USE OF THE ROOM USED.

THE FOLLOWING SUBCLASS OF STUDENTS WAS CONSIDERED:

SEX: MALE - YES	CLASS: FRESHMAN - YES	COLLEGE: TRINITY COLLEGE - YES	MAJOR: UNDECIDED - YES
FEMALE - NO	SOPHOMORE - YES	WOMAN'S COLLEGE - YES	HUMANITIES - YES
	JUNIOR - YES	SCHOOL OF NURSING - YES	SOCIAL SCIENCES - YES
	SENIOR - YES	SCHOOL OF ENGINEERING - YES	PHYSICAL SCIENCES - YES

THE FOLLOWING TIME SUBSET WAS USED:

DAY: MONDAY - YES
TUESDAY - YES
WEDNESDAY - YES
THURSDAY - YES
FRIDAY - YES
SATURDAY - YES
SUNDAY - YES

TIME: FROM 0 TO 2400

THIS RUN ACTUALLY USED 172 STUDENTS OUT OF A POSSIBLE 294 IN THE SAMPLE. THIS RUN WAS MADE ON 11/29/69 AT 15:25:00.

THIS IS TABLE SERIES #2 IN A SET OF 3 SERIES.

```
XXXXXXX   XXXXXXX   X
X         X         X
X         X         X
XXXX      XXXX      X
X         X         X
X         X         X
XXXXXXX   X         XXXXXXX
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--PROGRAMMED BY JUDY KING--

DISTRIBUTION OF STUDENTS' TIME BY MAJOR ACTIVITY AND ROOM USE

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	CLASS-ROOM	LAB	OFFICE	STUDY	SPECIAL USE	RECRE-ATION	FOOD SERVICES	MEDICAL CARE
ACADEMIC	2601.24 (28.92) * 93.63*	706.65 (7.86) * 92.62*	252.00 (2.80) * 59.53*	264.67 (2.94) * 94.36*	61.00 (0.68) * 92.19*	148.00 (1.65) * 46.20*	7.17 (0.08) * 24.86*	722.15 (8.03) * 21.57*
RESIDENTIAL	16.17 (0.39) * 0.58*	4.17 (0.10) * 0.55*	9.50 (0.23) * 2.24*	2.00 (0.05) * 0.71*	0.0 (0.0) * 0.0 *	6.33 (0.15) * 1.98*	1.83 (0.04) * 6.36*	2004.12 (48.62) * 59.87*
RECREATIONAL	41.33 (1.19) * 1.49*	9.67 (0.28) * 1.27*	92.33 (2.66) * 21.81*	5.00 (0.14) * 1.78*	5.17 (0.15) * 7.81*	20.50 (0.59) * 6.40*	17.67 (0.51) * 61.27*	552.98 (15.92) * 16.52*
TRANSPORTATIONAL	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *
MISCELLANEOUS	119.33 (4.14) * 4.30*	42.50 (1.47) * 5.57*	69.50 (2.41) * 16.42*	8.83 (0.31) * 3.15*	0.0 (0.0) * 0.0 *	145.50 (5.05) * 45.42*	2.17 (0.08) * 7.51*	68.00 (2.36) * 2.03*
TOTALS	2778.07 (11.85) *100.00*	762.98 (3.25) *100.00*	423.33 (1.81) *100.00*	280.50 (1.20) *100.00*	66.17 (0.28) *100.00*	320.33 (1.37) *100.00*	28.83 (0.12) *100.00*	3347.25 (14.27) *100.00*

DISTRIBUTION OF STUDENTS' TIME BY MAJOR ACTIVITY TYPE AND ROOM USE (CONT.)

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	SUPPORT FACIL.	RESID-ENTIAL	NON-AS-SIGNABLE	UNAS-SIGNED	OFF-CAMPUS	UNDE-FINED	TOTALS
ACADEMIC	26.50 (0.29) * 2.26*	2750.91 (30.58) *100.00*	0.0 (0.0) * 0.0 *	16.33 (0.18) * 13.24*	1350.46 (15.01) * 27.45*	0.0 (0.0) * 0.0 *	8994.39 (100.00) * 38.35*
RESIDENTIAL	1046.43 (25.39) * 89.28*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	18.00 (0.44) *14.59*	1011.93 (24.55) * 20.57*	0.0 (0.0) * 0.0 *	4122.15 (100.00) * 17.58*
RECREATIONAL	29.00 (0.83) * 2.47*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	63.33 (1.82) * 51.35*	1858.43 (53.51) * 37.77*	0.0 (0.0) * 0.0 *	3473.23 (100.00) * 14.81*
TRANSPORTATIONAL	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	3979.41 (100.00) * 16.97*
MISCELLANEOUS	70.17 (2.43) * 5.99*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	25.67 (0.89) * 20.81*	699.09 (24.25) * 14.21*	0.0 (0.0) * 0.0 *	2882.49 (100.00) * 12.29*
TOTALS	1172.09 (5.00) *100.00*	2750.91 (11.73) *100.00*	0.0 (0.0) * 0.0 *	123.33 (0.53) *100.00*	4919.91 (20.98) *100.00*	0.0 (0.0) * 0.0 *	23451.66 (100.00) *100.00*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	CLASS-ROOM	LAB	OFFICE	STUDY	SPECIAL USE	RECRE-ATION	FOOD SERVICES	MEDICAL CARE
LECTURE	2153.76 (62.81) * 82.80*	279.33 (8.15) * 39.53*	105.50 (3.08) * 41.87*	3.83 (0.11) * 1.45*	0.0 (0.0) * 0.0 *	122.17 (3.56) * 82.55*	5.67 (0.17) * 79.07*	5.00 (0.15) * 0.69*
LABORATORY	23.00 (3.94) * 0.88*	327.33 (56.08) * 46.32*	44.67 (7.65) * 17.72*	4.00 (0.69) * 1.51*	61.00 (10.45) *100.00*	1.33 (0.23) * 0.90*	1.33 (0.23) * 18.60*	0.0 (0.0) * 0.0 *
ROTC DRILL	3.00 (5.68) * 0.12*	4.67 (8.83) * 0.66*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *
ART WORK - REHEARSAL	0.17 (0.17) * 0.01*	22.00 (22.07) * 3.11*	0.0 (0.0) * 0.0 *	4.50 (4.52) * 1.70*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	2.00 (2.01) * 0.28*
STUDY	412.83 (8.76) * 15.87*	71.00 (1.51) * 10.05*	60.50 (1.28) * 24.01*	247.83 (5.26) * 93.64*	0.0 (0.0) * 0.0 *	23.17 (0.49) * 15.65*	0.17 (0.00) * 2.33*	707.15 (15.00) * 97.92*
BEING COUNSELLED	8.50 (7.37) * 0.33*	2.33 (2.02) * 0.33*	41.33 (35.84) * 16.40*	4.50 (3.90) * 1.70*	0.0 (0.0) * 0.0 *	1.33 (1.16) * 0.90*	0.0 (0.0) * 0.0 *	8.00 (6.94) * 1.11*
ACADEMIC TOTALS	2601.24 (28.92) * 93.63*	706.65 (7.86) * 92.62*	252.00 (2.80) * 59.53*	264.67 (2.94) * 94.36*	61.00 (0.68) * 92.19*	148.00 (1.65) * 46.20*	7.17 (0.08) * 24.86*	722.15 (8.03) * 21.57*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE (CONT.)

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	SUPPORT FACIL.	RESID-ENTIAL	NON-AS-SIGNABLE	UNAS-SIGNED	OFF-CAMPUS	UNDE-FINED	TOTALS
LECTURE	7.83 (0.23) * 29.56*	336.50 (9.81) * 12.23*	0.0 (0.0) * 0.0 *	10.67 (0.31) * 65.31*	362.00 (10.56) * 26.81*	0.0 (0.0) * 0.0 *	3428.91 (100.00) * 38.12*
LABORATORY	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	111.33 (19.07) * 8.24*	0.0 (0.0) * 0.0 *	583.66 (100.00) * 6.49*
ROTC DRILL	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	45.17 (85.49) * 3.34*	0.0 (0.0) * 0.0 *	52.83 (100.00) * 0.59*
ART WORK - REHEARSAL	2.00 (2.01) * 7.55*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	69.00 (69.23) * 5.11*	0.0 (0.0) * 0.0 *	99.67 (100.00) * 1.11*
STUDY	15.17 (0.32) * 57.23*	2414.42 (51.22) * 87.77*	0.0 (0.0) * 0.0 *	5.50 (0.12) * 33.67*	749.32 (15.90) * 55.49*	0.0 (0.0) * 0.0 *	4714.05 (100.00) * 52.47*
BEING COUNSELLED	1.50 (1.30) * 5.66*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.17 (0.14) * 1.02*	13.67 (11.85) * 1.01*	0.0 (0.0) * 0.0 *	115.33 (100.00) * 1.28*
ACADEMIC TOTALS	26.50 (0.29) * 2.26*	2750.91 (30.58) *100.00*	0.0 (0.0) * 0.0 *	16.33 (0.18) * 13.24*	1350.46 (15.01) * 27.45*	0.0 (0.0) * 0.0 *	8994.39 (100.00) * 38.35*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	CLASS-ROOM	LAB	OFFICE	STUDY	SPECIAL USE	RECRE-ATION	FOOD SERVICES	MEDICAL CARE
SLEEPING	10.50 (0.53) * 64.95*	0.0 (0.0) * 0.0 *	7.17 (0.36) * 75.44*	0.50 (0.03) * 25.00*	0.0 (0.0) ********	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	1816.81 (91.38) * 90.65*
EATING	3.17 (0.17) * 19.59*	4.00 (0.21) * 96.00*	2.33 (0.12) * 24.56*	0.0 (0.0) * 0.0 *	0.0 (0.0) ********	3.33 (0.17) * 52.63*	1.83 (0.10) *100.00*	100.67 (5.25) * 5.02*
PERSONAL HYGIENE	2.50 (1.16) * 15.46*	0.17 (0.08) * 4.00*	0.0 (0.0) * 0.0 *	1.50 (0.69) * 75.00*	0.0 (0.0) ********	3.00 (1.39) * 47.37*	0.0 (0.0) * 0.0 *	86.67 (40.06) * 4.32*
RESIDENTIAL TOTALS	16.17 (0.39) * 0.58*	4.17 (0.10) * 0.55*	9.50 (0.23) * 2.24*	2.00 (0.05) * 0.71*	0.0 (0.0) * 0.0 *	6.33 (0.15) * 1.98*	1.83 (0.04) * 6.36*	2004.12 (48.62) * 59.87*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE (CONT.)

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	SUPPORT FACIL.	RESID-ENTIAL	NON-AS-SIGNABLE	UNAS-SIGNED	OFF-CAMPUS	UNDE-FINED	TOTALS
SLEEPING	3.00 (0.15) * 0.29*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	10.00 (0.50) * 55.56*	139.00 (6.99) * 13.74*	0.0 (0.0) * 0.0 *	1988.15 (100.00) * 48.23*
EATING	1042.10 (54.34) * 99.59*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	7.83 (0.41) * 43.52*	751.95 (39.21) * 74.31*	0.0 (0.0) * 0.0 *	1917.72 (100.00) * 46.52*
PERSONAL HYGIENE	1.33 (0.62) * 0.13*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.17 (0.08) * 0.93*	121.00 (55.93) * 11.96*	0.0 (0.0) * 0.0 *	216.33 (100.00) * 5.25*
RESIDENTIAL TOTALS	1046.43 (25.39) * 89.28*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	18.00 (0.44) * 14.59*	1011.93 (24.55) * 20.57*	0.0 (0.0) * 0.0 *	4122.15 (100.00) * 17.58*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	CLASS-ROOM	LAB	OFFICE	STUDY	SPECIAL USE	RECREATION	FOOD SERVICES	MEDICAL CARE
READING - HOBBIES - TV - ETC.	7.00 (1.23) * 16.94*	2.67 (0.47) * 27.59*	5.33 (0.94) * 5.78*	3.33 (0.59) * 66.67*	0.0 (0.0) * 0.0 *	6.83 (1.20) * 33.33*	0.67 (0.12) * 3.77*	243.83 (42.84) * 44.09*
BULL SESSION	9.00 (1.57) * 21.77*	0.50 (0.09) * 5.17*	7.00 (1.22) * 7.58*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	4.50 (0.78) * 21.95*	0.0 (0.0) * 0.0 *	241.00 (42.02) * 43.58*
SPORTS	2.83 (0.33) * 6.85*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	1.67 (0.19) * 33.33*	0.0 (0.0) * 0.0 *	2.00 (0.23) * 9.76*	0.0 (0.0) * 0.0 *	8.50 (0.99) * 1.54*
MOVIE - GAME	2.17 (0.41) * 5.24*	0.0 (0.0) * 0.0 *	3.67 (0.69) * 3.97*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	2.00 (0.38) * 9.76*	4.00 (0.75) * 22.64*	0.33 (0.06) * 0.06*
WORK WITH STUDENT ORGANIZATION	17.50 (4.67) * 42.34*	6.50 (1.73) * 67.24*	75.00 (20.02) * 81.23*	0.0 (0.0) * 0.0 *	5.17 (1.38) *100.00*	5.17 (1.38) * 25.20*	13.00 (3.47) * 73.58*	11.33 (3.02) * 2.05*
PARTY	2.83 (0.50) * 6.85*	0.0 (0.0) * 0.0 *	1.33 (0.23) * 1.44*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	48.00 (8.44) * 8.68*
RECREATIONAL TOTALS	41.33 (1.19) * 1.49*	9.67 (0.28) * 1.27*	92.33 (2.66) * 21.81*	5.00 (0.14) * 1.78*	5.17 (0.15) * 7.81*	20.50 (0.59) * 6.40*	17.67 (0.51) * 61.27*	552.98 (15.92) * 16.52*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE (CONT.)

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	SUPPORT FACIL.	RESID-ENTIAL	NON-AS-SIGNABLE	UNAS-SIGNED	OFF-CAMPUS	UNDE-FINED	TOTALS
READING - HOBBIES - TV - ETC.	3.17 (0.56) * 10.92*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	1.67 (0.29) * 2.63*	293.66 (51.60) * 15.80*	0.0 (0.0) * 0.0 *	569.16 (100.00) * 16.39*
BULL SESSION	18.67 (3.25) * 64.37*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	52.60 (9.07) * 82.11*	240.83 (41.99) * 12.96*	0.0 (0.0) * 0.0 *	573.[illegible] (100.) * 16.51*
SPORTS	1.00 (0.12) * 3.45*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.50 (0.06) * 0.79*	840.14 (98.07) * 45.21*	0.0 (0.0) * 0.0 *	856.64 (100.00) * 24.66*
MOVIE - GAME	0.50 (0.09) * 1.72*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	293.83 (55.35) * 15.81*	0.0 (0.0) * 0.0 *	530.83 (100.00) * 15.28*
WORK WITH STUDENT ORGANIZATION	5.67 (1.51) * 19.54*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	9.17 (2.45) * 14.47*	118.17 (31.54) * 6.36*	0.0 (0.0) * 0.0 *	374.67 (100.00) * 10.79*
PARTY	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	71.83 (12.64) * 3.87*	0.0 (0.0) * 0.0 *	568.50 (100.00) * 16.37*
RECREATIONAL TOTALS	29.00 (0.83) * 2.47*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	63.33 (1.82) * 51.35*	1858.43 (53.51) * 37.77*	0.0 (0.0) * 0.0 *	3473.23 (100.00) * 14.81*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	CLASS-ROOM	LAB	OFFICE	STUDY	SPECIAL USE	RECRE-ATION	FOOD SERVICES	MEDICAL CARE
WAIT	83.00	17.83	11.17	1.83	0.0	10.33	0.33	3.33
	(15.92)	(3.42)	(2.14)	(0.35)	(0.0)	(1.98)	(0.06)	(0.64)
	* 69.55*	* 41.96*	* 16.07*	* 20.75*	********	* 7.10*	* 15.38*	* 4.90*
ERRAND	3.67	3.33	9.83	4.83	0.0	121.16	0.67	11.83
	(0.43)	(0.39)	(1.15)	(0.57)	(0.0)	(14.19)	(0.08)	(1.39)
	* 3.07*	* 7.84*	* 14.15*	* 54.72*	********	* 83.28*	* 30.77*	* 17.40*
PART-TIME JOB	0.0	0.0	35.50	2.17	0.0	0.50	1.17	0.0
	(0.0)	(0.0)	(14.97)	(0.91)	(0.0)	(0.21)	(0.49)	(0.0)
	* 0.0 *	* 0.0 *	* 51.08*	* 24.53*	* 0.0 *	* 9.34*	* 53.85*	* 0.0 *
OTHER - SPECIFIED	30.17	17.50	13.00	0.0	0.0	13.50	0.0	52.83
	(2.75)	(1.59)	(1.18)	(0.0)	(0.0)	(1.23)	(0.0)	(4.81)
	* 25.28*	* 41.18*	* 18.71*	* 0.0 *	********	* 9.28*	* 0.0 *	* 77.70*
UNDETERMINED OTHER	2.50	3.83	0.0	0.0	0.0	0.0	0.0	0.0
	(1.45)	(2.22)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	* 2.10*	* 9.02*	* 0.0 *	* 0.0 *	*566.67*	* 0.0 *	* 0.0 *	* 0.0 *
MISCELLANEOUS TOTALS	119.33	42.50	69.50	8.83	0.0	145.50	2.17	68.00
	(4.14)	(1.47)	(2.41)	(0.31)	(0.0)	(5.05)	(0.08)	(2.36)
	* 4.30*	* 5.57*	* 16.42*	* 3.15*	* 0.0 *	* 45.42*	* 7.51*	* 2.03*

DISTRIBUTION OF STUDENTS' TIME BY INDIVIDUAL ACTIVITY AND ROOM USE (CONT.)

TIME IN HOURS AND HUNDREDTHS OF HOURS
(--.--) ROW PERCENTAGE
--.-- COLUMN PERCENTAGE

	SUPPORT FACIL.	RESID-ENTIAL	NON-AS-SIGNABLE	UNAS-SIGNED	OFF-CAMPUS	UNDE-FINED	TOTALS
WAIT	12.67 (2.43) * 18.05*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	8.50 (1.63) * 33.12*	168.76 (32.25) * 24.05*	0.0 (0.0) * 0.0 *	521.49 (100.00) * 18.09*
ERRAND	44.83 (5.25) * 63.90*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	5.00 (0.59) * 19.48*	230.66 (27.02) * 32.99*	0.0 (0.0) * 0.0 *	853.64 (100.00) * 29.61*
PART-TIME JOB	11.33 (4.78) * 16.15*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	2.50 (1.05) * 9.74*	100.83 (42.52) * 14.42*	0.0 (0.0) * 0.0 *	237.17 (100.00) * 8.23*
OTHER - SPECIFIED	1.33 (0.12) * 1.90*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	9.67 (0.88) * 37.66*	199.50 (18.18) * 28.54*	0.0 (0.0) * 0.0 *	1097.32 (100.00) * 38.07*
UNDETERMINED OTHER	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	173.00 (100.00) * 6.00*
MISCELLANEOUS TOTALS	70.17 (2.43) * 5.99*	0.0 (0.0) * 0.0 *	0.0 (0.0) * 0.0 *	25.67 (0.89) * 20.81*	699.09 (24.25) * 14.21*	0.0 (0.0) * 0.0 *	2882.49 (100.00) * 12.29*

Traffic pattern analysis

The diaries provided the students with a device by which they could record events (activity and location) sequentially. Hence, students can be "tracked" from each location to the next throughout the week of data collection. Computer programs were written to use the diary records and summarize trips between locations on the campus; trips off campus were summarized into two or three categories. This method is perhaps an improvement over other origin and destination studies, in that the data collected can be more comprehensive in recording time and location; data also can be continuous. On the other hand, it is recognized that the study can be only as reliable as the data collected. The plot shown in Figure 3.22 was produced on a CalComp plotter, a mechanical plotter using a ballpoint pen and driven by a computer. The task of the computer was to summarize trips between locations and calculate the width of the bands to be plotted. The width of each band is proportional to the number of trips between the two building nodes. (Numbers by the nodes are the building codes.)

The plot is drawn at a scale which enables it to be used as an overlay to the campus map and permits the planner to see the patterns as a "snapshot" view of student movement. A limitation of the current computer program is that the bands of traffic are straight line and rarely follow the actual road, sidewalk or path which the vehicle or pedestrian would take; the planner must interpret the overlay: A more sophisticated and involved computer program could be written for more detailed plotting.

Further computer programming could enable the planner to have overlays showing patterns at various time periods of the day, e.g., the morning versus the afternoon versus the evening; or of various sub-samples, e.g., coeds versus male students, freshmen versus seniors, etc.

Like so many analysis techniques, traffic patterns should be studied over a period of time to see the effects of data collected at different times of the year, of changes in student mixes and of changes in facilities.

Distribution of student hours by day and activity

The table in Figure 3.23 shows a summary of the number of hours logged by the students in each activity by day of the week. The percentages in parentheses indicate the distribution of that activity over the days of the week. Thus, the distribution of "Lecture" is 17-21% Monday through Friday and diminishes to 6% on Saturday and to less than 1% on Sunday.

The percentages between asterisks are calculated on the basis of the total hours recorded for a given day. Note that the activity "Study" is fairly constant Sunday through Thursday (17-21%) and takes a definite nose-dive on Friday and Saturday. There is a corresponding peak in the time recorded for "Movie/game" and "Party" for Friday and Saturday.

These patterns are predictable, but the value gained here is that quantities are assigned to the activities and thus may provide more useful information to the planner.

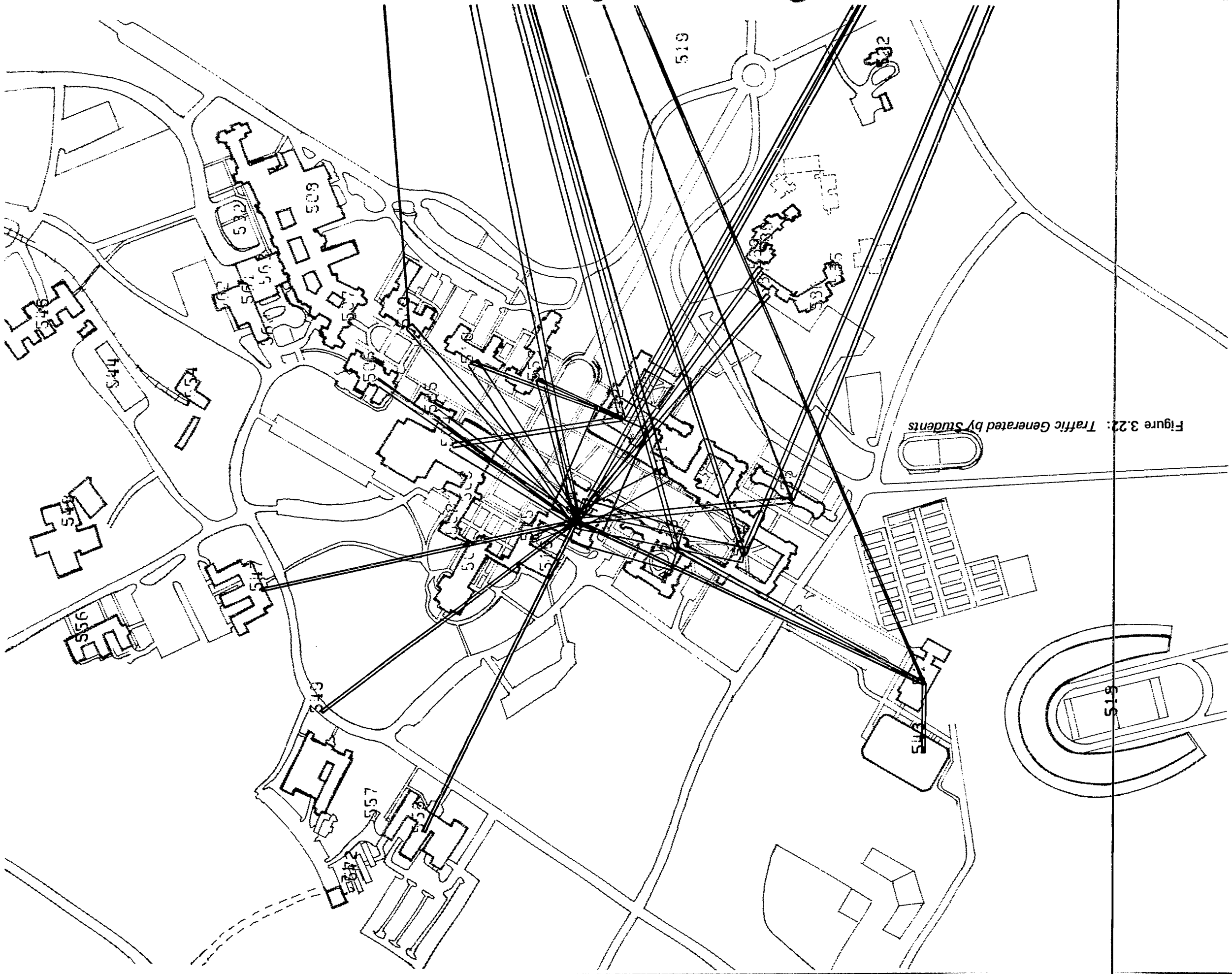

Figure 3.22: *Traffic Generated by Students*

DISTRIBUTION OF HOURS BY DAY AND ACTIVITY — DUKE UNIVERSITY

(XX.XX)=ROW PERCENT
XX.XX=COLUMN PERCENT

	MON	TUE	WED	THR	FRI	SAT	SUN	TOTAL
LECTURE	710.00	579.00	696.00	533.00	537.00	189.00	21.00	3270.00
	(21.71)	(17.70)	(21.28)	(16.45)	(16.42)	(5.77)	(0.64)	
	10.32	* 8.27*	* 9.65*	* 7.73*	* 7.83*	* 2.96*	* 0.31*	* 6.82*
LABORATORY	147.00	188.00	149.00	183.00	81.00	10.00	10.00	768.00
	(19.14)	(24.47)	(19.40)	(23.82)	(10.54)	(1.30)	(1.30)	
	* 2.13*	* 2.68*	* 2.06*	* 2.63*	* 1.18*	* 0.15*	* 0.14*	* 1.60*
ROTC DRILL	16.00	3.00	10.00	1.00	6.00	1.00	0.00	37.00
	(43.24)	(8.10)	(27.02)	(2.70)	(16.21)	(2.70)	(0.00)	
	* 0.23*	* 0.04*	* 0.13*	* 0.01*	* 0.08*	* 0.01*	* 0.00*	* 0.07*
ART WK REHEARSAL	18.00	47.00	29.00	31.00	20.00	7.00	19.00	171.00
	(10.52)	(27.48)	(16.95)	(18.12)	(11.69)	(4.09)	(11.11)	
	* 0.26*	* 0.67*	* 0.40*	* 0.44*	* 0.29*	* 0.10*	* 0.28*	* 0.35*
STUDY	1358.00	1378.00	1549.00	1189.00	796.00	531.00	1242.00	8043.00
	(16.88)	(17.13)	(19.25)	(14.78)	(9.89)	(6.60)	(15.44)	
	19.74	*19.70*	*21.47*	*17.10*	*11.61*	* 8.32*	*18.62*	*16.78*
COUNSELLED	17.00	39.00	28.00	29.00	25.00	7.00	7.00	152.00
	(11.18)	(25.65)	(18.42)	(19.07)	(16.44)	(4.60)	(4.60)	
	* 0.24*	* 0.55*	* 0.38*	* 0.41*	* 0.36*	* 0.10*	* 0.10*	* 0.31*
SLEEPING	2112.00	2252.00	2165.00	2198.00	2074.00	2057.00	2201.00	15059.00
	(14.02)	(14.95)	(14.37)	(14.59)	(13.77)	(13.65)	(14.61)	
	30.71	*32.19*	*30.01*	*31.61*	*30.26*	*32.25*	*33.01*	*31.41*
EATING	387.00	429.00	416.00	422.00	390.00	362.00	367.00	2773.00
	(13.95)	(15.47)	(15.00)	(15.21)	(14.06)	(13.05)	(13.23)	
	* 5.62*	* 6.13*	* 5.76*	* 6.07*	* 5.69*	* 5.67*	* 5.50*	* 5.78*
PER HYGIENE	321.00	292.00	330.00	334.00	327.00	315.00	277.00	2196.00
	(14.61)	(13.29)	(15.02)	(15.20)	(14.89)	(14.34)	(12.61)	
	* 4.66*	* 4.17*	* 4.57*	* 4.80*	* 4.77*	* 4.93*	* 4.15*	* 4.58*
READ/HOBBIES	318.00	338.00	401.00	365.00	407.00	439.00	486.00	2754.00
	(11.54)	(12.27)	(14.56)	(13.25)	(14.77)	(15.94)	(17.64)	
	* 4.62*	* 4.83*	* 5.56*	* 5.25*	* 5.93*	* 6.88*	* 7.28*	* 5.74*
BULL SESSIONS	253.00	258.00	269.00	366.00	356.00	286.00	339.00	2127.00
	(11.89)	(12.12)	(12.64)	(17.20)	(16.73)	(13.44)	(15.93)	
	* 3.67*	* 3.68*	* 3.72*	* 5.26*	* 5.19*	* 4.48*	* 5.08*	* 4.43*
SPORTS	109.00	151.00	147.00	138.00	99.00	101.00	45.00	790.00
	(13.79)	(19.11)	(18.60)	(17.46)	(12.53)	(12.78)	(5.69)	
	* 1.58*	* 2.15*	* 2.03*	* 1.98*	* 1.44*	* 1.58*	* 0.67*	* 1.64*
MOVIE/GAME	25.00	27.00	44.00	35.00	152.00	325.00	84.00	692.00
	(3.61)	(3.90)	(6.35)	(5.05)	(21.96)	(46.96)	(12.13)	
	* 0.36*	* 0.38*	* 0.61*	* 0.50*	* 2.21*	* 5.09*	* 1.25*	* 1.44*
WORK STUDENT ORG	95.00	82.00	69.00	80.00	67.00	85.00	67.00	545.00

Figure 3.23: *Summary of Student Hours by Activity and Day of Week*

	(17.43)	(15.04)	(12.66)	(14.67)	(12.29)	(15.59)	(12.29)	
	* 1.38*	* 1.17*	* 0.95*	* 1.15*	* 0.97*	* 1.33*	* 1.00*	* 1.13*
PARTY	40.00	21.00	30.00	99.00	232.00	463.00	200.00	1085.00
	(3.68)	(1.93)	(2.76)	(9.12)	(21.38)	(42.67)	(18.43)	
	* 0.58*	* 0.30*	* 0.41*	* 1.42*	* 3.38*	* 7.25*	* 2.99*	* 2.26*
WALK	309.00	295.00	283.00	280.00	260.00	235.00	192.00	1854.00
	(16.66)	(15.91)	(15.26)	(15.10)	(14.02)	(12.67)	(10.35)	
	* 4.49*	* 4.21*	* 3.92*	* 4.02*	* 3.79*	* 3.68*	* 2.87*	* 3.86*
BICYCLE	3.00	1.00	3.00	2.00	2.00	1.00	2.00	14.00
	(21.42)	(7.14)	(21.42)	(14.28)	(14.28)	(7.14)	(14.28)	
	* 0.04*	* 0.01*	* 0.04*	* 0.02*	* 0.02*	* 0.01*	* 0.02*	* 0.02*
BUS	87.00	87.00	57.00	88.00	84.00	73.00	29.00	505.00
	(17.22)	(17.22)	(11.28)	(17.42)	(16.63)	(14.45)	(5.74)	
	* 1.26*	* 1.24*	* 0.79*	* 1.26*	* 1.22*	* 1.14*	* 0.43*	* 1.05*
CAR	109.00	101.00	97.00	124.00	206.00	236.00	252.00	1125.00
	(9.68)	(8.97)	(8.62)	(11.02)	(18.31)	(20.97)	(22.40)	
	* 1.58*	* 1.44*	* 1.34*	* 1.78*	* 3.00*	* 3.70*	* 3.77*	* 2.34*
WAIT	85.00	70.00	80.00	53.00	88.00	108.00	33.00	517.00
	(16.44)	(13.53)	(15.47)	(10.25)	(17.02)	(20.88)	(6.38)	
	* 1.23*	* 1.00*	* 1.10*	* 0.76*	* 1.28*	* 1.69*	* 0.49*	* 1.07*
ERRAND	134.00	138.00	154.00	136.00	140.00	110.00	62.00	874.00
	(15.33)	(15.78)	(17.62)	(15.56)	(16.01)	(12.58)	(7.09)	
	* 1.94*	* 1.97*	* 2.13*	* 1.95*	* 2.04*	* 1.72*	* 0.92*	* 1.82*
PART TIME JOB	77.00	65.00	67.00	50.00	69.00	73.00	62.00	463.00
	(16.63)	(14.03)	(14.47)	(10.79)	(14.90)	(15.76)	(13.39)	
	* 1.11*	* 0.92*	* 0.92*	* 0.71*	* 1.00*	* 1.14*	* 0.92*	* 0.96*
OTHER	141.00	141.00	130.00	164.00	318.00	270.00	440.00	1604.00
	(8.79)	(8.79)	(8.10)	(10.22)	(19.82)	(16.83)	(27.43)	
	* 2.05*	* 2.01*	* 1.80*	* 2.35*	* 4.64*	* 4.23*	* 6.59*	* 3.34*
OTHER UNSPEC	6.00	12.00	9.00	47.00	116.00	94.00	230.00	514.00
	(1.16)	(2.33)	(1.75)	(9.14)	(22.56)	(18.28)	(44.74)	
	* 0.08*	* 0.17*	* 0.12*	* 0.67*	* 1.69*	* 1.47*	* 3.44*	* 1.07*
	6877.00	6994.00	7212.00	6952.00	6852.00	6378.00	6667.00	47932.00

Figure 3.23: *Summary of Student Hours by Activity and Day of Week*

Five hundred diaries were distributed; 292 (58.4%) were returned and in condition suitable for use. Since there are 168 hours available in seven days, there should be a maximum of 49,056 hours recorded by the 292 students. In fact, 47,932 hours were logged, or 97.7% of the maximum.

Distribution of student time by activity and room use

Figure 3.24 is a matrix which reflects the distribution of activity time (column headings) to the various space classified by room use (row headings). The entries in each cell of the matrix are: Total number of hours recorded by the students, percentages of each activity in the particular room use figures in parentheses), percentages of the total time for the particular activity in each room use classification, (figures between asterisks) the number of occurrences (individual records of the activity), and the average time per activity (total time divided by number of occurrences). The first room use classification listed is "Undefined," which means that the student failed to note his location or recorded a location which was not possible to code, or that a location was coded improperly. Looking at the column percentages for this room use (percent of the activity hours in this room use), we find, unfortunately, that a high percentage of time was recorded, time which resulted in this "Undefined" category. However, 42.8% (row percentages) of the time assigned to this room use was residential activities, which are known generally to occur in the dormitories.

Academic time is distributed 23% to rooms used as classrooms, 5% to laboratories, 2% to offices, 4% to study facilities, and 12% to residential facilities. Academic activities included lecture, laboratory, and study.

Distribution of student time by activity and group size

Figure 3.25 is a table which shows the distribution of the time spent in each activity according to the group size with which the recording student identified. If the respondent and another student were studying "together" in a library room, the group size should have been recorded as "one other" although there may have been twenty other people in the room. Again, each cell in the table contains the number of hours and the row and column percentages.

The success of this data collection is questionable, since 24% of "Bull Session" Time was recorded as being engaged in "alone." Other entries appear reasonable, such as study (28% alone, 12% with one other, 3% with 2-10 others). With more careful definition and emphasis on this item, future diaries could collect significant information.

EFL/DISTRIBUTION OF STUDENT TIME BY ACTIVITY AND ROOM USE/SUMMARY

NUMBER OF HOURS
(ROW PERCENT)
COLUMN PERCENT
NUMBER OF OCCURRENCES
AVG TIME PER ACTIVITY

	ACADEMIC	RESIDENTIAL	RECREATIONAL	TRANSPORT	MISC
UNDEFINED	6268.0 (18.9) * 51.5* 4406.0 1.4	14199.0 (42.8) * 71.0* 9846.0 1.4	6648.3 (20.1) * 82.9* 5946.0 1.1	3513.2 (10.6) * 100.0* 14052.0 0.3	2526.3 (7.6) * 78.2* 3747.0 0.7
CLASS	2799.8 (94.4) * 23.0* 2748.0 1.0	12.0 (0.4) * 0.1* 13.0 0.9	47.6 (1.6) * 0.6* 65.0 0.7	0.0 (0.0) * 0.0* 0.0 0.0	106.5 (3.6) * 3.3* 404.0 0.3
LAB	664.4 (93.6) * 5.5* 470.0 1.4	2.2 (0.3) * 0.0* 4.0 0.5	9.7 (1.4) * 0.1* 12.0 0.8	0.0 (0.0) * 0.0* 0.0 0.0	33.3 (4.7) * 1.0* 97.0 0.3
OFFICE	288.2 (61.7) * 2.4* 263.0 1.1	15.5 (3.3) * 0.1* 11.0 1.4	89.5 (19.2) * 1.1* 88.0 1.0	0.0 (0.0) * 0.0* 0.0 0.0	73.6 (15.8) * 2.3* 121.0 0.6
STUDY	455.0 (96.1) * 3.7* 305.0 1.5	1.0 (0.2) * 0.0* 2.0 0.5	4.5 (1.0) * 0.1* 10.0 0.4	0.0 (0.0) * 0.0* 0.0 0.0	13.1 (2.8) * 0.4* 25.0 0.5
SPECIAL	1.5 (23.1) * 0.0* 1.0 1.5	0.0 (0.0) * 0.0* 0.0 0.0	5.0 (76.9) * 0.1* 2.0 2.5	0.0 (0.0) * 0.0* 0.0 0.0	0.0 (0.0) * 0.0* 0.0 0.0
GENERAL	141.4 (50.2) * 1.2* 142.0 1.0	11.2 (4.0) * 0.1* 32.0 0.3	18.7 (6.6) * 0.2* 22.0 0.8	0.0 (0.0) * 0.0* 0.0 0.0	110.5 (39.2) * 3.4* 481.0 0.2

3.24 Distribution of Student Time by Activity and Room Use

SUPPORT	7.0	0.7	9.3	0.0	1.0
	(38.9)	(3.9)	(51.7)	(0.0)	(5.6)
	* 0.1*	* 0.0*	* 0.1*	* 0.0*	* 0.0*
	11.0	1.0	10.0	0.0	7.0
	0.6	0.7	0.9	0.0	0.1
RESIDENTIAL	1481.9	4689.3	1043.5	0.0	184.1
	(20.0)	(63.4)	(14.1)	(0.0)	(2.5)
	* 12.2*	* 23.4*	* 13.0*	* 0.0*	* 5.7*
	1073.0	1865.0	1343.0	0.0	275.0
	1.4	2.5	0.8	0.0	0.7
FOOD	15.9	965.0	47.6	0.0	76.0
	(1.4)	(87.4)	(4.3)	(0.0)	(6.9)
	* 0.1*	* 4.8*	* 0.6*	* 0.0*	* 2.4*
	20.0	1900.0	76.0	0.0	238.0
	0.8	0.5	0.6	0.0	0.3
RECREATION	0.5	0.0	0.0	0.0	0.0
	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)
	* 0.0*	* 0.0*	* 0.0*	* 0.0*	* 0.0*
	2.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0
HEALTH CARE	0.0	1.3	0.0	0.0	0.0
	(0.0)	(100.0)	(0.0)	(0.0)	(0.0)
	* 0.0*	* 0.0*	* 0.0*	* 0.0*	* 0.0*
	0.0	4.0	0.0	0.0	0.0
	0.0	0.3	0.0	0.0	0.0
NON-ASGNABLE	42.4	99.7	94.8	0.0	104.1
	(12.4)	(29.2)	(27.8)	(0.0)	(30.5)
	* 0.3*	* 0.5*	* 1.2*	* 0.0*	* 3.2*
	42.0	119.0	201.0	0.0	381.0
	1.0	0.8	0.5	0.0	0.3
OFF CAMPUS	0.0	0.0	0.0	0.0	0.0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	* 0.0*	* 0.0*	* 0.0*	* 0.0*	* 0.0*
	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0
TOTALS	12169.9	19998.3	8022.3	3513.2	3230.8
	(25.9)	(42.6)	(17.1)	(7.5)	(6.9)
	* 100.0*	* 100.0*	* 100.0*	* 100.0*	* 100.0*
	9482.0	13797.0	7775.0	14052.0	5776.0
	1.3	1.4	1.0	0.3	0.6

Figure 3.24: *Distribution of Student Time by Activity and Room Use*

EFL/DISTRIBUTION OF STUDENT TIME BY ACTIVITY AND GROUP SIZE

NUMBER OF HOURS
(ROW PERCENT)
COLUMN PERCENT

	ALONE	ONE OTHER	2-10 OTHERS	11-20 OTHERS	21-50 OTHERS	OVER 50
UNDEFINED	370.3	1.0	0.0	0.0	0.0	0.0
	(99.7)	(0.3)	(0.0)	(0.0)	(0.0)	(0.0)
	* 1.1*	* 0.0*	* 0.0*	* 0.0*	* 0.0*	* 0.0*
LECTURE	1040.9	22.2	153.8	664.3	913.9	474.8
	(31.8)	(0.7)	(4.7)	(20.3)	(27.9)	(14.5)
	* 3.2*	* 0.4*	* 3.4*	* 43.2*	* 52.6*	* 36.5*
LABORATORY	361.0	33.3	70.5	179.3	122.3	4.8
	(46.8)	(4.3)	(9.1)	(23.2)	(15.9)	(0.6)
	* 1.1*	* 0.6*	* 1.6*	* 11.7*	* 7.0*	* 0.4*
ROTC DRILL	16.8	0.5	4.2	2.0	1.8	10.8
	(46.5)	(1.4)	(11.5)	(5.5)	(5.1)	(30.0)
	* 0.1*	* 0.0*	* 0.1*	* 0.1*	* 0.1*	* 0.8*
ART/REHEARSE	122.2	7.2	17.3	4.5	8.0	10.7
	(71.9)	(4.2)	(10.2)	(2.6)	(4.7)	(6.3)
	* 0.4*	* 0.1*	* 0.4*	* 0.3*	* 0.5*	* 0.8*
STUDY	6401.9	967.5	233.8	57.5	80.8	30.3
	(82.4)	(12.4)	(3.0)	(0.7)	(1.0)	(0.4)
	* 19.5*	* 18.0*	* 5.1*	* 3.7*	* 4.7*	* 2.3*
COUNSEL	103.0	29.8	12.3	4.3	0.0	0.0
	(68.9)	(20.0)	(8.2)	(2.9)	(0.0)	(0.0)
	* 0.3*	* 0.6*	* 0.3*	* 0.3*	* 0.0*	* 0.0*
SLEEPING	13632.1	1282.8	104.5	3.0	0.0	2.2
	(90.7)	(8.5)	(0.7)	(0.0)	(0.0)	(0.0)
	* 41.5*	* 23.9*	* 2.3*	* 0.2*	* 0.0*	* 0.2*
EATING	1266.3	442.8	885.4	57.0	43.3	81.8
	(45.6)	(15.9)	(31.9)	(2.1)	(1.6)	(2.9)
	* 3.9*	* 8.2*	* 19.5*	* 3.7*	* 2.5*	* 6.3*
PERS HYGIENE	2039.3	101.8	44.8	2.8	5.7	2.0
	(92.8)	(4.6)	(2.0)	(0.1)	(0.3)	(0.1)
	* 6.2*	* 1.9*	* 1.0*	* 0.2*	* 0.3*	* 0.2*
READ/HOBBY	1887.0	265.0	414.5	153.3	19.0	7.0

Figure 3.25: *Distribution of Student Time by Group Size*

	(68.7)	(9.7)	(15.1)	(5.6)	(0.7)	(0.3)
	* 5.8*	* 4.9*	* 9.1*	* 10.0*	* 1.1*	* 0.5*
BULL SESSION	521.8	604.9	986.1	33.2	6.0	0.8
	(24.2)	(28.1)	(45.8)	(1.5)	(0.3)	(0.0)
	* 1.6*	* 11.3*	* 21.7*	* 2.2*	* 0.3*	* 0.1*
SPORTS	317.3	48.7	118.7	122.2	130.0	57.2
	(40.0)	(6.1)	(14.9)	(15.4)	(16.4)	(7.2)
	* 1.0*	* 0.9*	* 2.6*	* 7.9*	* 7.5*	* 4.4*
MOVIE/GAME	171.0	201.5	164.7	10.8	21.7	125.7
	(24.6)	(29.0)	(23.7)	(1.6)	(3.1)	(18.1)
	* 0.5*	* 3.8*	* 3.6*	* 0.7*	* 1.2*	* 9.6*
STDNT ORG	182.7	54.2	142.2	40.7	60.7	66.7
	(33.4)	(9.9)	(26.0)	(7.4)	(11.1)	(12.2)
	* 0.6*	* 1.0*	* 3.1*	* 2.6*	* 3.5*	* 5.1*
PARTY	197.7	120.7	232.8	103.0	167.2	266.3
	(18.2)	(11.1)	(21.4)	(9.5)	(15.4)	(24.5)
	* 0.6*	* 2.2*	* 5.1*	* 6.7*	* 9.6*	* 20.5*
WALK	1387.0	304.5	122.8	4.8	5.3	10.8
	(75.6)	(16.6)	(6.7)	(0.3)	(0.3)	(0.6)
	* 4.2*	* 5.7*	* 2.7*	* 0.3*	* 0.3*	* 0.8*
BICYCLE	19.5	5.3	1.0	0.0	1.5	0.5
	(70.1)	(19.2)	(3.6)	(0.0)	(5.4)	(1.8)
	* 0.1*	* 0.1*	* 0.0*	* 0.0*	* 0.1*	* 0.0*
BUS	350.9	61.3	27.7	21.8	57.3	17.5
	(65.4)	(11.4)	(5.2)	(4.1)	(10.7)	(3.3)
	* 1.1*	* 1.1*	* 0.6*	* 1.4*	* 3.3*	* 1.3*
CAR	494.9	295.0	321.1	1.2	0.2	1.8
	(44.4)	(26.5)	(28.8)	(0.1)	(0.0)	(0.2)
	* 1.5*	* 5.5*	* 7.1*	* 0.1*	* 0.0*	* 0.1*
WAIT	272.3	73.0	79.3	22.7	19.0	29.2
	(55.0)	(14.7)	(16.0)	(4.6)	(3.8)	(5.9)
	* 0.8*	* 1.4*	* 1.7*	* 1.5*	* 1.1*	* 2.2*
ERRAND	609.0	199.7	74.3	5.0	1.8	5.5
	(68.0)	(22.3)	(8.3)	(0.6)	(0.2)	(0.6)
	* 1.9*	* 3.7*	* 1.6*	* 0.3*	* 0.1*	* 0.4*
JOB	266.5	64.5	98.7	13.2	14.3	7.5

Figure 3.25: *Distribution of Student Time by Group Size*

	(57.4)	(13.9)	(21.2)	(2.8)	(3.1)	(1.6)
	* 0.8*	* 1.2*	* 2.2*	* 0.9*	* 0.8*	* 0.6*
OTHER	784.9	181.5	232.3	32.2	56.2	88.3
	(57.1)	(13.2)	(16.9)	(2.3)	(4.1)	(6.4)
	* 2.4*	* 3.4*	* 5.1*	* 2.1*	* 3.2*	* 6.8*
TOTALS	32816.4	5368.6	4542.9	1538.8	1736.1	1302.3
	(69.4)	(11.3)	(9.6)	(3.3)	(3.7)	(2.8)
	* 100.0*	* 100.0*	* 100.0*	* 100.0*	* 100.0*	* 100.0*

Figure 3.25: *Distribution of Student Time by Group Size*

Remarks on statistical applications for analysis

Previous sections of this chapter have discussed methods of reducing data to manageable proportions and generating tabular displays which summarize its various aspects. Some of the possible uses of the techniques and some of the comparisons which one might wish to make between the various tabular displays were discussed. In this section, discussion moves to a more general level.

The following paragraphs will first present an elementary review of the notion of *levels of measurement,* and its significance in choosing appropriate statistics for descriptive and hypothesis testing analyses.[46] Then we shall discuss several analyses of potential interest illustrating the relevance of levels of measurement in selecting appropriate statistics for use in planning studies. Since these analyses have not yet been completed, results are not reported. Neither will the logic involved in the statistics discussed be detailed or computational examples be provided. Rather, the reader will be referred to appropriate sources of equations and illustrative applications. Throughout this discussion major emphasis will be upon the data gathered by means of the Student Information Questionnaire, because these data aptly illustrate all of the major factors involved in statistical decision making of the sort under consideration.

In choosing a statistic it is important to be aware of the difference between a *variable* and a *scale* of measurement. A variable generally means a theoretically relevant abstraction, such as a "function of the college or university." It will be recalled that the functions of the college or university were defined as the consequences of its institutional structure. The notion of function, or its hypothesized antecedent the institutional structure, is clearly a high level abstraction which defies direct observation. The functions of the college or university have been translated into an operational form in which it is possible to observe, or measure, their relative importance as judged by our respondents. Question 13 of the Student Information Questionnaire measures the importance of each function of a four-point *scale.*

Clearly this scale tells something about the variable *functional importance.* The scale and the variable, however, are not equivalent, as is evident from the fact that a virtually limitless number of alternative scales might have been usefully substituted for the one chosen. All of these data are recorded in terms of scales: categories for measurement of variables. In all cases other scales could have been substituted for those actually employed, and the fact that they were not reflects the investigator's judgment regarding varied factors including, but not limited to, anticipated modes of analysis and facility of observation (data gathering).

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[46] The reader who is already familiar with the logic involved in this discussion may wish to skip most of it. We suggest that he *not* skip over Figure 3.22, in which levels of measurement embodied in our scales are summarized. For the reader who wishes a more extensive discussion of levels of measurement which does not require a high level of mathematical sophistication, we would recommend: Freeman, Linton C., *Elementary Applied Statistics: for Students in Behavioral Science* (New York: John Wiley and Sons, 1965), pp. 3-10; or Siegel, Sidney, *Nonparametric Statistics for the Behavioral Sciences* (New York: McGraw-Hill, 1956), pp. 21-31. These volumes also include computational equations and examples of applications for a number of useful statistics which will be mentioned below.

96 Once data are in hand, and analysis is begun one is committed to the chosen scales. It is the scaled data, not the variable, which is subjected to statistical analysis. Scales of measurement vary with respect to the amount of information which they include, and one would be well advised to use as much of the information provided by any given scale as possible. Unfortunately, the decision as to how much information is captured by a given scale, and the subsequent decision as to which statistic(s) to employ in analyses involving it, is not always clearcut. For this reason, some familiarity with the theory of measurement is essential if one seeks to make optimal use of the data available to him. From the theory of measurement one will find the following three *levels of measurement* useful conceptual tools in choosing appropriate statistics:

Nominal measurement: A nominal scale is the simplest form in which data may be classified. It consists of a set of mutually exclusive, exhaustive categories which are frequently named, sometimes by means of numbers,[47] hence the designation as "nominal." The mathematical operation appropriate to such data is the equality operation. Either two observations are equal, or they are not equal. In the former case they are co-classified on the scale, in the latter case they must be placed in different categories. "Sex" exemplifies a nominal scale with two categories: male and female. "Major" is another nominal classification scheme — two students who major in sociology are placed in the same category, which will be different from the category assigned to economics, physics, or Greek majors.

Ordinal measurement: An ordinal scale, like a nominal scale, consists of a set of exhaustive, mutually exclusive categories. It has the additional attribute that the categories form an ordered series; hence the name, ordinal scale. This added attribute implies the additional applicability of the mathematical operation *greater than*. "Class in school" is a variable which has this added feature; it not only classifies the students, but also orders them. The addition of order in this illustration underlies our willingness to assert that being classified as a "senior" implies that one is not only different from, but also *more than* a "junior." "Social status" is often considered an ordinal scale, and other illustrations could easily be provided.

Interval measurement: Interval data possess the characteristics of ordinal data plus one important added quality. An interval scale is so constructed that the distance between any category and an adjacent category is identical to the distance between any other pair of adjacent categories. In other words, the intervals of the scale are identical. This is an important property. Consider the following series of numbers:

1 2 4 5 6 9 23 639 1127 9999

1 2 3 4 5 6 7 8

5 10 15 20 25 30 35 40 45 50

---

[47] It is important not to be seduced by the magic of numbers. The fact that one assigns numbers to represent categories of data does not endow the data so represented with the attributes of "pure numbers." Simply because one assigns a score of 23 to "Romance Languages," 22 to "Religion," and 21 to "Psychology" does not make an ordinal scale. Religion is not *greater than* psychology, nor is Romance languages greater than religion. The numbers merely stand-in for the names of classes on a nominal scale. This caution is relevant in all instances where data are recorded in numerical form.

The first is only an ordinal scale, since order is present, but not equal intervals. The second and third are both interval data, since the intervals are equal (i.e., 10-5=50-45=25-20 . . . etc.). With interval data there is true measurement, and the mathematical operations of additivity become permissible; linear transformations can be performed. *If* one were willing to accept the assumption that class in school had a standard scale such that the difference between a freshman and a sophomore was precisely equivalent to the difference between any other adjacent pair of classes, then class in school might be legitimately treated as an interval scale. Similarly, if the difference between a D and an F is equivalent to the difference between any other adjacent pair, one might be willing to argue that grades constitute interval data.[48]

Figure 3.26 lists the variables measured by the Student Information Questionnaire, together with several variables which can be derived from the Student Activity Diary, according to the type of scale in which data is considered to be cast. In some instances one might cogently argue that a given scale has the properties appropriate to either of two classifications. For example, question two of the Student Information Questionnaire might be viewed as consisting either of a set of nominal categories, or of an ordered hierarchy. These two perspectives on the same scale result from the possibility of differing interests and differing emphases. Thus, if one's concern is sociological in nature, he might be quite likely to view these as categories ordered along a continuum of relative interpersonal involvement, with "married" representing greater involvement than "engaged"... and so forth on down to "unattached" which represents the least involvement. Where we feel there is little ambiguity regarding the level of measurement attained by a given scale, we have classified it once. On the other hand, if, as in the case of "marital status," we judge there to be noteworthy ambiguity regarding the proper classification for a given scale, we have entered it twice in Figure 3.26.

VARIABLES CLASSIFIED BY LEVEL OF MEASUREMENT

The first group of variables in each category is found in the Student Questionnaire; the second group is found in the student diaries.

LEVEL OF MEASUREMENT	VARIABLE NAME
Nominal	Sex
	Marital status
	Educational aspiration*
	Major
	Declaration of major
	Residential status
	Organization membership
	Organization officership
	Location
	Space type
	Activity
Ordinal	Marital status*
	Class in school
	Educational aspiration*
	Occupational aspiration*
	Father's occupation*
	Educational attainment of parents
	Income sources for educational expenses
	University or college functions, importance of
	Organizational involvement level
	Attitude toward participation
	Group size
Interval	Age
	Occupational aspirations*
	Father's occupation*
	Grade average (Quality point ratio)
	SAT scores
	Activity hours (hrs. per activity)
	Group hours
	Space hours
	Location hours

Figure 3.26: *Classification Variables*

[48] This assumption underlies the most common precedures for computing grade point averages — hence the use of GPA strongly militates for adoption of this assumption in other statistical analyses where GPA will serve as data.

98 The discussion of levels of measurement, and the previous paragraph dealing with the appropriate classification of scales by level, have developed the basic logic employed in choosing statistical techniques. Note that each scale type admits only certain types of mathematical operations. The more information included in the measurements, the more mathematical operations are appropriate during statistical manipulation of the resulting data. The statistics which one can employ in analyzing data vary with respect to the mathematical operations which they require; hence one must be certain to select statistics appropriate to the available data. The three levels of measurement provide a convenient means for summarizing the characteristics of data which must be taken into account in selecting statistics, since various statistics may be classified in parallel fashion.[49] If one uses a statistic appropriate for nominal scales with ordinal or interval data, information will be lost because the statistic fails to make use of the added mathematical properties justified by the level of measurement. On the other hand, if one uses a statistic appropriate for an interval scale with nominal or ordinal data he will be guilty of *number seduction* as mentioned in footnote 47 under nominal scales. Such number seduction results either in uninterpretable statistics, or in statistics which *appear* to provide information which in fact they do not. In either case, the resulting state of affairs is unfortunate, and avoidable.

In the first section of this chapter some of the applications of CHLOE were discussed. The possibility was suggested of comparing the activities distributions produced by respondents falling into different categories with respect to sex, or other nominal scales, through the use of difference tables. The logic of the Chi-square test of significance discussed in the previous chapter could also be usefully applied for such comparisons. Application of Chi-square statistics to data of the sort generated by CHLOE would have the advantage of indicating whether or not any significant differences between the two tables were obtained by a single numerical value. It would not, of course, tell where the significant difference(s) in the tables were located. In the event that such differences were found in relatively few table cells, inspection might lead the investigator to pass this off as "random variation" while the Chi-square statistic would provide an overall index of the likelihood that such variation was the result of random variability. The reader is referred to Siegel, *op. cit.,* for discussion of several Chi-square tests applicable to these problems.

Another type of analysis which would be of interest may be introduced to further illustrate the statistical applications to which these data are amenable. For each of the 27 "functions of the university" listed in question 13, each respondent has provided a ranking with respect to importance. It would be of interest to know to what extent respondents, or particular groups of respondents, agreed with respect to these rankings. The appropriate measure of correlation for these ordinal data is Kendall's Coefficient of Concordance, W.[50] This statistic provides a

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[49] Both Freeman and Siegel, *op. cit.,* classify the statistics which they discuss in terms of the levels of measurement for which they are appropriate. The reader is referred to these volumes for more detailed discussions of the specific statistics mentioned in the following paragraphs.

[50] See Siegel, *op. cit.,* pp. 229-238.

measure of the agreement among a set of judges (respondents) regarding the rankings assigned to a set of objects (functions). One might reasonably hypothesize, for example, that fraternity members are more likely to agree on these items than independent men; and comparison of the appropriate values for W would provide a test of this hypothesis.

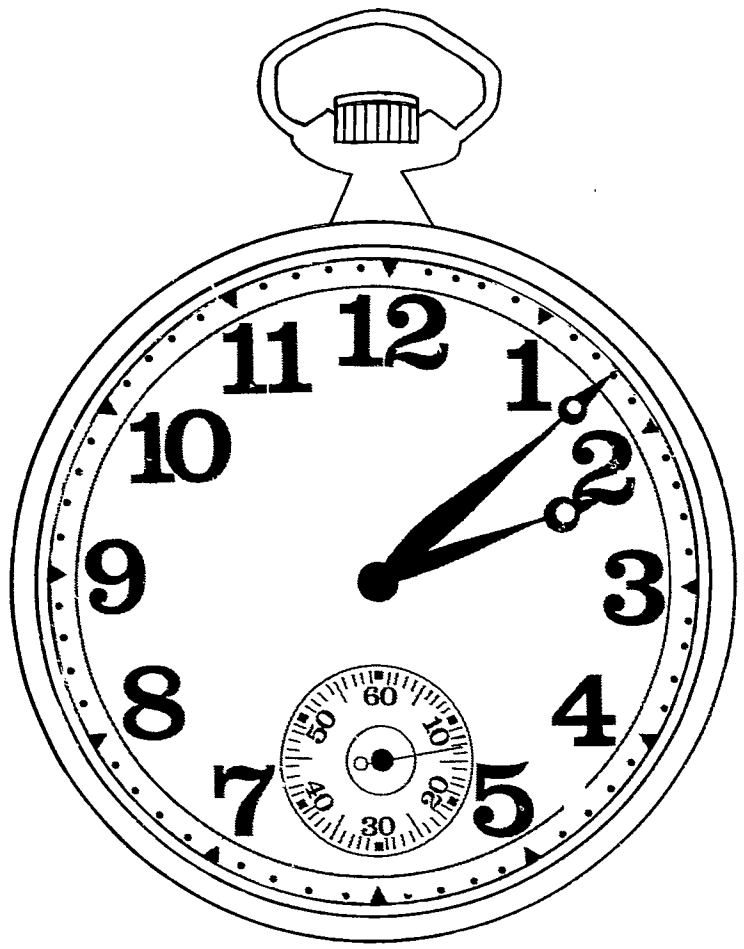
Another hypothesis which one might wish to test is that group size (original data) is associated with location (nominal data). Here, one is interested in knowing whether or not the size of the group engaging in some particular type(s) of activity is determined by the size characteristics of the space employed.[51] Freeman presents an extension of the Wilcoxon signed-ranks test, called the coefficient of differentiation, which is appropriate for problems involving the relationship between one nominal scale and one ordinal scale. He also provides, in another chapter, a test of significance which can be applied to relationships of this sort.

Illustrations of the sort presented in the previous paragraphs could be multiplied. It is hoped that this final section of the present chapter has served to introduce the reader to some primary considerations in the choice of statistics and to suggest the range of possible uses for such data through presentation of selected examples.

[51] Clearly physical space has maximum capacities — beyond which more people cannot be accommodated. Some activities, such as studying, do not necessarily require large groups of participants — and may be engaged in locations of varied sizes. If relatively large groups study in relatively small locations such as dormitory rooms, while pairs of individuals seek out "private" use of auditoriums or lecture halls for studying, an inverse correlation would obtain. On the coefficient of differentiation, see Freeman, *op. cit.*, pp. 108-119.

APPENDICES

Appendix A1



STUDENT ACTIVITY DIARY COMPUTER AIDED CAMPUS PLANNING

Duke University
DURHAM
NORTH CAROLINA
27706

Dear Respondent:

Thanks for giving us your help!

This project is sponsored jointly by Educational Facilities Laboratories and Duke University. Briefly, the objectives of the study are as follows:

- To test techniques for collecting data on university life which will provide good information for university planners.
- To suggest means by which university planners may specify for the architect of a specific building project the nature and amount of activity which the new facility must accommodate.
- To provide a tool for testing the desirability of certain facilities prior to committing limited funds to build them.

In support of these objectives we are seeking to collect information on student use of facilities. With your help we hope to reduce the uncertainties in planning classrooms, laboratories, dormitories, unions, recreational spaces, parking, etc.

We are asking you to provide us with two kinds of information. This booklet contains an Activity Diary in which we are asking you to record information about your activities during a one-week period. A short Student Information Questionnaire asks for information concerning you and your views on some aspects of university life.

For this study, everything you do is important. If you go to class, we would like to know about it; if you do not go to class, what you do instead is equally significant. It is especially important that you tell us about your unscheduled activities such as recreation, study, parties, sleeping, etc. Student reports are the only way this information can be obtained; hence, our information will be only as valid as you make it.

Please understand that your anonymity will be protected; for that reason we ask that you label your answer sheets with a sample number only, which is indicated on this booklet.

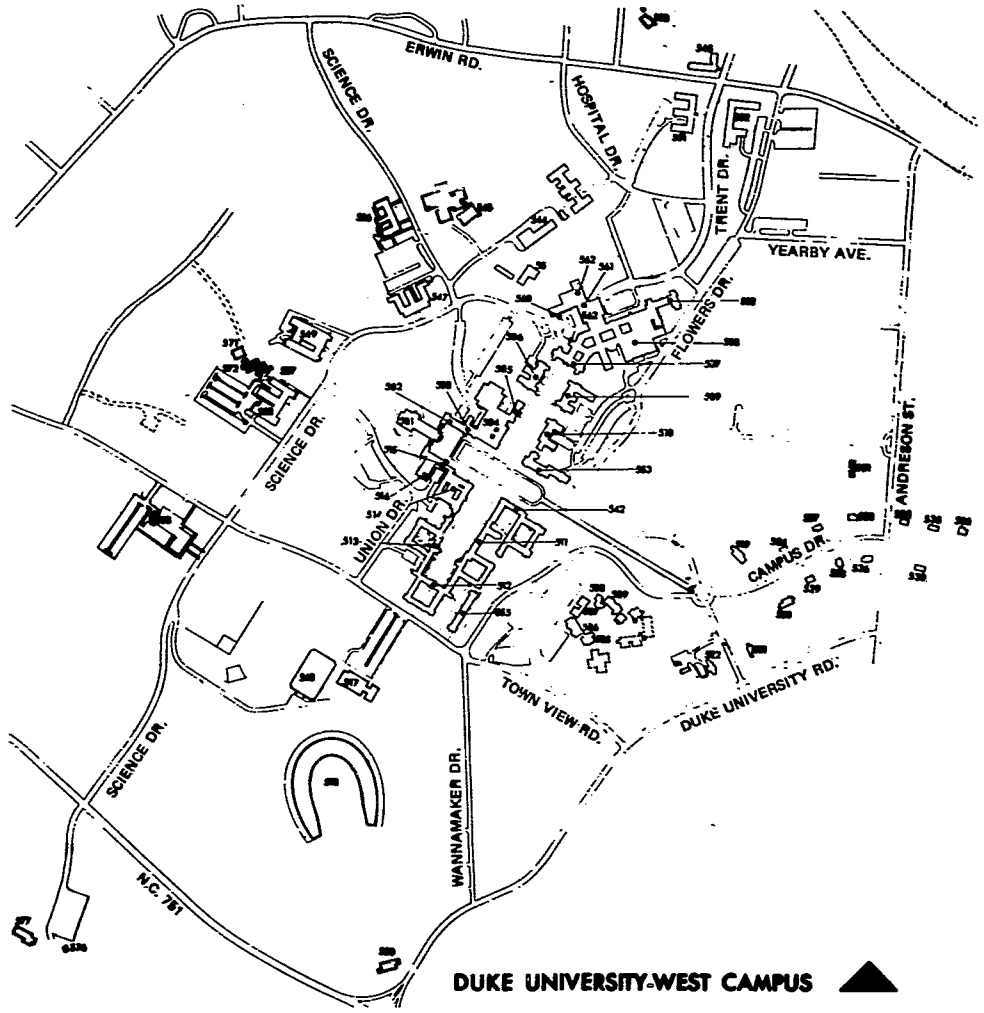
The results from your diary will be processed by computer. Tabulation of your entries will be available to you.

Thanks again for your help.

Sincerely,

Walter J. Matherly

Walter J. Matherly
Principal Investigator
Computer-Aided Campus Planning Research Project

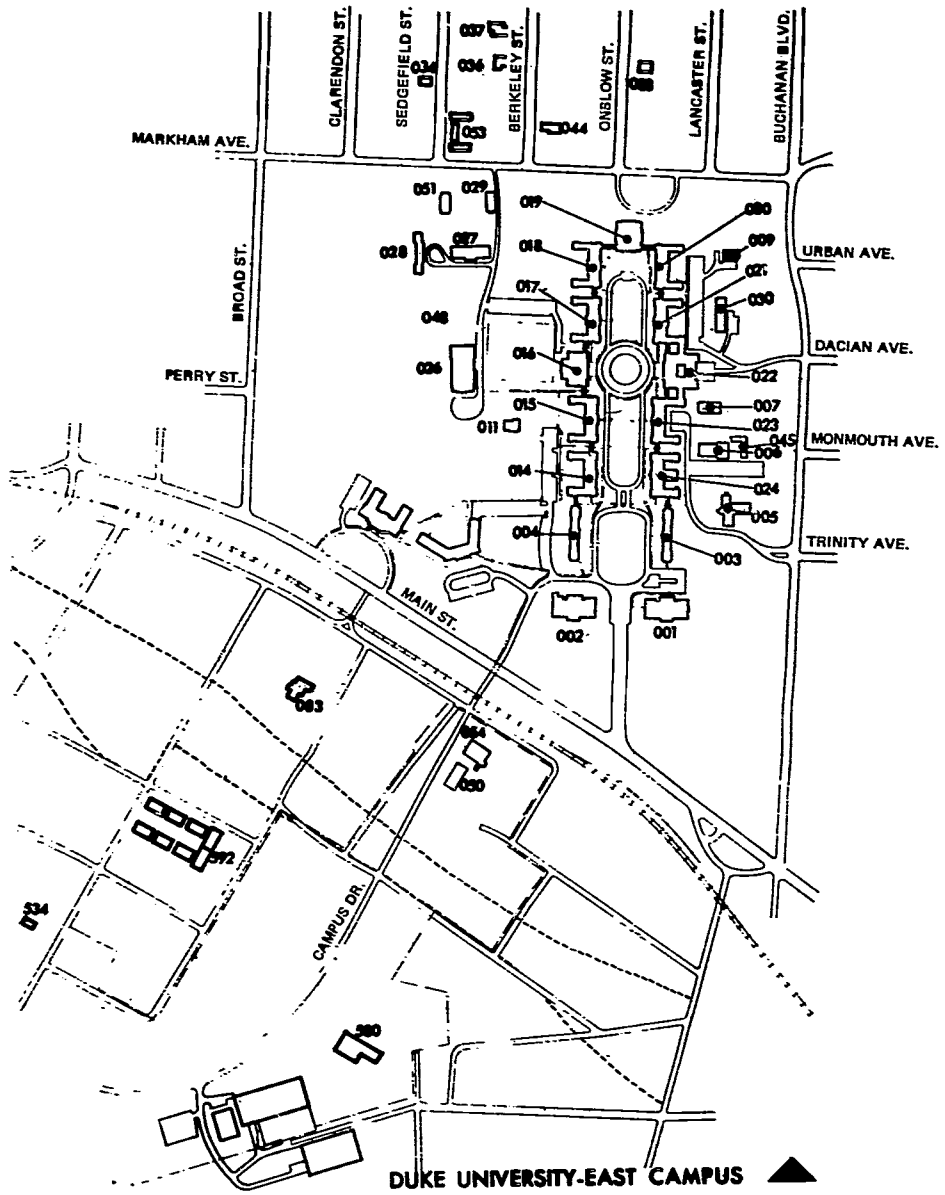


DUKE UNIVERSITY-WEST CAMPUS

DUKE UNIVERSITY-WEST CAMPUS

*047	OLD DUKE HOMEPLACE
501	DUKE CHAPEL
502	GRAY BUILDING
503	DIVINITY SCHOOL
504	GENERAL LIBRARY
505	LANGUAGE CENTER
506	CHEMISTRY BUILDING
507	SCHOOL OF MEDICINE
508	DUKE HOSPITAL
509	SOCIOLOGY–PSYCHOLOGY
510	SOCIAL SCIENCES
511	CRAVEN QUADRANGLE
512	CROWELL QUADRANGLE
513	KILGO QUADRANGLE
514	UNION BUILDING
515	FLOWERS BUILDING
516	PAGE AUDITORIUM
517	CARD GYMNASIUM
518	DUKE STADIUM
519	ALUMNI OFFICE
520	ADVANCEMENT OFFICE
522	ADMISSIONS OFFICE
526	INTERNATIONAL HOUSE
528	PERSONNEL OFFICE
531	GARDEN GREENHOUSES
532	BAKER HOUSE
536	HERRING HOUSE (E.I.P.)
542	FEW QUADRANGLE
543	INDOOR STADIUM
544	MAINTENANCE WAREHOUSE & GARAGE
545	HANES ANNEX
546	BELL BUILDING
547	ENGINEERING
548	RESEARCH LABORATORY
549	PHYSICS BUILDING
550	DR. HART'S RESIDENCE
551	HANES HOUSE
552	GRADUATE CENTER
553	ALLEN BUILDING
554	HEATING PLANT
555	WANNAMAKER DORMITORY
556	A.R.O.D.
557	ACCELERATOR BUILDING
558	BIOLOGICAL SCIENCES
559	LAW BUILDING
560	GERONTOLOGY
561	D & T
562	CLINICAL RESEARCH
563	MAIN ENTRANCE HOSPITAL
571	PHYTOTRON
572	BIO. SCIENCE GREENHOUSES
*574	ANIMAL BEHAVIOR STATION
*575	DUKE UNIVERSITY APARTMENTS
576	G. C. CADDY HOUSE
577	G. C. CADDY HOUSE
*578	G. C. TOOL HOUSE
**579	ERWIN ROAD RESIDENCE
580	LAUNDRY BUILDING
*582	UNIVERSITY HOUSE
583	DEAN BALL'S HOUSE
*584	KENNEL FACILITIES
585	TABARD HALL
586	MIRECOURT
587	TAYLOR HALL
588	LANCASTER HOUSE
589	YORK HOUSE
*590	FORESTRY BUILDING
*591	FACULTY CLUB
592	TOWN HOUSE APARTMENTS
593	ON CAMPUS – OTHER
594	OFF CAMPUS – DURHAM
595	OFF CAMPUS – CHAPEL HILL
596	OFF CAMPUS – OTHER

*NOT WITHIN MAP LIMITS
**BUILDINGS TOO NUMEROUS TO LOCATE ON MAP



DUKE UNIVERSITY-EAST CAMPUS

DUKE UNIVERSITY-EAST CAMPUS

001 EAST DUKE
002 WEST DUKE
003 AYCOCK DORMITORY
004 JARVIS DORMITORY
005 EPWORTH INN
006 DOPE SHOP
007 THE ARK
009 DUKE PRESS
011 CAMPUS CENTER
014 CARR BUILDING
015 GILES DORMITORY
016 WOMAN'S COLLEGE LIBRARY
017 ALSPAUGH DORMITORY
018 PEGRAM DORMITORY
019 WOMAN'S COLLEGE AUDITORIUM
020 BASSETT DORMITORY
021 BROWN DORMITORY
022 WOMAN'S COLLEGE UNION
023 APARTMENT (FACULTY)
024 SCIENCE BUILDING
025 SOUTHGATE DORMITORY
026 MEMORIAL GYMNASIUM
027 ASBURY BUILDING
028 BIVINS BUILDING
029 BRANSON BUILDING
030 GILBERT–ADDOMS DORMITORY
031 INFIRMARY
045 GARAGE
048 BELL TOWER
050 WAREHOUSE
051 ART BUILDING
053 PRE–FABRICATED APARTMENTS
054 HEATING PLANT

INSTRUCTIONS FOR USE OF ACTIVITY DIARY FORMS

The Activity Diary requests the following information about your daily activities:

WHAT is the nature of the activity?
WHEN were you engaged in the activity?
WHERE did you engage in the activity?
HOW MANY other people engaged in it with you?

Please read all of the following material carefully before you attempt to make any entries in your Activity Diary.

ACTIVITIES

You will note that the activities listed at the top of each page of the Activity Diary have been grouped under five headings. Each activity is defined here in general terms.

ACADEMIC

LECTURE — attendance at seminars and lectures which are required as part of your course work.

LABORATORY — science and language laboratory work, social science laboratory work, and required training in the use of computational equipment or other scientific apparatus.

ROTC DRILL — drill only; formal instruction in military science is under lecture or laboratory.

ART WORK/REHEARSAL — time spent *outside of class* in rehearsing, exercising or other preparation for art, music, or speech courses.

STUDY — normal preparation for class: reading, writing, library research, etc.

BEING COUNSELED — time you spent with your advisor, time spent discussing course work with the instructor outside of class, counseling about academic matters with deans or guidance office personnel.

RESIDENTIAL

SLEEPING — intentional sleeping.

EATING — all meals, snacks, and coffee breaks, wherever you have them.

PERSONAL HYGIENE — shaving, setting your hair, bathing, dressing, etc.

RECREATIONAL

READING — recreational activities which do not require the participation of others; reading for pleasure, knitting, working with a stamp collection, drawing or sketching, listening to records, or watching TV. If your hobby is skiing, golfing, or riding, classify it under sports.

BULL SESSIONS — *informal conversation* regardless of topic.

SPORTS — voluntary or required athletic activities in which you participate.

MOVIE/GAME — an athletic event, movie, concert, public lecture (not course related), play, or debate, which you attend.

WORK WITH STUDENT ORGANIZATION — activities in a Greek letter organization, student government, campus clubs, and special interest groups. Ski Club, International Club, Engineering Society, political clubs, are examples.

PARTY — formally organized or impromptu.

TRANSPORTATION

WALK

BICYCLE — includes motorscooter or cycle, for our purpose.

BUS

CAR — private car or taxi.

MISCELLANEOUS

WAIT — time spent waiting for a bus, in lines, for class to start, or for a professor to keep an appointment.

ERRAND — mailing a letter, picking up your mail, asking a friend about an assignment or borrowing his book. Typically, an errand involves going somewhere.

PART–TIME JOB — typing term papers, working in the library, pumping gas, tutoring, selling something, singing or playing an instrument as a means of increasing your income. Part-time jobs require less than 40 hours per week.

OTHER — activities which do not come under the above classifications. Write a brief description of the activity next to the word "Other" at the top of the column on the page where you have used this category.

GROUP SIZE

The next set of columns on the Activity Diary is headed "Group Size." We want you to estimate the number of people engaged with you in the same activity at the same time and place. You and another person may be studying in a library room. There may be 20 other people in the room, but your group size would be "one other."

BUILDING AND ROOM

On the right-hand of the Activity Diary page are two columns headed Building and Room. Facing each page of the diary is a list of code numbers and their corresponding building names for all Duke Buildings. Write the *code number* of the building in which your activity is located. If the room in which you engage in the activity has a number, that number should be entered. If the room is not numbered, enter its commonly accepted name (e.g. Ladies' Room, Library Lobby, Dope Shop. etc.). If the location of your activity is off campus, use one of the code numbers provided for off-campus locations. Colored cards will be placed inside each classroom indicating the number of the building and room.

TIME

Each Activity Diary page covers an eight-hour period and the rows represent consecutive 10-minute intervals.

Place a mark in the row corresponding to the time your activity *begins*. You need not mark every 10-minute interval for the duration of one activity; a single mark at the beginning of each activity is sufficient.

If you change location while continuing the same activity, indicate both time and new location as though it were a new activity.

An Example

The following example illustrates how you would record a number of different activities.

It is Monday, and you awake at 9:05. It is the first day of the diary. You were at a party until 2 a.m. at a friend's house – six couples, beer and a hi-fi. Since the party started about eight o'clock the night before, you mark it down in the first row of page one. At 2 a.m. you took your date home by car, about a 10-minute drive including the time it took for your buddy to drop off his girl at another dorm; make an entry in the 2:00 row. Then you went back to the dorm, still in the car, which took several minutes more. At about 2:20 you were getting ready for bed, and you made it into the sack by 2:30. Two more entries bring you up to now, 9:10 a.m.

If you hurry, you'll make your 10:30 class. Shower, shave, dress, and by 9:40 you are walking to the Dope Shop for a bite to eat before class. At 9:50 you are standing in line at the Dope Shop. As soon as you get your snack, you walk to the Soc-Psych building for your Soc. Class in Room 133. You get to class four or five minutes early and use the time to catch up on your diary, entering your activities since you got out of bed and headed for the shower.

The sample page(s) from the Activities Diary, which are reproduced on the following pages, show how these activities would be entered.

During the Week

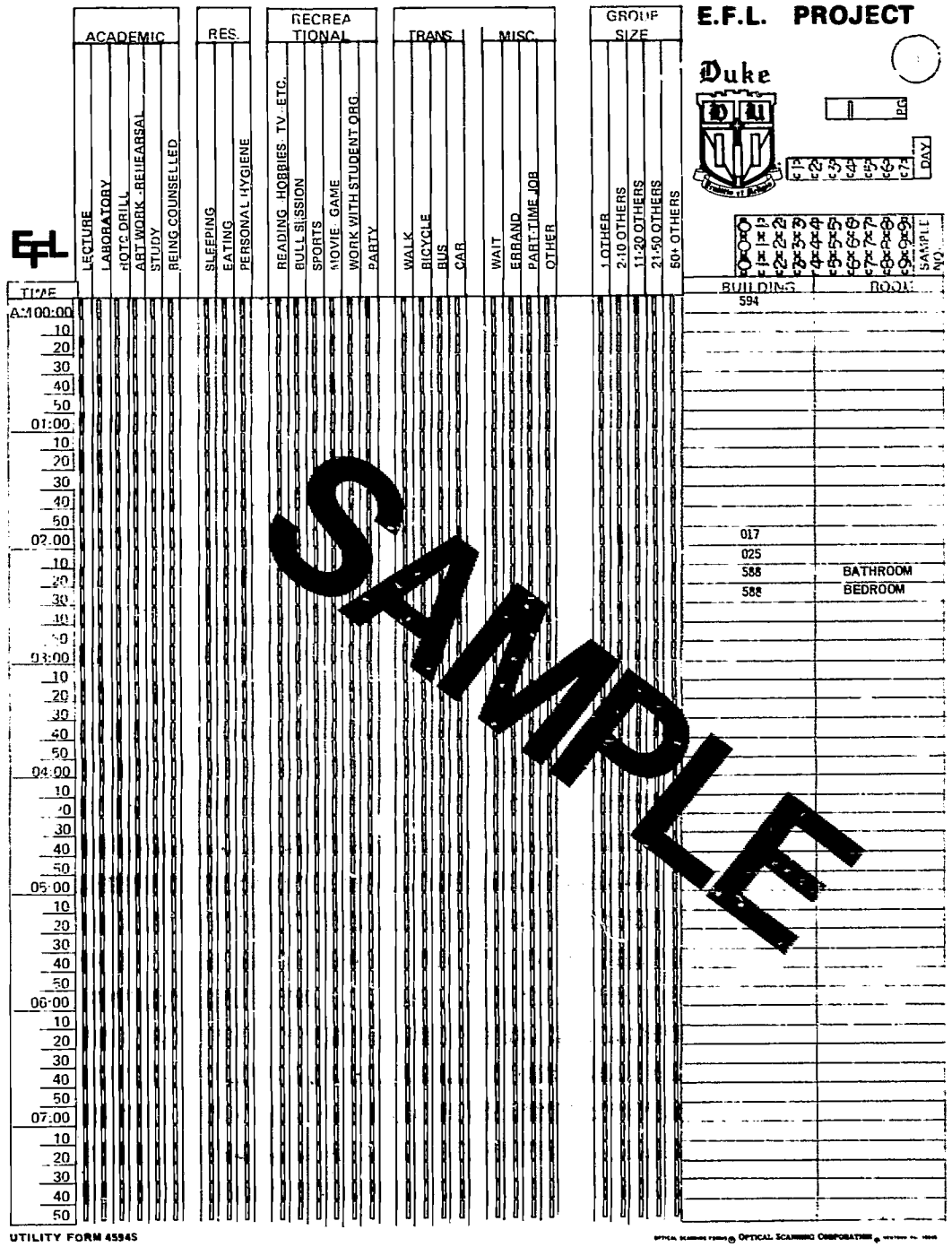
- Unless you specify a group size, we assume you were alone. Estimate group size for scheduled group activities in which you participate; for non-scheduled activities estimate the number of people directly engaged with you, such as a chat with friends in the Dope Shop.
- We do not need to know the route you take with your "transportation" entries, but we must know where you came from and where you went.
- It is not necessary for you to record each activity as it happens, but you should bring your diary up-to-date at frequent intervals throughout the day.
- The building code numbers are listed on the page facing each diary page. The map of the Duke Campus, printed inside the cover of this booklet, will help you locate any buildings that you might not know by name.
- If you have any questions, or are in doubt about anything in conjunction with your role as a participant in this project, contact the student supervisor who gave you the booklet.

At the End of the Week

Before returning your project booklet to your supervisor please

- Check to make sure your Sample Code Number is indicated on each page of the Activities Diary.
- Complete the Student Information Questionnaire at the back of this booklet.

Thanks for your help.



Sample

DUKE UNIVERSITY — WEST CAMPUS

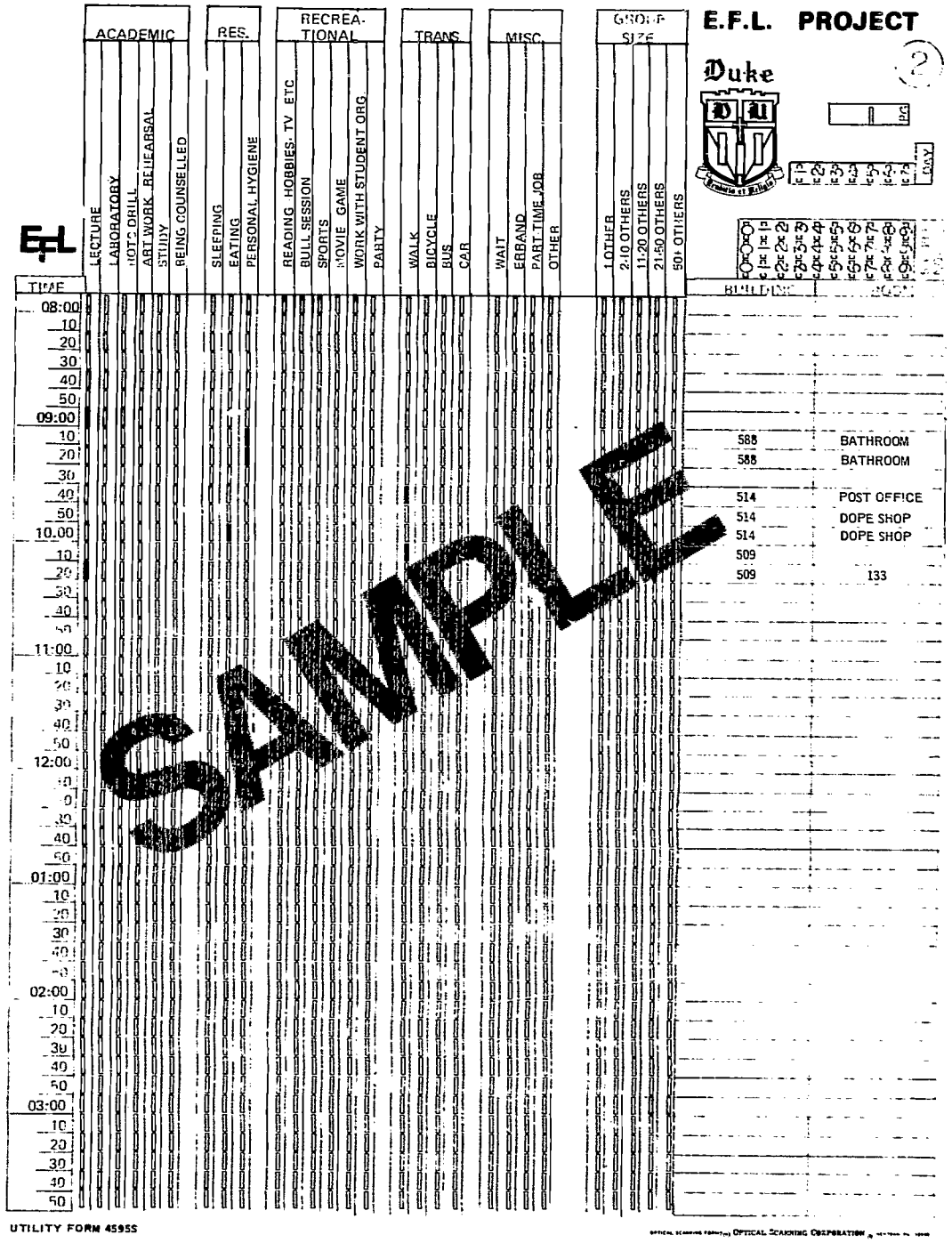
557	ACCELERATOR BUILDING	
520	ADVANCEMENT OFFICE	
522	ADMISSIONS OFFICE	
556	A.R.O.D.	
519	ALUMNI OFFICE	
553	ALLEN BUILDING	
* 574	ANIMAL BEHAVIOR STATION	
532	BAKER HOUSE	
546	BELL BUILDING	
558	BIOLOGICAL SCIENCES	
572	BIO. SCIENCE GREENHOUSES	
517	CARD GYMNASIUM	
506	CHEMISTRY BUILDING	
562	CLINICAL RESEARCH	
511	CRAVEN QUADRANGLE	
512	CROWELL QUADRANGLE	
561	D & T	
563	DEAN BALL'S HOUSE	
503	DIVINITY SCHOOL	
550	DR. HART'S RESIDENCE	
501	DUKE CHAPEL	
508	DUKE HOSPITAL	
518	DUKE STADIUM	
575	DUKE UNIVERSITY APARTMENTS	
547	ENGINEERING	
** 579	ERWIN ROAD RESIDENCE	
* 591	FACULTY CLUB	
542	FEW QUADRANGLE	
515	FLOWERS BUILDING	
* 590	FORESTRY BUILDING	
531	GARDEN GREENHOUSES	
504	GENERAL LIBRARY	
560	GERONTOLOGY	
576	G. C. CADDY HOUSE	
577	G. C. CLUB HOUSE	
* 578	G. C. TOOL HOUSE	
502	GRAY BUILDING	
552	GRADUATE CENTER	
545	HANES ANNEX	
551	HANES HOUSE	
536	HERRING HOUSE (E.J.P.)	
554	HEATING PLANT	
521	(RESIDENCE—PRIVATE)	
526	INTERNATIONAL HOUSE	
543	INDOOR STADIUM	
* 584	KENNEL FACILITIES	
513	KILGO QUADRANGLE	
505	LANGUAGE CENTER	
559	LAW BUILDING	
580	LAUNDRY BUILDING	
586	LANCASTER HOUSE	
544	MAINTENANCE WAREHOUSE & GARAGE	
563	MAIN ENTRANCE HOSPITAL	
586	MIRECOURT	
584	OFF CAMPUS — DURHAM	
585	OFF CAMPUS — CHAPEL HILL	
596	OFF CAMPUS — OTHER	
* 047	OLD DUKE HOMEPLACE	
583	ON CAMPUS — OTHER	
516	PAGE AUDITORIUM	
528	PERSONNEL OFFICE	
548	PHYSICS BUILDING	
571	PHYTOTRON	
548	RESEARCH LABORATORY	
507	SCHOOL OF MEDICINE	
509	SOCIOLOGY—PSYCHOLOGY	
510	SOCIAL SCIENCES	
585	TABARD HALL	
587	TAYLOR HALL	
582	TOWN HOUSE APARTMENTS	
514	UNION BUILDING	
* 582	UNIVERSITY HOUSE	
555	WANNAMAKER DORMITORY	
589	YORK HOUSE	

DUKE UNIVERSITY — EAST CAMPUS

017	ALSPAUGH DORMITORY
023	APARTMENT (FACULTY)
061	ART BUILDING
027	ASBURY BUILDING
003	AYCOCK DORMITORY
020	BASSETT DORMITORY
048	BELL TOWER
028	BIVINS BUILDING
021	BROWN DORMITORY
029	BRANSON BUILDING
011	CAMPUS CENTER
014	CARR BUILDING
008	DOPE SHOP
009	DUKE PRESS
001	EAST DUKE
005	EPWORTH INN
045	GARAGE
015	GILES DORMITORY
030	GILBERT—ADDOMS DORMITORY
054	HEATING PLANT
031	INFIRMARY
004	JARVIS DORMITORY
026	MEMORIAL GYMNASIUM
018	PEGRAM DORMITORY
053	PRE—FABRICATED APARTMENTS
024	SCIENCE BUILDING
025	SOUTHGATE DORMITORY
007	THE ARK
050	WAREHOUSE
002	WEST DUKE
016	WOMAN'S COLLEGE LIBRARY
019	WOMAN'S COLLEGE AUDITORIUM
022	WOMAN'S COLLEGE UNION

*NOT WITHIN MAP LIMITS
**BUILDINGS TOO NUMEROUS TO LOCATE ON MAP

UTILITY FORM 4593



Sample

DUKE UNIVERSITY — WEST CAMPUS

567	ACCELERATOR BUILDING	
520	ADVANCEMENT OFFICE	
522	ADMISSIONS OFFICE	
556	A.R.O.D.	
519	ALUMNI OFFICE	
563	ALLEN BUILDING	
* 574	ANIMAL BEHAVIOR STATION	
532	BAKER HOUSE	
546	BELL BUILDING	
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562	CLINICAL RESEARCH	
511	CRAVEN QUADRANGLE	
512	CROWELL QUADRANGLE	
561	D & T	
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505	LANGUAGE CENTER	
559	LAW BUILDING	
590	LAUNDRY BUILDING	
585	LANCASTER HOUSE	
544	MAINTENANCE WAREHOUSE & GARAGE	
563	MAIN ENTRANCE HOSPITAL	
586	MIRECOURT	
594	OFF CAMPUS — DURHAM	
595	OFF CAMPUS — CHAPEL HILL	
596	OFF CAMPUS — OTHER	
* 047	OLD DUKE HOMEPLACE	
593	ON CAMPUS — OTHER	
516	PAGE AUDITORIUM	
528	PERSONNEL OFFICE	
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571	PHYTOTRON	
548	RESEARCH LABORATORY	
507	SCHOOL OF MEDICINE	
509	SOCIOLOGY—PSYCHOLOGY	
510	SOCIAL SCIENCES	
586	TABARD HALL	
587	TAYLOR HALL	
592	TOWN HOUSE APARTMENTS	
514	UNION BUILDING	
* 582	UNIVERSITY HOUSE	
555	WANNAMAKER DORMITORY	
570	YORK HOUSE	

DUKE UNIVERSITY — EAST CAMPUS

017	ALSPAUGH DORMITORY
023	APARTMENT (FACULTY)
061	ART BUILDING
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003	AYCOCK DORMITORY
020	BASSETT DORMITORY
048	BELL TOWER
022	BIVINS BUILDING
021	BROWN DORMITORY
029	BRANSON BUILDING
011	CAMPUS CENTER
014	CARR BUILDING
006	DOPE SHOP
009	DUKE PRESS
001	EAST DUKE
005	EPWORTH INN
046	GARAGE
015	GILES DORMITORY
030	GILBERT—ADDOMS DORMITORY
064	HEATING PLANT
031	INFIRMARY
004	JARVIS DORMITORY
026	MEMORIAL GYMNASIUM
018	PEGRAM DORMITORY
063	PRE—FABRICATED APARTMENTS
024	SCIENCE BUILDING
025	SOUTHGATE DORMITORY
007	THE ARK
060	WAREHOUSE
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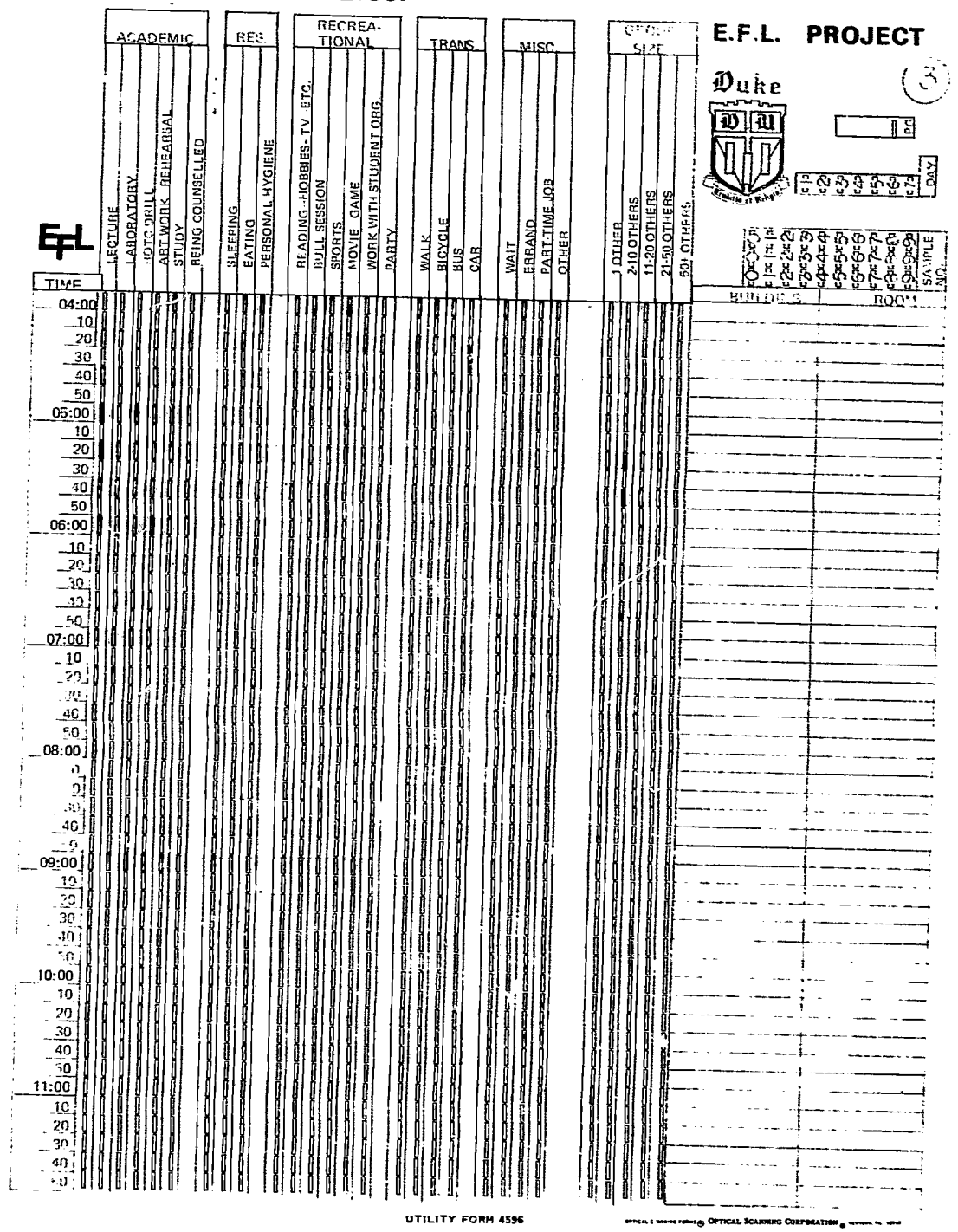
*NOT WITHIN MAP LIMITS
**BUILDINGS TOO NUMEROUS TO LOCATE ON MAP

UTILITY FORM 4593

Three sheets are necessary for each day of the Diary. The sheets are identical except for the times, 00:00 to 7:50, 8:00 to 3:50, 4:00 to 12:00.



UTILITY FORM 4596 © OPTICAL SCANNING CORPORATION

DUKE UNIVERSITY — WEST CAMPUS

567	ACCELERATOR BUILDING
530	ADVANCEMENT OFFICE
522	ADMISSIONS OFFICE
556	A.R.O.D.
519	ALUMNI OFFICE
553	ALLEN BUILDING
• 574	ANIMAL BEHAVIOR STATION
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547	ENGINEERING
•• 579	ERWIN ROAD RESIDENCE
• 581	FACULTY CLUB
542	FEW QUADRANGLE
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• 580	FORESTRY BUILDING
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DUKE UNIVERSITY — EAST CAMPUS

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048	BELL TOWER
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021	BROWN DORMITORY
029	BRANSON BUILDING
011	CAMPUS CENTER
C14	CARR BUILDING
006	DOPE SHOP
309	DUKE PRESS
001	EAST DUKE
005	EPWORTH INN
045	GARAGE
015	GILES DORMITORY
030	GILBERT—ADDOMS DORMITORY
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*NOT WITHIN MAP LIMITS
**BUILDINGS TOO NUMEROUS TO LOCATE ON MAP

UTILITY FORM 4593 © OPTICAL SCANNING CORPORATION

QUESTIONNAIRES
DESCRIPTION OF CODING PROCESS

A. Mark appropriate square with No. 2 pencil. As in the coding of place locations, mark your initials and the sample number in the top right-hand corner. Code the sample number in number in the appropriate box.

B. Question Number	Possible Codes
1. Sex	M= male (1 digit) F= female
2. Marital Status	married (1 digit) engaged pinned going steady unattached
3. Birthdate	year only (1 digit)
4. School Class	freshman (1 digit) sophomore junior senior graduate or professional
5. Intended Degree	none (1 digit) Associate (or equivalent) Bachelor's (BA, BS) Master's (MA, MS) Doctorate (Ph.D., Ed.D.) Other: 1. MD 2. MDiv 3. LL.B. 4. "don't know"
6. Major	01 accounting (2 digits) 02 anthropology 03 art 04 botany 05 business 06 classical studies 07 chemistry 08 economics 09 education 10 engineering 11 English 12 French 13 geology 14 German 15 health, PE 16 history 17 mathematics 18 music 19 nursing 20 philosophy 21 physics 22 political science 23 psychology 24 religion 25 Russian 26 sociology 27 Spanish 28 zoology 29 other — journalism 30 other — biology 31 other — medicine 32 other — interdisciplinary 33 other — architecture 99 undecided
7. Major Declared	No (1 digit) Yes
8. Probable Occupation	See Appendix A4 — Socio-economic Index (4 digits) Additional occupational codes used include 9996 housewife 9997 student 9998 don't know
9. Residential Status	dormitory (1 digit) fraternity or sorority house organized independent house other independent campus house parent(s)' home relative(s)' home (other than parent) own apartment or room
10. Father's Occupation	See Appendix A4 — Socio-economic Index (4 digits)
11. Parents' Education (2 columns) F = Father M = Mother	Under each column — (1 digit) some grade school completed grade school some high school completed high school some college completed college some graduate work completed graduate or professional degree
12. College Expenses, payment (6 columns) P = Personal Savings JD= Part-time job at Duke J = Part-time job elsewhere F = Parental or family aid L = Repayable loan S - Scholarship, grant, gift	Under each column: 0—25% 26—50% 51—75% 76—100%
13. Personal Objectives Importance (27 columns) a., b., c., . . . z., aa.	Under each column: none somewhat considerable highly
14. General Objectives (6 columns)	Two columns for each letter, coded as a two-digit number 01 = a. 15 = o. 02 = b. 16 = p. 03 = c. 17 = q. 04 = d. 18 = r. 05 = e. 19 = s. 06 = f. 20 = t. 07 = g. 21 = u. 08 = h. 22 = v. 09 = i. 23 = w. 10 = j. 24 = x. 11 = k. 25 = y. 12 = l. 26 = z. 13 = m. 27 = aa. 14 = n.
15. Duke offers most (6 columns)	
16. Duke offers least (6 columns)	
17. Organizational Membership (1—10 three-field groups)	001—999 (3 digits) Assigned in order of appearance to coder. *Note: When coding organizational membership — Codes are assigned to a certain organization according to the number on the top of a deck of IBM cards numbered from 001 to 999. After assigning a code number to an activity (the first time it appears) pencil the letter-section and the name of the specific activity on to the IBM card and remove it from the deck. Enter the new code number on the reference sheets. It will be used for that particular activity each time it occurs thereafter. Always check the reference sheets first before coding an activity, to avoid assigning two numbers to the same activity.
17a. Office	Y = Yes, student is an officer. (1 digit) N = No, student is a member only.
17b. Involvement	1 relatively inactive 2 3 4 highly active
18. Response	dull (1 digit) somewhat dull neutral some interest interesting

Appendix A2

INSTRUCTIONS FOR ANSWERING

"STUDENT INFORMATION QUESTIONNAIRE"

The Student Information Questionnaire includes 20 items which have been designed to provide some general information about the students who are participating in this survey.

Please answer every question to the best of your ability.

All of your answers will be kept in strictest confidence.

Except as noted for specific questions, simply place an X in the blank next to the answer which applies to you. *Please read each item carefully.*

STUDENT INFORMATION QUESTIONNAIRE

for 291 (sample number)

1 Sex: M____ F X

2 At present, are you
- married ____
- engaged ____
- pinned ____
- going steady ____
- unattached X

3 In what year were you born?
1948

4 What is your present class in school?
- freshman ____
- sophomore ____
- junior X
- senior ____
- graduate or professional ____

5 What is the highest academic degree that you intend to obtain?
- none ____
- Associate (or equivalent) ____
- Bachelor's (BA, BS) ____
- Master's (MA, MS) ____
- Doctorate (Ph. D Ed. D) ____
- other (please specify) MD

6 As of now, which is your most probable major field of study?
- accounting ____
- anthropology ____
- art ____
- botany ____
- business ____
- classical studies ____
- chemistry ____
- economics ____
- education ____
- engineering ____
- English ____
- French ____
- geology ____
- German ____
- health and P.E. ____
- history ____
- mathematics ____
- music ____
- nursing ____
- philosophy ____
- physics ____
- political science ____
- psychology ____
- religion ____
- Russian ____
- sociology ____
- Spanish ____
- zoology ____
- other (please specify) [illegible]

7 Have you formally declared your intention to major in the field indicated above?
Yes ____ No X

8 What occupation do you think it most probable that you will *actually* be engaged in 10 years from now? Please be as specific as you can.
doctor in large hospital

9 Which *one* of the following best describes your *current* residential status?
- live in a dormitory on campus X
- live in a fraternity or sorority house ____
- live in an organized independent house ____
- live in other independent campus house ____
- live with my parent(s) ____
- live with relative(s) [not parents] ____
- live in my own apartment or room ____

10 What is your father's primary occupation? [If he has held more than one job recently, specify the job at which he worked for the longest period in the last five years. If he is deceased, unemployed, or retired, please specify what his occupation was when he last worked. *Please be as specific as possible* — for example, sales manager, vice-president of a four-man insurance agency, skilled laborer, sales clerk in a paint department of a large department store, etc.]
officer US Navy

11 Please indicate the highest level of education completed by each of your parents:

	Father	Mother
some grade school	____	____
completed grade school	____	____
some high school	____	____
completed high school	____	____
some college	____	X
completed college	____	____
some graduate work	____	____
completed graduate or professional degree	X	____

12 Approximately what proportion of your *total* college expenses are met by:

	0-25%	26-50%	51-75%	76-100%
personal savings and/or summer job	____	X	____	____
part-time job during school at Duke	X	____	____	____
part-time job during school not at Duke	____	X	____	____
parental or other family aid	____	____	____	____
repayable loan	____	____	____	____
scholarship, grant, or other gift	____	____	____	____

13 On the following page there is a list of objectives which have been suggested as important for the college student. Please indicate how important each of these is to you *personally*.

13 continued

		DEGREE OF IMPORTANCE			
		None	Somewhat	Considerable	High
a.	Have a good time socially		X		
b.	Have one or more close male friends			X	
c.	Have one or more close female friends				X
d.	Fall in love and get married		X		
e.	Be accepted by fellow students and gain a sense of belonging			X	
f.	Develop intellectual skills				X
g.	Prepare for a career				X
h.	Develop my talent for dramatics, music, painting, or sculpture			X	
i.	Develop talent for writing	X			
j.	Develop leadership skills in extra-curricular activities for campus organizations	X			
k.	Develop ability in sports	X			
l.	Secure an undergraduate degree				X
m.	Evaluate my beliefs critically				X
n.	Maintain the highest possible grade average		X		
o.	Avoid the draft	X			
p.	Be widely known and very popular on campus	X			
q.	Live in attractive housing			X	
r.	Eat good food		X		
s.	Have privacy when I need it				X
t.	Become a more responsible citizen				X
u.	Meet people of diverse backgrounds			X	
v.	Develop religious understanding			X	
w.	Develop a mature approach to life				X
x.	Learn about issues of today and tomorrow		X		
y.	Be independent, on my own			X	
z.	Reflect on basic issues		X		
aa.	Enhance my chances for occupational success after college				X

14 Please read over the list of items on the previous page and circle the letters (below) corresponding to the *three* items which you consider *most important for college students in general.*

a b c d (e) f g h i j k (l) m n o p q

r s t u v w x (y) z aa

15 Please review the list again, this time circling the letters (below) corresponding to the *three* items which you think that *DUKE best facilitates.*

a b c d e (f) g h i j k (l) m n o p q

r s t u v w x y z (aa)

16 Finally, please go over the list once again, circling the letters which correspond to the *three* items you think *DUKE least facilitates.*

a b c d e f g h i j k l m n o (p) q

r (s) t u v (w) x y z aa

17 Please place an X next to each of the following extra-curricular organizations in which you are a member. Then place an X in the second column for any of these in which you *currently* hold an elective or appointive office. Finally, please indicate, by circling the appropriate number, the extent to which you are actively involved in the activities for each organization in which you claim membership.

ORGANIZATION (Please write in the names of the specific organizations in the blanks provided below.)	MEMBER	OFFICER	LEVEL OF ACTIVE INVOLVEMENT (Relative to other group members) Highly Active ... Relatively Inactive
a. Academic honoraries TIME	X		4 3 2 (1)
b. Athletics, varsity			4 3 2 1
c. Athletics, intramural			4 3 2 1
d. Bands and Orchestra			4 3 2 1
e. Choral groups			(4) 3 2 1
f. Dramatic groups Women's Glee Club	X	X	4 3 2 1
g. House officer (which house)			4 3 2 1
h. Judicial boards			4 (3) 2 1
i. Leadership honoraries Judi Rep		X	4 3 2 1

17 continued ORGANIZATION
(Please write in the names of the specific organizations in the blanks provided below.)

		MEMBER	OFFICER	LEVEL OF ACTIVE INVOLVEMENT (Relative to other group members) Highly Active		Relatively Inactive	
j.	Outing clubs (including sailing, etc.)			4	3	2	1
k.	Political groups (Demo., Rep., SDS, etc.)			4	3	2	1
l.	Professional societies			4	3	2	1
m.	Publications			4	3	2	1
n.	Radio			4	3	2	1
o.	Religious groups Episcopal center	X		4	3	2	1
p.	Social fraternity			4	3	2	1
q.	Social service (YMCA, YWCA, etc.)			4	3	2	1
r.	Student Government			4	3	2	1
s.	Student union			4	3	2	1
t.	OTHER			4	3	2	1

(If you are a member of more than one organization in any one category of organizations, continue on other page.)

17 continued ADDITIONAL ORGANIZATIONS

Place the letter corresponding to the organization category in the blank labelled *Organization Type Code* and then complete as you did on the preceding page.

ORGANIZATION TYPE CODE	ORGANIZATION NAME	MEMBER	OFFICER	LEVEL OF ACTIVE INVOLVEMENT (Relative to other group members) Highly Active		Relatively Inactive	
A	Ivy	X		4	3	2	(1)
E	chapel choir	X	X	(4)	3	2	1
				4	3	2	1
				4	3	2	1
				4	3	2	1
				4	3	2	1
				4	3	2	1
				4	3	2	1
				4	3	2	1
				4	3	2	1

18 Please check the response below which best characterizes your feelings with regard to participation in the study.

participation was highly interesting and enjoyable
participation was somewhat interesting and enjoyable
I feel relatively neutral about participation
participation was somewhat dull and unenjoyable
participation was very dull and unenjoyable X

19 If you consent to let us have your Quality Point Ratio and SAT Scores for this study, please sign on the line below. Your signature will authorize the registrar to give them to us. After signing, remove this strip from the booklet and send it to the registrar via inter-campus mail.

Signature

Appendix A3

Educational Facilities Laboratories Project
Computer Lab, AROD Building

Dear Professor_____

We would like to enlist your assistance in a pilot study designed to explore ways of improving university planning.

University building planners tend to base their decisions more on architectural aesthetics than on the space requirements of members of the academic community. One reason for this is that data on these requirements are seldom available in a useful form.

This office is currently conducting a study (funded by Educational Facilities Laboratories, a Ford Foundation subsidiary) of ways by which building design and location can be more effectively matched with student and faculty needs. One aspect of the study is the development of methods of collecting data on the use of existing buildings. We would like to request your assistance in this portion of the study.

You have been selected, as part of a sample of Duke faculty and staff to aid in this effort by answering a few questions regarding your activities. Attached is a copy of an "Activities Questionnaire", on which you are asked to indicate the amount of time you devote to various space-using activities. We would appreciate it if you would set aside a few minutes each day during the next week to provide us with these data. The entire task should take no more than fifteen minutes per day. The potential returns in terms of improved university planning may prove highly significant.

Very truly yours,

Walter J. Matherly
Principal Investigator

WJM/jv

Consulting Staff
John Blackburn, Associate Professor, Economics
Robert Chamberlin, Project Manager
Hamilton Hoyler, Coordinator, Institutional Data Processing
Robert Mattox, Architect and Planner, Caudill Rowlett Scott
Richard Willard, Consultant, New England Educational Data Systems
Cliff Wing, Director of Student Resources

ACTIVITIES QUESTIONNAIRE — FACILITIES USE ITEMS

The following items relate to your daily use of several different types of university facilities. We would appreciate it if you would set aside a few minutes each day to respond to these items — describing the day's usage pattern.

1. What proportion of your time on campus did you spend in each of the following campus locations? Please check to be sure that each day's entries total to 100%.

CAMPUS LOCATION	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Please do not write in this colume.
Your "primary" office (1)	____	____	____	____	____	____	____	_____
Other office assigned to you (2)	____	____	____	____	____	____	____	_____
Other office assigned to you (3)	____	____	____	____	____	____	____	_____
Lecture or large classroom(s)	____	____	____	____	____	____	____	_____
Seminar of conference room(s)	____	____	____	____	____	____	____	_____
"Teaching" laboratory facilities	____	____	____	____	____	____	____	_____
Shared laboratory facilities	____	____	____	____	____	____	____	_____
Your own laboratory	____	____	____	____	____	____	____	_____
The university library	____	____	____	____	____	____	____	_____
A departmental library	____	____	____	____	____	____	____	_____
A departmental lounge area	____	____	____	____	____	____	____	_____
A university lounge area	____	____	____	____	____	____	____	_____
A university cafeteria or dining room facility	____	____	____	____	____	____	____	_____
A gymnasium or athletic facility	____	____	____	____	____	____	____	_____
Other university facilities	____	____	____	____	____	____	____	_____
TOTAL TIME SPENT ON CAMPUS, %=	100	100	100	100	100	100	100	_____
2. How many hours do each of the above daily totals represent?	____	____	____	____	____	____	____	_____

3. On the following page the above list of campus locations is repeated. Please indicate, in the spaces provided, the specific building and room numbers to which you referred in answering question number one, above. All university owned buildings are listed alphabetically, by name, with their associated numbers on the back of this page — for your convenience.

DUKE UNIVERSITY BUILDINGS
(Codes and Building Names)

Code	Building Name
556	AROD—Computer Laboratory
522	Administration Office — Faculty Housing No. 4
520	Advancement Office
553	Allen Building
519	Alumni Office
574	Animal Behavior Station
023	Apartment (Faculty)
051	Art
532	Baker House
546	Bell Building
558	Biological Sciences
572	Biological Sciences Greenhouse
517	Card Gym
014	Carr
501	Chapel
506	Chemistry
562	Clinical Research
561	D & T No. 3
583	Dean Ball's House
503	Divinity
550	Dr. Hart's Residence
531	Duke Garden Greenhouses
009	Duke Press (Faculty Club)
518	Duke Stadium
536	Educational Improvement Program
001	East Duke
547	Engineering
591	Faculty Club — Teer House
515	Flowers
011	Flowers Residence (Campus Center)
590	Forestry School
504	General Library
560	Gerontology
502	Gray
508	Hospital
543	Indoor Stadium
505	Language
559	Law Building
563	Main Entrance Building
507	Medical School
026	Memorial Gymnasium
516	Page
528	Personnel Office
549	Physics
571	Phytotron
548	Research Laboratory
024	Science Building
509	Sociology — Psychology
510	Social Science
582	University House
557	Van De Graff Building
514	West Campus Student Union
002	West Duke
019	Women's College Auditorium
016	Women's College Library No. 2
593	On Campus — Other

[Question 3, continued]

CAMPUS LOCATION	BUILDING NUMBER	ROOM NUMBER(S)*
Your "primary" office (1)		
Other office assigned to you (2)		
Other office assigned to you (3)		
Lecture or large classroom(s)		
Seminar or conference room(s)		
"Teaching" laboratory facilities		
Shared laboratory facilities		
Your own laboratory		
Libraries (main building or branches)		
A departmental lounge area		
A university lounge area		
A university cafeteria or dining room facility		
A gymnasium or athletic facility		
Other university facilities		

*If several locations are included in one category, please list the one you use most first, the one you use next most second, etc. In the event that a room number is unknown to you, please enter the common campus designation, e.g., "dope shop", "graduate reading room", "Gothic book shop", "sauna", etc.

DEFINITIONS OF ACTIVITIES

Teaching-Research: Research activity engaging one or more apprentice researchers for

DEFINITIONS OF ACTIVITIES

Teaching-Research: Research activity engaging one or more apprentice researchers for whom this research involvement is part of their formal educational program and for whom the principal investigator is "research administrator" and preceptor.

Teaching: Instruction of students in formal courses and supervised study. (Including preparation).

Research: Methodical study and activity conducted to augment and develop knowledge in any field.

Art and Scholarship: The personal production of works of art (paintings, ceramics, poems, plays, novels, symphonies); the direction and presentation of plays, concerts, and other performances; creative designing in architecture, tapestries, and the like.

Teaching through Art and Scholarship: Creative activity engaging one or more apprentices for whom this involvement is part of their formal educational program and for whom the principal artist or scholar is director, manager, and preceptor.

Public Service: Activities primarily intended as services to the community, the state, and the public of this and other countries (exclusive of all activities reported in the five preceding categories). Or: all activities in which your academic and professional competence is made available to the general public or to special groups.

Administration: The coordination and direction of others in regard to the formulation of policy, decision-making and its implementation.

Formal Personal Education: Activities relating to courses, workshops and practice in which one engages as a student, and one's own thesis or dissertation research and writing. (This includes all attendance at class, even though no degree is sought.)

Intra-university Activities: Other activities by which one makes one's skills and resources available to other persons or organizations within the university for university purposes (exclusive of activities reported under all preceding categories).

Other Extra-university (excluding Public Service): Include all activities directed to persons, agencies, and other organizations outside the university which are not primarily Public Service activities, i.e., consultation.

ACTIVITIES QUESTIONNAIRE — GENERAL ITEMS

We would appreciate it if you would provide us with all of the supplementary information requested below. Answers to many of these items may be a part of your vita — in which case you may wish to attach a copy in lieu of responding to those items which are covered therein.

1. Age _____

2. Highest degree _____ Date received _____

3. With what discipline do you identify yourself? _____

4. What is your area of specialization? _____

5. Do you engage in professional activities jointly with persons from other disciplines?
   Yes_____ No_____ If yes, with people from what disciplines? _____
   _____

6. Would you like to engage in more interdisciplinary professional activities? Yes_____
   No_____ If yes, with people from what disciplines? _____
   _____

7. Would you characterize your interdisciplinary activities as: [Place "7" in the appropriate blanks.]

	Primarily	Occasionally	Seldom
Teaching Research	_____	_____	_____
Teaching	_____	_____	_____
Research	_____	_____	_____
Art and Scholarship	_____	_____	_____
Teaching Thru Art and Scholarship	_____	_____	_____
Public Service	_____	_____	_____
Administration	_____	_____	_____
Formal Personal Education	_____	_____	_____
Intra-University	_____	_____	_____
Other Extra-University	_____	_____	_____

8. Please return to the previous question and place "8" in the blanks which are appropriate to indicate the way in which you would characterize your desired pattern of interdisciplinary activity involvement.

9. What proportion of your professional activities do you undertake in each of the following locations? (Circle percentages for each, totaling 100%.)

On campus											
In your office(s)	0	10	20	30	40	50	60	70	80	90	100
At the library	0	10	20	30	40	50	60	70	80	90	100
In departmental laboratory	0	10	20	30	40	50	60	70	80	90	100
In other campus locations	0	10	20	30	40	50	60	70	80	90	100
Off campus											
At your home	0	10	20	30	40	50	60	70	80	90	100
At another college or university	0	10	20	30	40	50	60	70	80	90	100
In other off-campus locations	0	10	20	30	40	50	60	70	80	90	100

10. In your opinion, are the facilities provided by Duke for your use in professional activities
    Fully Adequate _____
    Reasonably Adequate _____
    Somewhat Inadequate _____
    Definitely Inadequate _____

11. In your opinion, how might Duke better provide facilities for your professional requirements?

12. In your opinion, are the facilities provided by Duke for your personal requirements
    Fully Adequate _____
    Reasonably Adequate _____
    Somewhat Inadequate _____
    Definitely Inadequate _____

13. In your opinion, how might Duke better provide for your personal facilities requirements?

Appendix A4

SOCIOECONOMIC INDEX FOR OCCUPATIONS IN THE DETAILED CLASSIFICATION OF THE BUREAU OF THE CENSUS: 1950

Occupations, by Major Occupation Group	Socio-economic Index	Transform to NORC Scale	Population Decile Scale
Professional, technical, and kindred workers			
Accountants and auditors	78	80	10 a
Actors and actresses	60	74	9
Airplane pilots and navigators	79	81	10
Architects	90	86	10
Artists and art teachers	67	76	10
Athletes	52	71	9
Authors	76	80	10
Chemists	79	81	10
Chiropractors	75	79	10
Clergymen	52	71	9
College presidents, professors, and instructors (n.e.c.)	84	83	10
Dancers and dancing teachers	45	69	8
Dentists	96	93	10