

SYSTEM 2000 - DATA MANAGEMENT FOR  
TRANSPORTATION IMPACT STUDIES

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INTRODUCTION

During the first year of work conducted by the Council for Advanced Transportation Studies (CATS) on Topic II, "The Environmental Impact of Interurban Transportation Systems on Rural Communities," it became apparent that large quantities of data would be collected. Part of the research required measuring and evaluating the transportation impact on an entire community, Sealy, Texas, for a 20-year period, from 1950 to 1970. The major task was to create descriptive models of changes during that period within the community and the transportation system, a task which has involved collecting and managing an extensive data base. Specifically, two large data sets were compiled. The first contained economic data, the second, an inventory of land sales compiled from title policies written for individual sales. This latter set contains over 20,000 pieces of data, including information covering 600 sales of parcels with 35 variables for each.

The first problems encountered entailed the storing and updating of these large data sets and the manipulation of the completed data sets at a reasonable cost in manpower and computer time. The information had to be accessible for multiple regression analysis and various other statistical analyses. A system was needed that was simple enough that persons with little experience could use the system and acquire results with a minimum outlay of effort. Thus the system had to be convenient and yet remain flexible enough to meet the requirements of different kinds of data.

STUDY ENVIRONMENT

The Computation Center at The University of Texas at Austin campus provides computing services for both students and researchers. The Computation Center is equipped with a Control Data Corporation (CDC) Model 6600 computer system, which was purchased and installed in 1966, and a CDC model 6400 computer,

which was purchased and installed in 1971.<sup>1</sup> The system (UT2D) is one of the most extensive academic computing systems in the United States. UT2D runs 24 hours a day, 7 days a week. High-speed card readers and paper printers are situated at 16 strategic locations on campus, three of which are in the engineering building complex. A timesharing system is provided through the Bell telephone system, allowing 128 users simultaneous connection to the central computer via keyboard terminals, teletypewriters, or similar apparatus. At the keyboard terminal, the user can write programs and run them in a conversational or interactive mode. The UT2D system includes permanent files which allow the user to reference data, programs, and binary decks without reconstructing a file each time he references it in successive jobs.

Not only does UT Austin have exceptional computer hardware, but it has an equally exceptional set of software programs easily accessible, including SPSS (Statistical Package for the Social Sciences); AID (Automatic Interaction Detection), an interactive, one-way AOV routine; and STEP01, a stepwise multiple regression analysis package. Most file editing is handled by EDIT, an interactive program for use from remote terminals. SYSTEM 2000 (S2K), which is the system ultimately chosen for this study, is the on-line, in-house data management system marketed by MRI Systems Corporation. Also available is OMNITAB, an interpretive computing system developed and maintained by the National Bureau of Standards.

#### IMPACT RESEARCH AND INDICATORS

Transportation impact studies are undertaken to measure the environmental effects caused by changes in transportation systems. Impact studies have evolved through various forms to their present state. The earliest and simplest form of impact study is the before-and-after study. Measurements of economic activity, land value, land use, etc., are taken, usually covering a period of 2 to 5 years before the project construction begins. Then another set of measures is taken 2 to 5 years after the project's completion and the two periods are compared. The difference is attributed to the transportation change.

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<sup>1</sup>University of Texas Computation Center. "User's Manual," Computation Center, The University of Texas at Austin, September 1972.

The major problem with this technique is that the total difference is probably not attributable to the change in transportation alone. For example, a factory in town may have closed for reasons unrelated to the transportation system. The backwash of this event would affect the whole community.

To separate the highway impact and nonhighway impact effects on a community, a survey-control area study method was developed. In this method, an area, designated the survey area, is chosen such that all of the area affected by the transportation change can be monitored. Then, a control area is designated outside of the area where the change in transportation took place. The control area's physical, social, and economic characteristics in the period before must be as similar as possible to those of the survey area. The difference in the survey area minus the difference in the control area is considered the effect of the transportation change. The problem with this method is that an adequate "control" area is almost impossible to find.

Another approach, the case study method, may employ the above techniques or other modes of analysis applied to a single set of indicators, such as the change in number of employees and business volume, etc., in a manufacturing concern. However, again it is difficult to isolate the influence of the change in transportation facilities. For example, the local, regional, and even national economies, as well as the policy decisions of an industry's executives, can have an effect on employment.

There are other forms of highway impact research, usually involving projected trends which are then compared with the actual situation after the change. These depend upon strongly subjective assumptions.

One tool used in several of these impact study techniques is that of multiple regression analysis. The data must be in quantitative form in order to be processed through a computer analysis to derive a best-fit equation. This tool enables the researcher to perceive the relative magnitude of various indicators in relation to other indicators. Multiple regression analysis is especially helpful in modeling the complex situations which impacts usually create.

The methodology chosen was to study a single community, Sealy, Texas, continuously over a long term period. An attempt was made to assess all forms of impact, both direct and indirect. The broad areas included both economic

and social pattern changes. The bias which is apparent in most impact research is eliminated in this study due to the longitudinal time base involved and the detail of the analysis.

Aside from methodology, problems have arisen because the available data sources are different in every location where an impact study has been undertaken. Therefore, in this project, an attempt was made to use data sources which would be readily available in most areas. In the detailed investigation of Sealy, Texas, the following indicators have been studied:

- (1) number of businesses opening, number of businesses closing (by category),
- (2) changes in bank deposits (by category),
- (3) changes in employment,
- (4) land use and value changes,
- (5) changes in travel patterns,
- (6) community social structure change, and
- (7) cognitive perception of transportation change.

Data management problems were encountered primarily in connection with the first four indicators. Changes in the community social structure were to be studied qualitatively. Data on travel patterns and on people's perception of change were to be used in developing a cognitive model which required special arraying of data, but posed no data management problems. The first four indicators were all easily quantifiable, but the study required that large data sets be created which could be frequently updated and could be output in a variety of forms.

#### ALTERNATIVES

An effective and efficient system had to be found to handle the data sets which the study required. The only three alternatives found that came near meeting the project's needs were a manual card file system, SYSTEM 2000, or the development of other computer programs.

A manual card file system would entail large amounts of bookkeeping. The information would be kept in ledger books, and when a data set might be needed, the appropriate pieces of data would have to be transferred to code sheets and from these punched onto data cards. Only then could the completed deck be analyzed with a statistical package or could other operations with the data be performed.

The second alternative, the use of SYSTEM 2000 (S2K), would involve an

initial loading of all data into the system, but then any data modifications could be made with S2K's wide range of update capabilities. The completed file set that S2K would create would be stored on permanent files so that after loading there would be no need for punching cards. Output format could be greatly varied.

The third alternative for data management would require the project to write its own program on the UT2D system. This program would be set up to handle the data and to give output in a variety of forms. Again all data would be on card image records on a permanent file in the UT2D system.

#### CHOICE

All three proposals were studied. The manual system was soon rejected. The project lacked the personnel to carry out all of the necessary bookkeeping. At the same time, this system would create greater chance of error because of overlooked or miscopied data. The final reason for rejecting the manual system was that, given the available computer capabilities, we could save time and manpower by choosing one of the other alternatives.

A project-developed program had its advantages in that it would take less time to get results than the manual system; such a program could handle large data sets, output could be varied, and EDIT could be used for data update. However, this approach would have its own disadvantages. Time is needed to write and debug such a program, time which the project did not have. A second disadvantage was that whenever the data specifications changed, the program would need to be rewritten and debugged.

SYSTEM 2000 (S2K) was chosen. It is on-line in-house and can be accessed either by punched card input or remote terminal input. S2K is quick and powerful. The maximum data size is limited only by the available file storage size. The decision was made that all data management work for the study would be handled by S2K in a remote terminal mode. This would provide convenience, since the data base could be called up and data extracted, edited, analyzed, and transferred to a hardprinter, all from a remote terminal. All of this could be accomplished in less than an hour. The system thus would allow near instant turnaround from idea to output.

In addition to convenience, S2K offers versatility and ease of access. S2K data bases consist of three separate but highly integrated

parts: the definition, the logical entries, and the two sets of pointers. One set of pointers describes the interrelationships of the data values, and the other, the inverted index, indicates locations of data values. The reason for S2K's economic feasibility is that the major part of data base qualification takes place within these two sets of pointers before any data values are accessed. Time is not required for a search of each piece of data. Since S2K uses pointer-directed, data set-qualification techniques, complex access criteria can be stated and processed very quickly.

The data base is defined using S2K's "Define Module." The user names the elements of the data base in language appropriate for the application and defines each element's relationship to that of other elements. Different types of data may be stored in an S2K-maintained data base. Name data are any alphanumeric data with all extraneous blanks edited out. Text data are data with all blanks retained. The last four data types are self-explanatory: Integer, Decimal, Date and Money.

Loading values into the data base is a simple process. After a data structure has been defined, the values are laid out in a value string, with element numbers associated with each value. No special coding is required, nor is it necessary to perform a preliminary sorting of the data before loading. S2K scores the data, performs error checking, and creates the data and tree structure tables. Data manipulation may begin immediately.

The permanent file system of UT2D was used to complement SYSTEM 2000. Magnetic tape permanent files were brought on line to retrieve the stored data base or to save a new data base. Punching of data cards was therefore unnecessary, saving the cost of cards and punchers. These permanent files were also used in other areas of the project for storage of programs and data.

#### CONSTRUCTING AND EDITING OF THE DATA BASE

ECON was the first data set created. It was built for a sub-topic of the project's research.

This study has a three-fold purpose:

- (1) identify the available sources of economic data in small communities,
- (2) determine whether the initial set of available data is suitable for the study of transportation impact, and

- (3) develop an appropriate methodology for modeling of economic impact in rural areas,

S2K's flexibility was highly valuable for handling such a broad study. A data base definition was used which would allow the storage of many types of data. The name of each economic activity in Sealy was stored along with a corresponding unique number. All appropriate Standard Industrial Classification codes were input for each business. Coordinates for each business location and years of operation were added. Employee and monetary data for each year were stored. The monetary data might be sales, assessed tax valuation, or other relevant information. The data base definition is shown in Figure A, p. 8.

The features of the data base definition in S2K allow for efficient use of storage. The KEY/NON-KEY designation allows the user to determine how one data element will be related to other data elements. The NON-KEY designation is used with elements which will not be specified as access criteria. Since these elements will not have inverted files created for them, storage space is reduced. The other feature which saves on storage is the use of repeating groups (RG's). Repeating groups allow for multiple occurrences of data set information. A repeating group acts like an inverted tree where all lower levels are accessible from all upper levels. There may be any number of branches to the tree, and where no branches are needed, none are created. For example, an element in a data base might be "Names of Children"; one man has five children, three men have one child each, and eight men have no children. In most programs, the definition would have to account for the case of the largest number of children. For the 12 men, 60 spaces would be made available, though only 8 would be used. The repeating group designation eliminates wasted storage because spaces are not set aside unless data are input. Repeating groups are most helpful when there is great variability in the amount of data to be stored for each data point.

A data set had been built for use in MAPRINT.<sup>2</sup> Business name, location, and years of operation for each business had been taken from the past telephone books of Sealy. These data, using EDIT, were written into a format appropriate

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<sup>2</sup>Graham C. Hunter, Richard Dodge, and C. Michael Walton, "MAPRINT: Computer Program for Analyzing Changing Locations of Non-Residential Activities." Research Memo 11, Council for Advanced Transportation Studies, University of Texas at Austin, March 1974.



Figure A

ECON DATA BASE DEFINITION

- 1 \* UNIQUE NUMBER
- 2 \* NAME (NK)
- 3 \* PRODUCT OR ACTIVITY CODE (RG):
  - 31 \* PRIMARY SIC
  - 32 \* OTHER SIC
- 4 \* ORGANIZATION TYPE
- 5 \* YEARS OF OPERATION (RG):
  - 51 \* BEGINNING YEAR
  - 52 \* LAST YEAR
- 6 \* LOCATION DATA (RG):
  - 61 \* LAST ADDRESS (NK)
  - 62 \* X-COORDINATE
  - 63 \* Y-COORDINATE
  - 64 \* NUMBER OF LOCATIONS SINCE 1950
  - 65 \* PREVIOUS LOCATIONS (RG IN 6):
    - 650 \* YEAR BEGIN FIRST LOCATION
    - 651 \* FIRST X-COORDINATE
    - 652 \* FIRST Y-COORDINATE
- 7 \* EMPLOYMENT DATA (RG):
  - 75 \* NUMBER OF EMPLOYEES IN YEAR
- 8 \* SALES DATA (RG):
  - 85 \* SALES AMOUNT IN YEAR

for building of the ECON data base. After ECON was created it was found that a new coordinate system was needed due to the inadequacies of the MAPRINT system. The MAPRINT coordinate system covered only the areas within the city, yet some businesses and transactions were outside the city limits. The necessary adjustments were in the form

$$X_{\text{new}} = C_1 X_{\text{old}} + C_2$$

$$Y_{\text{new}} = C_3 Y_{\text{old}} + C_4$$

The constants ( $C_1, C_2, C_3, C_4$ ) were found by choosing points under the old system and finding the points in the new system. An algebraic equation was solved finding the constants. All of the X coordinates were changed using the command

CHANGE C62 = ( $C_1$ ) \* C62 + ( $C_2$ ) WHERE C62 EXISTS:

Y coordinates were similarly changed using C63 rather than C62.

Employment information was available from primary sources. As each piece of employment data was collected, it was added to the data base. Over 600 update operations were carried out on ECON with no trouble.

Output from S2K for ECON is in two forms. Employment data is output in lists of business activities by unique number and number of employees. These lists contain each year's data, further broken down by the activity of the business as defined by the SIC code at the second digit level. For the study of the spatial distribution of the business activity, the businesses are mapped using lists of coordinates from S2K. These lists are input into MAPRINT and the information plotted for study.

## LANDSALE

LANDSALE data base was used for the study "Land Value Modeling in Rural Communities," by Lidvard Skorpa, Michael Walton, and Richard Dodge. The ultimate goal of this study was to evaluate a descriptive model for land values in a given community with specific characteristics and served by a specific transportation system. The land value model from this case study can possibly be refined and expanded to a general descriptive model. The descriptive model in this case study phase was given the form of a function. The dependent variable was the land sale price, and the independent variables

were the different community and transportation related factors which might influence land value; use, location, access, and so on. Data for ten different variables were collected for each of over 600 land sales in Sealy in the period from 1950 to 1970. These included

- (1) parcel sale date,
- (2) size of the parcel,
- (3) improved or unimproved parcel,
- (4) parcel land use before the sale,
- (5) parcel land use after the sale,
- (6) site quality,
- (7) CBD accessibility,
- (8) bus and train accessibility
- (9) highway accessibility, and
- (10) neighborhood quality.

Four more variables were created and stored using combinations of the above. Variables dependent on time, including population, transportation system quality, connectivity to highway, and traffic volumes, were input by half years. (Transgenerated variables were formed by combining the original variables.) The original data base was created before the problem had been completely defined. Since these new variables did not have a storage slot, a new definition was written taking into account all anticipated data needs. The data were unloaded from the original definition using the UNLOAD command and immediately reloaded into another data base definition which better matched the necessary qualifications.

The output from LANDSALE was in the form of list output. Data for a particular transaction were placed in a card image upon a file which was then stored. The files were later transferred to the local file for statistical analysis by STEP01 and AID. The major advantage of this system was that the data file could be created using any set of qualifications. Files were created based on whether the lot was improved or unimproved at the time of the sale. Descriptive models were then created for each data set. Later data files were created using "Land Use Before" as the qualifying variable. Using the X and Y coordinates as qualifiers, specific geographical regions could be isolated and analyzed. These data files were also used in our locational analysis by serving as input for mapping.

## S2K USE<sup>3,4</sup>

All of the data management for CATS Topic II using SYSTEM 2000 (S2K) was accomplished in an interactive mode from remote terminals. Use of the constructed data base is very simple. Only 3 control cards are needed to access the data base. For a data base Z stored on permanent file 1234 under the file name Y the following control cards are needed:

```
READPF, 1234, Y
S2KRS, DR, Y
S2K, CMR = TTY, D = TTY
```

The user is now S2K. All commands in S2K are followed by a colon (:). If S2K accepts the line input, it will answer by 3 dashes (\_\_\_). If data base Z has a password of X, then data base Z can be brought up with the commands

```
U S E R, X:
DATA BASE NAME IS Z:
```

If the Data Base is brought up, S2K will return with "ASSIGNED Z" followed by the definition version number, data version number, date created, and time created. Following this, work with S2K on Z may be accomplished. To leave S2K requires only the command, "EXIT:".

To get a listing of the data base definition requires the command, "DESCRIBE:". An example of this is the definition of the data base named LANDSALE in Figure B, p. 12.

A complex data management system is of little utility without adequate output capabilities. There are three basic output commands in S2K, PRINT, LIST, and TALLY. The first two are general output commands. TALLY provides a means of obtaining statistical information about the unique values of elements stored in the data base. A TALLY for C7, ZONE, is shown in Figure C, p. 13. The purpose of the PRINT command is to retrieve data from the data base as specified in the "WHERE" clause and to output the data in a simple sequential list.

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<sup>3</sup>MRI Corporation, "SYSTEM 2000, Reference Manual," MRI Corporation, Austin, Texas, 1973.

<sup>4</sup>UT Computation Center, "A Supplemental Guide to SYSTEM 2000 at UT Austin," TPB 143 UT Computation Center, Austin, Texas, July 1973.

---  
DESCRIBE  
---

SYSTEM RELEASE NUMBER 2.2288  
DATA BASE NAME IS SEALYSALE  
DEFINITION NUMBER 1  
DATA BASE CYCLE 99

- 1♦ TIMEONE (INTEGER NUMBER 999)
- 2♦ TIMETWO (INTEGER NUMBER 999)
- 3♦ UNIQUE NUMBER (INTEGER NUMBER 999)
- 4♦ X-COORDINATE (INTEGER NUMBER 9999)
- 5♦ Y-COORDINATE (INTEGER NUMBER 9999)
- 6♦ FRONT STREET (NAME X(122))
- 7♦ ZONE (INTEGER NUMBER 9)
- 8♦ UNIT MARKET VALUE (INTEGER NUMBER 9(6))
- 9♦ TIME (DECIMAL NUMBER 99.9)
- 10♦ SIZE (DECIMAL NUMBER 999.99)
- 11♦ IMPROVEMENT (INTEGER NUMBER 9)
- 12♦ PREVIOUS LAND USE (INTEGER NUMBER 9)
- 13♦ POST SALE LAND (INTEGER NUMBER 9)
- 14♦ SITE QUALITY (INTEGER NUMBER 9)
- 15♦ DISTANCE TO CBD (DECIMAL NUMBER 99.99)
- 16♦ STREET ADJUSTMENT FACTOR (NON-KEY DECIMAL NUMBER 9.9)
- 17♦ BUS DEPOT DISTANCE (NON-KEY DECIMAL NUMBER 99.99)
- 18♦ RAILWAY STATION DISTANCE (NON-KEY DECIMAL NUMBER 99.99)
- 19♦ CBD ACCESS (DECIMAL NUMBER 99.99)
- 20♦ RT ACCESS (DECIMAL NUMBER 99.99)
- 21♦ DIST TO HWY (DECIMAL NUMBER 99.99)
- 22♦ INTERCHANGE TYPE (NON-KEY INTEGER NUMBER 9)
- 23♦ PARCEL LOCATION FACTOR (INTEGER NUMBER 9)
- 24♦ HIGHWAY ACCESS (DECIMAL NUMBER 99.99)
- 25♦ ONEDUM (NON-KEY DECIMAL NUMBER 99.99)
- 26♦ NEIGHBORHOOD QUALITY (DECIMAL NUMBER 99.99)
- 27♦ TIMETHREE (DECIMAL NUMBER 99.9)
- 28♦ TIMEFOUR (DECIMAL NUMBER 99.9)
- 29♦ QUALITY OF INTERURBAN HWY (NON-KEY INTEGER NUMBER 9999)
- 30♦ USE OF INTERURBAN HWY (NON-KEY INTEGER NUMBER 9(5))
- 31♦ RAIL SERVICE (NON-KEY INTEGER NUMBER 99)
- 32♦ LOCAL TRAFFIC COND (NON-KEY INTEGER NUMBER 99)
- 33♦ CONNECTION TO HWY (NON-KEY INTEGER NUMBER 99)
- 34♦ SMSA CONNECTION (NON-KEY INTEGER NUMBER 99)
- 35♦ POPULATION GROWTH RATE (NON-KEY INTEGER NUMBER 999)
- 36♦ TWODUM (NON-KEY DECIMAL NUMBER 99.9)
- 37♦ THREEDUM (NON-KEY DECIMAL NUMBER 99.9)

Figure B

LANDSALE "DESCRIBE" COMMAND

*****	
ELEMENT-	ZONE
*****	
FREQUENCY	VALUE
-----	
78	1
148	2
50	3
49	4
113	5
76	6
57	7
40	8
-----	
8	UNIQUE VALUES
-----	
611	OCCURRENCES
-----	
---	

Figure C

TALLY FOR C7 ZONE

The general format for a print statement is

PRINT (print clause) (ordering clause) WHERE (conditions exist),  
(print clause) - what is to be printed,  
(ordering clause) - order to be printed,  
(conditions clause) - qualifications for data to be printed.

An example is shown in Figure D, p. 15. The purpose of the LIST command is to provide the user with a means of displaying output data in a columnar format with optional page headings and footings. The majority of the project's output was printed using this command.

The general format for the LIST command is

LIST/TITLE (title specifications) / (ordering clause) WHERE  
(conditions exist)  
(list clause) - what is to be output,  
(ordering clause) - the order of the data to be output,  
(conditions exist) - qualifications to be met to be output.

Headings and column titles are inserted using the title specifications of the list format. Arithmetic statistics about the data values contained in the data base are obtainable from the system functions. Capabilities include minimums, maximums, sums, averages, and standard deviations.

All output commands are tempered by the qualification clause, the WHERE statement. The WHERE statement follows the format

WHERE (conditions exist):,  
(conditions exist) any number of legal WHERE clause conditions  
Legal conditions may be of four types

- (1) unary operator
- (2) binary operator
- (3) ternary operator
- (4) normalized

Combinations of these statements are made using the Boolean Operators AND, OR, NOT. Complex qualifications are available through judicious use of the WHERE clause.

Update in S2K may be performed from the remote terminal. The update commands are few in number, unique in purpose, and contain great power. The

PRINT C3,C7,C8,C9,DB C3 WHERE C3 LT 10:

UNIQUE NUMBER\* 1  
ZONE\* 3  
UNIT MARKET VALUE\* 31297  
TIME\* 55.0  
UNIQUE NUMBER\* 2  
ZONE\* 1  
UNIT MARKET VALUE\* 4323  
TIME\* 56.5  
UNIQUE NUMBER\* 3  
ZONE\* 1  
UNIT MARKET VALUE\* 24949  
TIME\* 56.5  
UNIQUE NUMBER\* 4  
ZONE\* 2  
UNIT MARKET VALUE\* 12107  
TIME\* 59.0  
UNIQUE NUMBER\* 5  
ZONE\* 2  
UNIT MARKET VALUE\* 10495  
TIME\* 60.0  
UNIQUE NUMBER\* 6  
ZONE\* 3  
UNIT MARKET VALUE\* 28956  
TIME\* 60.5  
UNIQUE NUMBER\* 7  
ZONE\* 3  
UNIT MARKET VALUE\* 37657  
TIME\* 60.5  
UNIQUE NUMBER\* 8  
ZONE\* 3  
UNIT MARKET VALUE\* 68467  
TIME\* 60.5  
UNIQUE NUMBER\* 9  
ZONE\* 1  
UNIT MARKET VALUE\* 10728  
TIME\* 60.5

---  
LIST/TITLE R10..(1),R(1),R(6),R(5) / C3,C7,C8,C9,DB C3 WHERE C3 LT 10:

\*\*\*  
1 3 31297 55.0  
2 1 4323 56.5  
3 1 24949 56.5  
4 2 12107 59.0  
5 2 10495 60.0  
6 3 28956 60.5  
7 3 37657 60.5  
8 3 68467 60.5  
9 1 10728 60.5  
---

LIST/TITLE NO,ZONE, PRICE ,TIME / C3,C7,C8,C9,DB C3 WHERE C3 LT 10:

\*\*\*  
NO ZONE PRICE TIME  
1 3 31297 55.0  
2 1 4323 56.5  
3 1 24949 56.5  
4 2 12107 59.0  
5 2 10495 60.0  
6 3 28956 60.5  
7 3 37657 60.5  
8 3 68467 60.5  
9 1 10728 60.5

Figure D

EXAMPLES OF LIST AND PRINT OUTPUT



commands may be used for adding, modifying, or removing data in the data base. The ADD command adds data within existing data sets where no data sets currently exist. The CHANGE command changes data within existing data sets where data exists. To remove data takes the REMOVE command. The ASSIGN command assigns new data values whether data previously existed or not.

#### CONCLUSIONS

SYSTEM 2000 has been very beneficial in the accomplishment of topic tasks. It has been quick and easy to use yet thorough in its work. The interfacing of S2K with other programs was handled quickly and easily. Above all other features the flexibility of output has allowed project personnel to handle a wide assortment of data for its maximum usefulness.

## THE AUTHORS

W. Gordon Derr is currently pursuing a Master of Science degree with emphasis on transportation planning. His major research efforts have centered around data management, and he is also involved doing research on the decision-making process behind the provision of transportation facilities. He received a Bachelor of Science degree in Civil Engineering from The University of Texas at Austin in 1974.

Richard L. Dodge has been Associate Professor of Architecture since September 1972. He completed his Bachelor's degree in Architecture at the University of California at Berkeley in 1961 and his Master's degree in Architecture at Yale University in 1967. His experience includes work as a Designer and Project Architect for Hatch, White, Hermann & Steinau in San Francisco, California, and for Stone, Marraccini and Peterson in San Francisco, California; and Project Architect for Charles W. Moore in New Haven, Connecticut designing housing for the elderly. He was also an Assistant Professor of Architecture at The University of Texas at Austin from 1967 until his promotion in 1972.

C. Michael Walton has been Assistant Professor of Civil Engineering since September 1971. He completed his B.S. in Civil Engineering at Virginia Military Institute in 1963, and his Master's and Ph.D. degrees in Civil Engineering at North Carolina State University in 1969 and 1971, respectively. His experience includes research work for North Carolina State University, North Carolina Highway Commission in their Planning and Research Department, the U.S. Department of Transportation, and the U.S. Army Corps of Engineers. He has also been a consultant to the Research Triangle Institute and the Office of Economic Opportunities in Raleigh, North Carolina. In addition, he taught for one year at North Carolina State University.