

Puget Sound Council of Governments Origin-Destination Travel Survey, 1985

ELAINE MURAKAMI AND DONALD R. PETHICK

Travel behavior of 783 households was collected using a mail-out travel diary and a follow-up telephone interview for data collection. Data was keyed directly onto a computer file during the telephone interview. This technique allowed quick access to the interview data and improved the accuracy of data collection. The response obtained was sufficiently large to calculate trips per household and length of trips by income quartiles with acceptable accuracy levels.

The four-county region of the Puget Sound Council of Governments (PSCOG) has a total population of approximately 2.5 million. Travel forecasting models for the four-county area currently use data collected in 1971 from three of the four counties. The fourth county, Kitsap, was chosen as the first county from which to collect new travel data. Kitsap County's largest city, Bremerton, has an estimated population (in 1985) of 37,760. Bremerton and the surrounding vicinity is dominated by the presence of the Puget Sound Naval Shipyard (PSNS).

A survey of 783 households in Kitsap County from a total of about 60,000 households was conducted in April and May 1985. Information was collected on trip origins and destinations, time and length of trip, trip purpose, and method of travel. An initial telephone call was made to request participation, travel diaries were mailed to participants, and a local market research firm called to collect the information from 1 to 3 days after the diaries were completed. The interviewers keyed the responses directly into a computer. The data was then transferred to the PSCOG via magnetic tape 1 week after the last interview, and data analysis began only hours after receipt of the tape.

The response rate to the telephone interview was 60 percent, representing 783 completed responses out of 1,305 screened household candidates. The response rates achieved are given in Table 1. The cost per completed survey was \$103; the total budget was \$74,500.

The travel forecasting models use variation of trip making by quartiles of household income. The response obtained was sufficiently large to calculate the average number of trips per household and length of trips for Kitsap County as a whole for the desired 90 percent confidence level with ± 5 percent accuracy. Because of the low participation by low-income households, the accuracy level by income quartiles ranged from ± 3.6 to ± 7.2 percent.

TABLE 1 PERCENTAGE OF RESPONSE RATES
ACHIEVED

	Initial Telephone Contact	Interview	Overall ^a
Estimated	65	85	55
Final	71.2	60.0	40.1

^aCompleted surveys (783) divided by initial supply of valid telephone numbers (1,951).

SAMPLE SIZE

Michael E. Smith's approach in "Small-Sample Home Interview Travel Surveys" (1) was chosen for determining sample size. The PSCOG also reviewed Peter R. Stopher's follow-up article (2) on modifications to this method.

For the PSCOG survey, samples were initially calculated for analyzing the county in two parts: Bremerton and nonBremerton. These calculations estimated a final sample of 1,714 completed surveys. Financial resources would not allow for a sample of this size; calculations for Kitsap County as a whole resulted in a total sample of 734 households.

It was hoped that 1,100 completed household surveys could be obtained, and if the coefficient of variation (CV) were lower than estimated, the two geographic areas could be separated when running the models.

SAMPLE SELECTION

Four approaches to obtaining a sample were considered: (a) residential customers from the local power company, (b) random digit dialing, (c) reverse directories, and (d) residential customers from the local telephone company.

Residential Customers from the Local Power Company

An initial attempt was made to get a list of households from the local power company. Although there were several advantages to obtaining a list from the company, its staff lawyers advised against releasing information partly because of current lawsuits related to confidentiality and release of information to police.

Random Digit Dialing

The firm, Survey Sampling in Connecticut, can provide lists of randomly selected telephone numbers generated from residential prefixes. Using random digit dialing avoids the problem of unlisted numbers, but increases the chances of dialing non-working numbers, disconnected numbers, and new business numbers.

Provided with only a telephone number, the interviewer is required to ask the name and address of the interviewee on initial contact. This increases the number of nonparticipants.

Reverse Directories

Reverse directories were available only for the City of Bremerton, and this would account for about one-half the population. There would be no easy way to obtain similar information for the rest of the county.

Telephone Listings

Three telephone companies serve Kitsap County; Pacific Northwest Bell (PNB) is one that provides all directory assistance for the county. PNB has a standard fee structure and process for obtaining customer lists and provides a typed list with name, address, and telephone number.

It was known that the use of telephone listings had inherent problems, especially with unlisted numbers and households without telephones.

Unlisted Numbers

PNB reported that about 12 percent of households in Oregon and Washington have unlisted numbers. They also acknowledged that the percentage of unlisted numbers is higher in metropolitan areas than in nonmetropolitan areas.

It was assumed that the percentage of unlisted numbers in Kitsap County would be lower than the 12 percent figure for Oregon and Washington as a whole because of the county's rural nature.

Households Without Telephones

To estimate the number of households without telephones, data from the 1980 U.S. Census were examined. Summary Tape File 3 (STF3) Table 118, "Tenure by Telephone in Housing Unit" by census tract was used. For all of Kitsap County, about 5.5 percent of households do not have a telephone (Table 2); however, in one census tract there were more households without telephones than households with telephones. Renters are more likely than homeowners to be without a telephone.

Deciding on a Sample Source

The telephone listing service was chosen because by having the household name, a better response rate to the screening call

TABLE 2 OCCUPIED HOUSING UNITS (STF3 TABLE 118)

	With Telephone		Without Telephone	
	No.	Percent	No.	Percent
Total	49,812	94.4	2,982	5.6
Renter	13,639	85.9	2,230	14.1

could be expected. PNB was provided with a listing of communities and the number of households needed for each community. The number of households was determined using 1983 population estimates generated using PSCOG data bases and 1980 U.S. Census figures. The initial request was for 1929 households.

After obtaining the list the data was entered into the PSCOG computer. All addresses were geocoded to census tract. The distribution of addresses was examined by census tract and 110 additional names in areas that were under-represented from the random sample were requested.

DETERMINING THE SURVEY METHOD

The next decision involved the method of data collection. This included the decision on what the process would be and who would implement it.

Process

Several options for the survey process were discussed: (a) mail out of log/telephone interview; (b) mail out/reminder call/mail back; (c) in-person interview; and (d) telephone screen/mail out/telephone interview.

Mail Out of Log/Telephone Interview

The origin and destination survey conducted in 1971 at the PSCOG was a blind mail out with a follow-up telephone call. A letter requesting participation was sent together with a number of travel log forms. A telephone interview was then conducted to collect the information.

This method has the potential of a very low response rate at the point of the telephone interview. Households that received the survey may not have completed them. Market research firms estimated the response rate using this method as 15 to 60 percent.

Mail Out/Follow-Up Reminder Call/Mail Back

Some research shows that this method can be an effective way to collect data. Werner Brög's research in Germany showing response rates to mail-back surveys ranging from 63 to 78 percent (3) was examined. Ohstrom, Ohstrom and Stopher (4) reported that a 58.5 percent response had been achieved for the mail-back portion of a travel survey in Oahu.

PSCOG staff felt that there were too many situations where it was confusing to report trips accurately, especially "change

mode" trips—that is, a trip to work that should be counted as two trips—involving a drive to the ferry terminal and a ferry trip, or a drive to a park-and-ride lot and a transit trip to work.

In-Person Interviews

A budget limitation of \$80,000 eliminated the possibility of in-person interviews. Of the \$80,000, only \$20,000 was allocated for outside vendors. If the interviewing were contracted out and 1,100 completed surveys were required, the budget would allow only \$18 per survey. An in-home survey could not be conducted for this amount.

Initial Telephone Screen/Mail Out of Log/Telephone Interview

The method of an initial telephone call, mail out of the travel diary forms, and a follow-up telephone interview was chosen. The initial telephone call requested participation in the survey, confirmed residential address, and requested the total number of household members. The number of trip diaries that were mailed was to be reduced, and a high return rate was wanted at the point of the interview, because that would be the most expensive task of the data-collection phase.

Travel diaries would then be mailed out with instructions and a telephone interview conducted to collect the information. It was believed that using an interviewer to collect the information, rather than using a mail-back survey, would facilitate correct trip counting. Careful interviewing would reveal otherwise unreported trips and help to check on seemingly irregular trips, such as one trip to work and no return trip home. It was at this point that on-line data entry became a point of discussion.

Implementing the Survey

After deciding on the process to be used, the staff had a brainstorming session on the procedures to be followed. The initial reaction was to conduct the survey in house and to have data entered on-line to the in-house computer. Two of the survey staff believed that considerable time, and therefore money, could be saved if data entry was completed concurrently with the telephone interview. There was a general feeling that this method should be pursued because it was a technological advance that could conceivably make the project very quick to shift from the data-collection phase to data analysis and thereby reduce a two-step process to one.

On-Line Data Entry

Several benefits of on-line data entry were identified:

1. Elimination of error between paper and keypunch;
2. Reduction of illegible responses on paper;
3. Programmed skip patterns;
4. Ability to track response by geographic location, interviewer, and so on; and
5. No boxes of primary data.

The disadvantages identified were that there would be no paper copy to compare keyed response for accuracy, and that there was no experience with this method.

Using either direct entry or delayed keypunching would likely have resulted in the same completion time for the project. Because the survey served as a test case for the larger region, it was an appropriate time to try something new.

In House or Contract Out

It was decided to conduct the survey in house, although this decision was later revised. The major advantage of this was that there would be complete control over handling of problems and of hiring and training interviewers. It was also believed that the in-house method might be cheaper. However, several major disadvantages were also identified:

1. Hiring and training part-time staff would result in more paperwork for administration, and more project-management time for PSCOG staff;
2. There was no software designed specifically for interviewing and keying to CRT; and
3. Staff would be inconvenienced by the use of office space and equipment by survey personnel.

Even considering the loss of some control over the survey during contracting out, several advantages of this method remain:

1. A firm that conducted many interviews would already have trained staff,
2. Software and hardware designed for surveying on CRT would be provided,
3. The firm could be monitored by PSCOG, and
4. There would be no staff interruptions at PSCOG offices.

Deciding on the Implementation

Current PSCOG hardware and software configuration was reviewed. Hardware was not a problem. The PSCOG has 20 terminals connected to an IBM 4331 and an IBM PC that can be used as a terminal; however, software was a problem. Programs could be written with existing software, but this would have been a time-consuming task. Another option was to purchase or lease additional software specifically for interviewing. Given the time constraints, adding new software before implementing this project was an administrative impossibility.

Local firms were called to find out whether they were using any interviewing software. Three firms were visited, each had the following different software and hardware configurations, respectively:

1. Nineteen terminals hooked to a Hewlett Packard 3000 (HP3000). Software from Computers for Marketing, Inc. Tape drive directly attached to computer.
2. Eight terminals hooked to DEC PDP-11. Software would be custom written because system was new.
3. Ten independent micros [Tandy Radio Shack (TRS-80)] with 5 1/4-in. disk drives.

STARTING POINT ADDRESS

NAME _____

ST _____

CITY _____ ZIP _____

STARTING POINT LAND USE

1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH.
 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV.
 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL.
 4. SHOPPING CENTER 11. PARK&RIDE LOT
 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL
 6. IND./BUS./RES. PARK 13. TRANSIT STOP
 7. OFF./COM. SERVICES 14. OTHER

KITSAP COUNTY TRAVEL SURVEY

APRIL-MAY 1985

TRAVEL DATE _____

TRIP #	DESTINATION ADDRESS	TIME LEFT	TIME ARRIVED	DESTINATION LAND USE	TRIP PURPOSE	METHOD OF TRAVEL	PERSONS IN VEHICLE	TRANSIT ROUTE	PARKING COST	CROSS/PASS THESE PLACES
EXAMPLE	CO ADMINISTRATION BLDG. ST 614 Division CITY Port Orchard ZIP 98366	8:45 AM	9:10 AM	1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH. 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV. 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL. 4. SHOPPING CENTER 11. PARK&RIDE LOT 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL 6. IND./BUS./RES. PARK 13. TRANSIT STOP 7. OFF./COM. SERVICES 14. OTHER	1. RETURN HOME 6. WORK RELATED BUSINESS 2. TO WORK 7. SOCIAL OR RECREATIONAL 3. SHOPPING 8. CHANGE METHOD OF TRAVEL 4. SCHOOL 9. SERVE A PASSENGER 5. PERSONAL BUS. 10. RIDE ALONG	1. AUTO DRIVER 8. SCHOOL BUS 2. AUTO PASSENGER 9. WALK 3. TRANSIT BUS/VAN 10. TAXI PASSENGER 4. PARATRANSIT BUS/VAN 11. MOTORCYCLE 5. FERRY AUTO DRIVER 12. BICYCLE 6. FERRY AUTO PASSENGER 13. OTHER 7. FERRY WALK-ON	2		X FREE	1. WARREN AVE BRIDGE 2. MANETTE BRIDGE 3. INTERSECTION SR-3 OLD BELFAIR HWY. 4. AGATE PASS BRIDGE 5. NONE
1	ST _____ CITY _____ ZIP _____	_____ AM	_____ AM	1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH. 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV. 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL. 4. SHOPPING CENTER 11. PARK&RIDE LOT 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL 6. IND./BUS./RES. PARK 13. TRANSIT STOP 7. OFF./COM. SERVICES 14. OTHER	1. RETURN HOME 6. WORK RELATED BUSINESS 2. TO WORK 7. SOCIAL OR RECREATIONAL 3. SHOPPING 8. CHANGE METHOD OF TRAVEL 4. SCHOOL 9. SERVE A PASSENGER 5. PERSONAL BUS. 10. RIDE ALONG	1. AUTO DRIVER 8. SCHOOL BUS 2. AUTO PASSENGER 9. WALK 3. TRANSIT BUS/VAN 10. TAXI PASSENGER 4. PARATRANSIT BUS/VAN 11. MOTORCYCLE 5. FERRY AUTO DRIVER 12. BICYCLE 6. FERRY AUTO PASSENGER 13. OTHER 7. FERRY WALK-ON			FREE	1. WARREN AVE BRIDGE 2. MANETTE BRIDGE 3. INTERSECTION SR-3 OLD BELFAIR HWY. 4. AGATE PASS BRIDGE 5. NONE
2	ST _____ CITY _____ ZIP _____	_____ AM	_____ AM	1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH. 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV. 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL. 4. SHOPPING CENTER 11. PARK&RIDE LOT 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL 6. IND./BUS./RES. PARK 13. TRANSIT STOP 7. OFF./COM. SERVICES 14. OTHER	1. RETURN HOME 6. WORK RELATED BUSINESS 2. TO WORK 7. SOCIAL OR RECREATIONAL 3. SHOPPING 8. CHANGE METHOD OF TRAVEL 4. SCHOOL 9. SERVE A PASSENGER 5. PERSONAL BUS. 10. RIDE ALONG	1. AUTO DRIVER 8. SCHOOL BUS 2. AUTO PASSENGER 9. WALK 3. TRANSIT BUS/VAN 10. TAXI PASSENGER 4. PARATRANSIT BUS/VAN 11. MOTORCYCLE 5. FERRY AUTO DRIVER 12. BICYCLE 6. FERRY AUTO PASSENGER 13. OTHER 7. FERRY WALK-ON			FREE	1. WARREN AVE BRIDGE 2. MANETTE BRIDGE 3. INTERSECTION SR-3 OLD BELFAIR HWY. 4. AGATE PASS BRIDGE 5. NONE
3	ST _____ CITY _____ ZIP _____	_____ AM	_____ AM	1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH. 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV. 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL. 4. SHOPPING CENTER 11. PARK&RIDE LOT 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL 6. IND./BUS./RES. PARK 13. TRANSIT STOP 7. OFF./COM. SERVICES 14. OTHER	1. RETURN HOME 6. WORK RELATED BUSINESS 2. TO WORK 7. SOCIAL OR RECREATIONAL 3. SHOPPING 8. CHANGE METHOD OF TRAVEL 4. SCHOOL 9. SERVE A PASSENGER 5. PERSONAL BUS. 10. RIDE ALONG	1. AUTO DRIVER 8. SCHOOL BUS 2. AUTO PASSENGER 9. WALK 3. TRANSIT BUS/VAN 10. TAXI PASSENGER 4. PARATRANSIT BUS/VAN 11. MOTORCYCLE 5. FERRY AUTO DRIVER 12. BICYCLE 6. FERRY AUTO PASSENGER 13. OTHER 7. FERRY WALK-ON			FREE	1. WARREN AVE BRIDGE 2. MANETTE BRIDGE 3. INTERSECTION SR-3 OLD BELFAIR HWY. 4. AGATE PASS BRIDGE 5. NONE
4	ST _____ CITY _____ ZIP _____	_____ AM	_____ AM	1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH. 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV. 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL. 4. SHOPPING CENTER 11. PARK&RIDE LOT 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL 6. IND./BUS./RES. PARK 13. TRANSIT STOP 7. OFF./COM. SERVICES 14. OTHER	1. RETURN HOME 6. WORK RELATED BUSINESS 2. TO WORK 7. SOCIAL OR RECREATIONAL 3. SHOPPING 8. CHANGE METHOD OF TRAVEL 4. SCHOOL 9. SERVE A PASSENGER 5. PERSONAL BUS. 10. RIDE ALONG	1. AUTO DRIVER 8. SCHOOL BUS 2. AUTO PASSENGER 9. WALK 3. TRANSIT BUS/VAN 10. TAXI PASSENGER 4. PARATRANSIT BUS/VAN 11. MOTORCYCLE 5. FERRY AUTO DRIVER 12. BICYCLE 6. FERRY AUTO PASSENGER 13. OTHER 7. FERRY WALK-ON			FREE	1. WARREN AVE BRIDGE 2. MANETTE BRIDGE 3. INTERSECTION SR-3 OLD BELFAIR HWY. 4. AGATE PASS BRIDGE 5. NONE
5	ST _____ CITY _____ ZIP _____	_____ AM	_____ AM	1. SINGLE FAMILY HOME 8. SCHOOL-HIGH SCH. 2. APARTMENT/CONDO 9. SCHOOL-COL./UNIV. 3. RETAIL SALES GEN. 10. MILT. BASE/FACIL. 4. SHOPPING CENTER 11. PARK&RIDE LOT 5. MANUF./IND. WRHSG. 12. FERRY TERMINAL 6. IND./BUS./RES. PARK 13. TRANSIT STOP 7. OFF./COM. SERVICES 14. OTHER	1. RETURN HOME 6. WORK RELATED BUSINESS 2. TO WORK 7. SOCIAL OR RECREATIONAL 3. SHOPPING 8. CHANGE METHOD OF TRAVEL 4. SCHOOL 9. SERVE A PASSENGER 5. PERSONAL BUS. 10. RIDE ALONG	1. AUTO DRIVER 8. SCHOOL BUS 2. AUTO PASSENGER 9. WALK 3. TRANSIT BUS/VAN 10. TAXI PASSENGER 4. PARATRANSIT BUS/VAN 11. MOTORCYCLE 5. FERRY AUTO DRIVER 12. BICYCLE 6. FERRY AUTO PASSENGER 13. OTHER 7. FERRY WALK-ON			FREE	1. WARREN AVE BRIDGE 2. MANETTE BRIDGE 3. INTERSECTION SR-3 OLD BELFAIR HWY. 4. AGATE PASS BRIDGE 5. NONE

FIGURE 1 Sample for Kitsap County travel survey.

It was decided that the survey would consist of a mix of in-house work and work to be contracted out because there was no appropriate office space or software to conduct the data collection interview in house. The initial telephone contact would be made by the PSCOG.

A request for proposal (RFP) was let out for a maximum of \$17,000 to conduct the telephone interviews and to transmit the data on magnetic tape within 4 weeks. The RFP listed such specifications as follows:

- Software must be able to handle (estimated) 760 variables per household or 170 variables per person, and
- Software must be able to target quotas for geographic areas (either zip codes or census tracts) and close interviews for those areas when quotas are met.

Three bids were submitted. Of the three companies, only one had both software and hardware operational at the time the contract was determined and this was the company selected.

RESULTS AND RECOMMENDATIONS

Initial Telephone Contact

The initial telephone contact did not use household selection techniques to identify quotas in appropriate cells (e.g., by number of vehicles, age of head of household, etc.) as in Ohstrom, Ohstrom and Stopher (4).

Because PSCOG models use income quartiles to differentiate trip-making behavior, a sample of households was wanted that would meet the income distribution of the population at large. It was believed, however, that the amount of household income could not be asked at the initial telephone contact, but that a sample sufficiently large, with the desired accuracy and confidence level, would be obtained.

Up to four calls were made to each household. The estimated positive response was 65 percent. A response rate of 71 percent (after subtracting disconnects and duplicate numbers, 1,390/1,951 = 71.2 percent) was achieved as given in Table 3.

TABLE 3 RESPONSES FOR INITIAL TELEPHONE CONTACT

Responses	Number	Percentage
Positive	1,390	68.0
Negative	408	20.0
No answer	153	7.5
Disconnected	91	4.4
Duplicates	2	0.1
Total	2,044	100.0

Survey Sampling, Inc., estimates a 13 percent disconnect rate for samples generated using directory-listed numbers. PSCOG disconnect rate of 4.4 percent is considerably lower. Nonetheless, even this low number of disconnects had not been allowed for in estimates for unusable numbers.

The Telephone Interview

Response

Of the 1,390 household numbers transmitted to the market research firm, 783 surveys were completed. The PSCOG estimated 85 percent completion rate for the interviews was unreasonable; a better estimate would have been between 60 to 80 percent.

After subtracting the pretest, undelivered trip diaries, and duplicates, the final response rate was 60.0 percent (783/1,305) as given in Table 4.

TABLE 4 TELEPHONE INTERVIEW

Completed	783
Incompleted and no answer	214
Terminated	308
Pretest ^a	41
Undelivered ^b	36
Duplicates	8
Total	1,390

^aTesting of questionnaire on first two nights. None of the 41 households were included in the final sample.

^bReturned by postal service. Reasons included: mailbox could not be found or was blocked, address was incorrect.

Problems

Although the survey admittedly had problems, PSCOG would not hesitate to use a procedure that included telephone interviewing with on-line data entry again. Generally speaking the results were satisfactory.

When the contractor debriefed the interviewers on their reaction to the survey the following observations were made:

1. Respondents were not aware of the level of detail required in filling out their diaries,
2. Respondents were confused over the definition of trip, and
3. The public was generally cooperative but lacked a clear understanding of the purpose of the survey.

PSCOG staff identified different problems:

1. Interviewers did not understand the "Suspend" function on the computer. At any point of the survey, the interviewer could type in the word "Suspend." This could be used if the interviewee had to leave the telephone and could not complete the survey at that time. The computer would automatically ask for a day and time for the call back to be scheduled. Unfortunately, several of the interviewers were unfamiliar with this computer option.

2. The interview was too long and too complex. Although inclusion of several questions was to satisfy various political and managerial requests, it cannot be stressed enough how the survey must be pared down to the barest requirements. The average interview took 20 minutes to complete on the telephone.

TABLE 5 OBTAINED ACCURACY USING 1979 INCOME DISTRIBUTION

Income Group	CV	Frequency	Factor	Weight	Optional Allocation ^a	Actual	Obtained Accuracy (%)
Low	0.77	0.234	0.180	0.237	148	54	8.3
Low middle	0.85	0.29	0.252	0.332	207	185	5.3
Upper middle	0.75	0.238	0.179	0.236	147	185	4.5
Upper	0.64	0.231	0.148	0.195	121	286	3.3
			0.759		623	710	

^aCalculations for optimal sample sized for 90 percent confidence and 5 percent accuracy.

3. PSCOG needed to understand default call-back routine in the computer. PSCOG needed to know what the routine was, then work with the research firm's programmer to change it. The software was set to have five time periods and a call back for busy signals. The whole weekend (Saturday morning to Sunday night) was considered one time period, therefore no call backs were made until Monday if the first call was on Saturday afternoon. Because a timely call to collect the trip information was crucial to this project, it was critical that this be changed. Unfortunately, PSCOG did not realize this was a problem until 1 week into the project.

4. It was difficult to correct errors. Basically, the interview screen is set up to ask one question at a time. The interviewer can return to a previous question, but must then re-enter all the responses to the following questions. That is, there was no retention after moving backward. This is an artificial constraint that can be eliminated with different software.

Benefits

Benefits of using an interview process that included direct entry of responses to a computer file included: good skip patterns, good monitoring capability, and ease of transmittal of data on tape. The flow of questions is very smooth when the computer is programmed to jump to appropriate next questions based on the current answer. As an example, if the travel mode was automobile driver the interviewer was to ask how many people were in the vehicle, and what, if any, were the parking costs. If the travel mode was public transit the interviewer was to ask what route was taken. Otherwise, the interviewer skipped to the question: Did you cross any of these points?

The research firm was very accommodating in allowing

PSCOG to monitor various interviewers during the process. Both the screen and the voice could be monitored during the interview. Although in some research projects it is extremely important that the wording of questions be entirely consistent, for the PSCOG survey it was more important to obtain complete information regardless of whether the questions were exactly worded or not.

The monitoring capability provided a good indication of which questions were inadequate and helped to provide additional training materials to assist the interviewers in correctly coding responses.

Use of a firm with fairly complex computer capability allowed PSCOG to specify how the data was to be transmitted to PSCOG offices at the end of the project. The information was collected as a household record (because tracking was by telephone number), but was transmitted as person records.

Validity and Use of the Data

All behavior surveys, including travel surveys, are liable to bias. Two sources of bias include error in selecting the sample households to be surveyed, and error caused by refusal of selected samples to participate in the survey.

An assessment of the survey results by household income indicated a substantial undersample of low-income households and an excess sample of the two upper-income groups. This distribution problem may be due in part to the fact that expected frequency by income group is based on 1979 dollars. During the last 6 years there has been a shift of people to higher-income groups creating smaller percentages in the lower-income group.

The goal of the survey was to achieve a desired accuracy

TABLE 6 OBTAINED ACCURACY ASSUMING 25 PERCENT INCREASE IN HOUSEHOLD INCOME

Income Group	CV	Frequency	Factor	Weight	Optional Allocation ^a	Actual	Obtained Accuracy (%)
Low	0.77	0.176	0.136	0.181	106	54	7.2
Low middle	0.85	0.281	0.239	0.318	187	185	5.1
Upper middle	0.75	0.253	0.190	0.253	149	185	4.6
Upper	0.64	0.291	0.186	0.248	146	286	3.5
			0.751		588	710	

^aCalculations for optimal sample sized for 90 percent confidence and 5 percent accuracy.

TABLE 7 KITSAP COUNTY HOUSEHOLD SIZE DISTRIBUTION

Number of Persons in Household							Average Household Size
1	2	3	4	5	6	Total	
1980 households ^a							
11,265	17,835	9,031	8,724	3,815	2,171	52,841	
21.3%	33.8%	17.1%	16.5%	7.2%	4.1%	100.0%	2.71
1985 households ^b							
129	292	153	139	47	23	783	
16.5%	37.3%	19.5%	17.8%	6.0%	2.9%	100.0%	2.70

^a1980 U.S. Census, STF-3, Report 18.^b1985 Kitsap Home Interview Survey.

TABLE 8 KITSAP COUNTY POPULATION BY AGE AND SEX

Age Interval (yr)	1980 ^a						1985 ^b					
	Male	Per-centage	Female	Per-centage	Total	Per-centage	Male	Per-centage	Female	Per-centage	Total	Per-centage
0-4	5,952	4.0	5,676	3.9	11,628	7.9	—	—	—	—	166 ^c	
5-9	5,802	3.9	5,585	3.8	11,387	7.7	55	3.3	51	3.1	106	6.4
10-15	7,228	4.9	6,984	4.8	14,212	9.7	67	4.1	77	4.7	144	8.7
16-18	4,057	2.8	3,417	2.3	7,474	5.1	37	2.2	32	1.9	69	4.2
19-24	10,139	6.9	6,946	4.7	17,085	11.6	56	3.4	57	3.4	113	6.8
25-29	7,056	4.8	6,513	4.4	13,569	9.2	95	5.7	87	5.3	182	11.0
30-44	16,123	11.0	14,962	10.1	31,085	21.1	255	15.4	242	14.6	497	30.0
45-59	9,988	6.8	10,064	6.8	20,052	13.6	128	7.7	117	7.1	245	14.8
60-64	2,965	2.0	3,159	2.2	6,124	4.2	36	2.2	53	3.2	89	5.4
65+	6,190	4.2	8,338	5.7	14,528	9.9	105	6.3	105	6.3	210	12.7
	75,500	51.3	71,644	48.7	147,144	100.0	834	50.4	821	49.6	1,655	100.0

^a1980 U.S. Census, STF-3 Report 15.^b1985 Kitsap Home Interview Survey.^cNot included in percentage calculations.

TABLE 9 KITSAP COUNTY HOUSEHOLD INCOME DISTRIBUTION

	1980 Households ^a	Per-centage	1985 Households ^b	Per-centage
Income (\$)				
10,000	12,350	23.4	54	6.9
10,000-19,999	15,671	29.6	185	23.6
20,000-29,999	13,440	25.4	185	23.6
30,000-39,999	6,735	12.8	150	19.2
40,000-49,999	2,531	4.8	76	9.7
50,000	2,091	4.0	60	7.7
Response				
Refused to answer	—	—	45	5.7
Unknown income	—	—	28	3.6
Total	52,818	100.0	783	100.0

^a1980 U.S. Census, STF-3, Report 68.^b1985 Kitsap Home Interview Survey.

level of ± 5 percent at a 90 percent level of confidence. Based on unadjusted distributions and the observed CVs, the obtained accuracies are given in Table 5.

To adjust for increases in income over time an estimate of accuracies was made assuming a 25 percent increase in incomes over the 1979 to 1985 time period in order to find what impact this would have. As seen in Table 6, low-income accuracy improves significantly to approximately 7 percent.

Preliminary survey results were compared with 1980 U.S. Census data to assist in determining survey validity and accuracy. The biases indicated will be adjusted through marginal weighting techniques if it is determined to be necessary. Unadjusted comparisons with 1980 data illustrated relatively close similarity to expected population and household characteristics.

In Tables 7-12 some of the preliminary survey demographic results are compared to the 1980 U.S. Census information. Household size distribution in Table 7 is given as approximately the same household size as in 1980.

A comparison of the distribution of population by age and

TABLE 10 KITSAP COUNTY VEHICLE AVAILABILITY

Number of Vehicles				Total Households	Total Vehicles	Vehicles Per Household
None	1	2	3			
1980 ^a						
3,843	17,638	18,568	12,607	52,656	96,377	1.83
7.3%	33.5%	35.3%	23.9%	100.0%		
1985 ^b						
18	226	334	196	783	1,584	2.05
2.3%	29.2%	43.2%	25.3%	100.0%		

^a1980 U.S. Census, STF-3, Report 123.^b1985 Kitsap Home Interview Survey.

TABLE 11 KITSAP COUNTY NUMBER OF WORKERS BY TRAVEL TIME TO WORK

Time (min)	Number of Workers, 1980 ^a	Percentage	Number of Workers, 1985 ^b	Percentage
< 5	2,539	4.2	21	2.9
5-9	6,735	11.0	70	9.7
10-14	9,880	16.2	108	15.0
15-19	10,083	16.5	151	21.0
20-29	12,609	20.7	134	18.6
30-44	9,529	15.6	149	20.7
45-60	2,965	4.9	53	7.4
> 60	6,648	10.9	34	4.7
Total workers	60,988	100.0	720	100.0
Average trip time (min)	24.9		24.0	

^a1980 Census, STF-3, Report 41.^b1985 Kitsap Home Interview Survey.

TABLE 12 FREQUENCY OF TRIPS PER HOUSEHOLD BY INCOME

Income (\$)	Trips Per Household
< 10,000	3.9
10,000-19,999	5.0
20,000-29,999	6.9
> 30,000	9.3
No income reported	4.5
All households	6.9

sex, between 1980 and 1985 in Table 8, shows a possible undersampling of the younger age groups and an oversampling of the older age groups. A possible explanation for the undersampling of the 19-24 age range is the large military population in Kitsap County that are not in households.

Vehicles per household increased slightly between 1980 and 1985 (Table 10). An underestimate of the number of trips taking longer than 60 min is indicated in Table 11. A problem may exist in those trips including the use of a ferry. Kitsap County has some unique travel characteristics because of the separation of the county from the mainland by Puget Sound.

The preliminary trip-production rates obtained from the survey are given in Table 12. As expected, the trip rates per household have increased over time, and upper income households take more trips.

The preliminary survey results described here are unadjusted or weighted. This information will be processed and used to update travel forecast models representative of travel characteristics in Kitsap County.

CONCLUSIONS

Origin-destination travel surveys will continually require a means of collecting accurate and timely information at a reduced cost. Using a small sample and direct input of responses to the computer during a telephone interview reduces time and effort needed for this kind of data collection. Computer hardware and software used in survey work will continue development toward ease of use, ease of programming, and attractiveness to nonprogrammers and the general public.

Data from this survey will be used to update travel forecast models. More importantly, the survey provided valuable

experience that will greatly enhance data collection when the PSCOG conducts its much larger mainland survey in the next fiscal year.

REFERENCES

1. M. E. Smith. "Design of Small-Sample Home Interview Travel Surveys." In *Transportation Research Record 701*, TRB, National Research Council, Washington, D.C., 1979, pp. 29–35.
2. P. R. Stopher. "Small Sample Home-Interview Travel Surveys: Applications and Suggested Modifications." In *Transportation Research Record 886*, TRB, National Research Council, Washington, D.C., 1982, pp. 41–47.
3. W. Brög, A. H. Meyburg, and M. J. Wermuth. "Development of Survey Instruments Suitable for Determining Non-Home Activity Patterns." In *Transportation Research Record 944*, TRB, National Research Council, Washington, D.C., 1983, pp. 1–12.
4. E. G. Ohstrom, J. B. Ohstrom, and P. R. Stopher. "Successful Administration of a Mailed 24-Hour Travel Diary: A Case Study." In *Transportation Research Record 987*, TRB, National Research Council, Washington, D.C., 1984, pp. 14–20.

Nationwide Personal Transportation Study: Experiences with Previous Surveys and Options for the Future

SUSAN LISS

The Nationwide Personal Transportation Survey (NPTS) is a survey of travel patterns of U.S. households, with a focus on the amount and nature of travel activity. The survey provides a benchmark of travel activity and a measure of the impact of selected demographic factors on travel patterns. The survey was conducted in 1969, 1977, and 1983, with the next survey in the series scheduled for 1988. The surveys conducted to date have been home-interview surveys, but there are current plans to conduct a telephone survey in 1988. Some of the factors pointing to the use of a telephone survey are (a) decreased cost per interview, (b) expanded sample size, (c) centralized interviewing, and (d) the capability of on-line editing. Balancing these advantages are concerns of comparability with the previous surveys, biases inherent in telephone surveys, and whether the overall length and complexity of the data are appropriate for telephone interviewing. Despite these concerns, the telephone methodology will most likely be used for the next NPTS. Telephone surveys are the predominant method of conducting travel surveys today, probably because they provide acceptable response rates at a low unit cost and have the benefit of personal contact with the household.

The National Personal Transportation Survey (NPTS) has much in common with other urban area travel surveys. Data is collected on the economic and demographic characteristics of

the sampled households, vehicle ownership patterns, and trips and travel by all modes of transportation. Like many of the urban area studies, a travel day concept is used in NPTS; that is, all trips and travel made by each household member in a given 24-hr period are collected. However, NPTS differs from urban area travel surveys in several important aspects, most notably

1. The survey area covers the entire United States,
2. Data collection extends over a 1-year period of time, and
3. The survey includes modes such as airplane, and intercity train and bus.

The vast coverage of the survey, both in terms of geography and time, creates problems that are unique to NPTS. The coverage considerations will, of course, affect any changes made in future surveys.

The NPTS is sponsored by four U.S. Department of Transportation (U.S. DOT) agencies: Office of the Secretary of Transportation, National Highway Traffic Safety Administration, Urban Mass Transportation Administration, and the Federal Highway Administration. The U.S. DOT conducts the survey to provide fundamental data on the amount and nature of household travel. The survey provides a benchmark of travel activity and a measure of the impact of selected demographic factors on travel patterns. The data is used within the U.S. DOT