



**U.S. Department  
of Transportation**

**Urban Mass  
Transportation  
Administration**

# CIRCULAR

**UMTA C 2710.1A**

Subject: SAMPLING PROCEDURES FOR OBTAINING FIXED ROUTE BUS OPERATING DATA REQUIRED UNDER THE SECTION 15 REPORTING SYSTEM July 18, 1988

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1. PURPOSE. This circular details a suggested alternative sampling technique for collecting fixed route bus operating data required under the Section 15 Uniform System of Accounts and Records Reporting System.
2. CANCELLATION. This circular cancels UMTA Circular 2710.1, "Sampling Procedures for Obtaining Fixed Route Bus Operating Data Required Under the Section 15 Reporting System," dated 2-22-78.
3. REFERENCES.
  - Urban Mass Transportation Act of 1964, as amended.
  - Uniform System of Accounts and Records and Reporting System; Clarification of Procedures for Addressing Noncompliance with Reporting Requirements; Final Rule (52 FR 36182) (49 CFR 630), dated 9-25-87.
  - Urban Mass Transportation Industry Uniform System of Accounts and Records and Reporting System: Volume I - General Description, dated 1-77; Volume II - Uniform System of Accounts and Records, dated 1-77; and Reporting Manual and Sample Forms (All Reporting Levels), dated 2-88.
  - UMTA Circular 2710.2A, "Sampling Procedures for Obtaining Demand Responsive Bus System Operating Data Required Under the Section 15 Reporting System," dated 7-22-88.
  - UMTA Circular 2710.4A, "Revenue Based Sampling Procedures for Obtaining Fixed Route Bus Operating Data Required Under the Section 15 Reporting System," dated 7-22-88.
  - UMTA Circular 9030.1A, "Section 9 Formula Grant Application Instruction," dated 9-18-87.
4. BACKGROUND. The Federal Register of September 25, 1987, specifies that certain operating data must be collected as part of the Section 15 Uniform System of Accounts and Records and Reporting System. The Urban Mass Transportation Administration developed several suggested sampling techniques for collecting annual estimates of unlinked passenger trips and passenger miles. The technique in this manual is one of these suggested techniques which will yield sample data at the required levels of precision and accuracy.

A transit agency may use a technique other than the UMTA recommended techniques as long as it meets the prescribed precision and confidence levels. Implementation of a sampling procedure that has not been confirmed in writing by UMTA as meeting the prescribed statistical requirements may result in adjustments to future Section 9 formula apportionments if the data are found to be unreliable.

Additional copies of the forms contained in this circular for collecting transit service consumed data can be reproduced by the user, or obtained from:

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## CHAPTER I

### INTRODUCTION

1. PURPOSE OF MANUAL. The Section 15 Reporting System requires that reporting agencies submit the following service consumed operating data elements annually:
  - a. Unlinked passenger trips
  - b. Passenger miles.

Unlinked passenger trips must be reported by average weekly time periods (AM peak, midday, PM peak, and other) and by average weekly total, average Saturday total, average Sunday total and annual total. Passenger miles must be reported only as totals for the average weekday, average Saturday, average Sunday, and annual.

The annual estimates for these service consumed data must be obtained by random sampling procedures according to specified confidence and precision levels unless 100% counts are taken.<sup>1</sup> The primary purpose of this manual is to provide the detailed sampling procedures that will conform to these specifications.

2. SUMMARY OF PROCEDURES. The circular is organized to provide you with the step-by-step sampling procedure without entering into any technical discussions. If followed carefully, these procedures satisfy the Section 15 reporting system requirements.

Chapter II gives you several alternatives as to the sample sizes and frequencies of sampling that will provide the required confidence and precision levels. You can select any alternative that fits your operation. Incidentally, these are minimum requirements to provide annual estimates. If for your own information you need daily, weekly, or monthly estimates within these confidence and precision levels, then you will need to increase the sample sizes.

Once you have selected the sample, the next step is to send the surveyor(s) out to collect the data. Chapter III provides you with the detailed procedures. You will find that this is a very simple process and that forms are provided on which the data are to be tabulated.

It is strongly recommended in Chapter IV that you record the sample results immediately after the survey is taken. A single form for this purpose is provided in Appendix C. The form provides columns for accumulation of the data on a weekly basis and over the entire year so that when the last sample is taken at the end of the year you will have all the information for the annual report to UMTA.

Chapter V discusses the Annual Report to UMTA. Here we ask that you send UMTA the accumulated numbers as well as the calculated values. This provides UMTA with additional sampling information that it needs to evaluate the procedures in the manual.

Finally, Chapter VI shows you how to select a random sample from your daily list of bus trips. The procedure uses the Table of Random Numbers provided in Appendix E. Random selection of the trips is an essential aspect of the entire process and is, perhaps, the only "new" concept you will encounter.

As indicated earlier, the information obtained by the procedures in the manual is an important part of the overall Section 15 Reporting System requirement. The data collected under this system will be used by UMTA and other groups as a basis for analyzing transit industry problems

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<sup>1</sup> Passenger miles are to be estimated with confidence and precision levels of 95% and 10%, respectively.

and alternatives. For a more detailed discussion of how the data are to be used see Urban Mass Transportation Industry Uniform System of Accounts and Records and Reporting System, Volume I, Chapter 3.

CHAPTER II

SAMPLE SIZE AND FREQUENCY

3. DEFINITIONS. The following key definitions need to be introduced at this point:
  - c. Bus Trip--This is a one way trip by a bus in revenue service starting at one terminal point of a route and ending at another terminal point. A round trip, therefore, is counted as two separate trips. In the case where the route is a pure loop involving entirely different streets and pick-up points, and where there is no logical way to identify terminal points, then the traversing of the loop can be regarded as a single trip.
  - d. Daily List of Bus Trips--This is the list from which the samples will be drawn. It is your complete list of bus trips. Some properties have this list in the form of driver or bus "run" sheets. Others have the list in the form of "schedules" or "time tables." In any case, what is needed is the complete list of one-way bus trips including trippers, shuttles, etc., i.e., all trips to be taken during the day except charter, school bus, and demand response (dial-a-ride) trips.
4. SAMPLE SIZE AND FREQUENCY. Table II-1 provides you with alternative sampling plans that you can use and still be within the required accuracy limits. Note that Plan No. 2 yields the lowest total sample size for the year. This calls for selecting only three bus trips at random from your daily run sheets every other day and sending your surveyors (counters) out to collect the information described in Chapter III.

However, Plan No. 2 may not be the best plan from the standpoint of your particular operation. For example, if you have traffic counters (surveyors) out in the field every day, it may be more practical and less costly to choose Plan No. 1 and assign them two randomly selected trips to survey every day. Alternatively, if it is more convenient and/or less costly to send your surveyors out less frequently, you may prefer Plan No. 6. This would probably tie up at least two persons all day long, but it may be worth it if it involves less interference with their other duties. The most important point is that once you have chosen a plan, be sure that you select the trips at random using the procedure described in Chapter VI.

Table II-1

ALTERNATIVE SAMPLING PLANS THAT WILL YIELD REQUIRED ACCURACY\*

Plan Number	Frequency of Sampling	Bus Trips in Sample	Total Sample Size for Year
1	Every Day	2	730
2	Every Second Day	3	549
3	Every Third Day	5	610
4	Every Fourth Day	7	644
5	Every Fifth Day	10	730
6	Every Sixth Day	15	915

\*95% probability that true value of total passenger miles lies within 10% of sample of estimate.

### CHAPTER III

#### COLLECTING THE DATA

5. GENERAL PROCEDURE. The general procedure for collecting the unlinked passenger trip and passenger mile data is for surveyors to ride the buses on the trips selected in the sample and count the passengers that board and de-board the bus at each point where the bus stops.<sup>2</sup> The distances between the stops are determined either directly from the bus odometer readings, maps, or by retracing the trip by automobile and recording the odometer readings. The combination of on-off counts and distances between stops provides all the information needed to obtain the two required estimates. The remainder of this chapter describes in detail the recommended procedure for conducting the on-board survey.
6. THE SURVEY TRIP SHEET. The recommended form for collecting the data appears in Appendix B. It is suggested that you study this form carefully before reading the following instructions. A filled-out trip sheet is also provided in the Appendix to help you trace the various steps in the procedure.
7. PRE-SURVEY PROCEDURES. A trip sheet should be used for each bus trip selected in the sample. If the trip involves more stops than are allowed for on a page, additional pages should be used, and the page numbers should be written in the upper right hand corner. The surveyor should carry several extra sheets with him in the event that this occurs.

Before going into the field, the surveyor should fill in the following items:

- e. Trip serial number--This is the unique number given to the trips on the daily list of trips. The method for assigning serial numbers is described in Chapter VI.
  - f. Date--The date the survey is taken.
  - g. Day of week--The day of week that the survey is taken. This is very important because data will eventually be recorded by day of week and time period (for unlinked passenger trips). The recording procedure is described in Chapter IV.
  - h. Time period--The time periods for weekdays are: AM peak, midday, PM peak, night (see definition in Appendix A). Saturdays and Sundays do not have time periods. The time at which the trip begins determines the time period in which it is classified.
  - i. Route number--This is optional. You may want to record the route number for future reference (e.g., if you want an analysis by route).
8. SURVEY PROCEDURES. The following instructions should be given to the surveyor:
    - j. Board the bus at the beginning point of the trip and station yourself so that you can observe both doors. During peak hours it may be necessary to have two surveyors, one stationed near each door. If two surveyors are used, the Survey Trip Sheets should have the same trip Serial Numbers and should be marked "Front Door" and "Rear Door," respectively.
    - k. The first step is to record item (6), Vehicle Inventory Number. This is important because then items (7) and (8) can be determined.

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<sup>2</sup> The passengers are not contacted in any way. The surveyor simply stations himself at a point where he can observe passengers boarding and de-boarding and counts. During peak hours two surveyors may be needed.

- l. Next, record stop #1 in column (9), the stop description of the beginning point in column (10), and the odometer reading in column (12) if the bus has an odometer. If not, leave this column blank.
- m. When the bus leaves the beginning point record the number of passengers who boarded the bus in column (13). Include any passenger who might have stayed on board from the last trip.
- n. Only at points where the bus stops during the trip, record (9) stop number, (10) stop description, (12) odometer reading (from driver),<sup>3</sup> (13) passengers boarded, and (14) passengers de-boarded.
- o. Between stops, count the number on board (15). This should agree with the following calculation:

passengers on board between previous two stops, plus passengers who boarded at last stop minus passengers who de-boarded at last stop.

For example, in the survey sheet in Appendix B there were 25 on board between stops #3 and #4. At stop #4, 14 boarded and 2 de-boarded; therefore, the number on board between stop #4 and #5 should be

$$25 + 14 - 2 = 37$$

This should check with an actual head count after Stop #4. It is important to check the number on board whenever possible, because this is the key number in determining passenger miles.

- At the last stop, indicate that this is where the trip ended as shown in the Survey Trip Sheet example.
9. POST SURVEY PROCEDURES. The remaining columns and totals should be completed back at the office.
  - p. If two surveyors are used, combine the results of the two trip sheets into a single one. Be sure to record the Trip Serial Number. Usually the only additional material that the rear-door surveyor will have is the rear-door de-board count (14). However, he should also be recording items (9), (10), and (15) so that this can be checked with the front-door surveyor.
  - q. Determine the distance between stops, column (16), from the bus odometer readings. If the bus odometer readings could not be obtained, determine the distances from a map or by retracing the route by automobile or a combination of both. Map distance alone may not be accurate if the route involves a large proportion of curved streets such as are in some suburban areas.
  - r. For each between stop distance, multiply the number of passenger on board (15) times the distance between stops (16) to get the passenger miles generated between stops.
  - s. Now sum all of the columns specified by the numbers in parenthesis at the bottom of the trip sheet:

$$(20) = \text{sum of column (12)} = \text{total passengers boarded}$$

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<sup>3</sup> If the bus has no odometer, or if the bus driver is too busy to call out the readings, leave this column blank.

(21) = sum of column (15) = total passengers on board.

This can be used to get the average on board between stops and maximum loads.

(22) = sum of column (16) = bus trip distance

(23) = sum of column (17) = total passenger miles for the trip.

- By referring to the vehicle category number and its corresponding model characteristics, determine (7) Total Capacity and (8) Seated Capacity. Total capacity is defined as the normal full load (seated plus standing) as determined by your loading policy.
- Now multiply (7) Total Capacity times (22) Bus Trip Distance to get (26) Capacity Miles.
- Multiply (8) Seated Capacity times (22) Bus Trip Distance to get (27) Seat Miles.

Items (20) through (27) are next recorded on the Daily Record Sheet as described in the next section.

## CHAPTER IV

### RECORDING AND ACCUMULATING SURVEY RESULTS

It is strongly recommended that you adopt the following procedure whereby the survey results for each survey day are systematically recorded each day and accumulated each week. This minimizes the work at the end of the year and reduces the chance of error or loss of information.

10. THE DAILY RECORD SHEET. The form for recording the survey results is called "Daily Record Sheet." A set of blank sheets is provided in Appendix C. An illustration of a partially filled-out set also appears in Appendix C.
11. RECORDING THE SURVEY RESULTS. At this point please refer to page 1 of the Daily Record Sheet Illustration (Appendix C) and the filled-out Survey Trip Sheet in Appendix B.

The Daily Record Sheet is designed to record the totals on the Survey Trip Sheet, i.e., items (20) through (27). On page 1 of the Daily Record Sheet note that the circled number 49 for item (20) "Passengers boarded" corresponds to 49 passengers boarded--item (20)--on the survey trip sheet. Similarly, the circled number 198 for item (21) "Passengers on Board" on the Daily Record Sheet corresponds to the total passengers on board--item (21)-- on Survey Trip Sheet, and so on. These figures have been entered on Tuesday during the A.M. Peak, because items (3) and (4) at the top of the Survey Trip Sheet indicate that this is when the survey trip was taken.

The procedure, therefore is simply to record the totals on the Survey Trip Sheet according to the day and time that the trips are made. If you will now examine pages 2 and 3 of the Daily Record Sheet, you will see that all the circled figures correspond to the totals on the Survey Trip Sheet. All are entered in the Tuesday-A.M. Peak position.

The other figures in page 1 of the Daily Record Sheet are the hypothetical results of the other surveys taken during the week. Samples of three trips were taken on Tuesday, Thursday, and Saturday, and the totals from the Survey Trip Sheets were recorded. For Saturdays, the combined totals for the three trips were recorded because Saturday (and Sunday) results are not recorded by time period.

Note: If more than one trip is taken during a time period on a weekday, just combine the totals on the trip sheets as you do for Saturday and Sunday.

12. ADDITIONAL INFORMATION. Two vital additional items of information are needed. First, please turn to page 3 of the Daily Record Sheet. It is essential that item (28) "Trips in Sample" be recorded according to time period and day of week. Otherwise it will be impossible to make the calculations according to the UMTA requirements.

Another essential additional data item is (29) "Number of Bus Trips." This is the total number of bus trips taken by all buses during the entire week by time period. Be sure to record the trips for the entire week, not just for the sample days. It is not necessary to record the trips by day of week, but it is essential to record them by time period.

In most cases the number of bus trips can be estimated directly from your schedules, because the number of trips each day will not change a great deal. However, when the schedule is changed, or when emergency conditions seriously affect the number of trips, an actual count should be taken and new estimating levels established. Some properties may find it simpler to record the number of trips, in each time period every day, because this information is usually needed and readily available. Be sure to include trippers, shuttles, downtown shopper, and other special trips. Do not include charter, school bus, and demand response trips.

13. ACCUMULATING THE RESULTS. When a week's sampling has been completed and the totals from the Survey Trip Sheets have been recorded, the results should be totaled for the week.

Now here is where a great deal of time can be saved at the end of the year when the UMTA report is due. Keep a running total of the results. Add the total for the week to the cumulative total of previous weeks to get a new cumulative total. If this procedure is followed faithfully, the cumulative total for the last week in the year will contain all the information necessary to complete the UMTA Annual Report described in the next chapter.

CHAPTER V

ANNUAL REPORT TO UMTA

A sample form (Form 406A) for the Annual Report to UMTA is provided in Appendix D. This report must be included along with the other reports required under Section 15.

If you have accumulated your sample data using the Daily Record Sheets, lines 1 through 8 can be copied directly from the "Cumulative Total" column from the last week of the year. The "night" time period is the same as the "other" time period on Form 406A.

14. ANNUAL UNLINKED PASSENGER TRIPS (line 11) are obtained by a two-step process:

- t. Divide the sample total number of passengers that boarded (line 1) by the total number of trips in the sample (line 7) to get the average number of unlinked passengers per trip (line 9).
- u. Multiply the average unlinked passengers per trip (line 9) by the total number of trips (line 8).

15. ANNUAL PASSENGER MILES (line 12) are also obtained by a two-step process:

- v. Divide the sample total passenger miles (line 4) by the total number of trips in the sample (line 7) to get the average passenger miles per trip (line 10).
- w. Multiply the average passenger miles per trip (line 10) by the total number of bus trips (line 8).

In addition to the Annual Report, you are requested to indicate your service time periods. A sample form (Form 401) and corresponding definition appear in Appendix A.

CHAPTER VI

SELECTING THE SAMPLE

Now that you have an idea of the entire process, there is one final procedure that needs to be discussed. This is the procedure for selecting trips in the samples. Here it is important that you use random sampling procedures; that is, every bus trip in your daily list of bus trips (see page II-1 for definition) must have the same probability of being selected. This section describes a method for ensuring that your selection process will be random.

16. DEVELOPING THE DAILY LIST OF BUS TRIPS. The first task is to identify and assign a number to all one-way bus trips to be taken during the day. For some properties the easiest procedure may be to use your bus schedules or timetables. Others may wish to use their daily driver run sheets. The main thing to remember is that a bus trip is a one-way trip and that express, trippers, shuttles, and other special trips (except charter, school bus, and demand-response) should be included.

Table VI-1 illustrates how trips may be identified and numbered from a route schedule. Each trip is given a serial number. The first two digits represent the route number. The second two digits represent the trip number for the route. The inbound trips are given odd numbers, and the outbound are given even numbers. It is not necessary to write down all the Trip Serial Numbers--just the first and the last so that you will know the range of numbers. In this case the range is 0201-0248.

When you have numbered the trips for all routes, you should set up a summary table as shown below.

<u>Route Number</u>	<u>Trip Serial Numbers</u>
1	0101-0172
2	0201-0248
3	0301-0364
4	0401-0464
•	
•	
•	
99	9901-9965

Table VI-1  
TRIP LIST FOR ROUTE #2

ROUTE #2				
Trip Serial Number	Bro. & Whitaker		Traffic Circle Lv.	Trip Serial Number
	Ar.	Lv.		
	PO	6:55		
0201		7:03	7:20	0202
0203	7:38	7:43	8:00	0204
•	8:18	8:23	8:40	•
•	8:58	9:03	9:20	•
•	9:38	9:43	10:00	•
	10:18	10:23	10:40	
	10:58	11:03	11:20	
	11:38	11:43	12:00	
	12:18	12:23	12:40	
	12:58	1:03	1:20	
	1:38	1:43	2:00	
	2:18	2:23	2:40	
	2:58	3:03	3:20	
	3:38	3:43	4:00	
	4:18	4:23	4:40	
	4:58	5:03	5:20	
	5:38	5:43	6:00	
	6:18	6:23	6:40	
	6:58	7:03	7:20	
	7:38	7:43	8:00	
	8:18	8:23	8:40	
	8:58	9:03	9:20	
0245	9:38	9:43	10:00	0246
0247		10:15	10:30	0248
		10:45		

"Route 99" can be your list of trippers and other special trips that are not part of your regular schedule.

There are many other ways that you can identify and number trips, and some of these will be discussed later on. The next subsection shows you how to select a random sample using your summary table of Trip Serial Numbers.

17. SELECTING THE SAMPLE. Suppose that you have elected Plan No. 2 in Table II-1 (Chapter II), which involves taking a sample of three bus trips every second day. Suppose further that you have only the four route and trippers shown in the summary table on page VI-1. Now the problem is to select a random sample of three trip serial numbers from the list.

The easiest way to do this is to use the Tables of Random Numbers that are provided in Appendix E. Table VI-2 presents one of these tables. The procedure for selecting the sample of three Trip Serial Numbers is as follows:

- x. Choose any line of digits in the table, say line 1.
- y. Because the Trip Serial Numbers contain only four digits, use only sets of four digits.
- z. Read along the line in successive sets of four digits until you find three numbers that are within your summary table. In this case the first set of four digits is 9674. The second set is 6742 (the first 9 is dropped, and the 2 on the next column is added). Continuing along the line we get:

7420 4208 2084 0848 0156

0156 is the first number encountered that is in the summary table. The other two are the circled numbers in line 3. These are 0441 and 0324.

Note: The blanks in the table should be counted as zeros.

- The three trips to be surveyed on the first day, therefore, are:
  - a. Route #1, trip #56
  - b. Route #4, trip #41
  - c. Route #3, trip #24

Now go back to your original lists for routes #1, #4, and #3 and locate trips #56, #41, and #24, respectively.

Then enter the Trip Serial Numbers on the Survey Trip Sheets. You are now ready to perform the pre-survey tasks indicated in Chapter III.

Table VI-2

RANDOM NUMBERS

9674	2084	8980	7694	2426	1895	8301	5635	8815	7259
2207	581	637	1836	2428	8376	3054	1127	4914	954
6668	2829	1583	5085	1274	5604	4182	1703	2471	2136
9569	2278	3553	8577	6941	4988	6344	8744	8827	9659
5917	7680	8874	6719	5342	5430	739	1639	7912	8144
3622	2605	5502	9880	1243	5406	2984	4692	2307	5757
9882	4881	1760	5567	1670	7512	3367	5860	4406	7560
5436	5350	7605	2284	2700	9905	1533	7702	8692	4366
6343	4270	4124	4484	1724	5120	8094	2934	6983	6474
150	9650	2735	6090	2524	2973	6618	1852	3064	4331
6714	8852	676	5450	7585	9596	6322	3318	5112	8166
3857	4396	7539	5474	6266	5807	1412	8940	4099	7481
2328	6234	4136	5507	1660	8911	7593	3154	1692	8072
8412	2312	2821	396	3425	4340	7766	9160	7454	5530
8935	1102	7627	8709	6397	6239	2467	8679	5097	3989
2549	5500	1278	5273	768	5846	9240	6254	1528	8909
891	6164	9372	9605	1737	7232	886	8042	8258	1535
8888	502	2812	5554	5229	3424	2517	9567	7728	8097
7766	5221	8061	82	9298	908	6628	3572	10	799
7715	7180	8915	9637	3484	3902	1923	1668	8592	4219
7378	8294	8495	7588	3504	5333	5712	3802	5203	6972
9625	1950	8854	9794	6582	962	5053	6470	8375	1984
459	4987	8372	9047	1170	5513	5862	786	1293	3274
404	2175	1642	2028	9223	1530	4727	9014	1959	4245
3461	8485	8315	1014	2254	7174	5388	4513	413	1308
2747	4770	9029	1027	4542	9732	3764	4332	9203	3730
7215	8890	8511	2855	5772	6341	9098	2461	7148	9939
677	8294	6000	2654	6531	8960	6309	9082	3081	3749
450	783	6559	6009	6114	895	6098	8597	3507	147
3779	4099	6510	2618	3429	8842	2692	5854	1227	5907
8390	6216	2403	8631	6232	6540	9586	2347	3817	9504
9592	8325	3441	6275	6706	171	4062	6330	1741	9144
7914	530	7440	1147	5450	5827	2004	4363	3530	6205
3791	2782	3026	717	1501	7080	3274	5722	5368	624
2029	4690	6180	4538	865	5179	159	2116	7175	8838
8999	9018	5201	6566	5617	2019	9764	7152	7409	5284
7616	4045	53	9391	2586	1081	6164	4605	1943	4293
4347	6132	2646	3160	5433	5324	7402	904	3969	7095
1707	9691	4229	1	4289	2856	1315	1752	4631	2493
9145	9111	2483	7042	8350	7430	5548	9713	8413	1310
2762	4863	9568	4103	1827	5696	1266	260	939	2876
5265	749	5865	9925	2615	8020	4802	7517	5121	3273
4685	5017	3042	4992	3868	3881	2101	3988	7348	3781
4097	6440	1956	8556	6656	2658	181	5346	8923	5564
2564	6536	1251	9110	9810	343	8172	3138	7065	2183
5198	7398	4011	5154	1257	3714	5711	4258	9801	1540
373	5222	2894	8380	1452	5013	3813	2811	2771	7426
4974	4093	6568	3341	9214	8601	5655	1513	3741	9563
2109	2061	7288	2835	6149	602	2276	7706	155	8891
5023	7955	3962	736	8307	4657	8883	2389	1821	8464

- Keep track of the lines that you have used in the tables of random numbers. On the next sample day continue where you left off and select three more trips, and so on throughout the year. If you run out of pages in the Appendix, reverse the process starting from the right side of the lines, or use some other technique that will not retrace the set of numbers you selected.

## 18. ADDITIONAL COMMENTS.

### aa. The Daily List.

- (1) Normally, you will not have to develop a new summary table of Trip Serial Numbers every day. As long as the schedules remain the same, the scheduled Trip Serial Numbers will remain the same. However, you may need to re-number your trippers more frequently. This is why it is a good idea to keep these separate.
- (2) Some properties have driver "run" sheets that list all the trips to be taken by each driver for the day. Here the assignment of Trip Serial Numbers can be keyed to the driver number and the trips that the driver takes. For example, suppose the driver numbers have four digits. Since no driver is likely to take more than 99 trips during one day, the next two digits can be the trip number. The Trip Serial Numbers will look like this:

<u>Driver</u>	<u>Trip</u>
XXXX	XX

You can generate a summary table containing the ranges of Trip Serial Numbers. This, incidentally, will automatically include drivers of trippers. The sample selection process is exactly the same, except six digits are used instead of four.

- (3) In general, any process, which assigns a unique number to a bus trip, is acceptable. If the serial numbers have a large number of digits, however, it becomes more difficult to find them in the table of random numbers.

- Sample Selection Process.

1. Don't substitute a sample selection process that appears to provide "more representative" trips. By doing this you may inadvertently introduce biases that cannot be evaluated by standard statistical methods. If you use another process, be sure that you can demonstrate that it is a random process and that it yields estimates within the prescribed limits given in Table II-1.
2. The random selection process will automatically distribute the trips according to time period, so you do not have to worry about whether you are getting adequate representation in peak periods. This is another reason for strict adherence to the random sampling process.

3. If for some reason a trip that you selected for your sample is eliminated from the schedule or terminated due to breakdown, simply choose another trip, using the same procedure.
  4. For surveyor scheduling purposes you may need to choose the samples well in advance of the days that the surveys are to be taken. This is acceptable if the daily trips are relatively constant. If major scheduling changes occur, however, the samples should be re-drawn.
  5. If you have a 7-day schedule, the day of the week that you start sampling does not matter, but be sure that you adhere to the frequency that you selected.
  6. If you have a 6-day schedule, be sure to start on a different day each week. The main thing to avoid is sampling on the same days every week. If you sampled on Monday, Wednesday and Friday the first week, be sure to sample on Tuesday, Thursday, and Saturday of the following week, and so on.
  7. Sampling theory assures that the sampling plans in Table II-1 apply to any size of operation. The problem with large operations with complex service structures is not the sample size but the ability to select a random sample. It is believed, however, that most large properties have accurate daily lists of bus trips or driver "run" sheets so that the selection process described above can be used.
  8. Some large properties with complex trip structures may be able to design a more efficient (same accuracy at less cost) sampling plan by using stratified sampling methods. A preliminary examination of several large properties indicated, however, that major improvements in efficiency are not likely.
- Charter, School Bus, and Demand Response Operations. The sampling procedures described in this circular do not apply to your charter, school bus (bus used exclusively for carry school children) and demand response (dial-a-ride) operations. Procedures for demand response operations are described in a separate manual.