

**HOW TO CONDUCT A SAFETY BELT SURVEY:
A STEP BY STEP GUIDE**

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OVERVIEW OF STEPS

Step 1: Decide on the Scope of the Survey

1. Decide on survey area.
2. Decide on the motor vehicle type(s) to include in the survey.

Step 2: Select Observation Sites

1. Determine the number of observation sites to include in the survey.
2. Obtain a detailed map of the survey area.
3. Draw a grid pattern onto a transparent sheet of plastic.
4. Randomly select the locations of the observation sites.
5. Determine where at the intersection an observer should stand.

Step 3: Schedule the Days and Times for the Observations

The ideal procedure

1. Randomly select a number between 1 and 7 to represent the day.
2. Randomly select a number between 0 and the number of hours of daylight minus one.

The grouping procedure

1. Determine how many person-days can be devoted to the observation of safety belts.
2. Divide the total number of sites to be observed by the number of groups.
3. Clearly mark the observation sites on a map of the survey area.
4. Group adjacent sites so that you have the proper number of groups and sites within each group.
5. Number each group.
6. Randomly select the day that the group is to be observed.
7. Determine the shortest-route path connecting all sites in a group.
8. Number each site consecutively along the path.
9. Select a random number between 1 and the number of sites within the group.
10. Randomly pick a starting time for the first site in a group to be surveyed.

Step 4: Train the Observers

1. Obtain survey materials.
2. Train observers in a classroom setting.
3. Train observers at an intersection with actual traffic.

Step 5: Conduct the Safety Belt Observations

1. Determine if the site can be surveyed.
2. Fill out the site form.
3. Find proper standing location.
4. Count all target vehicles on all designated traffic lanes for five minutes.
5. Observe and record safety belt use for 50 minutes.
6. Count all target vehicles on all designated traffic lanes for five minutes.

Step 6: Analyze the data

1. Count up the total number of target vehicle occupants for each site.
2. Count up the total number of target vehicle occupants who were belted for each site.
3. Count up the total number of target vehicles observed at each site.
4. Record the pre- and post-survey vehicle counts for each observation site.
5. Run the program ANALYSIS.EXE

Step 7: Interpret the Results

INTRODUCTION

Each year, large sums of money are spent in an effort to increase compliance with safety belt laws. Some of this money is put into public information and education (PI&E) programs designed to point out the benefits of using safety belts, the costs of not using safety belts, and the fact that it is simply against the law not to use a safety belt. The largest portion of the money, however, is spent on enforcement of safety belt laws. These costs include officer wages and the administration for processing citations. With so much capital invested in safety belt law compliance, it is essential to know the effectiveness of enforcement efforts and PI&E programs.

The best way to measure compliance with a safety belt law is to conduct a direct observation survey of motor vehicle occupants in some geographic area of interest. In such a survey, people stand at various roadway intersections and record information on belt use. This method yields much more accurate belt use information than other types of surveys, such as ones that simply ask drivers to report how frequently they use a safety belt.

This guidebook is designed for those interested in determining a safety belt use rate for some geographic area using a direct observation survey. We adopt a "cookbook" format so that those with little or no background in experimental design can still acquire a belt use rate that is representative and scientifically valid for some area of interest. Once decisions are made about the scope of the survey, a step by step procedure can be followed to design, conduct, and analyze the survey.

It will take approximately six to eight person-hours to design the survey and another three or four person-hours to analyze the results. Training will require about four hours per observer. The rest of the survey time is spent out in the field observing safety belt use. In general, it takes about 1.5 hours for each site that will be surveyed.

Step 1: Decide on the scope of the survey.

In order to conduct a scientifically valid survey you must have a clear idea of what you want to learn from the survey. There are two decisions that must be made at this step.

1. *What will be your survey area?* The survey area is the exact boundaries of the place for which you want to know the belt use rate. Example survey areas include school districts, political regions, cities, or counties. When defining your survey area remember that this area is the only area for which the belt use rate found in the survey will apply. For example, if you were to select the city of Owosso, MI as your survey area, then the belt use rate found in the survey would only be valid for roadways within the city boundaries. You would not be able to generalize the city of Owosso's use rates to Owosso township (which is adjacent to the City of Owosso) or to Shiawassee County where Owosso is located. If you wish to have use rates for these other areas, then one of them should be defined as the survey area.

2. *What types of motor vehicles will be included in the survey?* There are six basic types of vehicles on a roadway: heavy trucks (e.g., semi, gravel haulers, dump truck), light trucks (e.g., vans, pickups), utility vehicles (e.g., four-wheel drive vehicles, motor homes), commercial vehicles (e.g., taxis, delivery, buses), government vehicles (e.g., patrol cars), and passenger cars (all small, medium, and large sedans and wagons). Again, when making this decision it is important to keep in mind that the use rate you obtain in the survey will only apply to the vehicle type(s) included in the survey. That is, if passenger cars were the only vehicle type that was observed, then you cannot extend these findings to heavy trucks. We recommend that only passenger cars be included in the survey because in most areas they make up about 70 percent of all roadway traffic, they can be easily surveyed for belt use, and they are the only vehicle type required by federal guidelines to be included in statewide safety belt use surveys.

Step 2. Select observation sites

The observation sites are the locations where an observer will stand and observe the occupants of target vehicles to determine safety belt use. We use the phrase "target vehicle" to denote the vehicle type(s) you have decided to include in your survey.

1) *Determine the number of observation sites to include in your survey.* To assist in this decision, we present Table 1. Table 1, shows two types of information needed to determine the proper number of observation sites: (1) the approximate belt use rate for the survey area and (2) an error rate. The approximate belt use rate is your best guess at the belt use rate for the survey area. If the survey area is in a state in which a statewide belt use survey has been conducted, then regional information may be available from the organization that conducted the survey. If there is no information about your specific area, then choose the statewide belt use rate.

The error rate is a value that defines the accuracy of the belt use rate estimated from the survey. To understand the error rate, it is important to note that surveys do not derive the actual belt use for an area. Instead, they allow us to estimate the belt use rate. This estimate can only give a range of belt use rates, within which the actual belt use rate is most likely to fall. The width of this range is partially determined by your selection of an error rate. Our recommendation is to pick the lowest error rate that yields the number of sites that can be economically surveyed. Keep in mind that the lower the selected error rate, the larger the number of sites that will have to be surveyed. If the number of sites derived from Table 1 exceeds the number of sites that can be surveyed within budget constraints, then the survey should not be conducted. The resulting belt use rate would have so much error that it probably would not be useful.

2) *Obtain a detailed map containing all (or at least a large majority) of the roads within the survey area.*

Table 1: The estimated number of required observation sites as a function of the approximate belt use rate in the survey area and acceptable error rate (see final note).

		Error Rate		
		2%	5%	7%
Approximate Belt Use Rate	90%	68	11	6
	80%	113	19	10
	70%	174	28	15
	60%	257	42	21
	50%	380	61	32
	40%	579	93	48
	30%	945	152	78
	20%	N/A	290	148
	10%	N/A	880	449

3) *Draw a grid pattern onto a transparent sheet of plastic.* A sample grid pattern is shown in Figure 1. The ideal way to create the grid transparency is to duplicate Figure 1 onto an overhead transparency. If the mapped survey area is larger than a single overhead transparency sheet, then two or more sheets will need to be cut and taped together carefully so that the grid spacing is maintained. It is okay if the grid pattern is larger than the mapped survey area, but it cannot be smaller. The columns (vertical) and rows (horizontal) in the grid should be numbered. This has already been done in Figure 1. (Note that in Figure 1, the "9" preceding, for example, the "30" means that the number is actually 29.) If multiple transparencies have been taped together, then ensure that the row and column numbers are changed so that they are continuous. The entire transparency should then be securely fastened over the map so that it will not move relative to the map. The grid squares should be small enough so that when placed over the map, most squares contain one intersection or less.

4) *Randomly select the locations of the observation sites.* For each site number you will be selecting two observation site locations. The first site is called the *primary site*. The second

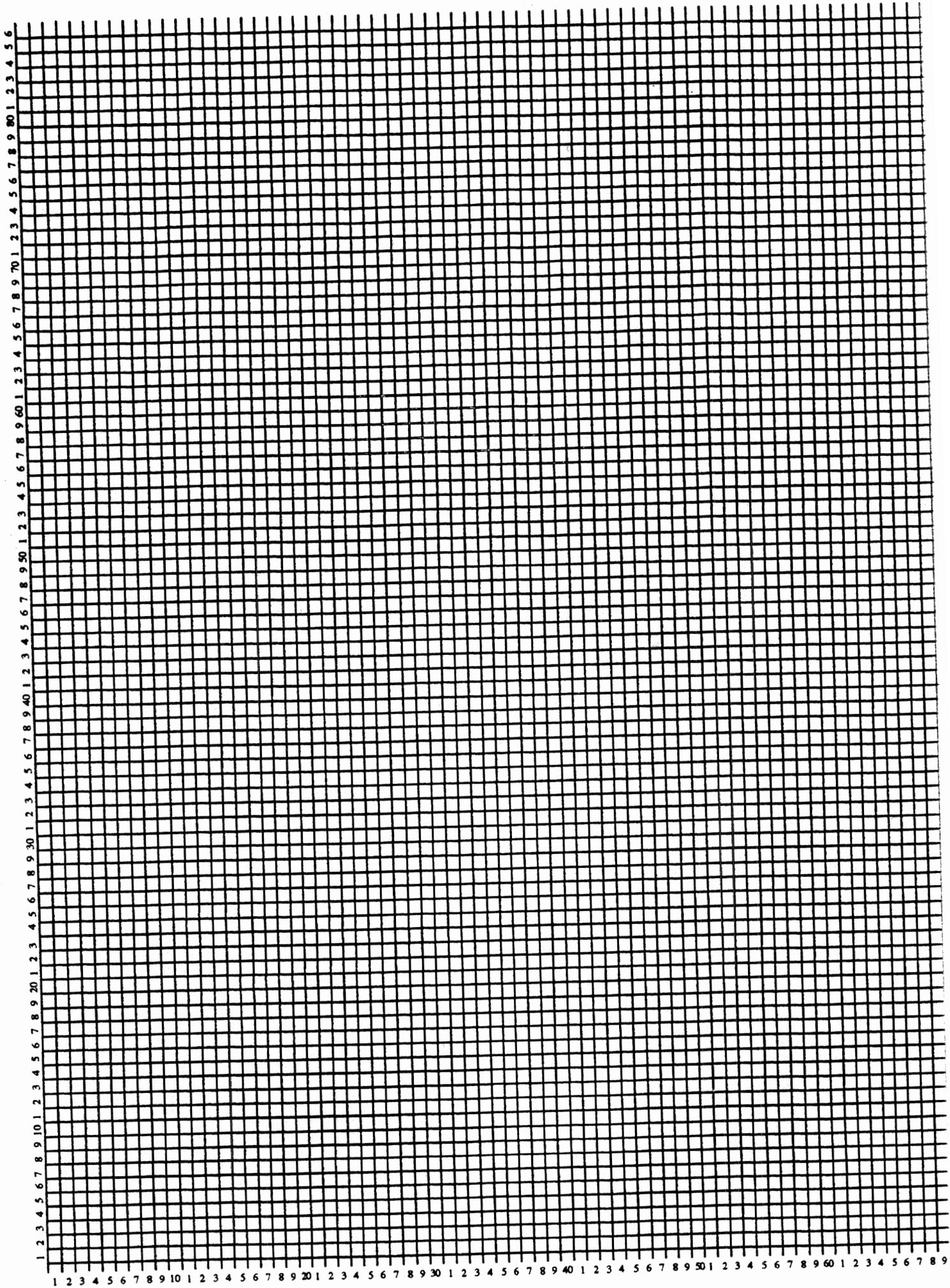


Figure 1.

site is the *alternate site*, which will be used if the primary site cannot be surveyed (due to construction, traffic crash, etc.). The following procedure should be repeated for each site number.

A. Randomly select a number between 1 and the total number of columns in the grid pattern. Note that tables of random numbers can be found in most statistics books or you can run the program RANDOM.EXE on the computer disk accompanying this manual by following the instructions in the analysis section (Step 6).

B. Randomly select a number between 1 and the total number of rows in the grid.

C. Determine the grid square at the intersection of the randomly selected row and column.

D. If there is no roadway intersection contained within this grid square, then go back to step A.

E. If the selected grid square falls outside of the survey area, then go back to step A.

F. If the selected grid square has been selected already, then go back to step A.

G. If there is just one intersection within the grid square then this intersection is the observation site.

H. If there is more than one intersection within the grid square, then pick one to be the observation site.

These steps should be repeated to determine the location of the alternate site. For each site

number, the street names of the primary and alternate sites should be carefully recorded. Keep in mind that many grid squares will be selected that are either outside of the survey area or that contain no intersections. This is expected since the grid squares are selected randomly. While this step is time-consuming, it is important to avoid taking shortcuts.

5. *Determine where at the intersection an observer should stand.* This is done by first determining the number of possible places an observer could stand to survey belt use. The number of standing locations is determined by the number of traffic legs where target vehicles *enter* the intersection. Figure 2 shows examples of four common types of intersections and the standing locations associated with them. There is one standing location for each traffic leg entering an intersection. Once the number of standing locations at a specific observation site has been determined, the standing locations should be numbered (as in Figure 2) and one of them selected by randomly picking a number between 1 and the total number of standing locations at that observation site. Again, the program RANDOM.EXE or a random number table can be used for generating the random numbers. A random standing location for each primary and alternate site should be selected and carefully recorded.

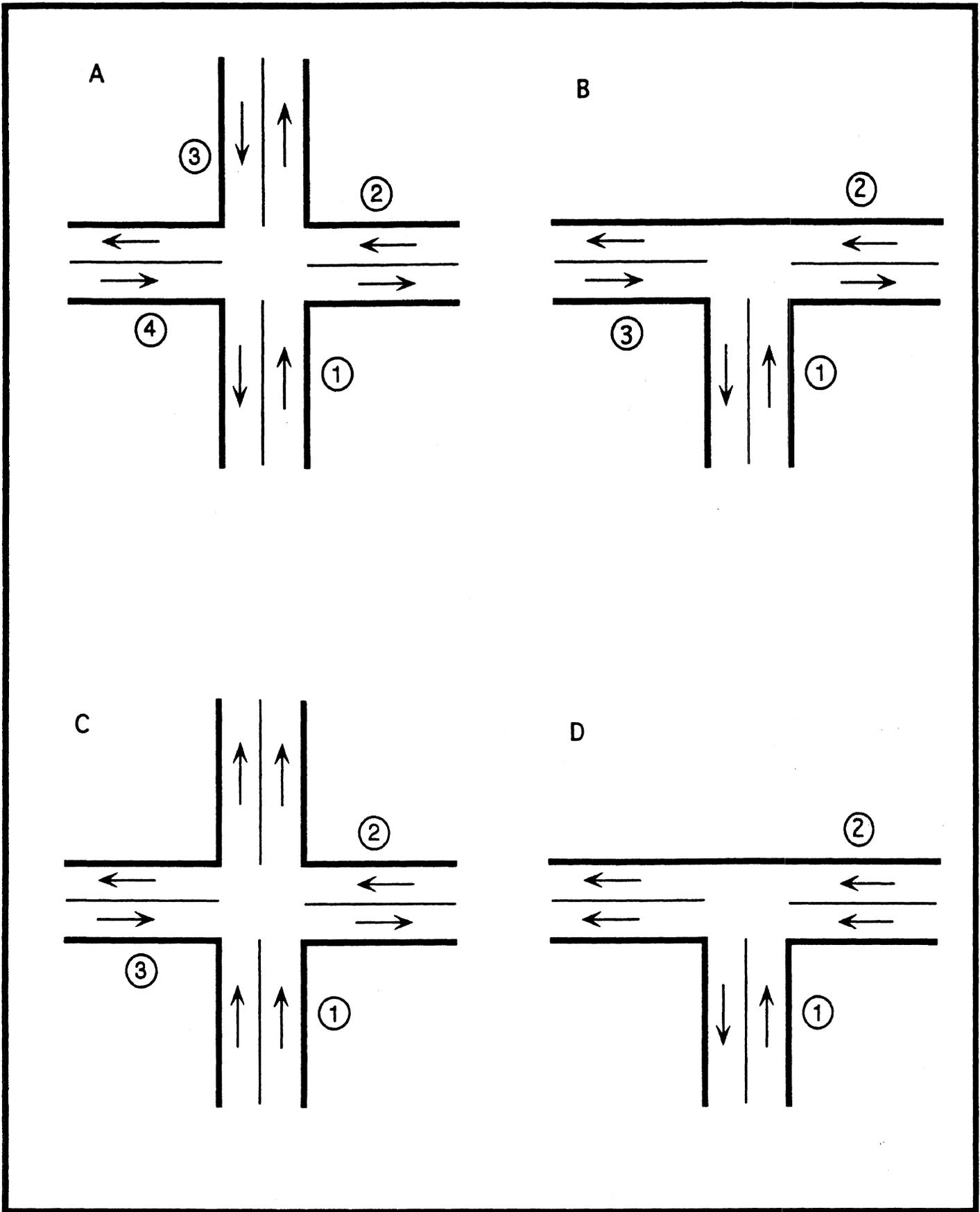


Figure 2

Step 3: Schedule the days and times for the observations.

Scheduling involves planning in advance a day and time for an observer to go and stand at an intersection and observe safety belt use. It is best to have a schedule in place and then follow it as closely as possible. However, when unforeseen problems arise, certain sites may not be able to be observed when scheduled. These sites should be reassigned a day and time for observation. They should not, however, be skipped. Each site must be observed for the survey to be complete.

The scheduling of the days and times is the main area where survey costs can be minimized. We present two methods for scheduling. The first method, the ideal procedure, will be the most costly. It is ideal with respect to experimental design, not economics. The second method, the grouping procedure, is less costly and represents a reasonable compromise between experimental integrity and economics.

The ideal procedure

The ideal scheduling method is to randomly assign a day and starting time to each primary observation site. This method should be used if feasible. These steps should be repeated for each observation site.

1) *Randomly select a number between 1 and 7.* This number represents the day of the week (with 1 being Monday, 2 being Tuesday, and so on) when the site should be surveyed. The program RANDOM.EXE can be used to assist in the random selection of a day.

2) *Randomly select a number between 0 and the number of hours of daylight minus one.* This number is the hour after sunrise that the site should be observed, where zero indicates sunrise, one indicates one hour after sunrise, and so on. One hour is subtracted from the number of daylight hours to ensure that observations starting during the latest hour will be completed before sunset. The program RANDOM.EXE can be used to assist in scheduling observation times.

The grouping procedure

A way to schedule days and times that is less costly than the ideal procedure is to use a *grouping procedure*. In a grouping procedure, sites that are located near each other are observed consecutively on the same day, thereby reducing the costs associated with traveling between distant sites.

1) *Determine how many person-days can be devoted to the observation of safety belts.* This number defines the number of groups.

2) *Divide the total number of sites to be observed by the number of groups.* The resulting number is the number of sites within each group. For example, let us say that the Owosso Police Department was interested in determining belt use for Owosso and they determined that they would need to observe thirty sites around the city. Let us also assume that they had three observers that were each available three full working days. This would constitute nine person-days (three people times three days). Dividing the number of sites by the number of person-days (thirty sites divided by nine person-days) gives us 3.33 sites per group. This means that within each group there will be either three or four sites and that there will be nine groups. If the number of sites within any group multiplied by 1.5 (1 hour to survey the site and .5 hours to travel between sites) exceeds the total number of daylight hours, then the survey should not be conducted--the sites cannot be observed within the budget allotted for the survey.

3) *Get the map of the survey area and clearly mark each primary observation site on it.* An example map with marked observation sites is shown in Figure 3.

4) *Group adjacent observation sites so that you have the proper number of groups and the proper number of sites within each group.* In our Owosso example this would be nine groups with six of these groups containing three sites and three of the groups containing four sites (a total of 30 sites). This example is shown in Figure 3.

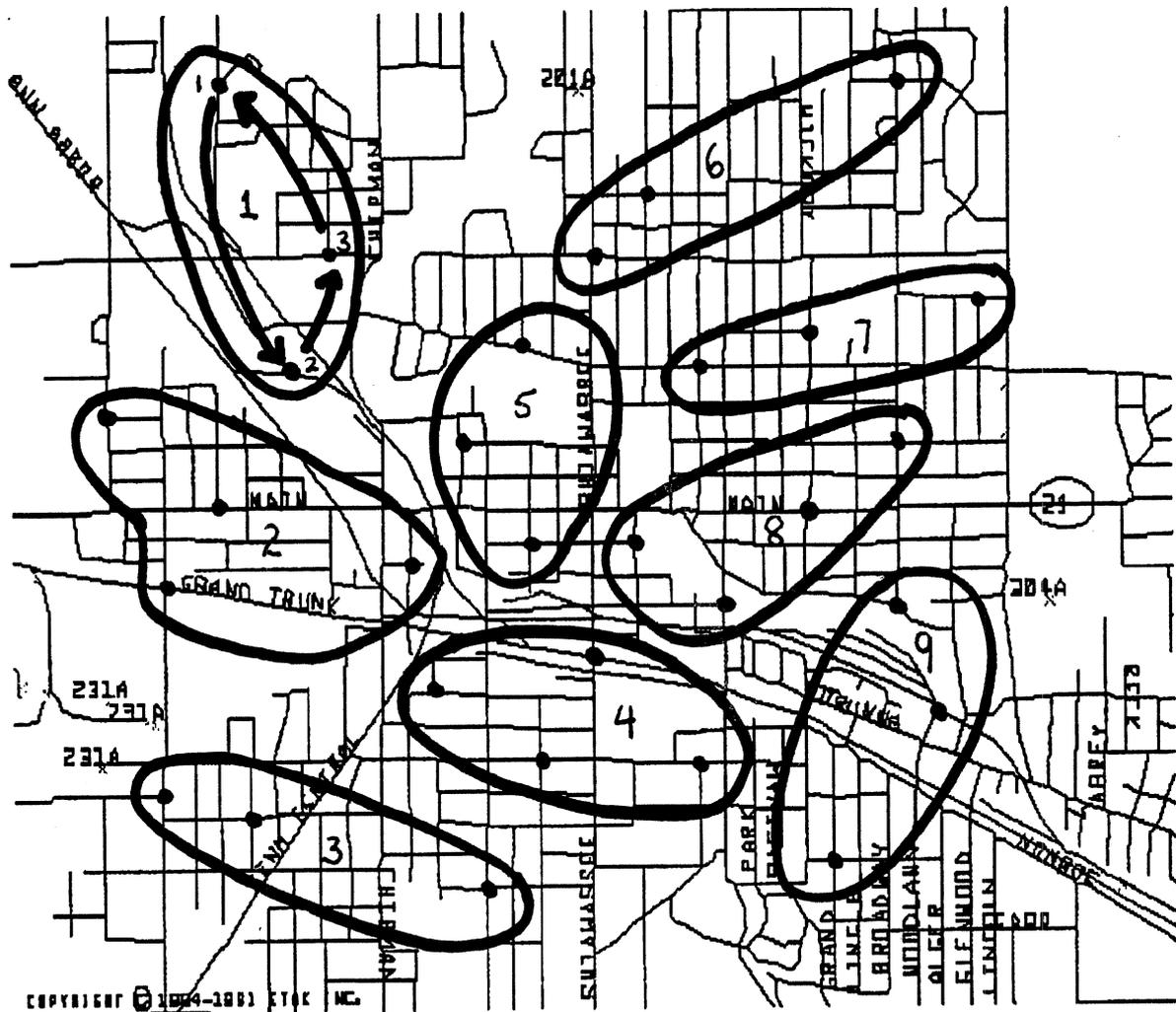


Figure 3: An example map of the city of Owosso, Michigan. Thirty sample observation sites have been marked with the small circles. The sites have been gathered together into nine groups with three of the groups containing four observation sites and six of the groups containing three sites. Each group has been numbered. For group number 1, we have shown the shortest-route path between each observation site and have numbered each site consecutively along this path.

- 5) *Number each group.*

- 6) *Randomly select the day that the group is to be observed by selecting a number between 1 and 7, where each number represents a different day of the week. The program RANDOM.EXE can be used for this purpose. All sites within a group are observed on the same day.*

- 7) *Determine the shortest-route path connecting all sites. An example of this is shown in Figure 3, where the shortest-route path between the sites in group 1 is depicted by the arrows.*

- 8) *Number each site consecutively along the path. This is shown in the same example in Figure 3 where all sites along the shortest-route path are numbered in sequence.*

- 9) *Select a random number between 1 and the number of sites within the group. This number denotes the site location for the first site that will be observed in that group. For example, if there are five sites in a group and the randomly selected number is three, then the order of site observation for that group is site 3, 4, 5, 1, and 2.*

- 10) *Randomly pick a starting time for the first site of the day to be surveyed. Once the first site survey time is selected, then the other sites are surveyed in the order determined in the last step. Make sure that the first site is observed early enough so that all sites within the group can be surveyed before sunset. For example, assume that a group had five sites and that these sites were going to be observed on a day in which there were twelve full hours of sunlight. The time required to survey all the sites in the group can be approximated by multiplying the number of sites in the group by one and one-half hours. This multiplier is*

used because it takes one hour to survey a site and about another half hour to travel between sites, fill out the site form, go to the bathroom, and so on. In our city of Owosso example, it will take about seven and one half-hours (five sites multiplies by one and one-half equals seven and one-half hours) to survey all sites in the group.

Any breaks that you may want to schedule into the day should be added to the total survey time. For our example, let us give the observer an hour lunch break and a half hour break some other time in the day. This means that the total survey time for the group would be nine hours.

Subtracting the total survey time from the number of daylight hours gives us the number of hours on which the first site in the group could be observed. In our example this number is three (twelve hours minus nine hours). We then would pick a random number between 0 and 3. The resulting number would be the hour after sunrise that the first site in a group should be observed, where zero would indicate sunrise as the starting time, one would indicate one hour after sunrise, and so on. The program RANDOM.EXE can be used to assist in randomly picking the starting time.

Step 4: Train the observers.

It is tempting to simply give the observers some instructions and then send them out to conduct the survey without any practice or training. This is a mistake. The belt use rate determined from the survey is only meaningful if you are sure that all observers are doing the same thing at each intersection. A few hours of training will ensure uniformity between observers and will significantly reduce the number of errors made during the survey.

1. *Obtain survey materials.* Prior to training it is necessary to have several items ready for each observer. They are:

- Site and data forms
- A clipboard for holding forms
- A pencil and pencil sharpener
- A watch or stopwatch for timing the survey intervals
- A complete map of the survey area, with all observation sites clearly indicated
- A written list of the addresses of all primary and alternate observation sites
- An orange safety vest or similar safety clothing to make the observer more visible to traffic

2. *Gather observers in a classroom setting and discuss the survey procedures.* The ideal way to train observers is to gather them together in a room with a knowledgeable trainer. At least two hours should be spent going over the procedures to be followed during the survey and the proper way to fill out the various forms.

The observers should be instructed that during the safety belt survey, they should be prepared for any weather conditions and should dress appropriately. It is important that the observers do not appear to be associated with a law enforcement agency, as they might if uniforms and/or patrol cars were visible. Many drivers who are familiar with the safety belt law will buckle up when they approach a law enforcement officer. This activity will bias the belt use rate estimated from the survey.

3) *Take observers to at least two example intersections and practice finding the proper standing location, observing safety belt use, and filling out the forms.* This step should be continued until all observers are comfortable with the entire procedure.

Step 5: Conduct the safety belt observations

In order to conduct the safety belt survey, the observer goes to an observation site at the scheduled day and time and surveys the site. At each site, the following procedure should be used.

1. *Determine if the site can be surveyed.* Occasionally a primary observation site cannot be surveyed. There are only two situations in which this might happen. The first is that no traffic is traveling on the traffic leg the observer was scheduled to survey. This can happen if the traffic leg is under construction, there is a crash, or the lane has been closed because of a special event. The second situation is that there is a risk to the safety of the observer if they survey the site. This could happen, for example, if there were no shoulder for the observer to safely stand on or unsavory individuals occupied the standing location site. If the primary site cannot be surveyed, then the observer should immediately proceed to the alternate site and repeat this step. If the alternate site cannot be surveyed, then a new primary and alternate site will need to be selected. Having to survey an alternate site will usually disrupt the site observation schedule for that day. In this instance, the observer should be instructed to continue observing sites in the order listed, starting the site survey whenever they arrive.

2. *Fill out the site form.* A sample site form is shown in Figure 4. At the very minimum a site form should contain places for indicating the site number and location, the day and time of observation, who observed the site, two vehicle counts, and comments. Figure 4 also includes a place for the observer to sketch the intersection and show where he or she stood, the type of traffic control, and any unique features of the site.

3. *Find the proper standing location.* The traffic lane and the direction of traffic flow to be observed was determined during the site selection step.

4. *Count all target vehicles on all designated traffic lanes for five minutes and record this number on the site form.* We call this count the *pre-survey vehicle count*. Some observation sites will be intersections that have more than one lane of traffic entering the intersection from

SITE FORM

SITE # _____ SITE LOCATION _____

SITE TYPE: Intersection
 Freeway

SITE CHOICE: Primary
 Alternate

TRAFFIC CONTROL:
 Traffic Light
 Stop sign
 None
 Other _____

DATE (month/day/year): ___/___/___

OBSERVER NAME

DAY OF WEEK

- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday
- Sunday

WEATHER

- Mostly Sunny
- Mostly Cloudy
- Rain
- Snow

START TIME: ___:___ (24 hour clock)

END TIME: ___:___ (24 hour clock)

Total number of target vehicles: _____

Total number of target vehicle occupants: _____

Total number of belted target vehicle occupants: _____

Pre-survey vehicle count: _____

Post-survey vehicle count: _____

COMMENTS:

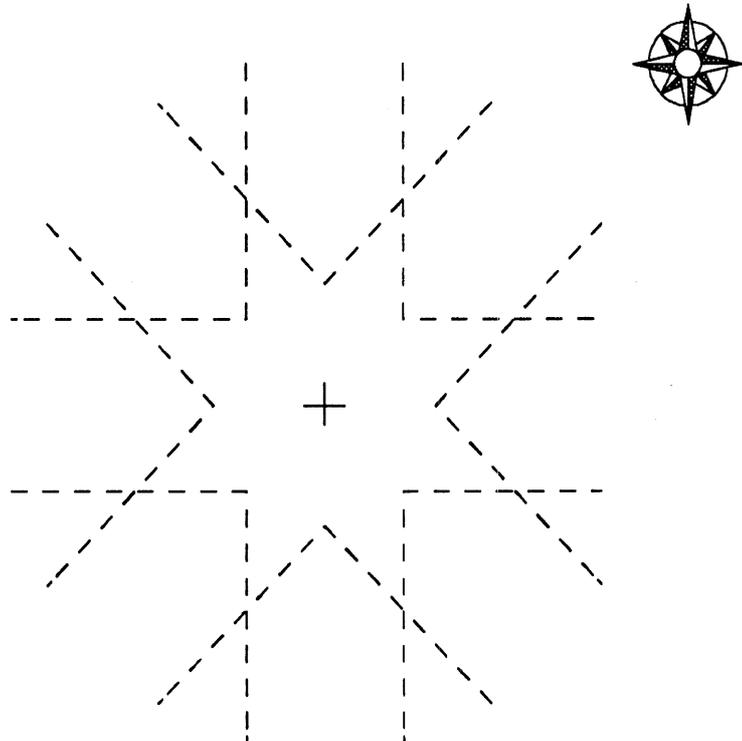


Figure 4: Sample site form.

the direction that the observer is surveying. For these sites count all target vehicles on the traffic lanes (including turn-lanes) entering the intersection from the direction that is being surveyed. An example of this type of intersection is shown in Figure 5. In this example, the observer has been scheduled to survey target vehicles entering the intersection from the right side of the figure. The three lanes of traffic that enter the intersection from this direction are labeled 1 through 3. During the pre-survey vehicle count, the observer should count all target vehicles on all three lanes and come up with an overall count for all these lanes.

5. *Observe safety belt use for 50 minutes.* Safety belt use is determined by looking at whether or not the driver and, if present, the front, window seat passenger are using a shoulder belt. If they are using a shoulder belt then they are marked as "Belted." If they are not using a shoulder belt then they are marked as "Not Belted." A sample data form for recording belt use is provided in Figure 6. On this form, each line is a single target vehicle. For each target vehicle, the observer makes two check marks on the form. The first check mark indicates whether or not the driver was belted, and the second check mark indicates that there was no passenger or whether the passenger was belted or not. It is important to mark "None" if there is no passenger present. Passengers sitting in any position other than the front, window seat are to be ignored.

During this 50-minute safety belt observation period, the observer should be surveying only a single lane of traffic, regardless of the number of traffic lanes that are present. Thus, it is possible that there will be sites in which the observer will perform the pre-survey vehicle count on more lanes than the safety belt survey. The observer should always survey target vehicles in the non-turning traffic-lane closest to the standing location. For example, the observation site shown in Figure 5 has three lanes of traffic entering the intersection from the direction that has been scheduled for observation. For this intersection, the 50-minute survey of belt use should be conducted on *only* target vehicles traveling in lane 1.

The observer should attempt to record information from all target vehicles in the proper lane of traffic. If, because of high traffic volumes, the observer cannot survey every target vehicle, then he or she should survey the *next* target vehicle they see after looking up from marking the data sheet for the last vehicle.

In many rural or residential sites, the traffic volumes will be quite low. It would not be unusual for only four or five target vehicles to pass an observer during the 50-minute interval for these low traffic volume sites. While somewhat tedious to survey, these low volumes are accounted for in the survey design, and should be observed for the entire 50-minute interval. On occasion, there will be sites in which *zero* target vehicles pass the observer during the 50-minute

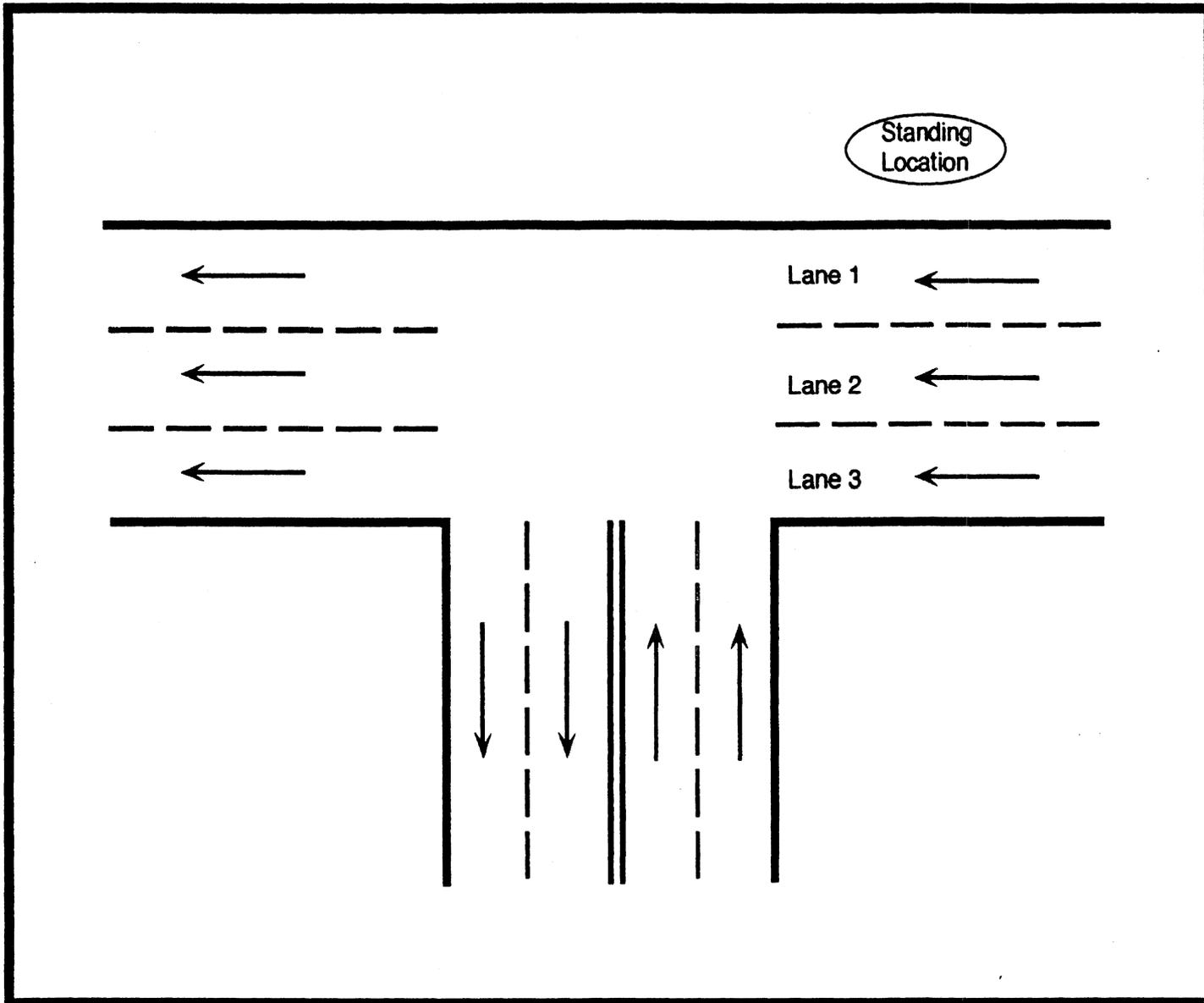


Figure 5

survey interval. If this happens, then the observer should immediately proceed to the alternate site and begin the survey procedure over at step 1. If the alternate site also yields no target vehicles, then record zero for all values at this site number.

6. Count all target vehicles on all traffic lanes for five minutes and record this number on the site form as was done in step 4. We have called this value the post-survey target vehicle count.

Step 6: Analyze the data

Before you begin analyzing the survey, you will need to tabulate the following information *for each observation site* from the completed data and site forms.

1. *Count up the total number of target vehicle occupants.* This is done by counting each driver and passenger observed at the observation site, regardless of whether they were belted or not. Write this number on the site form.
2. *Count up the total number of vehicle occupants that were belted.* You do this by counting each passenger and driver recorded as using a safety belt at the observation site. Write this number on the site form.
3. *Count up the total number of target vehicles observed during the 50 minute safety belt observation period.* This is done by counting the number of lines that were filled in on all data sheets for an observation site. Remember that each line is a separate target vehicle. Write this number on the site form.
4. *Record the pre- and post-survey vehicle counts.* These numbers should already be recorded on the site form. If the observer forgot to record one or both of these numbers, then use zero for each missing number.

The only other piece of information that you will need to analyze the survey is the number of observation sites included in the survey. The survey should be analyzed using the software program ANALYSIS.EXE. This program uses the survey data to compute the belt use rate and all necessary statistics associated with this rate.

Instructions for running the computer programs: ANALYSIS.EXE, RANDOM.EXE.

In order to run these programs you will need an IBM or IBM-compatible personal computer with a 5¼ inch disk drive. The computer programs will not run on an Apple Macintosh system.

1. Boot-up the computer. That is, turn on the computer and wait for it to go through the memory check and other processes before using it.
2. If the computer is running in *Windows*, then exit *Windows* into *DOS*. If necessary, consult your *Windows* manual for instructions on doing this.

3. Insert the computer disk into the disk drive and determine the drive letter. On most machines the drive letter for the 5¼ inch drive will be either A: or B:. For these instructions we assume that the drive is A:. If your drive is B: or some other letter, then type this letter when appropriate.

4. Type **A:** and then press the **ENTER** (or **RETURN**) key.

5. If you want to run the survey analysis program, then type: **ANALYSIS** and press the **ENTER** (or **RETURN**) key. Follow the instructions in the program to complete the analysis.

6. If you want to run the random number program, type **RANDOM** and press the **ENTER** (or **RETURN**) key. Follow the instructions in the program to generate the appropriate random numbers.

Step 7: Interpret the results

ANALYSIS.EXE computes and reports five values: belt use rate, variance, relative error, weighted number of motor vehicle occupants, and weighted number of belted motor vehicle occupants. Each of these values is important and should be reported along with your belt use rate. To facilitate your understanding of these values, we include a discussion of what each indicates and the equations the program uses to calculate them.

Weighted Number of Motor Vehicle Occupants and Weighted Number of Belted Motor Vehicle Occupants. Both of these values are related to the number of occupants, number of belted occupants, and the pre- and post-survey vehicle counts that were entered into the computer program for each observation site. The intent of the survey design was to obtain a belt use rate that was scaled or weighted by the different traffic volumes at each observation site. That is, sites that have a high traffic volume count more toward the belt use rate than do those sites with a low traffic volume. Because it is impossible to survey belt use on all target vehicles in all lanes at each observation site, the two five minute target vehicle counts are used as a way to assess the traffic volume at each intersection. The target vehicle counts are used to scale the actual number of occupants and belted occupants that were observed at each observation site.

For each observation site, the weighting was accomplished by adding the pre- and post-survey vehicle counts and then multiplying this sum by five. This gives a weighted count that reflects the total number of target vehicles that should have passed by the observer during the fifty minute survey period. If the weighted count is less than the number of target vehicles surveyed, then no weighting is done. If the weighted count is greater than the actual number of target vehicles surveyed for a certain observation site, then a weighting factor is computed by dividing the weighted count by the number of target vehicles surveyed. For each observation site the computed weighting factor is multiplied by the number of observed occupants and by the number of occupants observed using a safety belt to get the weighted values for each of these counts for that observation site. If no weighting factor is computed for a certain observation site, because the weighted count is less than the surveyed target vehicle count, then a weighting factor of one is used. The weighted total number of belted occupants is the sum of the weighted number of belted occupants over all of the observation sites. The weighted total number of occupants is the sum of the weighted occupants for each observation site.

Belt use rate. The belt use rate is the estimate of the percentage of drivers and front, window-seat passengers in the target vehicle type(s) that were using a shoulder belt in the survey area during the duration of the survey as a function of traffic volume. It is computed by dividing the weighted number of belted occupants by the weighted total number of occupants. The belt use rate also includes a "±" value. This value is called the *95 percent confidence band* and

defines a range, or band, of percentages centered around the belt use rate. This band is a statistical measure that means we can be 95 percent sure that the actual belt use for the survey area lies somewhere within the band of percentages. Remember that the survey only allows us to *estimate* belt use, meaning that there will always be some uncertainty in the belt use rate derived from the study. The 95 percent confidence band is computed using the formula:

$$95\% \text{ Confidence Band} = \text{Belt Use Rate} \pm 1.96 \times \sqrt{\text{Variance}}$$

Variance. The variance measure shows how similar the belt use rates were between each of the observation sites. The larger the variance the more dissimilar the observation sites and the more error we have in our ability to estimate the belt use rate. The variance is computed using the formula:

$$\text{Variance} = \frac{n}{n-1} \sum_i \left(\frac{g_i}{g_{all}} \right)^2 (r_i - r_{all})^2$$

where n is the number of observation sites, g_i is the weighted number of target vehicle occupants at observation site i , g_{all} is the total weighted number of target vehicle occupants summed over all observation sites, r_i is the belt use rate at each observation site, and r_{all} is the overall belt use rate for the survey area.

Relative error. The relative error value is quite similar to the variance in that it is a measure of how much variability there is in the survey. This number, however, is scaled based upon the estimated belt use rate and shows the precision of the estimate. Federal guidelines strongly encourage a relative error of 5 percent or less. The higher this value, the less meaningful your belt use rate. Relative error is computed by the formula:

$$\text{Relative Error} = \frac{\sqrt{\text{Variance}}}{\text{Belt Use Rate}}$$

If the computed relative error is greater than 15 percent, then it is best to increase your number of observation sites. This can be done by going back to step 2 and selecting additional sites to survey following the procedures as you did before. For the analysis, the additional sites should be analyzed along with the previous sites and a new belt use rate and associated statistics computed.

FINAL NOTE

When determining the number of observation sites that are necessary to achieve a reasonable estimate of belt use, it was necessary for us to make some assumptions about the similarity between observation sites. Since we have no advance knowledge about the area you wish to survey, we have used a conservative estimate based upon information we have obtained for the state of Michigan. If the survey area is within Michigan, then the number of observation sites derived from Table 1 will be accurate in most cases. If the survey area is within an area that is unlike Michigan, then the number of observation sites obtained from Table 1 may be too small. In either case, if the final results show a relative error that is greater than 15 percent, you should select additional observation sites, collect more safety belt use information at these sites, and then reanalyze the survey with the new sites included.