Automobile Occupancy, Vehicle Trips, and Trip Purpose: Some Forecasting Problems

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ABSTRACT

The problems with estimating automobile occupancy by trip purpose for use in travel forecasting and in the policy decisions that frequently follow from forecasts are described. Investigations of data and development of logit models of mode choice reveal that the occupants of multioccupant automobiles frequently have disparate trip purposes, even within the restricted trip-purpose definitions usually encountered in practical transportation planning. These disparate purposes mean that, although occupants can be classified by trip purpose, the automobile vehicle cannot be defined as being used for a single trip purpose, as is necessary to compute accurately the automobile occupancy for a purpose and to convert automobile-person trips by purpose to automobile-vehicle trips for assignment of automobile vehicles to the highway network. This has serious repercussions on a variety of contemporary policy decisions. The problems are discussed, and some alternative procedures that can be used as a compromise computation of vehicle occupancy by purpose are given. The problems and solutions are demonstrated in the context of a case study.

Automobile occupancy plays a number of roles in practical transportation planning. First, it is used as a statistic to verify the correctness of collected data and the validation of forecasting models. In both cases it is usually used as a purpose-specific measure. Second, it is used to convert automobile-person trips (the product of standard modeling procedures) to automobile-vehicle trips for assignment of vehicles to the highway network. This is again purpose specific, except in the case of estimating 24-hr assignments (1). A peak-hour or peak-period assignment uses purpose-specific occupancy in building a peak trip table from different proportions of trips by each of the purposes. Finally, automobile occupancy is an important component in policy decisions concerning high-occupancy vehicles (HOVs), where the forecasts of automobile trips in such vehicles is of critical importance. Again, occupancy is generally required to be purpose specific, particularly because most HOV facilities will operate only during peak periods (2,3).

Before the general introduction of multimodal logit models of mode choice in practical transportation planning, occupancies by purpose were estimated outside the standard modeling stream and were introduced for the conversion of automobile-person trips to automobile-vehicle trips. HOV policies were not of much interest at that time, and automobile occupancy was not an issue in model or data validation. Usually, occupancy by purpose was obtained from roadside interviews, with the driver's trip purpose defining the vehicle trip purpose.

The introduction and expanding use of the logit mode-choice model with varying levels of automobile occupancy or the use of an automobile driver and automobile passenger split in the automobile alternatives has revealed hitherto unrecognized problems and issues in the use of purpose-specific automobile occupancy. Briefly, the issues explored by this paper are that

1. Automobile occupancy by purpose cannot be estimated from modal-split models that specify occupancy levels by purpose, and these models cannot be validated by use of automobile occupancy;
2. Standard measurement procedures for automobile occupancy do not estimate occupancy by purpose, and it is not clear if this can be estimated by any current methods; and
3. Use of automobile occupancy by purpose for any of the uses previously described must involve some approximation, for which currently there are neither empirical nor theoretical rules available to guide the practitioner.

In this paper these problems are described in more detail, the additional common problem of measurement of automobile occupancy is explored, and the problems with a case study from Honolulu, Hawaii (4), are discussed. Some suggested ad hoc procedures are outlined, although no final solutions to the problems are offered. It is hoped that the problems discussed in this paper will serve to alert practitioners to inherent problems in working with purpose-specific automobile occupancies, will assist in discouraging the practice of using automobile occupancy by purpose to validate data and models, and will encourage research to deal with this problem more effectively than is done by the ad hoc procedures outlined here.

OUTLINE OF PROBLEMS

The problems that arise can be defined most clearly by considering the two alternative automobile-occupancy model specifications most commonly used for logit mode-choice models. In the first model specification, the automobile mode is defined as the submode of drive-alone automobile, two-occupant automobile, and three-or-more-occupant automobile (5-7); person trips in each submode are divided by the average occupancy for the submode (1, 2, and about 3.3, respectively) to derive automobile-vehicle trips. The second specification defines the two submodes of automobile driver and automobile passenger (8,9), in which automobile-vehicle trips are set equal to the number of automobile drivers, and the number of automobile passengers plays no role in the assignment. Before developing these descriptions further, however, some discussion of trip purposes is necessary.

Trip Purpose

In most practical applications, trip generation and trip distribution use six to eight trip purposes, whereas modal-split and highway and transit assignments use three or four purposes. In the Honolulu case study (4), as in a number of other transportation studies, trip generation and trip distribution each use six trip purposes for resident travel:

1. Home-based work,
2. Home-based school,
3. Home-based shopping,
4. Home-based social-recreational,
5. Home-based other, and
6. Nonhome based.

After trip distribution, the six purposes are aggregated to four by forming a new home-based other category [sometimes referred to as modal-split other (MSO) to distinguish it from the category 5 trip purpose] by combining purposes 3-5.

Of particular concern in the issue of automobile occupancy and trip purpose is the treatment of serve-passenger trips. In common with conventional procedures, the 1982 modeling in Honolulu treated home-based serve-passenger trips as home-based other trips, whereas non-home-based trips with a serve-passenger origin or destination were classified as non-home-based trips.

Definition of Principal Issues

Bearing in mind the definitions of trip purpose, the problems associated with the automobile-occupancy models can be described.

Multioccupancy Reporting Error

The reporting of automobile occupancy for multioccupant automobiles may exhibit one or more of several systematic and random errors in the recording of the actual occupancy of the vehicle:

1. Sampling error, resulting in driver and passenger bias,
2. Automobile drivers differing from automobile passengers in reporting occupancy,
3. Occupants improperly include or exclude themselves (depending on the wording of the question) in determining the occupancy, and
4. Children younger than 5 years are generally included in the occupancy response, although no travel information is usually collected for this age group (e.g., this results in four person trips using a five-occupant automobile).

These errors are critical to the correct analysis and application of these data to automobile-occupancy models.

Automobile Occupancy by Trip Purpose

Automobile occupancy by trip purpose is frequently derived by cross-tabulating person trips by automobile occupancy and trip purpose. However, multioccupant vehicles with two or more trip purposes will necessarily include an unknown number of trips of other purposes in the occupancy response. In effect, this will lead to varying levels of double counting, as is discussed later in the case study.

Model Specification Mixtures

The two model specifications previously discussed may be used for different trip purposes. However, this leads to additional error in converting person trips to automobile-vehicle trips for multioccupant, multipurpose vehicles. Consider the common case of a two-passenger vehicle with a serve-passenger driver taking a student from home to school: a home-based other and a home-based school trip. If home-based other trips are modeled with a driver and passenger model, the driver yields 1.0 automobile-vehicle trips. If home-based school uses the occupancy model, the passenger converts to 0.5 automobile trips, yielding 1.5 automobile-vehicle trips where only 1.0 actually occurred.

SOLUTIONS

The following case study gives techniques to quantify the multioccupancy reporting errors and to adjust the data accordingly. As mentioned previously, these adjustment procedures are ad hoc and somewhat arbitrary, but they represent the state of the art for this problem.

For multioccupant, multipurpose automobile trips, it would appear that the first potential solution might be to restrict calibration data to those automobile trips where all occupants are traveling for the same purpose. Two problems arise here. First, the purposes of other automobile occupants are not collected in contemporary surveys, and their collection may prove to be cumbersome and difficult. Second, although such a stratagem may solve the problem of calibrating the automobile submodes correctly and would allow automobile occupancy to be estimated by mode-choice purpose for the calibration data, it does not solve the basic issue of calculating occupancy by purpose for multioccupant, multipurpose automobiles, nor does it solve the forecasting problems. Instead, it excludes them and replaces them with a loss of trips and information.

Therefore, alternative compromises to provide feasible solutions for practical transportation planning are proposed, which offer less overall error at the expense of varying levels of error by purpose. The compromises can be illustrated by considering two common situations in multioccupant, multipurpose automobile trips:

1. The driver is performing a serve-passenger trip (either home based or nonhome based) with a passenger(s) traveling to work or school; the driver will be classified as making either a home-based other or a non-home-based trip and the passenger(s) will be classified as making either a home-based work or home-based school trip; and
2. One occupant of the automobile is traveling to work or school, while another occupant is traveling to the same destination for a nonwork, nonschool purpose.

In both cases the use of occupancy by purpose will double count automobile trips, thereby obscuring the estimation of automobile occupancy by trip purpose. Three alternative compromises are defined. First, it could be assumed that all double counting occurs with at least one occupant traveling for work or school, so that estimated double counting is deducted from work and school purposes only. This solution will tend to understate the volume of automobile-vehicle trips for work and school and will most affect peak-hour assignments. Second, all double-counted automobile vehicles could be deducted from the home-based other and non-home-based trips. This is equivalent to assuming that every automobile user performing a serve-passenger trip has the same purpose as his passengers. If peak-hour assignments or policies concerning HOV lanes and carpooling are of primary concern, then this option, even though it overstates the number of vehicles affected, will be the best option.

Third, and arbitrarily, half of the double count for home-based work trips can be deducted from each of the home-based work trips and the two nonwork, nonschool purposes; and half of the double count for home-based school can be deducted from itself and the other half deducted from the two nonwork, nonschool trips. This is difficult to justify because the fraction of deduction is purely arbitrary. Yet it may also be interpretable as the least biased of the three compromise solutions.

CASE STUDY

The problems and solutions described in the preceding sections are demonstrated much more clearly with the case study, which illustrates all the problems previously mentioned. Furthermore, the home-based work (HBW) and home-based school (HBS) models were originally developed as multioccupant models, whereas the home-based other (HBO) and non-home-based (NHB) models were of the driver-passenger type, thereby demonstrating the pitfalls of this inconsistent treatment of the automobile mode. Two other items are of interest in the case study. First, evidence was uncovered that the reporting of automobile occupancy appears to be subject to a large reporting error, which serves to obscure the computation of corrections for double counting; and second, there was an initial incorrect assumption made about average occupancy for the 3-or-more-occupant automobiles, the effect of which turns out to be small compared with the effects of double counting.

The case study is for Honolulu, for which data were collected in the fall of 1981. The data were collected by means of a 24-hr travel diary in a procedure described in a paper by Ohstrom et al. elsewhere in this Record.

Reporting Automobile Occupancy and Purpose

An analysis of the survey data clearly indicates that the problematical mixed-purpose trips occur frequently, even though trip purposes of other automobile occupants were not requested. The results obtained from the survey data are given in Table 1. The last two categories show that there are a number of people who are engaged in serve-passenger trips, whereas the first two categories show an imbalance between car drivers and car passengers within the purposes. However, this latter issue of an imbalance is not conclusive evidence on its own. First, a question arises as to whether the small sample data produce a balance between automobile drivers and automobile passengers, which implies that for every two-occupant automobile driver there should be a two-occupant passenger; for every three-occupant driver there should be two three-occupant passengers; and so forth. This is far from what is found in the data, which indicate that there are far too few passengers or too many drivers at each occupancy level (Table 2).

TABLE 1 Drivers, Passengers, and Occupancy from Honolulu Survey Data

				Serve Passenger	
Mode	Occupancy	HBW	HBS	Home Based	Nonhome Based
Automobile driver	2	225	79	426	391
Automobile passenger	2	205	158	–	–
Automobile driver	⩾3	71	93	315	285
Automobile passenger	⩾3	74	374	–	–

Six reasons can be advanced for this:

1. The sample contains more drivers than passengers, thus representing a bias between passengers and drivers;
2. Many of the drivers misread the occupancy question and counted themselves as well (i.e., reporting one too many occupants);
3. The extra passengers are under 5 years old, who are correctly reported as occupants, but for whom there are no trip logs, thus producing no passenger reports;
4. Automobile passengers reported occupancy incorrectly;
5. There is a higher probability of forgetting to report an automobile-passenger trip than an automobile-driver trip; the 100 missing trip logs from the households that provided responses to the mail survey were from people making predominantly automobile-passenger trips; and
6. Automobile passengers misread the survey question and marked themselves down as automobile drivers in some cases.

TABLE 2 Drivers and Passengers by Reported Occupancy Level

	Occupants						
	1	2	3	4	5	6-10	⩾11
Driver	6,001	2,422	867	359	124	78	4
Passenger	1	1,374	700	484	231	141	19
Total	6,002	3,796	1,567	843	355	219	23

Probably, part of the answer is to be found in each of these six reasons. It is unlikely that any one reason is solely responsible, or that any one has no effect. For example, that 6,001 drivers reported zero other occupants indicates that most drivers probably reported occupancy correctly. (If this question was consistently misread, there would be zero one-occupant automobiles.) That the question was misread sometimes is apparent because there is one automobile passenger who reported zero other occupants. Similarly, if all the automobile drivers were shifted to one lower occupancy, there would be serious imbalances in the opposite direction. Identical arguments can be made for automobile passengers.

The discrepancy is also not likely to be due entirely to children younger than 5 years old. If this were the case, there would be 3,288 trips by children younger than 5 years old as automobile passengers. Assuming that half of the surveyed households with two or more people in them have one child younger than 5 years old (which would appear to be an overestimate), then the survey households would have not more than 624 children younger than 5 years old. This would mean that these youngsters each make 5.27 trips per day compared with an average person-trip rate of 2.83 trips. Alternatively, every household with more than one person would have to have one child younger than 5 years old in the household to average the trip rate of all people older than 5 years old; this is equally unlikely.

Similar arguments apply to the 100 missing trip logs. These would have to have contained more than 32 automobile-passenger trips each to compensate for the missing automobile passengers. Assuming an average of 4 automobile-passenger trips per missing log would account for only 400 of the shortfall of automobile-passenger trips. Finally, although there is some evidence that respondents in the sample have a slightly higher income than the average, and that there were some intentional biases on household size, it appears unlikely that the sample could be biased to the extent that less than half of the automobile passengers that would be expected were found in the sample (3,854 sampled automobile-driver trips, where the number of passenger trips by occupancy would lead to the expectation of 1,965 trips). This would represent a large bias, and nothing else in the data supports such a supposition.

Given this, the sample should be adjusted so that it behaves consistently with the use of the model outputs. The models are used to estimate automobile use by occupancy, and every two-occupant automobile trip is assumed to generate 0.5 automobile-vehicle trips, while every three-or-more-occupant automobile trip generates 1/3.7 automobile-vehicle trips for HBW trips and 1/4.2 automobile-vehicle trips for HBS trips, as found empirically in these data.

Referring back to Table 2, there are 3,796 automobile trips with two occupants. These would be assumed to be split evenly between drivers and passengers, giving 1,898 of each. This generates a multiplier of 0.784 for two-occupant automobile drivers and 1.381 for two-occupant automobile passengers. By a similar process, 837 automobile drivers would have been estimated from the three-or-more-occupant categories out of 3,007 automobile trips, leaving 2,170 automobile passengers; but 1,432 drivers and 1,575 passengers were observed. Therefore, correction multipliers of 0.584 for automobile drivers and 1.378 for automobile passengers can be deduced. These figures yield an all-purposes average occupancy of 3.59 for the three-or-more-occupant automobiles.

The raw survey data indicate that there are 817 automobile drivers making serve-passenger trips with two occupants in the car. Factoring this, as indicated in the preceding paragraph, yields a total of 641 automobile-driver, two-occupant, serve-passenger trips. The data indicate that 15.06 percent of automobile passengers in two-occupant automobiles were making HBW trips, and 11.61 percent were making HBS trips. Assuming that the drivers making serve-passenger trips are distributed across all purposes in the same proportions as the automobile passengers, then 15.06 percent (97) HBW automobile passengers and 11.61 percent (74) HBS automobile passengers are being driven by serve-passenger drivers. In the HBW data there are 443 automobile trips with two occupants. By using the procedure applied to model forecasts, this would generate an estimate of 222 automobile-vehicle trips. But 97 of these automobile-vehicle trips are already counted in the MSO (HBO for modal split) and NHB purposes for automobile drivers. Therefore, only 125 automobile-vehicle trips from the 443 automobile-person trips should be counted to avoid double counting. This yields a factor of 1/3.54 instead of 1/2 for the two-occupant automobile-person trips to convert them to automobile-vehicle trips. This is a 43.6 percent reduction in the automobile-vehicle trips from those estimated without correction. Similarly, the school trips produced an observation of 241 automobile-person trips with two occupants, which would produce an estimate of 121 automobile-person trips. However, 74 of these are already counted in MSO and NHB trips. Therefore, the conversion factor from automobile-person trips to automobile-vehicle trips for two-occupant HBS automobile trips is (121 - 74)/241, or 1/5.13.

An identical procedure should be applied to the three-or-more-occupant automobile trips. The reader can readily confirm that this produces conversion factors to automobile-vehicle trips of 1/5.69 for HBW and 1/13.24 for HBS trips.

The next question is to determine the effect of this on the estimates of automobile-vehicle trips obtained for the 159 zones and 1985 data (Table 3). The original estimate of automobile-vehicle trips for these person trips was 421,112. Applying the new conversion factors yields an estimate of 393,338 automobile-vehicle trips. This shows a double counting of 27,774 automobile-vehicle trips, or 6.6 percent of the automobile-vehicle trips previously estimated for HBW trips. Results for the HBS trips are given in Table 4 and indicate a reduction of 22,394 automobile-vehicle trips, or 24.6 percent of the original estimate.

TABLE 3 Changes in Automobile-Vehicle Trip Estimation After Correction (HBW)

Automobile-Occupancy Category	Person	Original Vehicle	New Vehicle
Estimated one-occupant trips	356,837	356,837	356,837
Estimated two-occupant trips	104,312	52,156	29,466
Estimated three-or-more-occupant trips	40,027	12,129	7,035
Total	501,176	421,112	393,338

TABLE 4 Changes in Automobile-Vehicle Trip Estimation After Correction (HBS)

Automobile-Occupancy Category	Person	Original Vehicle	New Vehicle
Estimated one-occupant trips	58,571	58,571	58,571
Estimated two-occupant trips	29,470	14,735	5,745
Estimated three-or-more-occupant trips	58,918	17,854	4,450
Total	146,959	91,160	68,766

In total, there were 1,880,090 estimated automobile-vehicle trips for 1985, which these conversion factors would reduce to 1,829,901, a reduction of 2.67 percent of the original estimate. There were 2,414,755 automobile-person trips in the 1985 estimates, which yielded an average automobile occupancy of 1.28. The revised automobile-vehicle trips increases this to 1.32 persons per automobile.

The initial use of an average occupancy for three-or-more-occupant vehicles of 3.3, corrected subsequently to 3.7 for HBW and 4.2 for HBS trips, contributed about 10 percent to the change noted in these figures. Thus, although it is important to use a correct average occupancy for the highest occupancy grouping, the effects of an incorrect value are small compared with the problem of double counting.

It is reasonable to assume that the number of double-counted automobiles will be a function of the volume of HBW and HBS trips. Therefore, the correct procedure must always be to initially estimate the double count from these trips. However, there has to be some inconsistency in determining occupancy by purpose and in attributing automobile-vehicle trips to purposes because of the mixture of purposes represented in any multioccupant automobile. There are three alternatives that could be used with some justification from this analysis.

Alternative 1: Reduction of Work and School Trips

Automobile-vehicle trips are reduced solely in the HBW and HBS purposes. Therefore, the conversion factors defined earlier in this paper are used to compute vehicle trips from person trips. The conversion factors are given in the following table (the results are summarized in Table 5):

Purpose and Occupancy	Factor
HBW	
Two occupants	1/3.54
Three or more occupants	1/5.69
HBS	
Two occupants	1/5.13
Three or more occupants	1/13.24

Alternative 2: Reduction of Nonwork, Nonschool Trips

The additional automobile-vehicle trips are deducted from MSO and NHB instead of from HBW and HBS, after first calculating the double count from the HBW and HBS trips. This involves calculating the fraction of automobile-person trips for each of two occupants and three or more occupants that represent double-counted automobile-vehicle trips. If there were no double counting, then two-occupant vehicle trips would be obtained by using a conversion of 0.5 on automobile-person trips. The difference between this and the revised conversion factor of 1/3.54 for HBW is 0.2175. Thus there is a double count of 0.2175 times the 104,312 two-occupant automobile trips. In similar fashion, the factors that represent double counted automobile-vehicle trips for each occupancy of each purpose can be calculated, as noted in the following table:

Purpose and Occupancy	Factor
HBW	
Two occupants	0.2175
Three or more occupants	0.0945
HBS	
Two occupants	0.3051
Three or more occupants	0.1626

In the sample data, 64.68 percent of the automobile-driver, serve-passenger, multioccupant trips were home based and 35.32 percent were nonhome based. Therefore, after summing the total double-counted automobile-vehicle trips, 64.68 percent are deducted from MSO trips and 35.32 percent are deducted from NHB trips.

Applying this to the 1985 regional trip estimates, 45,042 automobile-vehicle trips are double counted. Deducting these from the MSO and NHB automobile-driver trips, by using the percentages given in the preceeding paragraph, reduces the number of automobile-driver trips (and therefore the number of automobile-vehicle trips) to 960,782 for MSO and to 361,982 for NHB. By using the corrected average occupancies for three or more occupants for HBW and HBS trips, new estimates of 419,814 vehicle trips for HBW and 87,342 for HBS are obtained.

Alternative 3: Reduction from All Trip Purposes

Although much less easy to justify, there is the proposition to deduct one-half of the double counts from each purpose. The double count for two-occupant HBW trips is 22,688 vehicle trips, of which 11,344 would then be deducted from the HBW trips and 11,344 from MSO and NHB trips together. Similarly, 1,891 vehicle trips would be deducted from HBW three-or-more-occupant automobile trips, 4,496 from HBS two-occupant trips, and 4,790 from HBS three-or-more-occupant trips. A total of 14,567 and 7,954 trips would be deducted from MSO and NHB trips, respectively, for a total of 22,521 trips.

It is instructive to see the effects of these alternatives against both the original estimates with no correction for double counting and the correction to a more correct average occupancy. These results are summarized in Table 5. It is also interesting to note the automobile occupancies by purpose that result from these various alternatives (Table 6). The results in Table 6 show some marked variations in automobile occupancy by purpose. Again, this serves to underline the problem of computing automobile occupancy by purpose.

TABLE 5 Comparison of Original Results and Alternative Solutions

Purpose and Occupancy	Uncorrected Person Trips	Uncorrected Vehicle Trips	Corrected Occupancy	Alternative 1	Alternative 2	Alternative 3
HBW 1	356,837	356,837	356,837	356,837	356,837	356,837
HBW 2	104,312	52,156	52,156	29,467	52,156	40,812
HBW ≥ 3	40,027	12,129	10,818	7,035	10,818	8,927
HBS 1	58,571	58,571	58,571	58,571	58,571	58,571
HBS 2	29,470	14,735	14,735	5,745	14,735	10,239
HBS ≥ 3	58,918	17,854	14,028	4,450	14,028	9,238
MSO d	989,915	989,915	989,915	989,915	960,782	975,348
MSO p	314,454	314,454	314,454	314,454	314,454	314,454
NHB d	377,891	377,891	377,891	377,891	361,982	369,937
NHB p	84,360	84,360	84,360	84,360	84,360	84,360

TABLE 6 Vehicle Occupancy by Trip Purpose for Alternatives

Purpose	Uncorrected Model	Vehicle Occupancy: Three or More Occupancy Correction	Alternative 1	Alternative 2	Alternative 3
HBW	1.19	1,19	1.27	1.19	1.23
HBS	1.61	1.68	2.14	1.68	1.88
HBO	1.32	1.32	1.32	1.33	1.32
NHB	1.22	1.22	1.22	1.23	1.32

As a final note, the overall magnitude of the changes noted in this paper are of a similar order of magnitude to many of the other errors in the forecasting process. Nevertheless, it is worthwhile to seek a correction for at least four reasons. First, much of the existing error in forecasting models cannot currently be removed. Simply because the errors noted here appear no greater than those errors is no argument for ignoring correction and the possible improvement in accuracy to be obtained from improved methods to estimate automobile occupancy. Second, it is important to discern the inappropriateness of using automobile occupancy to assess the validity of data and models. Failure of data or models to reproduce observed automobile occupancy by purpose provides no information on validity. Third, when HOV lanes are of policy concern, the magnitude of the errors is large, proportionately. Depending on the method used, HOV lane volumes may range up to 100 percent greater with one method than with another. Fourth, the errors in automobile occupancy could be reduced by redefining some of the questions customarily asked in transportation surveys. In particular, attention should be given to determining whether or not a survey instrument design can be created that will both remove current potentials for misreporting or mismeasuring automobile occupancy, and permit data to be obtained on the purposes of all occupants in a multioccupant vehicle. With respect to the measurement problem, it is worth noting, anecdotally, that various designs of questions used by the authors that specify "including yourself" and various other terms designed to specify unambiguously how to count have all met with relatively similar rates of failure. Apparently, most people just do not bother to read the question properly and therefore are uninfluenced by any qualifiers on occupancy.

CONCLUSIONS

Two final comments are in order. First, one automobile-occupancy model specification should be applied across all trip purposes, with the occupancy model offering better information relative to current transportation planning issues. One model specification will simplify some of the problems in dealing with the multioccupant, multipurpose automobile. However, the analysis will still be necessary to adjust the derivation of automobile occupancy by trip purpose for use in calculating automobile-vehicle trips and for estimating the effects of HOV policies and similar issues.

Second, if policies relating to carpooling, HOV lanes, and similar concerns are to be examined, then alternative 2 should be used, which will provide a correct estimate of the number of three-or-more-occupant automobiles that are being used to work and to school, primarily in the peak period. Use of alternative 1 would result in ignoring a number of three-or-more-occupant automobiles because they are included in the MSO and NHB trips but are not explicit as to occupancy. When automobile occupancy by period or purpose is not critical, then alternative 1 (which is simpler) is probably the best procedure to use. Beyond this, the alternative procedures are a matter of the preference of the analyst. Of course, there is a danger that these various methods can be used to justify alternative strategies, and great care must be taken to select an alternative that is objectively justifiable and not subjectively convenient.

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