FORECASTING DEMAND FOR PERIPHERAL PARK-AND-RIDE SERVICE

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A method of estimating the usage of peripheral park-and-ride services is demonstrated in this study. The purpose of such a method is to evaluate the demand potential of alternative park-and-ride service operations. The data used in this study are based on a license plate survey conducted in the two peripheral park-and-ride lots in the Albany area. Results of graphical and regression analyses in this study indicate that differences in travel time, cost, and distance for the park-and-ride mode and the alternative mode (e.g., automobiles) as well as the geographic location of the parking lot have a bearing on whether a park-and-ride service is able to attract patronage from its potential service area. An example application of the regression model is demonstrated in which the expected number of park-and-ride users from one of the service subareas of a peripheral parking lot is estimated when the Albany service is expanded from state employees only (as is now the case) to the general public.

•PARK-AND-RIDE operations, both remote and peripheral, have received increased attention in recent months because of the energy crisis, the resultant shortage of gasoline, and interest in means of decreasing the consumption of gasoline by private automobiles. Park-and-ride services offer drivers an opportunity to decrease gasoline consumption as well as many of the costs associated with regular commuting.

In suggesting a method of determining the demand for peripheral park-and-ride systems, this report provides the transportation planner and transit operator with a relatively simple means of identifying locations where these systems would have a high probability of successful operation. This report expands earlier research concerning methods of park-and-ride planning. Other papers address appropriate ridership-estimating models and procedures for remote park-and-ride facilities (1), summarize park-and-ride surveys taken to date (2), and provide guidelines for park-and-ride lot (PPL) implementation (3). Together, these documents are intended to assist transit managers, transportation planners, and public administrators in instituting successful park-and-ride operations.

PERIPHERAL VERSUS REMOTE PARK-AND-RIDE

Although the differences between remote and peripheral park-and-ride services have been detailed elsewhere (3), some of the factors that distinguish the two services are pointed out here. Both remote and peripheral park-and-ride operations provide for commuting to major activity centers via an interim parking facility and express transit service to the destinations. In remote operations, the parking areas and the point of transit origination are located relatively far (more than 3 miles or 4.8 km) from the activity center, close to a residential concentration to which the service is directed. Peripheral operations, on the other hand, are located relatively close to the activity center. Thus, remote operations are characterized by express transit service for a major portion of the commutation trip and private automobile or walking as the principal means of access. Peripheral operations rely on express transit service only for a minor portion of the commutation trip, that part closest to the activity center. The

peripheral parking lot acts as a collector for commuters from a wide area, permitting them to board the transit system for a short portion of their trip, usually the most congested.

DEMAND FORECASTING METHOD FOR PERIPHERAL PARK-AND-RIDE SERVICES

The development of a patronage-estimating procedure for the remote situation (1) assumes that time difference is a significant factor in a person's decision to use the park-and-ride facility, and, in fact, the likelihood that a person will patronize the system can be predicted from the amount of time that a person will save (or lose) by using the park-and-ride service.

Peripheral park-and-ride services, however, are viewed as offering other incentives, including decreased commuting costs (lower or no parking fees). Thus the following assumptions are made for this study:

1. Some combination of time and cost factors is the basis for the decision to use peripheral park-and-ride services rather than other modes, and
2. The service area for a peripheral park-and-ride system is in the shape of a cone whose point is located at the parking lot site and whose boundaries are determined by the existing highway arterial system.

The following analysis reports on these two facets of peripheral park-and-ride services by using observations made in the Albany area. Although the data appear to support the above assumptions, preliminary attempts to define a mathematical model to describe the precise relationships between the measured variables have proved to be successful only in providing general guidelines for the planner or transit operator interested in instituting such services. Although the analysis presented is useful in determining whether a particular peripheral park-and-ride site should be considered, it is not sufficiently accurate to estimate precise usage. It may be used to evaluate several proposed park-and-ride sites in a given area, from a relative standpoint. It is hoped that further research will expand on this base to provide those methodologies.

DATA SOURCE AND DESCRIPTION

Peripheral Park-and-Ride System in Albany

The peripheral park-and-ride system operated for state employees in the Albany-Schenectady-Troy area by the New York State Office of General Services was chosen for analysis. The study was begun and data were collected in July 1973.

Peripheral park-and-ride service to the downtown-South Mall area of Albany is provided in two areas: the Washington Avenue site, located to the north and west of the South Mall near New York State Thruway Exit 24 and the McCarty Avenue site near Exit 23. Persons using the service may enter these lots, park their automobiles (or disembark from a vehicle that then leaves the parking area, i.e., kiss-and-ride), and board a transit vehicle or suburban type of bus, which then travels nonstop to the destination area (downtown Albany). The charge for this service is $5 per month per vehicle. No additional charge is levied for vehicles carrying more than one person. There is no additional fare charged for using the bus service. During the peak hours buses leave the parking areas, or downtown-South Mall boarding areas, every 5 to 7 min; during off-peak hours the headways are a minimum of 40 min. The lots offer a combined capacity of 1,900 vehicles—1,200 at the Washington Avenue facility and 700 at McCarty Avenue.

The local transit system, operated by the Capital District Transportation Authority, provides no regular service to either parking lot area, although the park-and-ride

buses from the McCarty Avenue location are owned and operated by the authority under contract with the state. A one-way fare on the authority's regular route system at the time of this study was 35 cents; to use the system daily for a month from these same general areas to the downtown-South Mall area averages $14. Persons traveling on routes from the Schenectady or Troy areas to downtown Albany paid twice this amount under the then-current fare structure.

Parking facilities in the destination area served (downtown-South Mall) are severely limited. Twenty-two parking areas controlled or operated by the Office of General Services (OGS) provide parking for approximately 1,900 vehicles of state employees at $5 or $10 per month. Private parking facilities charge from $15 to $40 per month.

Alternatives to this system are metered parking on both major and minor streets in the area and parking in restricted areas with its consequent hazards. All of these alternatives are not open to the average driver, however, since the OGS-controlled lots have limited capacities and long waiting lists for those spaces that do become available. The situation at the private facilities is similar although not so severe. In summary, it has been estimated that, in 1972, there was a shortage of some 6,600 legal parking spaces in the downtown-South Mall area. This deficiency was apparently being made up by illegal parking, parking outside the downtown area (4), and the park-and-ride system analyzed.

This park-and-ride system is unique in at least two important respects.

1. It is provided by the state as a convenience for state employees. (Compare the $5 monthly charge for park-and-ride service with a minimum $14 monthly fare on the regular route system.)
2. It is available only to state employees who work in those areas where parking facilities are severely restricted, in large part because of state actions (construction of the South Mall complex).

Both of these points should be kept in mind throughout this study and in any application of the principles developed here to other situations.

Zip Code Areas

The Capital District area was divided by zip code for the purpose of analysis. The area considered was within approximately a 30-mile (48-km) radius of Albany and consisted of 41 zip code areas. A comprehensive map of the zip code area boundaries was found to be lacking, so an approximation was constructed from a series of locally published maps containing this information (5).

Zip code areas were selected for analysis because the information about both the user and eligible populations already contained zip code data and required no further coding or distribution on other geographical bases. Although using zip code areas simplified data collection, in this case, there is nothing in the analysis to suggest that zip areas are better or worse than any other geographical base that could be used, if comparable data could be obtained.

Eligible User Population

The population of persons eligible to use the peripheral park-and-ride system studied consists of state employees whose principal work location is the downtown-South Mall area of Albany. A listing of all persons employed by the state in this area was obtained from payroll records of the State Department of Audit and Control. Approximately 50 percent of these state employees had listed a home zip code. The residential distribution of these persons is assumed to be random; consequently, a factor of 2 was applied uniformly to give an estimate of the total population of eligible users.

Actual Peripheral Park-and-Ride Users

The zip codes of actual users of the peripheral park-and-ride system were obtained from the State Department of Motor Vehicles on the basis of a license plate survey conducted on July 10, 1973, at both the Washington and McCarty Avenue lots. Of the 830 user plates recorded on that day, 117 could not be matched to a local zip code from Department of Motor Vehicles records. This can be accounted for by various reasons:

1. New registrations between time of license plate survey and the actual computer match,
2. Recent local residence by out-of-state persons and by persons from other parts of the state who had not yet changed their vehicle registrations,
3. Incorrect listing of numbers by surveyors, or
4. Inaccurate keypunching.

Table 1 gives the number of eligible and actual users of each lot, by zip code.

METHOD OF ANALYSIS

It is assumed that all the park-and-ride users residing in the same zip code zone originate their daily work trips from a single point. This point is chosen on the basis of the population distribution within the zone and is usually the center of the population density.

A person residing in any zone can either drive her or his car directly to the downtown-South Mall area or drive to one of the peripheral parking lots, park her or his car, and then use the shuttle bus to her or his destination. It is felt, however, that the extent of the park-and-ride system usage of each zone is largely determined by the convenience and savings in travel time or travel cost or both by using the park-and-ride service instead of driving directly to the destination area from that zone. It is therefore of interest to determine how the changes or differences in travel time and cost, along with the location of the lot with respect to the trip origin and destination, affect travelers' decisions on whether to use the peripheral parking services.

The extent of the park-and-ride system usage is represented in this study by the percentage of the eligible population in each zip code zone that uses the peripheral park-and-ride system. Travel time and cost figures associated with traveling between any of the origin zones and the jobsite by the two available modes are computed on the basis of the distances of the various trip segments. (Traveling by bus is also a possible mode. However, because bus-user trips constitute only 2 percent of the total work trips in the Albany-Schenectady-Troy area, they are not considered in this study.) The proportion of park-and-ride usage from each zone is plotted against the savings (or loss) in total travel time (ΔTT), total travel cost (ΔTC), or total air distance (ΔAD) resulting from using the park-and-ride instead of driving an automobile. In addition, simple linear regression models are estimated based on these variables.

Travel Time and Cost Elements

For an automobile trip, the entire trip consists of walking to the car at trip origin, driving the car from trip origin to CBD, finding a parking space and parking the car, and finally walking to the trip destination (jobsite). A park-and-ride trip, on the other hand, is composed of walking to the car at trip origin, driving from trip origin to the PPL, parking the car, waiting for the bus, and riding the bus to the destination. The cost elements associated with each method of travel are as follows:

Mode	Cost
Park-and-ride	Automobile operation to PPL Service fee
Automobile	Automobile operation to activity center Parking fee

Level-of-Service Variables

The definitions and specifications of the various time, cost, and distance variables are discussed below.

Automobile Air Distance

The straight-line distance between a given zonal trip origin and the automobile trip destination (e.g., PPL for park-and-ride user and downtown-South Mall area for automobile driver). The actual driving distances are obtained by factoring the automobile air distance by an index of 1.2 to account for over-the-road distance.

Walk Time to Car

A uniform 1 min is assigned as the time it takes a traveler to walk from her or his home to where her or his car is parked.

Automobile In-Vehicle Time

The time spent in an automobile is estimated on the basis of the average automobile speeds. Three speed rings are assigned in this study according to the extent to which expressway driving and local street driving are mixed. Those travelers who do not have to drive more than 4.8 miles (7.7 km) whether or not they use park-and-ride service are assigned an average automobile speed of 18 mph (29 km/h). This is because an automobile trip of 4.8 miles or less generally involves a high degree of local street driving.

The choice of the 4-mile (6.4-km) ring is based on the geographic size of the Capital District urbanized area. In the second case, where the travelers' driving distance is between 4.8 and 21 miles (7.7 and 34 km), the travel routes usually consist of equal portions of expressway and local street driving. Therefore, an average automobile speed of 25 mph (40 km/h) is assigned. In the third case, in which the travelers have to drive more than 21 miles (34 km), the travel routes are predominantly expressway, and an average speed of 35 mph (56 km/h) is assigned.

Automobile Operating Cost

The automobile operating cost is assumed to be 6 cents/mile (1.6 km). This figure approximates what travelers actually perceive as the cost to run the car and does not include insurance, depreciation, or the cost of purchasing the car.

Automobile Out-of-Vehicle Time at CBD

A total of 15 min is assigned as the time required of the automobile driver at the terminal end of the trip. This includes the time the traveler spends looking for the parking space and parking the car, plus the time spent walking from parking space to the jobsite.

Automobile Parking Cost at Activity Center

The average daily parking cost is assumed to be 60 cents, and therefore the parking cost for the morning trip is 30 cents. The cost figure considers the fact that some people park their cars on the street at little or no cost (risking the chance of receiving a traffic ticket) and some others pay as much as $40 per month to park in a garage.

Park-and-Ride Service Time

This element includes the time the park-and-ride user spends at the PPL parking the car and waiting for the shuttle bus, plus the bus in-vehicle time to the jobsite. A park-and-ride service time of 16 min is assigned to those travelers who use the Washington Avenue PPL and 20 min to those who use the McCarty Avenue PPL. These figures are based on the shuttle bus schedules and bus running times.

Park-and-Ride Service Cost

Based on a $5/month fee, park-and-ride users are charged a fee of 12.5 cents per trip.

Graphical Results

Figure 1 shows the percentage of park-and-ride users plotted against the level-of-service differences between the automobile and park-and-ride modes. The difference in total travel time is ΔTT. The figure indicates, as expected, that, the longer it takes to use the park-and-ride mode as compared to using the automobile mode, the lower the proportion of park-and-ride users will be. Also, for eight out of the 10 zones that show more than 20 percent park-and-ride usage, there is a slight time saving by using the park-and-ride mode. Another interesting observation is that the Washington Avenue PPL service provides travelers from more than half of its service zones a time saving of as much as 10 min; the McCarty Avenue PPL service generally does not provide its users any travel time saving. This is probably one of the reasons that the average zonal share of park-and-ride users is 15.0 percent for the former and only 5.0 percent for the latter.

A graph of the percentage of park-and-ride users versus the difference in total travel cost (ΔTC) is shown in Figure 2. This figure also indicates that as ΔTC increases the proportion of park-and-ride users decreases. However, it should be noted that, with the exception of one zone (Rensselaer) that has only 2 percent park-and-ride usage, none of the other zones shows any park-and-ride usage when the cost of the park-and-ride mode equals that of the automobile mode. Furthermore, zonal park-and-ride usage of more than 20 percent occurs only when the cost saving is relatively large, on the order of 35 cents per trip. Comparison of Figures 1 and 2 shows that travelers are relatively sensitive to the savings of time but relatively insensitive to that of cost. In Figure 1, park-and-ride usage increases when this mode offers a time saving of around 5 min. On the other hand, Figure 2 shows that park-and-ride usage increases when a cost saving of approximately 35 cents is offered by that mode. This appears to imply a travel time value of 7 cents/min (or $4.20/hour). This is of course a rough estimate. Again, however, the Washington Avenue lot appears to be more attractive than the McCarty Avenue lot in that the former offers users a larger cost saving than the latter.

The percentage of park-and-ride users versus the difference in the total air distance (ΔAD) is shown in Figure 3. In general, the straight-line distance is longer for a driver who goes to the downtown-South Mall area via the park-and-ride route than for one who drives there directly. However, an interesting point is that, for seven of the 10 zones that have greater than 20 percent park-and-ride usage, there is virtually no

Figure 1. Proportion of park-and-ride mode usage versus travel time difference.

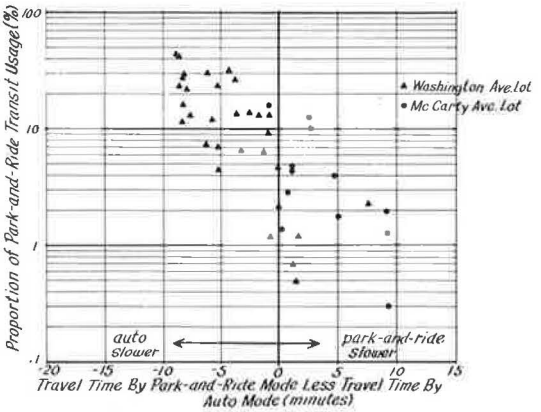


Table 1. PPL users and those eligible for PPL usage.

Zip Code	Number of Users	Number of Eligibles	Users as Percentage of Eligibles
Washington Avenue area			
12009	11	82	13.4
12010	16	52	30.8
12019	5	36	13.9
12020	9	28	32.1
12047	14	316	6.5
12054	6	506	1.2
12065	17	222	7.6
12084	8	36	22.2
12110	23	350	6.6
12118	19	72	26.4
12144	5	218	2.3
12159	7	50	14.0
12180	7	1,274	0.5
12182	5	226	2.2
12186	7	30	23.3
12188	5	54	9.2
12189	7	148	4.7
12203	56	1,248	4.5
12205	68	944	7.2
12206	9	716	1.2
12208	9	1,236	0.7
12211	16	120	13.3
12302	19	142	13.4
12303	36	128	28.1
12304	27	116	23.3
12305	7	16	43.8
12306	44	104	42.3
12307	7	42	16.7
12308	8	68	11.8
12309	27	92	29.3
12866	12	98	12.2
Total	526	8,770	
McCarty Avenue area			
12051	3	24	12.5
12054	20	506	4.0
12077	9	56	16.1
12143	6	128	4.7
12144	4	218	1.8
12158	4	88	4.5
12161	3	4	75.0
12180	4	1,274	0.3
12182	3	226	1.3
12186	3	30	10.0
12189	3	148	2.0
12202	8	576	1.4
12209	17	590	2.9
12414	4	0	—
Total	91	3,868	

Figure 2. Proportion of park-and-ride mode usage versus travel cost difference.

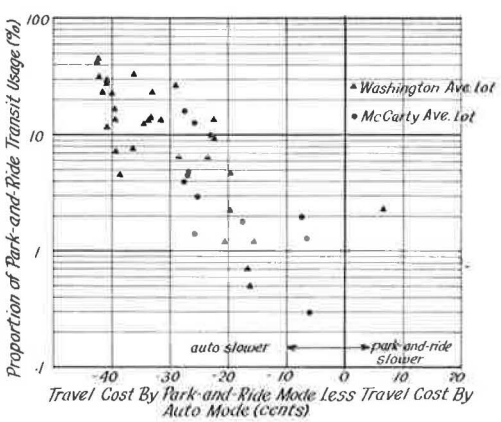
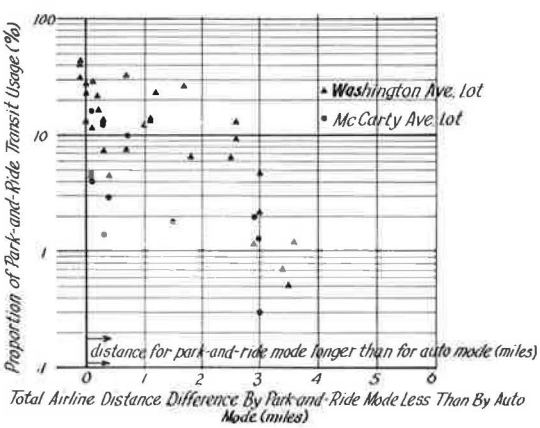


Figure 3. Proportion of park-and-ride mode usage versus total air distance difference.



difference (i.e., no greater than 0.2 mile or 0.3 km) in air distance between the two modes. For the remaining three zones, although there is some difference in total air distance, the best (or most likely) travel routes for those travelers who reside in these zones actually go past the Washington Avenue PPL. In fact, the Washington Avenue lot is located in the vicinity of the Northway Expressway as well as the several major arterials in the area. Consequently, the observation can be made that a peripheral parking lot is likely to attract more patronage if it is geographically located such that (a) the trip origin, the peripheral parking lot, and the trip destination, in that order, remain on a relatively straight line; or (b) the peripheral parking lot is situated along the most likely travel routes linking the trip origin and the trip destination. Furthermore, the average air distance between trip origin and destination for the 10 zones with the highest park-and-ride usage is 15.6 miles (25 km). This suggests that PPLs attract people who live far from their trip destinations.

A comparison of the means (averages) of the various transportation attributes for the two lots and the zones indicating the highest percentage of users, as well as their corresponding park-and-ride modal share, is given in Table 2. Although this is a highly simplistic presentation of how the various transportation attributes affect park-and-ride usage, it does demonstrate the necessary ingredients required for successful peripheral park-and-ride service. That is, the service must provide possible savings in time and considerable saving in cost, and most importantly the parking lot must be ideally located.

Regression Analysis

An attempt was made to develop a linear model so that the share of the park-and-ride usage is represented as a function of the difference or ratio of travel time-cost for the park-and-ride mode and the automobile mode. The method of estimation employed is the stepwise regression. The models are calculated based on the set of data associated with the Washington Avenue PPL because, based on the findings of the graphical analysis in this study, that PPL is clearly superior to the McCarty Avenue PPL. The service subareas of the Washington Avenue PPL are shown in Figure 4. The proportions of park-and-ride usage for these service subareas are given in Table 3. It is felt that development of a good model must be based on a successful peripheral park-and-ride service.

As discussed previously, the values of the travel cost and travel time variables in this study are derived from the same basic information, the air distance. The high correlation that this introduces between the two explanatory variables makes it implausible to include both of them in the same model. In fact, the resulting models either have incorrect model parameters or are statistically unacceptable.

On the other hand, it is evident that the traveler's decision on whether to use the park-and-ride mode is influenced by the savings (or loss) in both travel time and travel cost. Therefore, a combined cost figure that is the sum of the travel cost and the monetary value of the travel time is used as the independent variable. Travel time information is converted to its equivalent cost figure by assuming a value of time of $4.20/hour (or 7 cents/min). This particular value of time is based on the value of time implied by the time and cost graphs in Figures 1 and 2. The model is shown below.

$$\text{Percentage of park-and-ride usage} = 3.082 - 0.209(\Delta CC)$$

where CC = combined cost of park-and-ride mode minus combined cost by automobile mode (for most cases ΔCC is negative).

This model indicates that only 3 percent of park-and-ride usage can be expected when the combined costs of traveling by the two modes are the same. In other words, to attract peripheral park-and-ride service patronage, the service must offer a considerable savings in the combined travel cost. Statistically, both the combined cost

Table 2. Comparison of attribute means.

Market Segment	Number of Zones	$\overline{\Delta TT}$	$\overline{\Delta TC}$	$\overline{\Delta AD}$	$\overline{P\text{-}R}$ (percent)
Top 10[a]	10	-7.0	-38.8	0.4	30.2
Washington Avenue PPL	31	-3.8	-30.1	-1.9	15.0
McCarty Avenue PPL	12	3.8	-20.6	1.0	5.1
Total	43	-1.7	-27.4	-1.5	12.2

[a]Zones that register more than 20 percent park-and-ride usage.

Figure 4. Washington Avenue parking lot service subareas.

Table 3. Usage of Washington Avenue PPL by service subarea.

Subarea	Eligible Users	Observed Users	Proportion of Usage (percent)
A	708	175	24.7
B	234	45	19.2
C	198	33	16.7
D	2,006	143	7.1
E	5,572	104	1.9
Total	8,718	500	5.7

Table 4. Comparison of patronage from Washington Avenue PPL service subarea A.

Patrons	Actual Expected Users	Eligible Users	Proportion of Usage (percent)
State employees only	175	708	24.7
Public			
$5/month	400	1,814	22.1
$10/month	353	1,814	19.5
$15/month	306	1,814	16.9

variable coefficient and the model as a whole are significant at greater than the 99 percent confidence level. The standard error is 0.43. However, the estimated residue measurement (R^2) is only 0.45, which is quite low. This means that the combined cost, although a necessary factor, is not fully sufficient to explain park-and-ride usage. (Income, for example, is not included in the analysis.) Nevertheless, this model does provide some general indications of the patronage that a certain peripheral park-and-ride facility may expect from its potential service market. This type of knowledge is especially helpful for transportation planners and transit service operators during the preliminary stages of a proposed park-and-ride service study.

PLANNING APPLICATION

The regression model obtained in this study may be applied to a variety of PPL planning situations. In particular, it enables transportation planners to address issues such as the number of people who are expected to use the park-and-ride service if a PPL is placed at a certain location or the changes in the park-and-ride usage corresponding to changes in certain operating policies, e.g., service fee, service market segment, and shuttle bus operating frequencies.

As discussed previously, the two peripheral parking lots in Albany only serve state employees who work in the downtown-South Mall offices. One of the questions a transit operator may want to ask is, How many people will use the park-and-ride service if the service is available to the public? As a simplified example, the park-and-ride patronage from one of the major service subareas of the Washington Avenue PPL (area A in Figure 4) will be estimated for the situation in which the park-and-ride service is available to the public.

Two items of information are needed to estimate park-and-ride usage in this case by applying the regression model. The first item is the difference of the combined cost between the two modes. This information may be obtained, as discussed earlier, by converting the air distances of the various trip segments into the differences in travel cost-travel time and combining these variables into a single combined cost variable by

assuming a travel time value of $4.20/hour.

The second item of information is the total number of eligible users in the area under consideration. It may be recalled that state employees who work in downtown-South Mall offices are the only eligible users for the existing park-and-ride facilities. However, if the facility is open to the public, then all persons who work in downtown Albany become potential customers of the service. The number of persons from each census tract who work in the Albany CBD is generally available from 1970 census data.

The proportion of park-and-ride usage from each census tract is calculated at park-and-ride service rates of $5, $10, and $15 per month. The attributes of the various rates are reflected in the regression model in values of the combined cost variable. For instance, at the rate of $5 per month the park-and-ride service cost is 12.5 cents per trip. On the other hand, at the rate of $10 per month the service cost per trip is 25 cents per trip, 12.5 cents per trip more than the previous rate; therefore, the total combined cost is also increased by 12.5 cents per trip. This, of course, results in a decrease in the proportion of park-and-ride usage.

Although many of the tracts have up to 24 percent of park-and-ride usage, the expected number of persons who will use the park-and-ride service is limited because of the low number of persons from those tracts who work in the Albany CBD. On the other hand, some other tracts that have a usage share of only 18 percent produce considerably more park-and-ride users. This is because there are a large number of potential (or eligible) users from these tracts.

A comparison of the number of park-and-ride service users from subarea A, when the service is limited to state employees and when it is available to the public at service rates, is given in Table 4 (the Amsterdam figures are not included).

A total of 670 persons from the town and city of Amsterdam, which has a proportion of 20.81 percent usage, work in the city of Albany. However, it is not known how many of these persons work in the Albany CBD. If we assume that those who work in Albany city actually work in the CBD area, a maximum of 139 persons from Amsterdam would be expected to use the Washington Avenue PPL. Clearly, this is not a proper assumption. One method of estimation is to use the proportion of CBD workers to the total city workers obtained from other subareas. For instance, the proportions for other subareas range from 15 percent in Rotterdam to 40 percent in Scotia. Evidently, there is no clear-cut value that can confidently be assumed. However, the number of park-and-ride users expected from Amsterdam can be approximated most probably between 21 to 56 as follows:

Item	Value
Park-and-ride usage, percent	20.81
Number working in Albany	670
Proportion of CBD workers	
100 percent	139
15 percent	21
40 percent	56

It should be noted that the characteristics of labor force and employment distributions are different in different localities. Therefore, planners must take great care in choosing proper estimates of these proportion values so that they are consistent with local situations.

CONCLUSIONS

Results of the graphic and regression analyses of the two peripheral park-and-ride services operated in the Albany area lead to the following conclusions.

1. Peripheral park-and-ride service tends to have a greater rate of patronage from travelers who live fairly far from their jobsites.
2. Users of these lots appear relatively sensitive to savings in time but relatively insensitive to cost differentials between park-and-ride and automobile modes.
3. More patronage can be attracted to a particular park-and-ride lot if the trip origin, the parking lot, and the trip destination, in that order, lie on a relatively straight line. This supports the intuitive view that the service area of a peripheral parking lot is a cone-shaped area with its tip located at the parking lot.
4. For areas that fall outside of the cone-shaped area, more patronage can be attracted if the parking lot is situated along the most likely travel route linking trip origin and destination.
5. Park-and-ride service must offer travelers time or cost savings if it is to receive sufficient patronage.

The purpose of this study was to obtain some quantitative knowledge on the most relevant attributes that influence usage of a peripheral park-and-ride service. It was not intended, however, that a universal formula be developed that could be directly applied to any situation. It should be stressed that the emphasis of this study was to provide overall guidelines for preliminary selection of alternative park-and-ride service lots. In particular, attempts to forecast the number of persons who might use a peripheral system solely on the basis of the above regression analysis are discouraged. A study specifically dealing with the demand estimations of this type of transit service has recently become available (5). As mentioned earlier, the combined cost variable is an important attribute but not the only one that influences the traveler's mode choice decision. Information on the traveler's income or automobile ownership and information on other members of the family working at other locations but sharing the same car would have been desirable.

Still, the regression model, along with the guidelines mentioned previously, can provide adequate indications of the potential attractiveness of proposed peripheral park-and-ride services or facilities. This is especially useful during the preliminary stages of a planning study when usually a number of alternative parking lot sites and alternative operating policies are involved.

Future research should try to determine what other factors, beside time and cost, affect the traveler's decision to use or not use a peripheral service. Interviews or surveys of persons using peripheral park-and-ride services can provide insight into their common characteristics, behavioral patterns, or attitudinal configurations. Information of this type may then provide the basis for a model capable of accurately predicting peripheral park-and-ride usage for given areas. It is hoped that this research will provide the basis for such a study.

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